Peninsula Advanced Energy Community (PAEC)

Task 6.4: Final Report on Electric Vehicle Charging Infrastructure Master Plan

<u>Prepared for</u>
California Energy Commission
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April, 2018

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About the Authors

Sven Thesen & Associates

Sven Thesen & Associates (STA) is a small electric vehicle and energy consulting firm located in Palo Alto with over 20 years of experience in the energy/ environmental space and 12 years focusing on electric vehicles and the electric utility nexus. At present, the practice assists local and regional governments, private employers and non-profits make intelligent, cost conscious choices in deploying electric vehicle infrastructure. Recent activities in addition to the Clean Coalition Peninsula Advanced Energy Community include obtaining a $240k Bay Area Air Quality Management (BAAQMD) grant for the city of Palo Alto to install 40 Level 2 chargers and co-organizing/ co-writing the June 2017 EV Adoption Accelerator Charrette and associated White Paper.

About the Clean Coalition

The Clean Coalition is a nonprofit organization whose mission is to accelerate the transition to renewable energy and a modern grid through technical, policy, and project development expertise. The Clean Coalition drives policy innovation to remove barriers to procurement and interconnection of distributed energy resources (DER) such as local renewables, energy storage, and demand response. The Clean Coalition also establishes programs and market mechanisms that realize the full potential of integrating these solutions. In addition to being active in numerous proceedings before state and federal agencies throughout the United States, the Clean Coalition collaborates with utilities (and other Load Serving Entities) and municipalities (and other jurisdictions) to create near-term deployment opportunities that prove the technical and economic viability of local renewables and other DER.

Ultimately, the Clean Coalition envisions the United States being 100% powered by renewable energy, substantially from local sources. To make this goal a reality, the Clean Coalition is working to achieve the following objectives by 2020:

- From 2020 onward, at least 80% of all electricity from newly added generation capacity in the United States will be from renewable energy sources.
- From 2020 onward, at least 25% of all electricity from newly added generation capacity in the United States will be from local renewable energy sources.
    - Locally generated electricity does not travel over the transmission grid to get from the location it is generated to where it is consumed.
- By 2020, policies and programs are well established for ensuring successful fulfillment of the other two objectives.
    - Policies reflect the full value of local renewable energy.
    - Programs prove the superiority of local energy systems in terms of economics, environment, and resilience; and in terms of timeliness.

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Legal Disclaimer

I. Executive Summary

The electric vehicle (EV) charging landscape is rapidly evolving due to the advent and adoption of mainstream affordable long-range battery electric vehicles. While accessibility to residential and workplace charging remains key to EV adoption particularly by first time EV users, the paradigm associated with publicly provided charging is shifting from Level Two (L2) charge rates with significant deployment densities (commonly found in retail settings) to third party direct current fast charge (DCFC) charging rates with less deployment densities. In essence, as EVs have longer ranges, matching that of internal combustion engine (ICE) vehicles, the public charging ecosystem is also evolving to partially match that of the gasoline station model. We see the mid-term future of EV charging is a combination of residential and workplace charging, urban DCFC, and travel DCFC stations strategically placed along highways and en route to remote destinations.

This EV charging infrastructure (EVCI) report covering the PAEC region addresses this shift from both the macro and micro perspective, while providing recommendations and an Electric Vehicle Charging Infrastructure-Master Plan (EVCI-MP) for the Redwood City Horseshoe and the southwest side of East Palo Alto[1]. If implemented as recommended, this EVCI-MP will yield ~$11.7M in EVCI at an external cost of ~$150,000.

Macro Level: To continue to accelerate EV adoption while addressing the increasing numbers of long range EVs, local governments should re-evaluate their EVCI deployment plans, their education and outreach efforts, and their EVCI code requirements. Within these three categories we recommend the following six actions:

1. Strengthen building codes to require EVCI installation for new buildings and renovations, with a density of one charger per residential unit;
2. Conduct EV ride and drives and related educational activities;
3. Encourage DCFC infrastructure ownership, installation and operation by 3rd parties;
4. Focus on low cost installations via grants & utility funded installs;
5. Increase public signage for EVCI; and
6. Develop pilot codes requiring some level of EVCI for existing multi-unit dwellings and workplaces.

Micro Level: This report completes a deep dive for EVCI installations in Redwood City, East Palo Alto, Menlo Park, Burlingame, San Carlos, and San Mateo County. Based on this work, we recommend:

1. Install EVCI during parking lot retrofits or lighting and energy upgrades;
2. Use existing pay for parking systems to collect EVCI charging fees and conduct enforcement; and

[1] The boundaries for the two areas are defined in the *Potential Locations for the Electric Vehicle Charging Infrastructure Master Plan (EVCI-MP) Evaluation and Recommendations*, completed as T6.2 under this PAEC grant.

3. Utilize PG&E's Charge Network for Level 2 workplace or multifamily installations, and Tesla and Electrify America's programs for DCFC chargers.

