



**CALIFORNIA  
ENERGY COMMISSION**



Clean Transportation Program

## **FINAL PROJECT REPORT**

# The Bay Area EV Corridor Project

**A Project of the Association of Bay Area  
Governments in Partnership with EV  
Communities Alliance**

**Prepared for: California Energy Commission**

**Prepared by: Association of Bay Area Governments in partnership  
with EV Communities Alliance**

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# California Energy Commission

Richard Schorske, EV Communities Alliance  
in cooperation with Jerry Lahr, Association of Bay Area Governments

**Primary Author(s)**

Association of Bay Area Governments  
101 Eighth Street  
Oakland, CA 94607

[Association of Bay Area Governments](https://abag.ca.gov/) <https://abag.ca.gov/>

**Agreement Number: ARV-10-032**

Lindsee Tanimoto

**Commission Agreement Manager**

Mark Wenzel

**Branch Manager**

**LIGHT-DUTY ELECTRIC VEHICLE INFRASTRUCTURE AND ANALYSIS**

Hannon Rasool

**Director**

**FUELS AND TRANSPORTATION**

Drew Bohan

**Executive Director**

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# PREFACE

Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Clean Transportation Program. The statute authorizes the California Energy Commission (CEC) to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013) reauthorizes the Clean Transportation Program through January 1, 2024, and specifies that the CEC allocate up to \$20 million per year (or up to 20 percent of each fiscal year's funds) in funding for hydrogen station development until at least 100 stations are operational.

The Clean Transportation Program has an annual budget of about \$100 million and provides financial support for projects that:

- Reduce California's use and dependence on petroleum transportation fuels and increase the use of alternative and renewable fuels and advanced vehicle technologies.
- Produce sustainable alternative and renewable low-carbon fuels in California.
- Expand alternative fueling infrastructure and fueling stations.
- Improve the efficiency, performance, and market viability of alternative light-, medium-, and heavy-duty vehicle technologies.
- Retrofit medium- and heavy-duty on-road and nonroad vehicle fleets to alternative technologies or fuel use.
- Expand the alternative fueling infrastructure available to existing fleets, public transit, and transportation corridors.
- Establish workforce-training programs and conduct public outreach on the benefits of alternative transportation fuels and vehicle technologies.

To be eligible for funding under the Clean Transportation Program, a project must be consistent with the CEC's annual Clean Transportation Program Investment Plan Update. The CEC issued PON- 09-006. In response to PON-09-006, the recipient submitted an application which was proposed for funding in the CEC's notice of proposed awards May 15, 2010 and the agreement was executed as ARV-10-032 on August 12, 2011.

# ABSTRACT

The Project successfully installed 340 charge points: 138 Level 1, 198 Level 2, and four Fast Charge points.

Level 1 chargers utilize 110 volt current and can accommodate both current generation and legacy Electric Vehicles such as the first generation Toyota RAV Electric Vehicle, Neighborhood Electric Vehicles, and e-bikes. Level 2 chargers utilize the SAE J1772 standard charging device and can recharge a Nissan Leaf from nearly empty to full capacity in approximately four hours (at 6.6 kilowatts). Fast Chargers operate at 480 volts and can recharge a Leaf from empty to 80 percent capacity in approximately 30 minutes (at 50 kilowatts), utilizing the Japanese CHAdeMO interconnection standard.

An initial plan to deploy 18 Fast Chargers was modified due to the failure of the contracted EV Service Provider mid-way through the project. The Association of Bay Area Governments issued a new Request for Proposals for Fast Chargers and Level 2 chargers serving multi-unit residential properties.

The Association of Bay Area Governments then contracted with the City of Benicia to install a battery-backed, solar-integrated Fast Charger; with PowerTree, Inc. to install Level 2 chargers in ten large multi-unit properties in San Francisco with integrated energy storage and solar; and with ECotality to install Fast Chargers and Level 2 electric vehicle charging stations in San Francisco's Mission Bay district.

Keywords: Electric Vehicles, Electric Vehicle Infrastructure, Fast Charging, Electric Vehicle Supply Equipment, Electric Vehicle Charging Stations, Electric Vehicle Corridor, Association of Bay Area Governments, Electric Vehicle Communities Alliance.

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# EXECUTIVE SUMMARY

The Project successfully developed a robust regional public charging network serving electric vehicle drivers in seven Greater Bay Area Counties and installed 340 charge points: 138 Level 1, 198 Level 2, and four Fast Charge points (three with CHAdeMO connectors and one SAE Combo 2).

An initial plan to deploy 18 Fast Chargers was modified due to the failure of the contracted electric vehicle Service Provider mid-way through the project.

Association of Bay Area Governments issued a new Request for Proposals for Fast Chargers and Level 2 chargers serving multi-unit residential properties and encouraged integration of solar PV and energy storage to mitigate utility demand charges, develop grid services revenue, and reduce electric vehicle-related emissions.

Association of Bay Area Governments then contracted with the City of Benicia to install a battery-backed, solar-integrated Fast Charger; with PowerTree, Inc. to install Level 2 chargers in ten large multi-unit properties in San Francisco with integrated energy storage and solar; and with ECOTality to install two Fast Chargers and eight Level 2 electric vehicle chargers in San Francisco's Mission Bay district.

Key findings are that stakeholders underestimated the complexity of electric vehicle supply equipment installation and Americans with Disability Act issues, the challenges of sustaining electric vehicle supply equipment operations over time, and that business models for sustaining the charging infrastructure need refinement.

Recommendations include:

- Develop additional resources for site analysis and engagement.
- Align future projects with regional electric vehicle service providers siting studies.
- Practice data-driven siting and collaborative data sharing.
- Implement charge pricing strategies to address congestion.
- Encourage development of sustainable electric vehicle supply equipment business models that integrate secure revenue streams from solar, energy storage, and grid services.



# CHAPTER 1:

## Project Purposes, Partners, Strategies, Management, and Implementation

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### Purposes

- To help develop a robust regional public charging network serving electric vehicle (EV) drivers in seven Greater Bay Area Counties: San Francisco, Marin, Alameda, Santa Clara, Santa Cruz, San Benito, and Monterey.
- To increase charging options for residents of multi-unit dwellings.
- To demonstrate the integration of EV charging with solar technology and fixed energy storage, for the purpose of mitigating utility demand charges, developing grid services revenue to sustain the growth of electric vehicle supply equipment (EVSE) networks, and reducing EV-related emissions.

### Partners

- **Local governments** in Alameda County and the Cities of San Francisco, San Jose, Fairfax, Larkspur, Mill Valley, Novato, San Anselmo. These local governments (all direct sub-awardees under ABAG provided site selection and installation management services.
- **Leading Non-Governmental Organizations** included Ecology Action (partnering with public and private site hosts in Santa Cruz, San Benito, and Monterey Counties), and EV Communities Alliance, which provided grant development and project management assistance to the ABAG. (Both Ecology Action and EV Communities Alliance were sub-awardees.)
- **Leading Companies in the electric vehicle Ecosystem** including PowerTree, Inc., a new EV Service Provider focusing on multi-unit residential developments; ChargePoint (the leading manufacturer of electric vehicle charging equipment), and ECOtality (a leading electric vehicle Service Provider, recently acquired by Car Charging Group.) In addition, ABAG contracted with Grant Management Associates, to help manage fiscal reporting by sub-awardees. Finally, many sub-awardees elected to work with Clean Fuel Connection, the state's largest EV installation contractor and (at the time of the grant award) the exclusive California ChargePoint dealer.

## **Strategies**

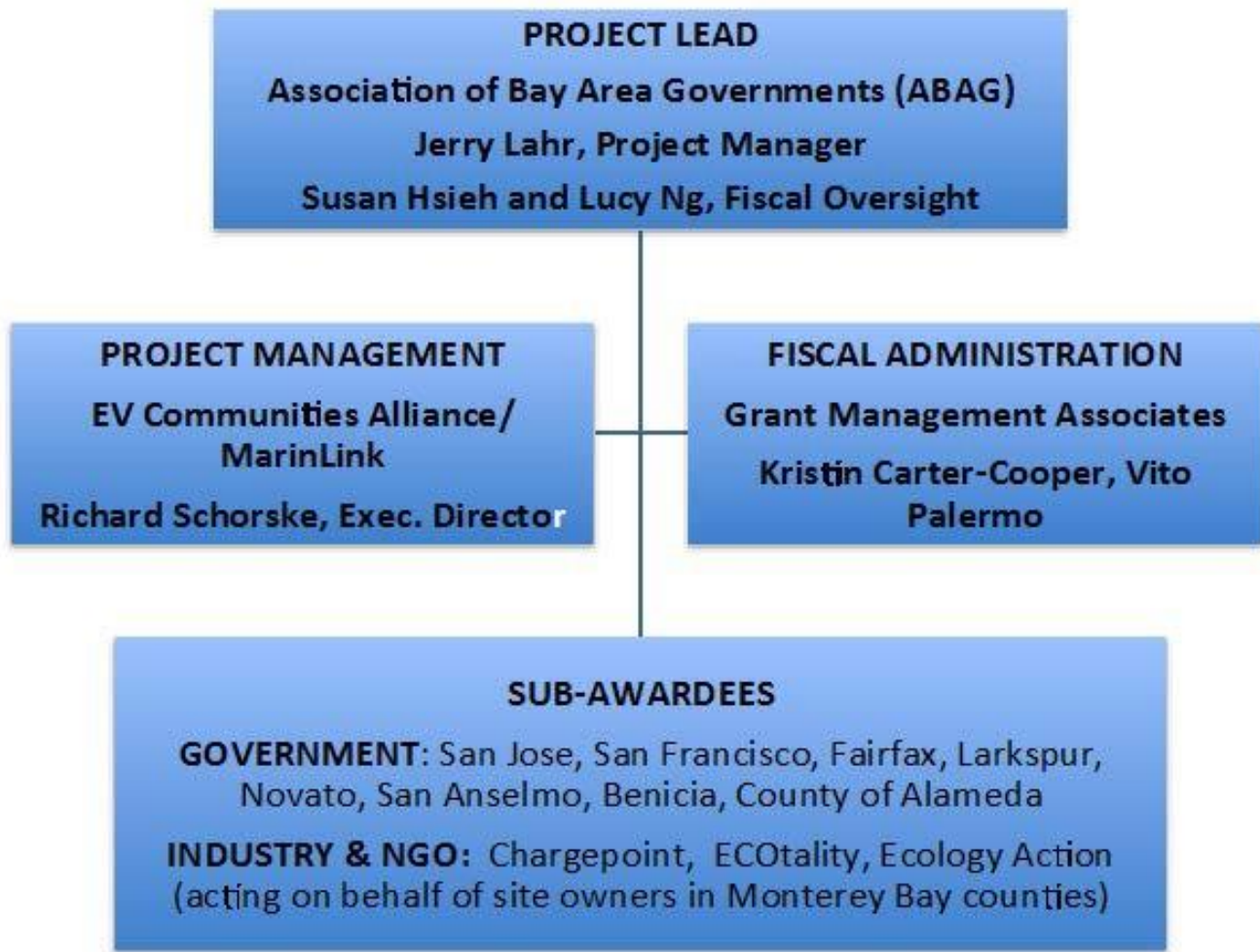
The key strategies to achieve project purposes included the following:

- Identification of appropriate sites based on collaboratively developed best-practice siting criteria;
- Selection of state-of-the-art networked electric vehicle charging stations, including:
  - Dual port Level 1 and Level 2 stations manufactured by ChargePoint,
  - DC Fast Charge points, manufactured by ECotality and BTC
  - Eaton Level 2 EVSE equipped with high-rate 240 volt/ 70 amp EVSE charging capable of AC charge rates of 22kW (vs. a 6.6kW maximum for most ChargePoint units).
- Installation of chargers meeting all applicable American Disability Act criteria for accessibility.
- Demonstration of EVSE charging integrated with solar and energy storage in multi-unit residential developments in San Francisco, and at the Benicia City Hall.