II. Background: Peninsula Advanced Energy Community (PAEC)

The Clean Coalition's Peninsula Advanced Energy Community (PAEC), supported by numerous local governments and PG&E, will accelerate the planning, approval, and deployment of an Advanced Energy Community (AEC) within a diverse community in the southern portion of San Mateo County. The core PAEC region encompasses the cities of Atherton, East Palo Alto, Menlo Park, and Redwood City as well as surrounding unincorporated areas. The PAEC region - largely built-out, yet also experiencing enormous commercial and residential growth pressure - is representative of similar regions throughout California, ensuring that the PAEC's success can be replicated statewide. The Clean Coalition views that these components are critical for the success of an AEC: abundant solar electricity, energy storage, and other Distributed Energy Resources (DER,) low or zero net energy (ZNE) buildings, Solar Emergency Microgrids (SEM) for power management and islanding of critical loads during outages, and charging infrastructure to support the rapid growth in electric vehicles.

AEC projects can provide significant energy, environmental, economic, and security benefits, but significant barriers too often impede their planning and deployment. Finding viable sites, securing project financing, and connecting AEC projects to the grid all represent significant challenges. The PAEC project is designed to overcome these barriers and establish a replicable model that can be used by other communities across California and beyond. The results of the PAEC will inform future action by policymakers, municipalities and other governmental agencies, utility executives, and other relevant audiences.

The goals and objectives of this project are to:

- Incentivize and accelerate the planning, approval, financing, and deployment of AECs
- Reduce the time, cost, and uncertainty associated with permitting and interconnecting commercial-scale solar and other DER
- Leverage ZNE, efficiency, local renewables, energy storage, and other DER to reduce 25 MW of peak energy across San Mateo County, which will strengthen the grid
- Reduce use of natural gas, gasoline and other fossil fuels via fuel switching to electricity and minimize the need for new energy infrastructure
- Create a model project and project elements that can be replicated throughout California and beyond

In addition to EVCI recommendations, this report also helps local governments to meet State of California climate goals by accelerating EV adoption, which decreases carbon emissions and minimize other risks associated with gasoline and its production from oil. This is doubly important as the carbon footprint of oil is increasing over time as it becomes more and more energy and carbon intensive to extract while the carbon footprint of electricity in the United States and particularly in California with our renewable portfolio standard requirements is only decreasing. Further, should some version of SB 100, the California Clean Energy Act, pass, California will likely have 100 percent carbon free energy by 2045. Therefore, it is critical to shift away from gasoline-based transportation and towards electric based transportation.

Environmental risks associated with oil and its extraction and production into gasoline and diesel is significant.[2] These include:

- Contaminated Drinking Water and negative community impacts: from hydraulic fracturing (fracking).
- Spills and Explosions: since 2010, over 3,300 incidents of crude oil and liquefied natural gas leaks or ruptures have occurred on U.S. pipelines. These incidents have killed 80 people, injured 389 more, and cost $2.8 billion in damages. They also released toxic, polluting chemicals in local soil, waterways, and air.
- Land Impacts: erosion, loss of soil productivity, flooding, increased runoffs, and landslides due to drilling and exploration.
- Water, Ecosystem, and Wildlife Impacts: the biggest and latest large marine oil spill occurred in the Gulf of Mexico in April 2010 with the release of an estimated 4.9 million gallons of crude oil from BP's Deepwater Horizon drilling rig. The spills damage ecosystems and cause mass die offs among impacted wildlife.
- Air Impacts: the extraction, refining, transportation, and combustion of oil and its primary products of gasoline and diesel releases multiple types of air pollutants including: carbon dioxide, carbon monoxide, nitrogen oxides, sulfur dioxides, particulates, mercury and a variety of hazardous air pollutants. This pollution causes illness and premature mortality of millions of people in the U.S. and around the world.

Additionally, from an energy perspective, internal combustion engine (ICE) based transportation is inefficient. Approximately, 75% of the energy resulting from the combustion in an ICE vehicle is wasted as heat. In 2015, the California Total Gasoline Retail Sales by Refiners was 1.58 billion gallons which approximately correlates to 40 billon driven miles. Likewise, this gasoline use equates to 53 terawatt-hours and had this energy been used to power electric vehicles, they could have driven 214 billion miles.

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[2] O'Rourke, D. and Connolly S., Just oil? The distribution of environmental and social impacts of oil production and consumption; Annu. Rev. Environ. Resour. 2003. 28:587–617 https://nature.berkeley.edu/orourke/PDF/JustOil-final.pdf

Finally, in regard to the electrical grid having enough electricity to fuel these EVs, the U.S. Department of Energy's (DOE) Pacific Northwest National Laboratory reported that there is enough off peak electrical generation capacity to fuel 70% percent of the U.S. light-duty vehicle (LDV) fleet.

Given the above facts, it is critical that California transition from a petroleum based transportation system to one based on renewable energy. As such, the solution is to electrify our transportation system.