## **Management**

The management of the electric vehicle Corridor Project involved two levels of oversight. At the top level, the ABAGs functioned as the lead agency, with overall responsibility for contract development and management, project oversight, and implementation. Underneath ABAG, electric vehicle Communities Alliance was contracted to provide field-level project management, with responsibility for communication with sub-awardees, program-reporting, and trouble-shooting. ABAG also contracted with Grant Management Associates to assist the ABAG fiscal department with fiscal services and liaison to sub-awardees. The table below summarizes the project organizational chart:

**Figure 1: Project Organizational Chart**



Source: ABAG

### **Implementation**

The Project successfully installed 340 charge points: 138 Level 1, 198 Level 2, and four DC Fast Charge points. The Fast Charge connections include a total of three CHAdeMO connectors and one SAE Combo 2 connector. (The Fast Charger at the City of Benicia includes both the Combo 2 and CHAdeMO designs, to accommodate the new generation of American and European EVs that will utilize the Combo 2 standard, as well as the current generation of Japanese cars that utilize the CHAdeMO connector.) An initial plan to deploy 18 Fast Chargers via 350 Green was modified due to the failure of the contracted EV Service Provider mid-way through the project. ABAG issued a new Request for Proposals for Fast Chargers and Level 2 chargers serving multi-unit residential properties and encouraged integration of solar PV and energy storage to mitigate utility demand charges, develop grid services revenue, and reduce EV-related emissions. ABAG then contracted with:

- City of Benicia to install a battery-backed, solar-integrated Fast Charger with two charge points (one CHAdeMO and one Combo 2).
- PowerTree, Inc., Inc. to install high-rate AC (up to 22kW) Level 2 chargers in 10 large multi-unit properties in San Francisco with integrated energy storage and solar.

- ECOTality to install two Fast Chargers and eight Level 2 EVSE at Mission Bay, a new office and residential community in San Francisco.

## **Siting and Installation of Level 1 and 2 Chargers and Response to Challenges**

### **Siting Approach**

The initial EV Corridor Project siting plan was developed over the course of the initial project grant development and planning period in late 2009. In some cases, site locations were changed to meet budgetary or physical constraints that were only clear upon full inspection of the site by qualified electricians. In many cases, at least a two hour walk-through and inspection of the site, including load calculations and full inspection of the electrical panel and capacity, was required before a site could be completely qualified for installation at a specific cost. Following the first-round submission of the EV Corridor Project Plan, in January of 2010, the CEC invited a second round proposal and provided an opportunity to update the original site list. For the newly selected sites, site selection guidelines published by EV Communities Alliance and the Bay Area Climate Collaborative in the *Ready, Set, Charge California!* document were utilized to qualify interested parties and viable sites. These guidelines were segmented into primary global principles, secondary global principles, and site-specific principles, defined as follows:

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

### **Primary Global Principles**

1. **Location:** Select a high-demand, high-visibility location (especially for the first few chargers). Better placement of EVCSs can come from data collection and polling of EV owners.
2. **Electricity:** Select a location where AC Level 1 (120V/15A) or AC Level 2 (240V/40A) electrical supply is or can be made available with relative ease and minimal cost.
3. **Economics:** The costs of charger installation and potential loss of parking space revenue should be weighed against the benefits of projected revenues, positive publicity, and increased visitor spending in the jurisdiction, as well as the broader societal benefits of spurring the transition to clean, low-carbon transportation.
4. **Access:** Consider and comply with American Disability Act guidelines for disabled access, and take precautions to ensure that chargers are placed with the user's convenience in mind (avoiding injury from tripping on cords and cables, etc.)
5. **Security:** Select a secure location with adequate lighting to enhance security and provide the customer with a good charging experience.

6. **Signage:** Provide enforcement and other signs that comply with the Manual on Uniform Traffic Control Devices and California Vehicle Codes, ensuring that signs are high enough, easily visible, and provide clear and accurate information.
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 concrete-filled steel bollards, while simultaneously taking into consideration ease of access to the charger, mobility of users, and foot traffic in the area.
8. **Fleet Use:** Consider “dual purpose” sites that could also benefit the jurisdiction’s fleet vehicles, as well as the general public, where feasible and appropriate.

## **Secondary Global Principles**

1. **Diversity of Intended Users:** PEV chargers should (progressively) be located in sites that will appeal to the diversity of PEV users (e.g., local residents, visitors and tourists, and fleet drivers)
2. **Public Safety:** Chargers should be located in areas with proper ventilation and away from potential hazards including traffic, explosive materials, flammable vapors, liquids and gases, combustible dust or fibers, materials that ignite spontaneously on contact with air, flood-prone areas, and areas that might be prone to vandalism.
3. **Duration of Use: AC** Level 1 charger sites should focus on locations where vehicles will be parked for six or more hours, while AC Level 2 Charger sites should focus on locations where PEV owners will be parked for a significant, though shorter periods of time (e.g., one to six hours). DC Fast Chargers sites should focus on locations where the PEV owner will be parked for a relatively short period of time (e.g., 15 minutes).
4. **Location Markings:** Indication of parking spaces, striping, driveways, and walkways.
5. **Cable Management:** To avoid injury from tripping, cables should not cross sidewalks or pedestrian traffic patterns.
6. **Shelter:** When possible, shelter is desirable to protect users from weather when connecting their vehicle to the charger. (However, chargers are designed to be safely operated in exposed locations in the rain, with no danger of electrical shock.)
7. **Aesthetics:** Some areas may benefit from the installation of landscaping or screening walls to shield the electrical transformer, panel, or other equipment from the public eye.
8. **Solar Power:** Some jurisdictions may choose sites where solar panels can provide energy to power the charging unit.
9. **Other PEVs:** Locations may be chosen to cater not only to freeway-capable Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) - which typically utilize the 240 volt “AC Level 2” connections for faster charging -- but also to slower-speed Neighborhood EVs, electric bicycles,

electric scooters, and electric motorcycles which typically utilize a 110V electrical connection.

### **Site Specific Principles:**

1. **Accessibility:** PEV charger location within a site should comply with American Disability Act access requirements. Specifically, the first two PEV chargers installed in any one location should take into consideration requirements in California Building Code Chapter 11C and DSA 97-03.
2. **Electrical Supply:** Select a location where it is as inexpensive as possible to provide AC Level 1 (120V) or level 2 (240V/40A) electrical supply.
3. **Benefits vs. Loss of Revenue:** When selecting the specific location of a PEV charger at a particular site, a jurisdiction should consider the balance of anticipated benefits (including "PEV readiness", revenue potential, and increased patronage of nearby business) versus potentially negative aspects of taking an available parking space (including negative impact on conventional vehicle drivers and lost revenue.)
4. **Cord Management:** When determining where to install a PEV charger, a location should be selected where cords will not interfere with the path of travel of the user or other pedestrians in the vicinity.
5. **Security:** A location should be selected that is secure for users at all times of day and night and relatively secure from vandalism (e.g., in a well-lighted area; and in well- traveled areas.)

### **Installation Approach and Response to Challenges**

Project partners in six of the EV Corridor Project counties (Alameda, Contra Costa, Marin, Santa Cruz, Monterey, and San Benito) elected to work with Clean Fuel Connection, Inc. (CFCI) as the "turn-key" project installer. CFCI offered to competitively bid each of the individual sites, while guaranteeing a "not exceed price" across the total project of \$4296 per charging station installation (for dual Level 1-2 units, or for Level 2 standalone units, not including hardware costs). In addition, Clean Fuel Connection was at the time the sole authorized California dealer for Coulomb Technologies (now ChargePoint) equipment. As a result, CFCI was able to offer favorable volume pricing on ChargePoint equipment, as well as a pre-qualified local contractor network. CFCI had extensive experience in large-scale EVSE deployment efforts beginning with the General Motors M EV-1 charger deployment and continuing through a recently completed BMW Mini-E deployment. Local jurisdictions felt that CFCI offered a streamlined approach to project management for the many agencies that did not have the requisite staff bandwidth and resources to internally manage the work. By aggregating all of the public agency installations in Santa Clara, Contra Costa, Santa Cruz, Monterey, San Benito, and Marin Counties, CFCI was able to attract more aggressive final bids, which were monitored to ensure that the average bid did not exceed the Master Installation Agreement reference price commitment of \$4296 per installation. (This "not to exceed" commitment was based on analysis of historic EVSE installation pricing in Northern California, and engineering bids received based on a cross- section of sites in the North and South Bay.)

In two jurisdictions, San Francisco and Marin County, average installation prices were found to consistently exceed the originally referenced bid. In those cases, the City of San Francisco and the Transportation Authority of Marin were able to provide additional local match to pay for



installation costs that were 50 percent to 100 percent above the average for the balance of the program. The reasons for the cost variation in these areas was that the cognizant local jurisdictions did not have many (or any) alternative locations when encountering high-cost circumstances, and thus were forced to address such challenging issues as extensive power capacity upgrades and long conduit runs.

The “master installer” approach did not perform consistently well across jurisdictions. In some areas, the contractor initially selected by CFCI was found to be insufficiently responsive, and the local jurisdictions requested an alternative or sourced their own contractor. However, jurisdictions that utilized their own internal staff also experienced significant challenges. The City of San Francisco, for example, discovered that a lengthy assessment of the power capacity issues at their sites had been done with faulty engineering assumptions, causing a very substantial delay in the installation process that ultimately necessitated an extension request from San Francisco to ABAG, and thus from ABAG to the CEC. Now that the participating agencies have first-hand experience interacting with EVSE contractors, it is likely that many more would opt to directly manage the installation process in the event of a second round of investment in EV charging infrastructure.

## **Installation of Fast Chargers and Response to Challenges**

The initially proposed EV Corridor Project plan included an ambitious program of Fast Charger installations that was developed in partnership with 350 Green. This proposed to install 18 Fast Chargers throughout the nine-county region with support from the California Energy Commission via ABAG and additional matching funds from the Bay Area Air Quality Management District, from which 350 Green had received a funding commitment. At the time, 350 Green had won several of the largest grant awards in the nation, including a multi-million dollar project in Chicago, and several others at the state level in Washington, Pennsylvania, and elsewhere. They were at one time the largest EV Supply Provider after ECOtality. The company was able to enlist the confidence of the project planning team by offering to install the Fast Chargers for a price of just \$15,000 in subsidy per site, with approximately \$35,000 to \$45,000 in matching resources per site. 350 Green claimed that they had more than \$10 million in private investment in the company in addition to more than \$10 million in grant awards. For the first nine months of the project, 350 Green employed a regional representative who worked diligently to fully inspect and qualify the initial site list. The company made ABAG’s initial deadline to secure all the necessary site agreements. To secure the 18 sites, approximately triple that number of prospective site hosts were visited and cultivated. Based on this initially positive performance, ABAG entered into a contract with 350 Green to install the finalized group of 18 sites. However, shortly thereafter (in the spring of 2012) reports surfaced that 350 Green was in trouble in its Chicago project for non-performance and was being investigated by the FBI and other authorities. By the summer of 2012, it was announced that 350 Green would be acquired by Car Charging Group. At this time, ABAG and CEC arranged a Critical Project Review meeting with the 350 Green leadership team, who assured ABAG and CEC that the Car Charging Group acquisition would be completed by July 2012. However, the acquisition was still not complete by January 2013, with no clear indication of when it would be done. At this point ABAG chose to terminate the contract with 350 Green. In the course of this difficult journey, it was determined that the many favorable sites that 350 Green had placed under contract were in legal limbo, without

the ability or willingness to either move forward or withdraw while the corporate takeover was pending. This was a significant setback to the entire regional EVSE network development process, as it tied up many favorable locations.

To move forward from the 350 Green situation, ABAG consulted with the CEC and agreed to re-issue a new Request for Proposals that would provide an opportunity for other parties to deploy some Fast Chargers or a combination of Fast Charging, rapid AC charging (at the 20kW level, vs. the normal range of 3.3kW to 6.6kW), and to integrate these technologies with energy storage and solar PV, for the purposes of: a) utility demand charge mitigation; b) development of supplemental grid services revenue streams to provide a hedge against low EVSE revenues, and; c) to reduce the GHG content of EV fueling (by supplementing grid electricity with locally generated and stored 100 percent green solar energy.) The final Request for Proposals is included in Appendix B, and the process whereby winners were selected is described in Chapter 2 below.

The “take-away” lessons from the 350 Green situation are numerous and apply to the EV ecosystem as a whole. First, in retrospect, the original proposal by 350 Green was arguably “too good to be true” insofar as 350 Green was not completely transparent about the sources of their private sector match. Second, the generous revenue sharing agreements and revenue projections shown to prospective site hosts required a level of utilization that, again in retrospect, was likely over-ambitious given the slower-than-expected penetration of EVs in the marketplace. Third, it is extraordinarily difficult and time consuming to secure site hosts for DC Fast Charger infrastructure. The DC Fast Charger, with its three-phase power requirement and 50kW output, is extremely costly to install. Typically, at least two parking spaces (or up to four in the case of co-located Level 2 chargers) must be dedicated to the Fast Charge “plaza” typically for terms of at least eight years to satisfy EV Supply Provider return-on-investment and amortization requirements. Most site hosts, even when offered a revenue split loathe to surrender that much parking, especially in highly impacted malls, downtown areas, and other desirable locations. The degree of difficulty of the Fast Charge site acquisition and installation process has been underscored in 2013 by the very slow start that NRG has had to its Freedom Station installation program, which is endeavoring to install DC Fast Chargers in some of the same locations originally targeted by 350 Green.

To address property owner reluctance to assume responsibility for Fast Charge equipment, it is likely that EV Supply Providers will need to substantially increase their payments to the site hosts to reflect the true value of the surrendered parking. In some urban centers, the nominal market value of a space is in the range of \$150 to \$300/month or more. Thus, a four-car Fast Charge Plaza configuration might reasonably be expected to yield \$450–\$1200/month for the property owner of a popular destination. This kind of revenue guarantee in turn might be possible (in the short run) for EV Supply Providers that are able to marshal a variety of revenue streams in addition to the EVSE charging revenue per se. To support the further development and demonstration of these new business models, ABAG specifically called out the option of including solar and energy storage technologies for respondents to the “rapid charging” request for proposals, as these technologies have relatively predictable and certain revenue streams that can yield a stronger return-on-investment for site hosts than a standalone charger.

# CHAPTER 2: Integration of EV Charging, Solar, and Energy Storage

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## City of Benicia Battery-backed Fast Charger

### Project Overview

The Association of Bay Area Governments and EV Communities Alliance partnered with the City of Benicia to provide a DC Fast Charger, battery backup, and solar-integrated energy management system located at the Benicia City Hall. Known as the Eco-Station Project, this installation is the first solar-powered, battery supported DC Fast Charging station in the greater Bay Area. The Fast Charger is a dual-port design that will be equipped with both CHAdeMO and SAE Combo-2 connectors. The initial installation will be CHAdeMO only, and the Combo-2 will be added as soon as the connector hardware is approved by Underwriters Laboratories (expected in the next 60 days), thereby enabling access by vehicles with both standards. The DC Fast Charger manufacturer, BTC, indicates that the Benicia installation will be one of the first dual-compatible Fast Chargers in the state. The Fast Charger in the City Hall parking lot is near a major commercial plaza that includes a Safeway grocery store, adjacent to the City's Public Library, and a short walk to the downtown shopping district. The charger is also immediately adjacent to a large-scale solar photovoltaic (PV) array covering the City Hall parking lot, and two existing Level 2 stations.

### Project Goals and Benefits

The Eco-Station will integrate an EV Fast Charger, battery storage, an Energy Operating System to guide the most economic use of energy resources, including grid electricity and the existing solar array. The energy operating system will be installed and integrated into the existing solar photovoltaic system and will provide the following benefits to EV drivers and the City of Benicia:

1. **Fast EV charging** services with dual connector compatibility
2. **Abatement of electricity costs from EV charging** (including demand charges) arising from the high power (50 kW) Fast Charger (through use of the energy storage and solar assets)
3. **Lowered electricity charges for the building** by automated energy storage actions, including charging the energy storage at night and using it during the day to avoid peak time energy rates.
4. **Increased value of solar electricity** by shifting dawn and dusk generated energy into peak times when electricity is more valuable to the grid operator
5. **Emergency battery backup for EV charging and essential building functions** in the event of a grid outage or other emergency

6. **Potential PG&E Demand Response program revenue:** The Eco-Station Project may also enable the city to participate in PG&E's Demand Response program, which can generate additional revenue when PG&E pays customers to reduce energy use during peak use periods. Automating energy storage as a Demand Response asset will allow participation in a Demand Response program without effecting operations of the facility.

The Project will demonstrate how the integration of fast EV charging combined with energy storage will lower energy cost and provide ancillary user benefits (including back-up power). Data from the project will help other EV ecosystem stakeholders in the state to develop lower-cost and higher-value solutions for EV Fast Charging, related energy storage, and renewable energy deployment efforts. Locally, the Project will demonstrate this system can be integrated at other City facilities that utilize large amounts of power and energy, such as the Wastewater Treatment Plant, which could benefit significantly from minimizing demand charges. The Energy Operating System produced by Growing Energy Labs, Inc. (GELI), the Project's lead systems integrator, will coordinate energy assets to maximize value across multiple value streams.

## **Project Funding**

The project cost of \$126,800 was primarily funded by the CEC sub-award of \$79,200. Additional funding of \$40,000 will be provided by the Self Generation Incentive Program funded by PG&E ratepayers. The Self-Generation Incentive Program provides financial incentives for the installation of new, qualifying self-generation equipment, including the battery tower supplied by CODA Energy Storage used in the Benicia installation. The City of Benicia is providing \$4,800 in in-kind project management contribution, and Bass Electric is providing \$2,800 of in-kind labor.

## **Partner Roles**

- **Project Lead: GELI:** GELI's role is to deploy and maintain the GELI Energy Operating System Software for the Eco-Station energy storage systems and microgrid.
- **Project Electrical & General Sub-Contractor: BASS Electric:** BASS Electric is a San Francisco-based licensed General Contractor, Electrical Contractor and provider of energy solutions. BASS Electric is sub-contracted with GELI and Energy Vault LLC for the purpose of the providing project management, design services, energy storage hardware and software.
- **Partner: Energy Vault, LLC:** Energy Vault, LLC is an energy system developer and operator working in the Eco-Station joint venture. Energy Vault provided key elements of the design for the physical integration of the energy storage, electric vehicle charging infrastructure and renewable energy system.

## **Project Management Tasks**

The following tasks are being completed to finish the Ecostation by November 30, 2013.

- **Energy Storage System Installation:** BASS Electric is installing the energy storage system with Coda battery tower and the GELI Energy Operating System

and integration components including an electrical sub-meter and electrical upgrades to the City Hall to reduce electricity demand charges and energy charges, stabilize solar generation, and provide the EV fast charging and backup power in the event of an emergency.

- **Configuration and commissioning:** GELI will ensure that all operating parameters are met.
- **Self- Generation Incentive Program Inspection:** An inspection by an Self-Generation Incentive Program official will provide validation of system operation.
- **City Inspection:** City Building Officials will conduct a post-installation inspection to ensure compliance with local and state building codes.
- **ABAG and EV Communities Alliance Inspection:** ABAG and EVCA will inspect the final system once in operation to ensure that program requirements have been met.

## **Anticipated Project Results**

Due to delays in shipping of the needed components, the Eco-station Project is being completed at the end of the grant period. Therefore, there will not be significant usage data available at the time of submission of the Final Report. However, the City of Benicia and the Eco-Station project team expects to achieve the following results, which will be visible within the first 30 days of operation. This information will be collected and provided to ABAG and EV Communities Alliance.

### **Goal 1: Demonstrate Fast EV Charging Services**

- The BTC Power EV Pump Fast charger with CHAdeMO and SAE Combo connector will be providing EV charging services to both City fleet vehicles and the general public.
- The GELI Energy Operating System will provide the analytics to track and reconcile the economic value of energy from multiple data streams including EV charging, demand response programs, and solar generation. The station may also increase economic activity in the city as users may visit local businesses while waiting for the charge to be completed. One (1) fast charge customer per day will result in \$1,870 per year in charging revenue. Two (2) fast charges per day will result in \$3,740 per year. Time of Use energy management will result in approximately \$1,800 per year savings in electricity costs. The city will be able to recover its costs of providing additional power for EV chargers.

### **Goal 2: Abate electricity charges arising from Level III Charger**

- Daytime EV charging energy will be provided from evening energy saved into the energy storage system purchased at low Time of Use (TOU) rates.

### **Goal 3: Lower electricity charges by charging the energy storage at night and using it during the day.**

- Daytime facility load will be partially provided from evening energy saved into the energy storage system purchased at low Time of Use rates in the evening hours.

**Key Technologies and Innovations:** The Eco-Station Project demonstrates a variety of innovative technologies necessary to store and distribute electricity for EV charging while maximizing City revenues streams (EV charging revenues and lowered energy charges). Key technologies include:

- **GELI Energy Operating System:** GELI developed a unique product Energy Operating System that consists of original integration, operational, economic, and network software. The GELI Energy Operating System is an Enterprise Software Operating System Platform for secure, economic, and reliable energy storage systems and microgrids enabling the integration, networking, controls, automation, and optimization of power conversion, energy storage, electrical meters, EV charging, electrical devices, other system software, hardware, communications, devices, the Internet, and the grid. The Energy Operating System will provide the following monthly data reporting:
  - Vehicle use patterns
  - Charging frequency and profiles
  - Electric fuel use
  - Climate variations
  - Availability of vehicle chargers
  - "Real world" electric range
  - Operating costs
  - Time of use rates

**Energy Vault LLC Integration:** This energy system integration demonstrates the advancement in cooperative operation of multiple energy system components that include solar generation, energy storage, fast EV charger, and building loads. Integration of these components has been historically difficult due to the varying communication protocols and lack of automation. The Energy Vault integration demonstrates how facility-appropriate technologies are easily automated in concert for maximum economic benefit.

- **CODA Battery Tower (40 kWh):** CODA Energy Solutions, located in Benicia, supplied a 40 kWh battery tower (including thermal management system) to store solar energy. This is a lithium-ion battery with built-in call algorithm, along with overvoltage, under voltage, overload, and temperature-limits protection, for safe and reliable operation. This technology allowed the city to apply for a PG&E Self-generation Incentive for approximately \$40,000 to offset the cost of the total project.
- **Shark 100s/200s Submeter:** This submeter measures revenue grade electrical energy usage and communicates back information using WiFi connections. The unit will communicate back to central software quickly and automatically. The meter contains a utility grade test pulse allowing power providers to verify and confirm that the meters are performing to their rated accuracy. Using the meter, the city can track energy usage data including demand profile. The GELI Energy Operating System Platform will utilize this meter data to maximize energy storage value by stacking, staggering, and bundling services including renewable energy reliability, demand charge

management, Time of Use shifting, demand response, and ancillary market<sup>1</sup> participation (when eligible).

- **Dual-Compatible (SAE Combo and CHAdeMO) Level III Charger (BTC Power):** BTC Power provided an EV Pump Fast charger for easy EV charging. The EV Pump fits all electric vehicles with the Japanese DC Fast Charge standard known as CHAdeMO or the SAE Combo connector and makes the customer experience simple by providing a credit card swipe for payment. The station collects user data and BTC Power transmits that data to the city for easy reporting and station management. The station also has demand response controls (provides user-configured demand period data usually every 5, 15, or 30 minutes) and allowed GELI to integrate its customized software for optimum performance.

### **Summary of Project Benefits and Implications for Broader Adoption**

The Eco-Station project has significant implications for supporting broader adoption of PEVs in California. First, it will be demonstrating the efficacy of a dual-compatible Fast Charger, which is crucial to build “future-proof” Fast Charge infrastructure in the state. In addition, it will provide these key benefits:

- **Demand Charge Management:** Currently, many site hosts will not allow DC Fast Charger installations because of justified concerns regarding demand charges, which can add \$1000/month or more to utility bills once certain thresholds are passed. The Eco-Station will enable the charger to switch to battery power when charging demand is high and monitor thresholds needed to mitigate or avoid demand charges.
- **Time of Use Energy Shift:** The battery backup similarly enables the charger to be operated from the battery tower during expensive times of use, when it may be more cost-effective to feed solar power back to the grid.
- **Demand Response Utility Energy Application:** The charger will be able to respond to demand response signals from the system operator to decrease load and switch to battery operation without change in building operation.
- **Market Participation:** The Eco-Station will enable the site host to gain revenue via wholesale energy market participation individually and in aggregate for ancillary services of regulation, frequency, and ramping (as this type of project becomes eligible to participate in the California Ancillary Services Market).