Within the context of electrifying the transportation system, STA is supporting the Clean Coalition in preparing this EVCI-MP containing both macro and micro recommendations for San Mateo County.

III. Electric Vehicle Overview

At present, there are three classes of light duty electric vehicles available to the general public: Plug-in Hybrid Electric Vehicles (PHEVs) commuter battery electric vehicles (BEVs) and long range electric vehicles. As discussed below, each of these has their own general functionality. For the purposes of this report, the term electric vehicle (EV) refers to all three classes.

a. Plug-in Hybrid Vehicles

Plug-in hybrid vehicles (PHEVs) use both gasoline or diesel and electricity as fuel. These cars have two fuel tanks, giving them the ability to run on electricity and a liquid, generally fossil based, fuel. Typically, local, short-distance miles run off the car's main battery pack, while longer distances are achieved via the internal combustion engine (ICE). In the United States, the best-selling PHEVs are the Toyota Prius Plus (20,936 units sold, 2017) and the Chevy Volt (20,349 units sold, 2017). The Toyota Prius Plus has a 25-mile electric range, with a 615-mile gasoline range. The Chevy Volt has a 53-mile all electric range with a 357-mile gasoline range.

Chevy *Volt*

Toyota Prius Plus

b. Commuter Battery Electric Vehicles

The commuter battery electric vehicle is a 100% electric, with a range on the order of 100 miles. These vehicles were not designed for long-distance travel but are the ideal car for the commuter or for local needs. Two well-known models are the Nissan Leaf, released in 2011 and the BMW i3 released in 2014. In the long term, given their range limitations, these vehicles are likely to be superseded by long range EVs. Nissan is addressing this by releasing a 150 miles range Leaf in early 2018 and promising a 200+ miles range Leaf for 2019.

Nissan Leaf

BMW i3

c. Long Range Electric Vehicles

Long-range electric vehicles, such as the Chevy Bolt and the Tesla Model 3, are the next generation of electric vehicles. These EVs have all electric ranges on the order of 200+ miles and are designed to be fully functional vehicles with no tailpipe emissions and with the associated lower energy/ carbon footprint. In addition to the General Motors and Tesla long range EVs, Volkswagen, Nissan, and Hyundai plus a number of start-ups have all announced plans for long range EVs, some with delivery dates as early as 2018.

It is clear and important to note that public perception of EV mile range appears to matter significantly. In 2017, the Chevy Bolt was the best-selling affordable EV in the United States with 23,297 units sold. While more units of the Tesla Model S were sold (27,060 units), this vehicle falls into the luxury category and is not representative of an average consumer making the switch to an electric vehicle.

Tesla Model 3

Chevy Bolt

For purposes of this report Tesla Motors Model S, X, and the Roadster are not included in the above category or addressed in this report due to their much greater price point compared to the typical automobile, electric or otherwise. It should be clear, however, that these EVs fully qualify as long range EVs.

IV. Electric Vehicle Charging Infrastructure Overview

At present, there are three different classes of electric vehicle charging infrastructure L1, L2, and direct current Fast Charging (DCFC). As depicted in Figure 1 and detailed below, each of these has their own benefits and limitations associated with its installation, maintenance and operations costs, convenience, rate of charge, electric utility impacts, ease of use, etc.

Figure 1: The Electric Vehicle Charging Pyramid

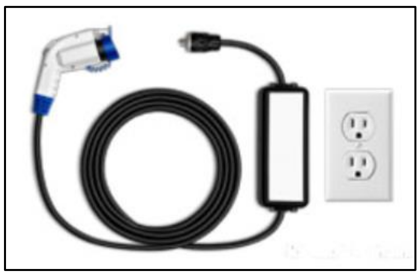
Historically, the above pyramid would not only note the differing charger types and their relative costs, but the charger area would also be in proportion to its likely use. For example, in Figure 1, home charging is implied to be significantly more frequent than DC fast charging. With the advent and adoption of mainstream affordable long-range battery electric vehicles this may no longer be completely true. Following our current gas station model, an EV driver with a Chevy Bolt (200+ miles of range) might simply fast charge on an as needed basis. However, these situations would likely be relatively rare as the cost per kWh at a fast charger is typically much greater than the cost of a kWh obtained at home, particularly if charging on a time of use rate and off peak. Additionally, due to the long range affordable EV, intercity trips will be as easy as completing them in a gasoline fueled vehicle only more quietly and with a much lower carbon and energy footprint.