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<sup>1</sup> The California Independent Service Operator oversees the ancillary services market made up of Participating Generators and Participating Loads. At this time, a single EV and a single 40 kWh battery tower do not meet the threshold to participate as a generator or load. In the future, this threshold may be lowered or may allow aggregation of multiple EVs and storage systems to meet the requirement.

**Summary:** The Eco-Station provided an excellent opportunity for Benicia to partner with hardware and software companies to demonstrate the first of its kind battery backed, solar powered, dual-connector Fast Charger in California. The Project will advance innovative technologies and providing energy, economic, emission reduction, and resiliency benefits to California and to the City of Benicia. Benicia hopes it can be an example for other Bay Area and California communities as they work to increase the number of PEVs in their community, reduce transportation emissions, and capture critically needed revenue sources related to demand response and smart grid technologies. These revenues make the value proposition for Fast Charging much stronger that it would be otherwise, accelerating much broader deployment of this key technology for enhancing the PEV consumer experience.

## **Multi-Unit Residential Charging, Energy Storage, and Solar PV (PowerTree, Inc., San Francisco)**

### **Project Overview**

PowerTree, Inc. was one of three respondents to the Rapid Charging Request for Proposals issued by ABAG and was chosen (with ECOtality) in a competitive selection process to provide high-rate AC charging integrated with energy storage and solar PV at ten large multi-unit residential properties in the City of San Francisco. Each property is between 10 and 50 units. All sites were equipped with Solar PV of at least 2.4 kW, and each property provided at least one dedicated parking stall with a contractual option for additional stalls as demand is proven for EV Charging. The EVSE charger selected is an Eaton 75 amp, 240 volt AC Level 2 J1772 PowerStation equipped with single port charging using PowerTree, Inc. InstantID technology. In addition, a 48 kW/51 kWh bidirectional Advanced Energy Storage unit is integrally linked to the EVSE, mounted on the parking garage wall in an eight foot by six foot by one foot deep enclosure. Building upgrades to support a maximum potential of four or six stations (building parking allowing) is planned in each case.

The PowerTree, Inc. project funded by CEC is part of a larger installation underway by PowerTree, Inc. that consists of 71 buildings in San Francisco, with a total of 1571 tenant units, 88 EV chargers, and expansion options for an additional 78 chargers. The larger project will be completed in Q1 2014, while the ten buildings in the CEC funded portion were completed as of November 15, 2013. The purpose of the energy storage array is to provide demand charge mitigation, back-up power for EV charging and other building services in the event of a power outage, and to enable wholesale market participation to augment the EVSE revenue stream for building owners. The solar PV is installed to provide net metering revenue to the building owner, and to provide carbon-free power to the EVs whenever conditions permit, and to provide back-up power to the building via the energy storage array. The combination of the energy storage and solar revenues enable PowerTree, Inc. to provide the entire system for free to building owners, and to provide a robust revenue share to incentivize building owner participation. Since parking stalls in San Francisco are highly valued, PowerTree, Inc. is providing as much as \$150 to \$300 per month to building owners to provide the dedicated stall for EV access only, in addition to revenue sharing on the other revenue streams (EVSE subscriptions, solar, and energy storage.) This revenue option may account for the high rate of penetration achieved by the PowerTree, Inc. model vs. other EV Supply Provider business models, which typically provide free installation and equipment, but not a



substantial revenue sharing option. All sites committed to the minimum ten year duration site agreement.

**Impact of High-Rate AC Charging:** Each EV charging port from Eaton is capable of a charge rate of 70 amps at 240 volts AC (16.8 kW per port, 24 kW peak) supporting the higher AC charge rates announced by EV makers. These include General Motors (3.3 to 6 kW), Ford (6.6 kW), Tesla (10 to 20 kW), VOLVO (22 kW AC), VIA Motors (6.6 to 14 kW), and others. Use of the SAE J1772 format rather than DC Charging ensures that 100 percent of the new vehicle fleet can be supported at minimized costs of infrastructure. High rates of AC charging can approach those of DC Charging systems, while avoiding demand charge cost issues in many cases. Table 1 provides charging data on EVs.

**Table 1: Charging Data**

Vehicle Model	Max AC Charging rate (kW)	Usable Battery Size (kWh)	Time to Charge from Empty (hrs)	Range added (miles) in 1 hr. at PowerTree, Inc. Station	Time to Charge on DC at public station (hrs)	Range added (miles) in 1 Hour of Charge at DC Station
Prius Plug	3.3	4.0	1.2	11.6	N/A no DC	0.0
VOLT	3.3	12.8	3.9	11.6	N/A no DC	0.0
Leaf	3.3	19.2	5.8	11.6	0.5	41.5
Ford Focus	6.6	20.7	3.1	23.1	N/A no DC	0.0
VIA Motors	6.6	21.6	3.3	23.1	N/A no DC	0.0
Volvo 60	18.0	32.0	1.8	63.0	1.6	70.0
Tesla S	20.0	76.5	3.8	70.0	1.0	267.8

Source: ABAG

The PowerTree, Inc. pricing model will provide unlimited use flat rate charge on a monthly basis to EV users seeking to charge and park their vehicles. However, within individual buildings or parking spaces in the network, pricing strategies will be applied to encourage the driver to move their car after it is fully charged (with notification via text message or e-mail.) PowerTree, Inc. subscribers will be able to access gate controls at the private parking areas where many of its charging stations will be located. PowerTree, Inc. members will not need to be residents of any of the PowerTree, Inc. buildings to join the service, however, and members of the public will be able to access the stations for their first use and on an emergency basis. For repeated use, they will be required to be a monthly subscriber, similar in pricing and policies to the NRG eVgo model.

**Impact of Advanced Energy Storage**

Each PowerTree, Inc. system uses up to six custom modified and controlled Outback Power Radian Inverter/Charger systems capable of UL1741 compliant grid tie at rates of 8kW discharge and up to 7 kW Charge rate. These inverters in turn charge each of the five 10 kWh battery packs (51.2 kWh) of Lithium Yttrium Iron Phosphate Batteries capable of over 3,000 charge/discharge cycles in normal operation and with an expected field life of over 15 years based on advance modeling and laboratory tests of performance against two years of hourly interval historical usage data. Configured Schweitzer Energy labs SEL-735 revenue grade meters (approved for revenue use by the California Independent System Operator), these advanced energy storage devices are intended for primary use as a Regulation Energy Management resource for the grid to enable more effective integration of variable renewable generation. With an average system Round Trip Efficiency of over 75 percent in a variety of operating conditions, this system easily exceeds key GHG reduction targets of 54.5 percent efficiency and 67.9 percent efficiency set by California Public Utilities Commission programs such as Self- Generation Incentive Program.

The Advanced Energy Storage is used in several ways:

- The Storage is used to provide Regulation Energy Management service to the California Independent Service Operator. This generates revenue while concurrently providing a rapid, more cost effective means of regulation service that reduces the need for GHG generating peaker plants to provide this service. This need is expected to grow as more and more volatile generation sources are connected to the grid. As the following chart shows, California Independent System Operator anticipates that increased volatility can result in an increase in GHG generation as RPS increases, unless there is a change in the grid regulation support by the use of rapid non-GHG emitting regulation systems such as dispatchable energy storage.
- In the case of grid outages, the storage can be switched out of grid service to provide local "islanded" power in support of safety-related operations on the host site (e.g., essential lighting, and security systems) and to assure that EV Charging capacity will be available so that transport for food, fuel, or medical needs can be achieved during emergencies.

**Impact of Integrated Solar PV Generation:** Each PowerTree, Inc. installation is equipped with a minimum of 2.4 kW of Solar PV which is used to provide GHG free generation on the local site during normal operations. During grid outages, this capability is switched, and the PV array provides energy to the fixed batteries in the Advanced Energy Storage system. This unique capability assures that additional host site emergency services (beyond those enabled by battery backup alone) can be supported. These include extended operation of security systems, door access, elevators, emergency lighting, and even refrigeration will work during natural disasters or emergencies and that electrified vehicles will still be able to receive a charge, enabling transport during extended emergencies.

The Solar PV also generates additional revenue flow for PowerTree, Inc.'s operations enabling the site host to receive all solar and EV equipment and installation at zero up front cost via a PPA arrangement for the solar and a revenue sharing arrangement on the EVSE. In addition, building owners can offer solar energy to tenants to reduce tenant energy consumption and GHG impact -- while also adding equity value the host property. The utilization of locally

generated solar for EV charging also counters “driving on coal” arguments from EV skeptics and reduces effective GHG emissions per vehicle mile travelled by EVs.

### **Business Model and Value Proposition for Building Owners**

PowerTree, Inc.’s business model is to deliver complementary energy based revenue services to each of its stakeholders; including the host site property owner, the host site tenant, the EV owner, the local community, and the grid operator. Solar is used to generate onsite energy and is sold to the host site owner via Virtual Net Metering. The Host Site Owner in turn sells, via a flat rate rental charge, access to this solar to their tenants. This generates additional rental income to the Host Site Owner increasing their property value and cash flow. The tenants in turn receive solar generated energy and receive an offset via credits on their energy bills from their local utility. Energy Storage is used to provide Regulation Energy Management as a Non-Generator Resource to the California Independent System Operator on an aggregated basis.

Due to the clean power generation from PowerTree, Inc. systems and its ability to deliver 100 percent of its rated power within two seconds from time of request, California Independent System Operator values this energy service highly. A portion of this revenue is shared on a quarterly basis with the Host Site Owner as a rent for the access to the grid connection and the physical placement of the Energy Storage system.

### **EV Driver Value Proposition**

EV Charging is provided to EV owners who subscribe their vehicles for a fixed flat monthly charge of between \$45 and \$135 per month per vehicle based on vehicle type for a minimum one year term in return for unlimited charging energy and free parking at any of PowerTree, Inc.’s operational locations while charging. The free parking provision while charging is a noteworthy element of the value proposition because most chargers in San Francisco and in many other locations are located in garages that charge both a parking fee and a charging fee. The PowerTree, Inc. value proposition compares favorably to other networks wherein the prices of charging and parking may combine to be higher for the EV owner than the equivalent cost of gasoline. PowerTree, Inc.’s dense location coverage will also provide broader driving options within the city for EVs than currently supported by the existing charger network.

If the charging is complete and no other member is requesting use of the location then the member has the option to pay for extended parking time in the location. These parking fees are tracked and then collected monthly along with the normal subscription payment. The parking collection fees are split between the property owner and PowerTree, Inc. By providing revenue sharing to site hosts, combined with a zero cost installation of both solar and charging systems, PowerTree, Inc. has been able to rapidly expand site host commitments and establish traction in the marketplace.

### **Strategy for Promoting PEV Ownership in Multi-Unit Dwellings**

Site host owners are commissioned to encourage their promotion of EV Charging at PowerTree, Inc. stations to their tenants. PowerTree, Inc. does not require any tenants to be existing EV drivers before installing its systems. Rather, it believes that tenants will be encouraged to purchase a plug in vehicle by the availability of convenient charging access.

This approach is in contrast to the NRG model, which requires that an EV driver subscribe to the NRG service before they will consent to install an actual EV charger in a “make ready” site.

In addition, to promotions within PowerTree, Inc. equipped locations, PowerTree, Inc. charging subscriptions will be marketed through partnerships with local EV auto dealers. A strong incentive package (in the range of \$100 to \$400 per vehicle subscribed depending on length of subscription) will be provided to dealers to bundle the new EV with PowerTree, Inc. services. This charging service package can in turn be financed with the vehicle purchases, providing a further hedge against fuel price inflation. This approach also “pre-solves” the charging problem for renters in multi-unit buildings, thereby dramatically expanding the reach for EV ownership. Finally, the additional financial incentives for PowerTree, Inc. subscriptions provided direct to the dealership and sales team will encourage the auto dealer to sell more electric vehicles.