It is important to note that the chargers themselves do not provide the electricity; they are safety devices between the electrical supply from the host and the EV. Nor in the case of L1 and L2, do the chargers convert the host supplied electricity from alternating current to direct current as is the case with direct current fast chargers. The charger's first function is safety, by ensuring that the device they are plugged into is an electric car capable and willing to accept a charge. In industry parlance, EV chargers are known as electric vehicle supply equipment (EVSE) while electric vehicle charging infrastructure (EVCI) encompasses the EVSE as well as the site's electrical components necessary to bring power to the EVSE.

d. Level One Charging

L1 charging is plugging into a regular 110V outlet. L1 is typically used in single and multi-family dwellings and less commonly in the workplace and the public space. The charge rate is between 1.4kW and 1.9kW resulting in charge rates of 5-10 miles/hour. L1 benefits include the simplicity of plugging into an existing 110v outlet, negligible impacts to the greater grid and the lowest installation cost as no electrician or additional electrical hardware is required. Potential negatives include the slow charge rate, though this may also be an advantage in avoiding an expensive retrofit to install a L2 charger. Note: specific charge rates will depend on the EV model and the existing state of charge of the EV's battery.

All EVs come with a L1 charger capable of plugging into a standard 110V outlet.



Mitsubishi Stock Charger and 110V Outlet

e. Level Two Charging

L2 supplies EVs with 240V which in the United States is the same voltage to what a typical residential electric oven or clothes dryer uses. L2 enables charging speeds up to 19.2 kW (~80 miles/ hour) though most PHEVs accept only up to 3.3kW (~12 miles/ hour) and dedicated battery electric EVs typically up to 6.6kW (~24 miles/ hour). As is the case with L1, specific charge rates will depend on the EV model and the existing state of charge of the battery.

Within the L2 class there are two types of L2, which are typically referred to as "networked" and "non-networked" chargers. Networked chargers have the ability to provide billing services, support the grid via ancillary services such as load-balancing and demand response programs as well as charger host control. Networked chargers are typically found in public spaces, multi-unit dwellings and workplace parking lots (in that order.) The billing feature is particularly important in the public space where a fee for charging will typically bifurcate those who *need* to charge from those who *want* to charge, and in MUDs where it is likely deemed important to appropriately allocate the overall electricity cost. These functionalities provided by networked charging come with costs and benefits. In particular, billing for electricity adds cost and complexity for both the user and host. Networked chargers have purchase prices between $4,000-$8,000 for a typical dual port unit plus ongoing annual network fees of between $200-$400 per port per year.

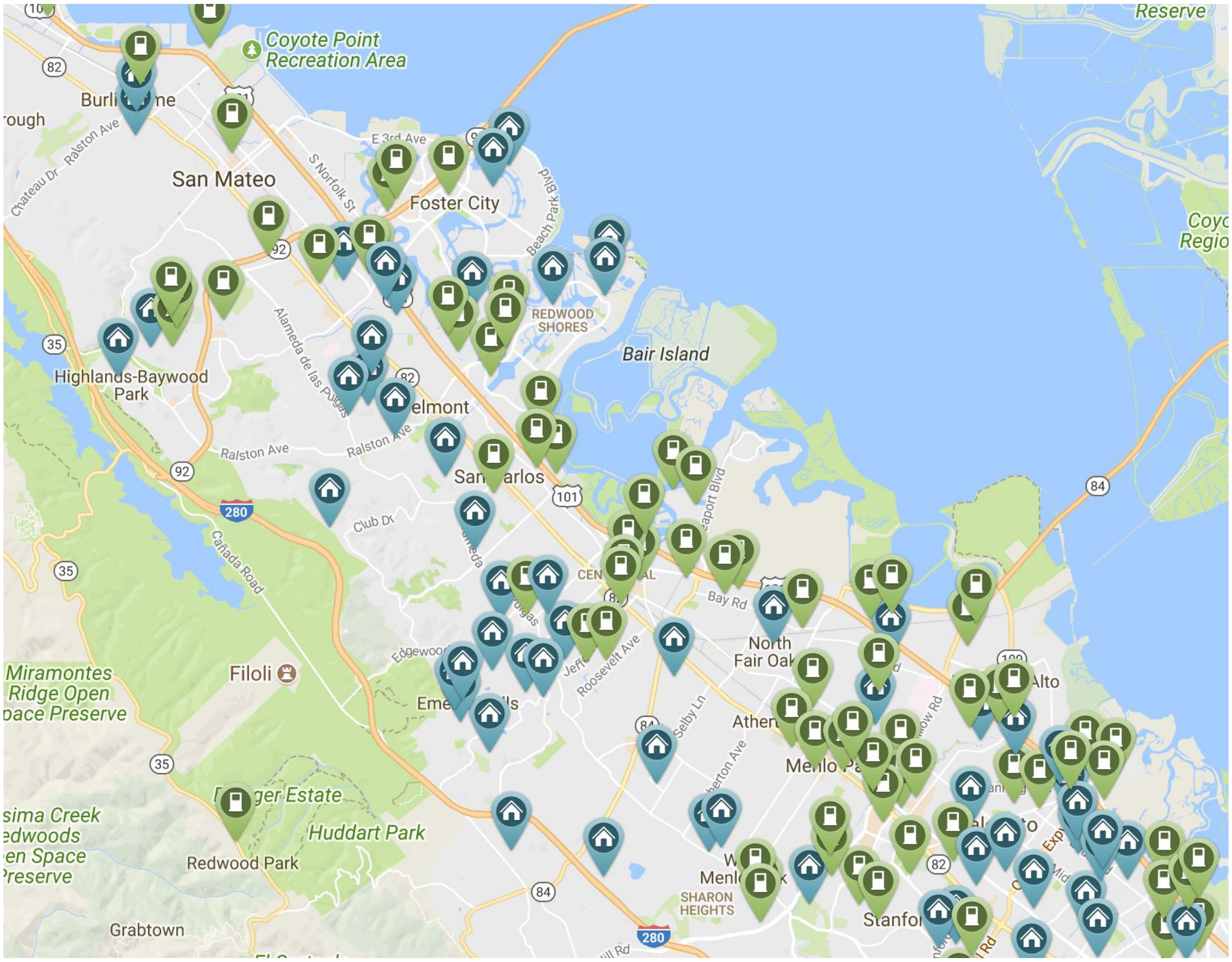
Non-networked L2 chargers are typically found in single family residences and the workplace with purchase prices of on the order of $300-$900. Non-networked chargers can be appropriate for use in MUDs and the workplace, particularly because there is a generally known vehicle pool. There are low-technology, "non-networked" options to ensure that the electricity cost is appropriately allocated without incurring the additional expenses of "networked" chargers.