In summary, the PowerTree, Inc. model is notable for four reasons:

- It establishes a path to profitable operation for sustaining EVSE network buildout,
- The high-rate AC infrastructure can serve 100 percent of the EV population in the Bay Area which provides a less expensive alternative and complement to Fast Chargers,
- The energy storage solution and solar microgrid configurations enhance grid reliability and ability to integrate a higher percentage of renewables, and
- The PowerTree, Inc. system enables faster system build-out among multi-unit dwelling site hosts because they are sharing multiple revenue streams.

# CHAPTER 3:

## Charger Deployment and Utilization

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### Pricing Charging Services: Challenges and Solutions

The large majority of EV Corridor Project participants have elected to provide charging services free of charge for either a one year period (e.g. San Francisco), or an indefinite period (e.g., Monterey site hosts), as illustrated in the chart in Appendix B. This has encouraged use of public and workplace charging. However, it has also contributed to congestion challenges at the City of San Francisco in particular, where EVSE installed in central garages, such as the Civic Center and the Mission Street Garage near Moscone Center, are chronically filled. This has discouraged many BEV drivers from coming into San Francisco at peak periods. The City will likely be addressing this challenge in 2014 when new policies go into effect that will charge EV drivers for use of the charging stations. Another challenge with the free initial charging period is that municipalities are not covering the cost of warranties and network operating agreements. Most municipalities are not prepared to subsidize the nearly \$1000/year cost of network agreements and labor plus parts warranties on ChargePoint units (above and beyond the energy cost.) Approaches to this challenge are discussed further below.

#### Dynamic Pricing

To address the pricing challenge, regional and state agency investors, EV Supply Providers, and site hosts may benefit by supporting development of charging management plans that dynamically price charging in response to changing demand profiles, with automatic messaging to alert drivers when charging is complete. For example, some site hosts in Silicon Valley (e.g., NetApp) are instituting relatively low charging fees (e.g., \$1/hour) during the first several hours of charging (or until charging is complete), and then levying much higher fees (as much as \$10/hour) to strongly incentivize drivers to move their vehicles.

**Budgeting for Network Management and Maintenance:** Initial public and private investments in PEV charging focused on maximizing the number of chargers deployed. Site owners and EV Supply Providers did not have sufficient data to accurately forecast utilization rates, revenues, and operating and maintenance costs. Now that some data is available, concern is growing that charging revenue may not be sufficient to cover costs in many cases. The challenges of the EV Supply Provider business model were evident in the high-profile failures of 350 Green and ECotality. Less dramatically, local site hosts that were chosen to own and operate their own charging equipment (rather than working with an EV Supply Provider) have also faced challenges covering costs. For the first year of deployment, the fees for networked chargers (~\$250/year for ChargePoint) and for parts warranties (~\$250/year) were covered by grants or by the original equipment manufacturers. However, beginning with their second year of operation, network fees and parts warranties are beginning to kick in, and some site hosts feel the need to cover operational risk with labor warranties (another ~\$250/year.)

Cities with large numbers of chargers, such as San Jose, have reported that annual operating costs for their chargers may exceed revenues by as much as \$10K - \$20K per year; an

unexpected budgetary burden, and that price elasticity of demand for chargers is such that raising charging rates may not effectively cover the gap. ChargePoint has reported that charging costs of approximately \$1.50/hour approach the equivalent cost of a gallon of gasoline, and that demand falls off for chargers as prices approach the \$1.50/hour level. By contrast, demand is relatively steady at rates in the neighborhood of \$1/hour. Given that information is now increasingly available on charger utilization, revenues, and costs, regional and state agencies, private investors, and site hosts may benefit by:

- Sharing EVSE operating data for the purpose of developing more accurate (and conservative) estimates of operating costs and revenues, or by
- Developing multi-year program budgets, incorporating both capital and operating costs, with clearly specified sources of support for operating costs.

Collaboratively developing better information on revenue and expenses will help both public and private site hosts to address the question of where to situate EVSE on the spectrum of public goods and/or employee benefits, how to price for charging, and how to fund any gap between revenue and expense.

### **Charger Technology and Driver Behavior, Addressing Out-of-Service Notifications and Charger Reservations**

A persistent challenge with current EVSE technologies, including but not limited to ChargePoint, is that out-of-service reporting is not fully comprehensive. Due to the nature of the problem, data on this phenomenon is necessarily anecdotal, but many drivers on Bay Area EV blogs and social media, such as EV Charger News and Plugshare, report that many chargers are out of service that are shown on the ChargePoint network map as in service. This problem has been reported to ChargePoint and several technical solutions are being pursued.

However, this problem as it stands has exacerbated the problem of BEV drivers finding it difficult or impossible to rely on existing maps for reliable indicators of EVSE availability. Another important technical gap is the inability of charger network operators to support reservation systems. While the software to support reservations is available from some vendors, the problems of “no show” reservations and “over-stay” reservations have not been resolved in the

U.S. market. In Japan, it is reported that a reservation system developed by Kanematsu for the large Fast Charger system is working well, but this has not been deployed as yet in the U.S. A potential area of future investment by CEC could include a large-scale reservation pilot.

### **Utilization of Chargers**

According to aggregate data made available by ChargePoint for Bay Area EV charging stations deployed by public agencies, including the chargers in the EV Corridor Project, the average utilization rate is two sessions per day, for a total of 40 hours per week. Due to data privacy legalities, we have not been able to obtain ChargePoint station data on an individual site basis, except for those EVSE deployed directly by ChargePoint. However, we believe that the aggregate data accurately reflects current utilization throughout the region. This reflects strong utilization in locations such as San Francisco, and relatively modest utilization in locations such as Novato, where EV density is lower. With rapid penetration of the market indicated by the current rate of PEV sales in the region (3.5 percent of Light-Duty Vehicles in

Q1-Q2 2013) we believe that utilization rates will increase significantly in the coming year and beyond.

### Adequacy of the Bay Area Charging Network

**Charger Network Expansion Needs:** While charging occurs predominantly at home, the ability of regional PEV drivers to charge at work and other public locations has an important impact on electric vehicle miles travelled (eVMT) by both PHEVs and BEVs. Further, the presence of a robust and visible EVSE network helps communicate to prospective PEV buyers that the Bay Area is truly “EV friendly.” As of September 2013, the PEV Readiness Plan estimates that there are more than 5,000 residential EVSE and 1,100 publicly available EVSE in the Bay Area. To determine future regional needs, the PEV Readiness study relied in part on studies from the Electric Power Research Institute (EPRI), which proposes a “benefits tested scenario” to achieve a high level of electric VMT (eVMT). In this scenario, more EVSE are actually required to maintain PHEV all-electric miles, when some PHEVs have as few as 10 miles of all-electric range. For purposes of the EPRI analysis, the charging station-to-vehicle ratio ranged from .01 for BEVs (one public charger per every 100 BEVs), to .15 for PHEVs (one charger for every ~7 vehicles). EVSE companies such as ChargePoint propose a ratio of .5 for PEVs generally (one public charger for every two vehicles). In the regional Readiness plan, an EVSE to PEV deployment ratio was developed by ICF International, Inc. that calls for somewhat fewer chargers than the EPRI level for PHEVs, while decreasing the deployment over time to account for market saturation, with results indicated in the table 2 below.

**Table 2: Estimated Non-Residential Level 1 and 2 EVSE to Support Forecasted PEV Population**

Year	Vehicle Forecasts		Level 1 and Level 2 EVSE		
			Estimates		EPRI Method
	PHEV	BEV	low	high	
2015	17,600	18,100	7,900	14,200	4,370
2020	70,000	44,700	13,960	30,960	16,730
2025	148,000	98,900	20,789	45,190	35,550

Source: ABAG

Based on the study parameters, it was estimated that by 2015 the Bay Area’s Level 1 and Level 2 network of EVSE may need to be increased by 1,000 to 2,000 EVSE from 2013 levels. ICF estimated the additional Level 1 & 2 EVSE required to support the region’s PEVs by 2015 will require \$1-\$5 million, depending on charge levels and locations. The CEC infrastructure funding recently made available via the November 2013 solicitation (and due to be supplemented later in 2014) could provide a “down payment” on this investment.

However, there are two key challenges that are increasingly evident in the regional charging ecosystem: (1) the problem of sub-optimal locations; and (2) the problem of charge network sustainability.

## Charger Network Location Optimization

With regard to locations, the first wave of charging stations installed in the region were selected based in part on their relative low cost of installation and level of site owner cooperation. Thus, many public Level 2 sites were installed in locations such as Walgreens -- which provided strong regional coverage "on paper" but which may have been less well-suited to the longer dwell times required for meaningful Level 2 recharging. (For example, the Nissan Leaf gains between 12 and 20 miles of range per hour of Level 2 charging, depending on whether it is using the on-board 3.3kW or 6.6kW charger, vs. approximately three miles of range per minute of DC Fast Charging and five miles per hour at Level 1. Also, many local governments installed charging stations at sites that were affordable and feasible based on limited grant funds, but which may not have been proximate to the areas of greatest PEV driver need. Conversely, several well-known "hot spots" have emerged throughout the region (e.g., San Francisco, most of downtown Palo Alto, and the entire Google campus). These congestion zones reflect:

- The highly concentrated deployment of PEVs
- Free or low cost charging policies that do not consistently penalize day-long dwell times
- The extraordinary cost of adding EVSE in sites with power capacity limitations.

For the next round of infrastructure deployment, both public and private investors should likely focus on the highest-priority, highest-demand locations, leveraging large-scale private sector and site host participation, and deploying innovative technologies and strategies to address site congestion and power issues.



# CHAPTER 4:

## Assessment of Results

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### Assessment of Results

The Bay Area EV Corridor Project successfully achieved its primary goals:

- To help develop a robust regional public charging network serving EV drivers in seven Greater Bay Area Counties: San Francisco, Marin, Alameda, Santa Clara, Santa Cruz, San Benito, and Monterey.
  - The addition of 340 Charging points to the regional charging network represents approximately 25 percent of the existing infrastructure and covers many of the most important destinations in the region. The deployment of 40 sites in the tri- county Monterey Bay area is particularly noteworthy as the ABAG project was one of the only sources of significant EVSE deployment in that sub-region.
- To increase charging options for residents of multi-unit dwelling
  - The support provided for the PowerTree, Inc. deployment model serving nearly 300 units of multi-unit dwelling housing (in ten separate buildings) in San Francisco is an important “down payment” on a very promising strategy to reach large numbers of multi-unit dwelling buildings throughout the region.
- To demonstrate the integration of EV charging with solar technology and fixed energy storage, for the purpose of mitigating utility demand charges, developing grid services revenue to sustain the growth of EVSE networks, and reducing EV-related emissions.
  - CEC and ABAG support for the City of Benicia Eco-Station project, as well as the PowerTree, Inc. project, will demonstrate the potential for the integration of solar, storage, and EVSE to propagate a more sustainable business model in EV charging, and achieve other important California goals, such as decreasing the GHG content of electricity and increasing the proportion of local renewable generation.

The Project successfully installed 340 charge points: 138 Level 1, 198 Level 2, and four Fast Charge points (three with CHAdeMO connectors and one SAE Combo 2.) Further, the Project brought together the first cohesive, multi-jurisdictional collaboration on EV issues in the region, which led directly to the creation of the Bay Area Strategic Council, which became a model for the establishment of PEV Coordinating Councils statewide. This collaborative network will likely pursue additional funding from the CEC and elsewhere to complete the buildout of the Bay Area’s EVSE network, and that the many lessons learned in the Corridor Project will be applied to the next phase of network growth.

# GLOSSARY

ASSOCIATION OF BAY AREA GOVERNMENT (ABAG)—ABAG stands for the Association of Bay Area Governments. Our mission is to strengthen cooperation and collaboration across local governments to build healthier, stronger communities.<sup>2</sup>

ALTERNATING CURRENT (AC)—Flow of electricity that constantly changes direction between positive and negative sides. Almost all power produced by electric utilities in the United States moves in current that shifts direction at a rate of 60 times per second.