With technological advances, non-networked chargers can be converted to limited networked chargers. For example, eMotorWerks has recently developed a product, the "Juice-Plug" that sits between the J1772 connector of the existing charger and the EV; and, utilizing existing WiFi is able to remotely control charging to support the grid by both charging during periods of intermittent renewables; but, also avoiding charging during peak times. This advancement is particularly important in residential use where the EV may be plugged in for 12+ hours (e.g.: overnight at home) but only needs 2-3 hours to fully charge.

From left to right, ChargePoint Networked charger, Clipper Creek non- networked charger and eMotorWerks JuicePlug

Figure 2, below, details both the current Level 2 public (green pointers) and residential (blue pointers) charging density in the PAEC region.

Figure 2: Level 2 Public and Residential Charging Station Density in the PAEC Region



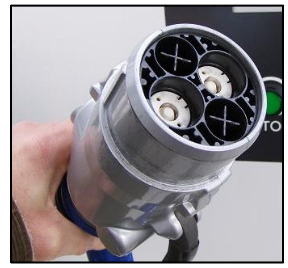
f. Direct Current Fast Charging

As detailed below, at present in the United States, there are three direct current Fast Charging (DCFC) standards, each with their own connector hardware and orientation. DCFC stations are essentially equivalent to gasoline stations with their purpose being to enable long distance and regional EV driving for the long range and commuter dedicated battery electric vehicles, and to provide charging for those without residential or workplace charging. These stations are significantly more expensive compared to L1 and L2 installations. Depending on the additional electrical infrastructure required, new DCFC may cost over $100,000 per charger install.

These chargers are typically installed along highways, at destination locations such as malls and motels or hotels, and car dealerships (both as a place to charge and for EV customer education). Given the high power requirements, these are not for the single-family dwelling, though they might serve a large multi-family dwelling, and are likewise rarely used for workplace charging. Figure 3 below notes the DCFC density in the PAEC region.

Tesla Connector

Tesla SuperChargers: Tesla Motors has built (and is rapidly expanding) an exclusive nationwide network of superchargers under their own charging standard both within and connecting most major cities in the country. These DCFC are currently rated at 120kW and depending on battery state of charge will add ~170 miles of range in approximately 30 minutes.