BATTERY ELECTRIC VEHICLE (BEV)—Also known as an “All-electric” vehicle (AEV), BEVs utilize energy that is stored in rechargeable battery packs. BEVs sustain their power through the batteries and therefore must be plugged into an external electricity source in order to recharge.

CALIFORNIA ENERGY COMMISSION (CEC)—The state agency established by the Warren-Alquist State Energy Resources Conservation and Development Act in 1974 (Public Resources Code, Sections 25000 et seq.) responsible for energy policy. The CEC's five major areas of responsibilities are:

1. Forecasting future statewide energy needs.
2. Licensing power plants sufficient to meet those needs.
3. Promoting energy conservation and efficiency measures.
4. Developing renewable and alternative energy resources, including providing assistance to develop clean transportation fuels.
5. Planning for and directing state response to energy emergencies.
6. Funding for the CEC's activities comes from the Energy Resources Program Account, Federal Petroleum Violation Escrow Account, and other sources.

CLEAN FUELS CONNECTION, INC (CFCI)—Clean Fuel Connection, Inc. distributes low-emission and renewable infrastructure products. Its products comprise solar photovoltaic systems; battery charging equipment or shore power connections for on-road and off-road electric drive vehicles.

DIRECT CURRENT (DC)—A charge of electricity that flows in one direction and is the type of power that comes from a battery.

ELECTRIC POWER RESEARCH INSTITUTE (EPRI)—An independent, nonprofit organization for public interest energy and environmental research that focuses on electricity generation, delivery, and use, in collaboration with the electricity sector, its stakeholders, and others. Conducts research, development, and demonstration projects to enhance quality of life by making electric power safe, reliable, affordable, and environmentally responsible.<sup>3</sup>

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<sup>2</sup> [Home | Association of Bay Area Governments \(ca.gov\)](https://abag.ca.gov/) <https://abag.ca.gov/>

<sup>3</sup> [Electric Power Research Institute](https://www.epri.com/#/about/epri?lang=en) (<https://www.epri.com/#/about/epri?lang=en>)

**ELECTRIC VEHICLE (EV)**—A broad category that includes all vehicles that are fully powered by electricity or an electric motor.

**ELECTRIC VEHICLE MILES TRAVELED (eVMT)** - Refers to miles driven using electric power over a given period of time. The more general term, VMT, is a measure of overall miles driven over a period of time.<sup>4</sup>

**ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE)**—Infrastructure designed to supply power to EVs. EVSE can charge a wide variety of EVs, including BEVs and PHEVs.

**GROWING ENERGY LABS, INC. (GELI)**—Geli, which stands for Growing Energy Labs, Inc., provides software and business solutions for designing, automating, and managing energy storage and microgrid systems. Geli's suite of products creates an ecosystem where project developers, OEMs, financiers, and project operators can deploy advanced energy projects using a seamless hardware-agnostic software platform.<sup>5</sup>

**GREENHOUSE GAS (GHG)**—Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (NO<sub>x</sub>), halogenated fluorocarbons (HCFCs), ozone (O<sub>3</sub>), per fluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

**KILOWATT (kW)**—One thousand watts. A unit of measure of the amount of electricity needed to operate given equipment. On a hot summer afternoon, a typical home—with central air conditioning and other equipment in use—might have a demand of 4 kW each hour.

**PLUG-IN ELECTRIC VEHICLE (PEV)**—A general term for any car that runs at least partially on battery power and is recharged from the electricity grid. There are two different types of PEVs to choose from—pure battery electric and plug-in hybrid vehicles.

**PLUG-IN HYBRID ELECTRIC VEHICLE (PHEV)**—PHEVs are powered by an internal combustion engine and an electric motor that uses energy stored in a battery. The vehicle can be plugged in to an electric power source to charge the battery. Some can travel nearly 100 miles on electricity alone, and all can operate solely on gasoline (similar to a conventional hybrid).

**PHOTOVOLTAIC (PV)**— Photovoltaic (PV) technologies – more commonly known as solar panels – generate power using devices that absorb energy from sunlight and convert it into electrical energy through semiconducting materials. These devices, known as solar cells, are then connected to form larger power-generating units known as modules or panels.<sup>6</sup>

**SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)**—A global association of more than 128,000 engineers and related technical experts in the aerospace, automotive, and commercial-vehicle industries. The leader in connecting and educating mobility professionals to enable safe, clean, and accessible mobility solutions.<sup>7</sup>

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<sup>4</sup> [U.C. Davis - International EV Policy Council](https://phev.ucdavis.edu/wp-content/uploads/Exploring-the-Role-of-Plug-In-Hybrid-Electric-Vehicles-in-Electrifying-Passenger-Transportation.pdf) (https://phev.ucdavis.edu/wp-content/uploads/Exploring-the-Role-of-Plug-In-Hybrid-Electric-Vehicles-in-Electrifying-Passenger-Transportation.pdf)

<sup>5</sup> [Our Story & Leadership – Geli](https://geli.net/team/) https://geli.net/team/

<sup>6</sup> [Photovoltaics | Department of Energy](https://www.energy.gov/eere/solar/photovoltaics) https://www.energy.gov/eere/solar/photovoltaics

<sup>7</sup> [Society of Automotive Engineers](https://www.sae.org/about/) (https://www.sae.org/about/)

# Appendix A: Site Data Summary

Tables 3 through 15 are site data summaries for different locations in the project.

**Table 3: Site Data Summary for Monterey**

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/ day per Charge Point x 5 hrs charging per day)	Est. kWh (= total hours of charging* 3kw/h avg. charge rate)	Pricing Approach
						Level 1	Level 2	FC					
RedTree Properties	809 Bay Avenue	Capitola	95010	1	CT2100	1	1		2	13-Sep	600	1800	Free
Carmel Valley Ranch	1 Old Ranch Road	Carmel Valley	93923	1	CT2100	1	1		2	13-Jan	3000	9000	Free
IBEW Local 234	10300 Merritt Street	Castroville	95012	1	CT2100	1	1		2	13-Jun	1500	4500	Free
Hartnell College	117 North 2nd Street	King City	93930	1	CT2100	1	1		2	13-Sep	600	1800	Free
City of Marina - Annex City Offices	211 Cypress Avenue	Marina	93933	2	CT2100	2	2		4	13-Oct	600	1800	Free

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/ day per Charge Point x 5 hrs charging per day)	Est. kWh (= total hours of charging* 3kw/h avg. charge rate)	Pricing Approach
						Level 1	Level 2	FC					
Monterey Bay Unified Air Pollution Control District	24580 Silver Cloud Court	Monterey County	93940	1	CT2100	1	1		2	13-Apr	1800	5400	Free
Monterey Peninsula Airport	200 Fred Kane Drive	Monterey County	93940	3	CT2100	3	3		6	13-Nov	0	0	Free
Hayward Lumber	1140 Sunset Drive	Pacific Grove	93950	1	CT2100	1	1		2	13-Feb	2700	8100	Free
Hartnell College Parking Lot	411 Central Avenue	Salinas	93901	1	CT2100	1	1		2	13-Sep	300	900	Free
Monterey County Agricultural Commission	1428 Abbott St.	Salinas	93901	1	CT2100	1	1		2	13-May	1800	5400	Free
Steinbeck Center Parking Garage	20 East Market Street	Salinas	93901	2	CT2100	2	2		4	13-Mar	4800	14400	\$1/hour

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/ day per Charge Point x 5 hrs charging per day)	Est. kWh (= total hours of charging* 3kw/h avg. charge rate)	Pricing Approach
						Level 1	Level 2	FC					
Transportation Agency for Monterey County	55B Plaza Circle	Salinas	93901	1	CT2100	1	1		2	13-May	1800	5400	Free
County of Santa Cruz	1080 Emeline Avenue	Santa Cruz	95060	1	CT2100	1	1		2	13-Jan	3000	9000	Free
New Leaf Market	1100 Fair Avenue	Santa Cruz	95062	1	CT2100	1	1		2	13-Aug	900	2700	Free
Staff of Life	1266 Soquel Avenue	Santa Cruz	95062	1	CT2100	1	1		2	13-May	1800	5400	Free
CSUMB Alumni & Visitor Center	4th Avenue	Seaside	93955	1	CT2100	1	1		2	12-Dec	3300	9900	Free
CSUMB Student Center	6th Ave. between B St. and Butler St	Seaside	93955	1	CT2100	1	1		2	12-Dec	3300	9900	Free
County of Santa Cruz, Health Services Agency	1430 Freedom Blvd	Watsonville	95076	1	CT2100	1	1		2	13-Jan	3000	9000	Free

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/ day per Charge Point x 5 hrs charging per day)	Est. kWh (= total hours of charging* 3kw/h avg. charge rate)	Pricing Approach
						Level 1	Level 2	FC					
Hartnell College - Alisal Campus	1752 E. Alisal Ave	Salinas	93901	1	CT2100	1	1		2	12-Aug	900	2700	Free
New SC County Sheriff's station	2400 Chanticleer Avenue	Santa Cruz	95062	1	CT2100	1	1		2	13-Apr	2100	6300	Free
Clement Hotel	750 Cannery Road	Monterey	93940	2	CT2100	2	2		4	13-Feb	5400	16200	Free
Asilomar	800 Asilomar Ave.	Monterey	93950	2	CT2100	2	2		4	13-Apr	4200	12600	Free
San Juan Oaks Golf Club	3825 Union Road	San Benito	95023	1	CT2100	1	1		2	13-Feb	2700	8100	Free
Central CA Alliance for Health	1600 Green Hills Road	Scotts Valley	95066	3	CT2100	3	3		6	13-Jan	9000	27000	Free
Central CA Alliance for Health	339 Pajaro Street	Salinas	93901	1	CT2100	1	1		2	13-Mar	2400	7200	Free
UCSC Core West Parking Garage	McLaughlin & Heller Drive	Santa Cruz	95064	4	CT2021	1	9		10	13-Sep	3000	9000	\$1/hour
					1 &								

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/ day per Charge Point x 5 hrs charging per day)	Est. kWh (= total hours of charging* 3kw/h avg. charge rate)	Pricing Approach
						Level 1	Level 2	FC					
City of Santa Cruz Public Parking Lot	710 Cedar Street & (Lincoln St.)	Santa Cruz	95060	2	Control Module Industries, Watt Point	0	2		2	13-Nov	0	0	Free
County of Monterey Administrative Building	116 W. Alisal Stree	Monterey	93901	1	CT2100	1	1		2	13-Aug	900	2700	Free
<b>TOTAL Monterey</b>				<b>40</b>		<b>35</b>	<b>45</b>	<b>0</b>	<b>80</b>				

Source: ABAG



**Table 4: Alameda County Site Data**

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/ day per Charge Point x 5 hrs charging per day)	Est. kWh (= total hours of charging* 3kw/h avg. charge rate)	Pricing Approach
						Level 1	Level 2	FC					
165- 13th St. Basement, Oakland	165- 13th St.	Oakland	94612	4	CT 2103	4	4		8	13-Jul	4800	14400	Free through the end of 2014.
165- 13th St. Upper Flrs, Oakland	165- 13th St.	Oakland	94612	10	CT 2103	10	10		20	13-Jul	12000	36000	Pricing likely after that but policy not yet established. Congestion not yet a problem.
7th & Jefferson St., Oakland	7th & Jefferson St.	Oakland	94607	9	CT 2103	9	9		18	13-Jul	10800	32400	
2500 Fairmont Dr., San Leandro	2500 Fairmont Dr.	San Leandro	94578	5	CT 2103	5	5		10	13-Jul	6000	18000	
399 Elmhurst, Hayward	399 Elmhurst	Hayward	94544	4	CT 2103	4	4		8	13-Jul	4800	14400	

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/ day per Charge Point x 5 hrs charging per day)	Est. kWh (= total hours of charging* 3kw/h avg. charge rate)	Pricing Approach
						Level 1	Level 2	FC					
24360 Amador St., Hayward	24360 Amador St.	Hayward	94544	6	CT 2103	6	6		12	13-Jul	7200	21600	
1131 Harbor Bay Parkway, Alameda	1131 Harbor Bay Parkway	Alameda	94502	2	CT 2103	2	2		4	13-Jul	2400	7200	
<b>TOTAL Alameda</b>				<b>40</b>		<b>40</b>	<b>40</b>	<b>0</b>	<b>80</b>				