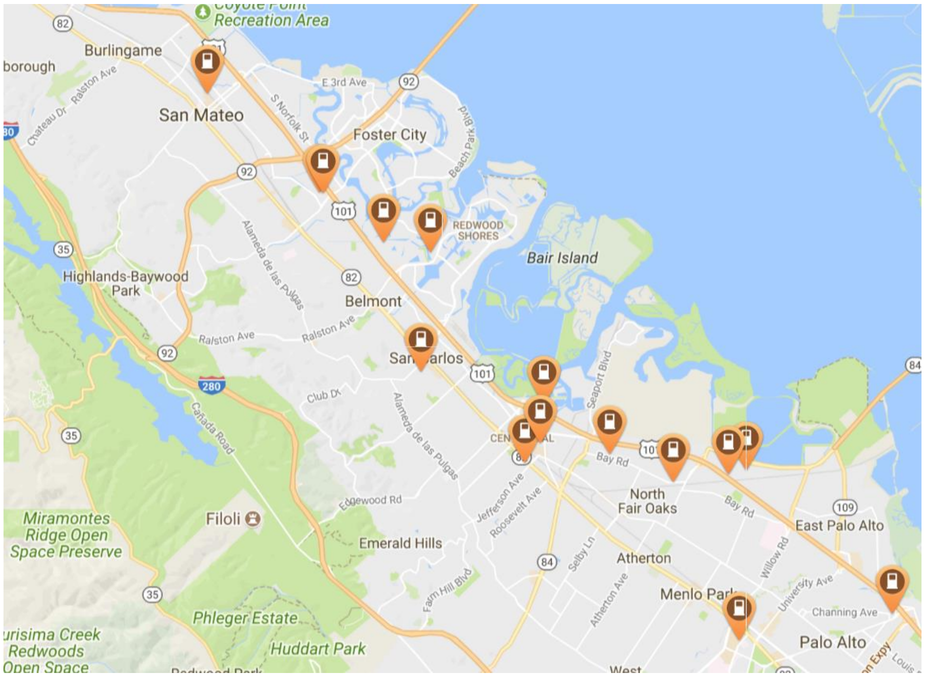
CHAdeMO Connector

CHAdeMO: The CHAdeMO standard was developed and is used by Toyota, Nissan, and Mitsubishi. Most stations have charge rates between 40 – 60 kW which is fast enough to charge a commuter EV Nissan Leaf to 80 percent full in approximately 30 minutes. In addition, there are a few 100kW stations being rolled out though at present there are no EVs (with the exception of Tesla's) capable of accepting such a charge rate. Finally, the CHAdeMO standard is being amended to increase the maximum charge rate to 150kW.

CCS Connector

Combined Charging System (CCS): The CCS standard was developed and is used by all of the American and German original equipment manufacturers (OEMs); such as, General Motors, Ford, Chrysler, BMW, VW, etc. plus Hyundai; and, is derived from the Society of Automotive Engineers (SAE) J1772 L2 connector. Most CCS stations have 50kW charge rates which is fast enough to charge a commuter EV Volkswagen e-Golf to 80 percent full in less than 30 minutes. In preparation for long range, high charging rate EVs, the first 150kW CCS station was recently installed in Fremont, California. Finally, in Europe, a consortium of German and American OEMs are planning to install 400 350kW charging stations based on the CCS standard.

Figure 3: DCFC Density in the PAEC Region



V. The Evolving Electric Vehicle Landscape

California drivers have many choices when it comes to EV makes and models and these choices are on a significant growth trajectory. There are many factors behind this expansion, some rooted in the market itself and others emerging from forward-thinking government policies and programs.

In terms of governmental regulatory levers, several countries, regions and major city-states around the world have recently adopted, or are in the process of adopting, regulations that phase out the sale of gasoline and diesel vehicles within a specific timeframe. In California, state assemblyman Phil Ting (D-SF) has introduced AB1745 that would ban the registration of internal combustion vehicles with gross vehicle weight less than 10,000 pounds within the state as of 2040, a date that matches the one set by France, the Netherlands, and the United Kingdom. Germany, China, and India are likely to follow suit, while Norway has outdone all nations by instituting a ban on new light duty ICEs as of 2025. *Popular Mechanics*[3] succinctly assesses the current automotive landscape in a September 2017 article on China's automotive policies, stating: "the message is clear: electric is the future."

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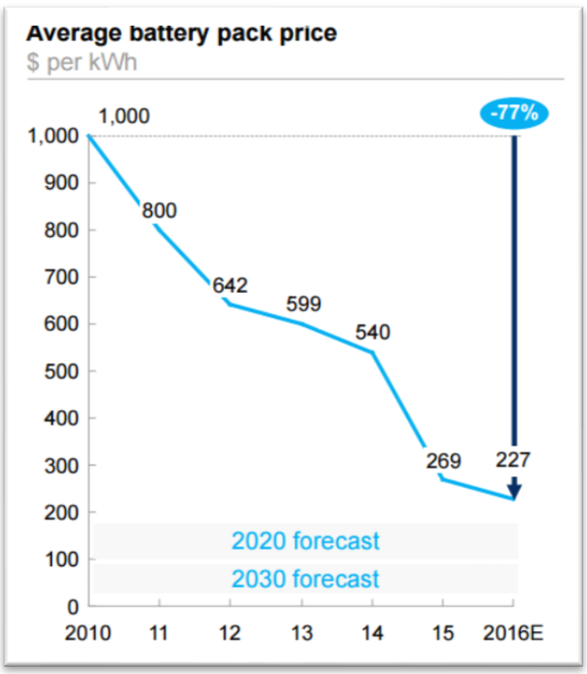
3 https://www.popularmechanics.com/cars/hybrid-electric/news/a28140/china-ban-cars-combustion-engines/

Also, it is important for California's automotive landscape to understand that modifications to the state's zero-emission vehicle (ZEV) regulation awards higher credits for incremental range increases versus a step function as was in prior versions. This has, in part, along with an ever-increasing stronger ZEV mandate, fueled the rise of startups like Tesla Motors, Faraday Futures, BYD, etc. These startups have catalyzed research and development by the OEMs and their battery partners, and the result is that EV ranges have been rising quickly. Additionally, the price of batteries has dropped precipitously; battery costs per kWh have already surpassed 2020 benchmarks, and Audi recently announced that its new long-range EVs will have batteries that cost only US$114 per kWh, a price that approaches 2030 benchmarks and makes the cost of mass production of EVs on par with ICE vehicles. By way of comparison, the original 2011 Nissan Leaf had a range of only 73 miles, and its battery costs for Nissan were a substantial US$600 per kWh.