Source: ABAG

**Table 5: City of San Francisco Site Information**

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/day per Charge Point x 5 hrs charging per day)	Est. kWh
						Level 1	Level 2	FC				(= total hours of charging* 3kw/h avg. charge rate)
Civic Center Garage	355 McAllister Street	San Francisco	94102	1	CT 2103	1	1		2	13-Nov	N/A	N/A
5th and Mission Garage	833 Mission Street	San Francisco	94103	5	CT 2103	5	5		10	13-Nov	N/A	N/A
Moscone Ctr. Garage	255 Third Street	San Francisco	94103	3	CT 2103	3	3		6	13-Nov	N/A	N/A
North Beach Garage	735 Vallejo Street	San Francisco	94133	3	CT 2103	3	3		6	13-Nov	N/A	N/A
Portsmouth Square Garage	733 Kearny St.	San Francisco	94108	1	CT 2103	1	1		2	13-Nov	N/A	N/A
St. Mary's Square Garage	433 Kearny St.	San Francisco	94108	3	CT 2103	3	3		6	13-Nov	N/A	N/A
1660 Mission St. Garage	1660 Mission Street	San Francisco	94103	1	CT 2103	1	1		2	13-Nov	N/A	N/A

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/day per Charge Point x 5 hrs charging per day)	Est. kWh (= total hours of charging* 3kw/h avg. charge rate)
						Level 1	Level 2	FC				
Sutter Stockton Garage	444 Stockton Street	San Francisco	94108	4	CT 2103	4	4		8	13-Nov	N/A	N/A
Union Square Garage	333 Post Street	San Francisco	94108	4	CT 2103	4	4		8	13-Nov	N/A	N/A
San Francisco Zoo	One Zoo Rd	San Francisco	94132	5	Eaton Level 2		4		4	13-Nov	N/A	N/A
Kezar Stadium Parking Lot	811 Stanyan St	San Francisco	94117	5	Eaton Level 2		5		5	13-Nov	N/A	N/A
<b>TOTAL San Francisco</b>				<b>35</b>		<b>25</b>	<b>34</b>	<b>0</b>	<b>59</b>			

Source: ABAG

**Table 6: City of San Jose Site Information**

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/day per Charge Point x 5 hrs charging per day)	Est. kWh (= total hours of charging* 3kw/h avg. charge rate)	Pricing Approach
						Level 1	Level 2	FC					
Market & San Pedro Square Garage	5 N. Market Street	San Jose	95113	4	CT2103	4	4		8	12-Dec	13200	39600	\$1/hour for charging in 2013 with parking free for local residents.
Third Street Garage	95 N. Third Street	San Jose	95113	3	CT2103	3	3		6	13-Feb	8100	24300	Policy change in discussion to shift to
Second & San Carlos St Garage	280 S. Second St.	San Jose	95113	2	CT2103	2	2		4	12-Dec	6600	19800	\$1.25 per session plus
Convention Center	150 W. San Carlos Street	San Jose	95113	3	CT2103	3	3		6	12-Dec	9900	29700	.35/kWh (roughly equivalent to \$1.25/hr)

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/day per Charge Point x 5 hrs charging per day)	Est. kWh (= total hours of charging* 3kw/h avg. charge rate)	Pricing Approach
						Level 1	Level 2	FC					
City Hall Garage	200 E. Santa Clara Street	San Jose	95113	2	CT2103	2	2		4	12-Dec	6600	19800	
Fourth & St. John Garage	50 N Fourth St	San Jose	95112	2	CT2103	2	2		4	13-Nov	0	0	
Fourth & San Fernando Garage	44 S Fourth St	San Jose	95112	2	CT2103	2	2		4	13-Nov	0	0	
Environmental Innovation Cntr.	1608 Las Plumas Ave.	San Jose	95133	5	CT2102	5	5		10	13-Nov	0	0	
<b>TOTAL San Jose</b>				<b>23</b>		<b>23</b>	<b>23</b>	<b>0</b>	<b>46</b>				

Source: ABAG

**Table 7: Coulomb/Charge Point Site Information**

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/day per Charge Point x 5 hrs charging per day)	Est. kWh (= total hours of charging* 3kw/h avg. charge rate)
						Level 1	Level 2	FC				
Sobrato	500 Race St	San Jose	95126	1	CT2021		1		1	12-Dec	1650	4950
Shelter Creek	701 Shelter Creek Lane	San Bruno	94066	4	CT2021		7		7	13-Mar	8400	25200
					&							
					CT2000							
Watergate	8 Captain Drive	Emeryville	94608	3	CT2021		6		6	12-Dec	9900	29700
Metropolitan	19503 Stevens Creek	Cupertino	95014	5	CT500		5		5	13-Mar	6000	18000
<b>TOTAL Coulomb</b>				<b>13</b>		<b>0</b>	<b>19</b>	<b>0</b>	<b>19</b>			

Source: ABAG

**Table 8: Fairfax Site Information**

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/day per Charge Point x 5 hrs charging per day)	Est. kWh (= total hours of charging* 3kw/h avg. charge rate)	Pricing Approach
						Level 1	Level 2	FC					
City Hall Parking Lot	142 Bolinas Road	Fairfax	94930	1	CT 2100	1	1		2	13-May	1800	5400	Free
Parkade Parking Lot	9 Broadway Ave	Fairfax	94930	2	CT 2100	2	2		4	13-May	3600	10800	Free
<b>TOTAL Fairfax</b>				3		3	3	0	6				

Source: ABAG



**Table 9: Novato Site Information**

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/day per Charge Point x 5 hrs charging per day)	Est. kWh  (= total hours of charging* 3kw/h avg. charge rate)	Pricing Approach
						Level 1	Level 2	FC					
City Council Chambers-1	901 Sherman Avenue	Novato	94945	1	Level 1/2	1	1		2	13-Mar	2400	7200	Free
Zenk Parking Lot	913 Reichert Ave (Zenk Lot)	Novato	94945	3	1 Level 1/2	1	3		4	13-Mar	4800	14400	Free
					3 Level 2								
Gymnastic Teen Center	950 7th Street (Gymnastic Teen Center)	Novato	94945	1	Level 1/2	1	1		2	13-Mar	2400	7200	Free
Hamilton Community Center	503 S. Palm Drive (Hamilton Airfield)	Novato	94949	1	Level 1/2	1	1		2	13-Mar	2400	7200	Free

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/day per Charge Point x 5 hrs charging per day)	Est. kWh (= total hours of charging* 3kw/h avg. charge rate)	Pricing Approach
						Level 1	Level 2	FC					
<b>TOTAL Novato</b>				<b>6</b>		<b>4</b>	<b>6</b>	<b>0</b>	<b>10</b>				

Source: ABAG

**Table 10: San Anselmo Site Information**

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/day per Charge Point x 5 hrs charging per day)	Est. kWh (= total hours of charging* 3kw/h avg. charge rate)	Pricing Approach
						Level 1	Level 2	FC					
<b>TOTAL San Anselmo</b> (Magnolia Lot)	San Anselmo Av	Novato	94960	4	Level 1/2	4	4	0	8	13-Jun	N/A	N/A	Free

Source: ABAG

**Table 11: Mill Valley Site Information**

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/day per Charge Point x 5 hrs charging per day)	Est. kWh  (= total hours of charging* 3kw/h avg. charge rate)	Pricing Approach
						Level 1	Level 2	FC					
<b>TOTAL Mill Valley</b> (Public Safety Building)	1 Hamilton Drive	Mill Valley	94942	1	Level 1/2	1	1	0	2	13-Aug	900	2700	Free

Source: ABAG

**Table 12: Larkspur Site Information**

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/day per Charge Point x 5 hrs charging per day)	Est. kWh (= total hours of charging* 3kw/h avg. charge rate)	Pricing Approach
						Level 1	Level 2	FC					
Piper Park	250 Doherty Drive	Larkspur		2	Level 2	0	2		2	13-Nov	N/A	N/A	Free
Twin Cities Police Station	250 Doherty Drive	Larkspur		1	Combo Level 1/2	1	1		2	13-Nov	N/A	N/A	Free
				<b>3</b>		<b>1</b>	<b>3</b>	<b>0</b>	<b>4</b>				
<b>TOTAL Larkspur</b>													

Source: ABAG

**Table 13: Benicia City Hall**

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/ day per Charge Point x 5 hrs charging per day)	Est. kWh	Pricing Approach
						Level 1	Level 2	FC				(= total hours of charging* 3kw/h avg. charge rate)	
<b>TOTAL Benicia City Hall</b>	250 E. L. Street	Benecia	94510	1	FC	0	0	2	2	13-Nov	N/A	N/A	Charged by kWh and time of use, with charges comparable to the Blink Network.

Source: ABAG

**Table 14: ECOTality Site Information**

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/day per Charge Point x 5 hrs charging per day)	Est. kWh (= total hours of charging* 3kw/h avg. charge rate)	Pricing Approach
						Level 1	Level 2	FC					
South Street	450 South St., Mission Bay	San Francisco	94158	5	FC/Level 2	0	4	1	5	13-Nov	N/A	N/A	\$5 per FC session for Blink members,
Owens	1670 Owens St., Mission Bay	San Francisco	94158	5	FC/Level 2	0	4	1	5	13-Nov	N/A	N/A	\$8 for non-members. Level 2 is \$1/hr for members \$2 for non- members.
<b>TOTAL ECOTality</b>				10		0	8	2	10				Membership is free but requires online sign-up

Source: ABAG

**Table 15: PowerTree, Inc. Site Information**

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/day per Charge Point x 5 hrs charging per day)	Est. kWh	Pricing Approach
						Level 1	Level 2	FC					
												(= total hours of charging* 3kw/h avg. charge rate)	
1500 Geneva	1500-1514 Geneva Avenue	San Francisco	94112	1	Eaton/PowerTree		1		1	13-Nov			PowerTree, Inc. offers a monthly subscription priced at approximately one third the cost of gasoline for an equivalent amount of \$5/ session
325 9th	325 9th Avenue	San Francisco	94118	1	Eaton/PowerTree		1		1	13-Nov			
					e 70A								



SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/day per Charge Point x 5 hrs charging per day)	Est. kWh	Pricing Approach
200 Rose	200 Rose Street	San Francisco	94102	2	Eaton/PowerTree		2		2	13-Nov			
					e 70A								
361 14th St	361 14th St	San Francisco	94114	1	Eaton/PowerTree		1		1	13-Nov			
					e 70A								
3449 22nd St	3449 - 22nd Street	San Francisco	94114	1	Eaton/PowerTree		1		1	13-Nov			
					e 70A								
3809 20th St	3809 20th St	San Francisco	94114	2	Eaton/PowerTree		2		2	13-Nov			
					e 70A								
287 Green St	287 Green St	San Francisco	94133	1	Eaton/PowerTree		1		1	13-Nov			
					e 70A								
600 Oak	600 Oak St	San Francisco	94117	1	Eaton/PowerTree		1		1	13-Nov			
					e 70A								

SITES	Address	Locality	Zip Code	# of EVSE	Charger Type	Charge Points			Total Charge Points	Date Placed in Service	Est. # chg. sessions @ avg. 2 sessions/day per Charge Point x 5 hrs charging per day)	Est. kWh	Pricing Approach
1320 Washington	1320 Washington St	San Francisco	94109	1	Eaton/PowerTree		1		1	13-Nov			
					e 70A								
1870 Pacific	1870 Pacific Avenue	San Francisco	94109	1	Eaton/PowerTree		1		1	13-Nov			
					e 70A								
1340 Taylor	1340 Taylor Street	San Francisco	94108	1	Eaton/PowerTree		1		1	13-Nov			
					e 70A								
4460 Redwood	4460 Redwood Highway	San Rafael	94903	1	Eaton/PowerTree		1		1	13-Nov			
					<b>e 70A</b>								
<b>TOTAL PowerTree, Inc.</b>				<b>14</b>		<b>0</b>	<b>14</b>	<b>0</b>	<b>14</b>				
<b>PROGRAM TOTAL</b>				<b>193</b>		<b>138</b>	<b>198</b>	<b>4</b>	<b>340</b>				

Source: ABAG

# **Appendix B: Request for Proposals to Deploy Rapid EV Charging and Related Energy Storage Infrastructure in the Greater Bay Area**

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Issued on Behalf of the Bay Area EV Corridor Project, a project administered by the Association of Bay Area Governments, in collaboration with EV Communities Alliance and Ecology Action. (Contracts issued under this request for proposal may be administered by a third party.)

Funding by the California Energy Commission.

**DUE DATE: April 29, 2013, 3:00 p.m.**

**Background on the Bay Area EV Corridor Project:** The Bay Area EV Corridor Project has been jointly developed by the Association of Bay Area Governments and EV Communities Alliance throughout the 12 county greater Bay Area region, including the traditional nine Bay Area Counties and the tri-county Monterey Bay Area (Santa Cruz, San Benito, and Monterey Counties.) The project is currently installing more than 300 charge points, primarily Level 2, with some Level 1 charge ports provided via dual-port EV Charging Stations. An initial contract to install 18 Fast Charge stations has been withdrawn and is now being re-issued in the form of this request for proposal.

The goal of this solicitation is to demonstrate and deploy innovative charging technologies in high- need locations, especially multi-unit developments. Eligible equipment configurations include DC Fast Charging and/or Level 2 charging (including higher-rate Level 2 charging), or any combination thereof. Respondents are also encouraged to integrate energy storage and local renewable resources into their charge stations, to deliver meaningful benefits to consumers and the environment, and spur EV and clean energy market acceleration.

**Available Grant Funds, Match Requirement, and Timeline for request for proposal Submission and Project Completion:** A total of \$200,000 is available from CEC funds, which requires a minimum match share of \$250,000. Other CEC funds cannot be used for match, but non-CEC state, federal, local, or private funds may be used as match. Staff costs and other auditable, in-kind contributions are eligible, subject to CEC and ABAG program audit requirements. The proposal must be submitted by 3:00 p.m. on Monday, April 22nd in hard-copy format, delivered to the Association of Bay Area Governments, at 101 Eighth Street, Oakland CA, 94607. Electronic submissions must also be submitted by the same deadline to JerryL@abag.ca.gov. Projects must be completed (with chargers installed and fully operational) by November 30, 2013.

## **Bay Area EV Ecosystem Context:**

**Charging Options for Multi-Unit Dwellings:** Over half of Bay Area residents in the region's larger cities live in multi-unit dwellings. Many of these residents are prime candidates for EV ownership but have not been able to readily address the challenge of residential charging, particularly when Level 2 solutions are viewed as essential (e.g., for most Battery-Electric Vehicle owners). Given the challenges of installing residential charging in rental properties and multi-unit dwellings, ABAG and the CEC are interested in business models that can sustainably scale up charging for EV owners in these settings, providing the necessary incentives to building owners to dedicate charging equipment to some of their parking spaces even in advance of an identified EV owner already residing in the building.

**The Need for Sustainable Business Models:** A number of public EV charge network operators have experienced financial challenges, due in part to business models that have relied heavily on grant resources and optimistic projections of early-stage network utilization. Given this trend, the Bay Area EV Corridor Project sponsors are particularly interested in identifying and showcasing new business models that do not rely significantly on ongoing grants or public subsidy, but may require initial, one-time public investments to reach difficult-to-serve customers, such as residents of multi-unit developments.

**New Models for Integration of Energy Storage, EV Charging, and Solar:** Given the challenges of "charging only" business models, new models are beginning to emerge that can diversify revenue for charge operators with the potential to enhance charge network sustainability. New models including integration of fixed battery storage with both Level 2 and Fast Charging, thereby enabling participation in the energy services market, notably in regulation energy for the California Independent System Operator. Broader-scale deployment of energy storage in tandem with EV charging also has potential to advance state policy goals for the integration of distributed renewable energy, as increased storage is an essential prerequisite to making efficient use of renewable resources on the grid. Integrating EV charging and energy storage with solar installations can also provide important "stacked benefits" that can lower the cost and the carbon intensity of "green electrons" delivered to EV drivers and provide an additional revenue stream for EV charging network developers and property owners.

**Solicitation Requirements:** As noted above, the core goal of this solicitation is to demonstrate and deploy innovative charging technologies in high-need locations, especially multi-unit developments. Respondents are also encouraged but not required to integrate energy storage and local renewable resources into their charge stations, where these technologies can help deliver meaningful benefits to consumers and the environment, and spur EV market acceleration. A total of \$200,000 is available through this solicitation for hardware and installation expenses related to the charge stations and integrated batteries (if any). Solar PV costs, if included in the overall project design, must be paid from other sources. Respondents must submit a narrative of no more than 15 pages (using 11 point type and one inch margins) that addresses the following issues.

Proposals shall include:

1. **Cover page:** clearly displaying 1) company name and 2) a contact person's name, address, phone and fax numbers, and e-mail address. The cover page must be signed by an officer of the company authorized to submit a firm proposal and sign subsequent contracts with ABAG.
2. **Proposed Locations and Supporting Data on Technologies and Cost:** Respondents shall identify the number, technology type, and specific locations for the proposed charger installations. It is strongly preferred that locations be identified to the specific address level. Where this is not feasible, a localized area (e.g., "within five blocks of the El Cerrito Del Norte BART station." Respondents may submit a list of possible addresses that is slightly larger than the number of EVCS to be installed, if it is anticipated that some sites may not prove feasible after further investigation of construction costs. The timeline for finalizing site host commitments where they are not already secured must be indicated with timeframes noted on a per site basis. The following format is recommended. Please note electrical requirements and technical integration elements as appropriate.

**Table 16: Suggested Format for Site Information**

Site	Address	EVCS	Ports	Storage/Solar	Notes
Nottingham Mall	1050 Smith Blvd. Daly City	1 Eaton 80 amp AC charger (up to 20 kW output) with credit card POS and cellular package  1 Eaton DC Fast Charging 50 kW (for 3-phase 480 volt service)	2 Level 2 ports  1 DC Fast Charge/ CHAdeMO (upgradeable to Combo 2 for est. \$15K additional)	20 kWh (new) storage  500kWh solar array (existing) to be tied to storage and bi-directional inverter	Fast Charge draws maximum of 20 kW from grid, outputs at 50 kW  Level 2 charger location can serve 4 spaces

Source: ABAG

3. **Rationale for Site Selection:** Explain how the locations will best meet the needs of current and future Bay Area EV drivers, based on relevant data regarding current and expected EV sales, and existing and planned chargers. Please note that strategies that address the potential for increased EV sales to residents of multi-unit developments and renters are especially encouraged.
4. **Site Host Agreement Status:** Agreements with site hosts are not required at the time of submission, but respondents must define the timeline and process whereby site host agreements will be secured. While site host agreements are not

required as part of this proposal, a demonstrated commitment by the site owner will be a significant factor in the proposal scoring (see below).

5. **Budget:** Include a budget showing equipment, installation costs, and project management expense. Where different levels of technology are involved at different sites, provide an average site cost profile for each different technology package (e.g., standalone Fast Charger, battery-backed Fast Charger, etc.) Note which project expenses will be covered by CEC and which by matching funds. A total of \$200,000 is available from CEC funds, which requires a minimum match share of \$250,000. (Proposals with more than the minimum local match are encouraged.) Other CEC funds cannot be used for match, but non-CEC state, federal, local, or private funds may be used as match. Staff costs and other auditable, in-kind contributions are eligible, subject to CEC and ABAG program audit requirements. The costs to obtain and document match fund commitments are not reimbursable through this grant, although the recipient may utilize match funds for this task. Match funds shall be spent concurrently or in advance of CEC funds for each task during the term of the Agreement. Match funds must be identified in writing and the associated commitments obtained before the recipient can incur costs for which the recipient will request reimbursement.

#### 6. **Technology Selection and Deployment**

- a. Provide a detailed description of proposed charging technologies, indicating how the selected technologies will accommodate future changes in charging standards, including expected shifts in DC Fast Charge technologies and high-rate AC charging technologies.
- b. Explain how consumers will interact with the charging equipment, including any required subscriptions, access devices (such as RFID cards), or other payment and tracking technologies.
- c. Provide information on how the project installation process will be managed, including initial overall project cost estimates, site-by-site bidding, contractor selection criteria, and cost control and project management processes.

#### 7. **Business Model and Customer Value Proposition**

- a. Explain the business model for provision of charging services. Provide evidence that the firm will be able to sustain ongoing operations of the chargers in working condition (if the business model involves ongoing ownership). If ownership passes to site hosts, explain how site hosts will realize sufficient revenue to maintain the units in operational condition.
- b. Provide a typical "pro forma" estimate of revenue generation to the average site, showing the return-on-investment to the infrastructure owner and the site host.
- c. Define the rate structure for charging customers, including one-time charges, "bulk purchase" discounts if any, time of use pricing variations, and subscription programs, where applicable. Define access control

protocols in relationship to various customer classes (e.g., subscription member, non-member, premium member etc.)

- d. If a subscription or network fee is involved, describe the customer value proposition and provide an example of literature promoting the service to the customer. This can be in the form of draft brochure that might be handed out at an EV dealership at the point of purchase, for example.

## 8. Team Capabilities and Experience

- a. Provide background statements and relevant experience for key project team members.
- b. Provide a statement of company background, relevant experience, and capabilities.
- c. Provide a client list and three references for previous relevant work installing EV charging stations or related equipment.
- d. Where appropriate, multi-company teams will be considered for the award, and teaming is encouraged as necessary to bring needed competencies to each task.

## Timeline

- **Release of request for proposal:** April 8, 2013
- **Responses due to request for proposal:** April 29, 2013, 3:00 p.m.
- **Consultant selection:** May 3, 2013
- **Contract approval goal:** May 17, 2013
- **Project completion:** November 30, 2013

Please note that the EV Corridor Project management team reserves the right to subdivide this contract into component parts and award it to multiple parties if appropriate, or to cancel the request for proposal for any or no reason. CEC approval of the contract workplan will also be required to proceed.

## Scoring Criteria:

- Project value to EV drivers based on EVSE locations, accessibility, and need: twenty points
- Degree to which project serves needs of multi-dwelling unit residents: ten points
- Demonstrated expertise and qualifications of project team to complete work on time and within budget: forty-five points
- Technical innovation with potential to advance the EV ecosystem: twenty points
- Value of match above required minimum: five points

## General Conditions

1. **Limitations:** This request for proposal does not commit ABAG to award a contract or to pay any costs incurred in the preparation of a proposal in response to this request for proposal.

2. **Award:** All "short listed" proposers may be required to participate in negotiations and to submit such price, technical, or other revisions of their proposals as may result from discussions. ABAG also reserves the right to award the contract without discussion, based upon the initial proposals. Accordingly, each initial proposal should be submitted on the most favorable terms from a price and a technical viewpoint.
3. **Binding Offer:** A signed proposal submitted to ABAG in response to this request for proposal shall constitute a binding offer from contractor to contract with ABAG according to the terms of the proposal for a period of ninety days after its date of submission, which shall be the date proposals are due to ABAG.
4. **Contract Arrangements:** The selected contractor/consultant will be expected to execute a contract similar to ABAG's standard agreement for services. Particular attention should be paid to ABAG's insurance and indemnification requirements. A copy of the standard agreement may be obtained from the Project Manager. If a proposer wishes to propose a change to any provision in the standard agreement, the provision and the proposed alternative language must be specified in the proposal submitted in response to this request for proposal. Submission of a proposal without the requested changes shall be deemed acceptance of the standard agreement's terms and conditions. The contract payment terms will be lump sum (firm fixed price) per site, with monthly payments made on the basis of receipt by ABAG of an acceptable invoice, and payment by the California Energy Commission. CEC requires a 10 percent hold-back on all invoices, payable within approximately 60 days of successful completion of the entire project.
5. **For additional information:** Please contact Richard Schorske, Executive Director, EV Communities Alliance, at (415) 310-2407, or at Richards@dsnetwork.org.