Figure 4:Battery Cost Reduction Curve



OEMs are now energetically responding to rapid changes in technology, policy, competition and consumer demand by announcing major long-range EV programs. While Nissan now offers 150 miles of range (EPA ratings) with its 2018 Leaf at $145 per kWh, new long-range EV offerings by Volvo, BMW, Mercedes-Benz, Jaguar, and Porsche will compete aggressively with Tesla for market share. Even performance luxury brands Lamborghini and Aston Martin have entered the EV market.

Consumer choice, the rapid development of long-range EVs, and the shrinking cost of batteries, are key factors that a municipality and/or government agency should consider when weighing the possibility of expanding its public/workplace EV infrastructure.

One might argue that personal EVs are but a stopgap, and that the future belongs to self-driving electric cars. While Tesla and Google have famously pioneered this technology, all of the OEMs and EV startups have autonomous programs in varying degrees progression. For example, Nissan has unveiled its Intelligent Driving System (IDS) concept car, which comes with over 200 miles of range and cutting-edge self-driving technology while GM is testing autonomous Chevy Bolts in San Francisco and Phoenix. Regardless of the level of autonomy, these EVs will still need to be charged. For the near term, this will likely emulate current charging practices. In the future, third party Level 5 autonomous fleets will likely charge primarily at night, via low and high power DC which will also eliminate the need for the onboard rectifier. Daytime charging, to maximize up time, will likely be limited to high power DC. Given these current and ongoing advances, widespread fleet, and consumer acceptance of self-driving cars is likely three to ten years away with a focus initially on urban/ suburban areas. Former GM vice chairman Bob Lutz has said as much, arguing in a recent piece in *Automotive News*[4] that "in 15 to 20 years—at the latest—human-driven vehicles will be legislated off the highways." Lutz sees a future of self-driving capsules and the effective end of retail car sales. Looking ahead fifteen to thirty years, there is little reason to disagree with him.

Regardless, of the future date that all vehicles are autonomous EVs, the Clean Coalition strongly recommends that local governments both adopt regulatory programs and execute on low cost/ no cost municipal EV infrastructure projects to accelerate EV adoption in the short- to mid-term.

VI. Electric Vehicle Survey

The Clean Coalition recently conducted a survey of both EV professionals and EV drivers primarily located in the Bay Area. The survey's main purpose was two-fold, first to determine the degree to which the respondents agreed with a position statement and, secondly, what recommendations the respondents would give a municipality with a $25,000 budget to accelerate EV adoption. Over a six-week period, the survey elicited 143 responses from both EV professionals and EV drivers.

Respondents were asked to read and reflect on the following position and then in question one, asked how strongly they agreed (or disagreed) on a scale of 1-5 with a series of five statements related to the position. Results, in pie chart format, follow each statement as noted below:

> *"The electric vehicle (EV) charging landscape is rapidly evolving due to the advent and adoption of mainstream affordable long range (150+ mile) battery electric vehicles. As a result, we see the 3-10 years future of EV charging as a combination of residential/ workplace charging (L1 and L2) and strategically placed direct current fast charger (DCFC) stations along highways and en route to remote destinations.*
>
> *The current paradigm has been that publicly provided Level Two (L2) charging with significant deployment densities is necessary so that short range EV drivers will not get stranded. With the increase of affordable long range EVs, this paradigm is shifting to DCFC chargers with less deployment densities. However, availability of residential and workplace charging (L1 and L2) remains critical to EV adoption.*

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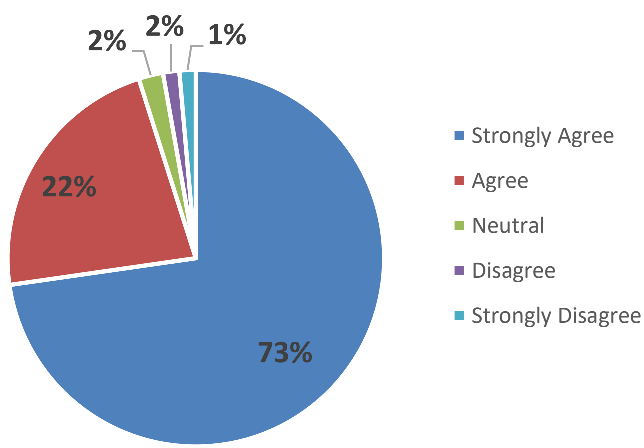
4 http://www.autonews.com/article/20171105/INDUSTRY_REDESIGNED/171109944/industry-redesigned-bob-lutz

Given the above paradigm shift, municipalities should focus on encouraging EV adoption by supporting EV education and outreach activities such as Ride and Drives; implementing municipal codes supporting dense charger installation for new construction and major remodels, particularly at multi-unit dwellings; and essentially only installing public charging infrastructure when the infrastructure can be paid for by grants and other funding sources (e.g. Air District, Utility programs, 3rd parties, etc.) They should also encourage the installation of DCFC, particularly high power DCFC."

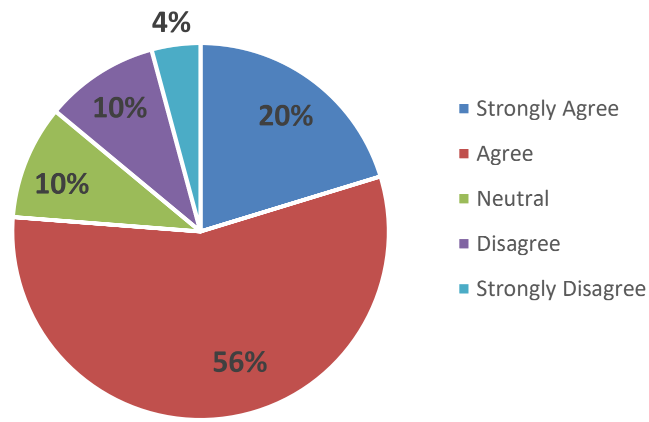
Statement 1 (Figure 5): Presently, residential and workplace charging (private L1/L2) is key to EV adoption

Figure 5: Results, Residential & Workplace Charging, Key to EV Adoption



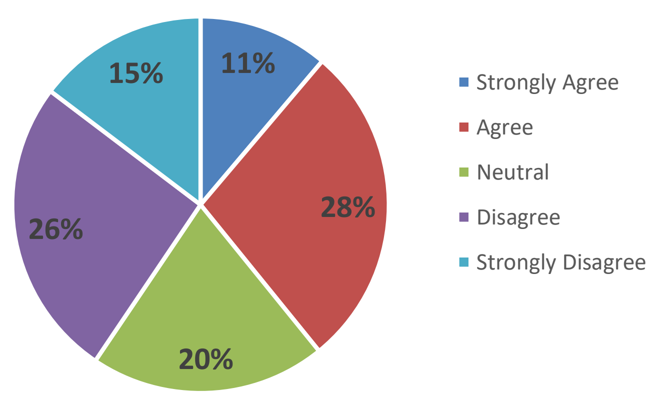
Statement 2 (Figure 6): Presently, public L2 charging supports short range EV drivers

Figure 6: Results, Public L2 Charging Supports Short Range EV Drivers



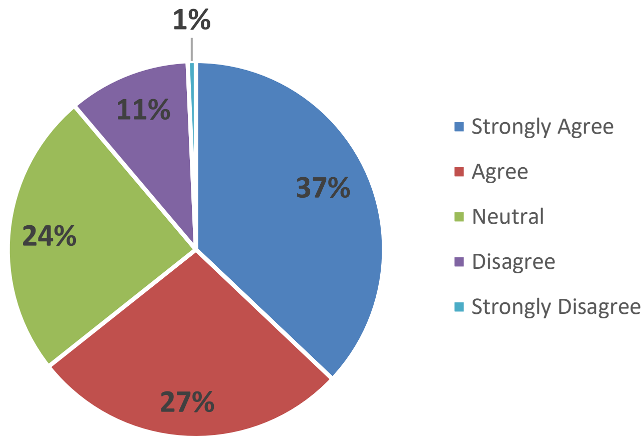
Statement 3 (Figure 7): Presently, public L2 charging supports long range EV drivers

Figure 7: Results, Public L2 Charging Supports Long Range EV Drivers



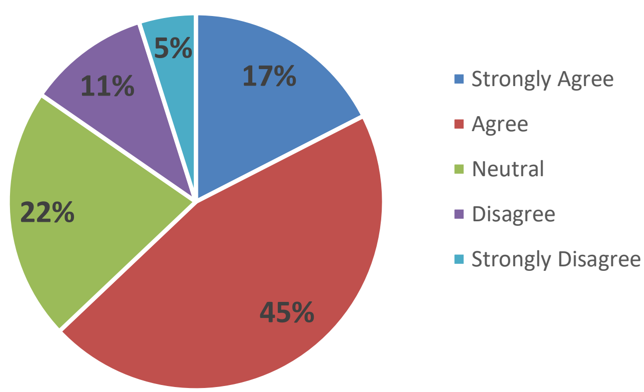
Statement 4 (Figure 8): In 3-10 years DCFC will be more useful and relevant than public L2 charging

Figure 8: Results, 3-10 Years, DCFC Will be More Relevant than Public L2 Chargers



Statement 5 (Figure 9): In 3-10 years public L2 charging will be useful and relevant

Figure 9: Results, 3-10 Years, Public L2 Chargers Will be More Relevant & Useful



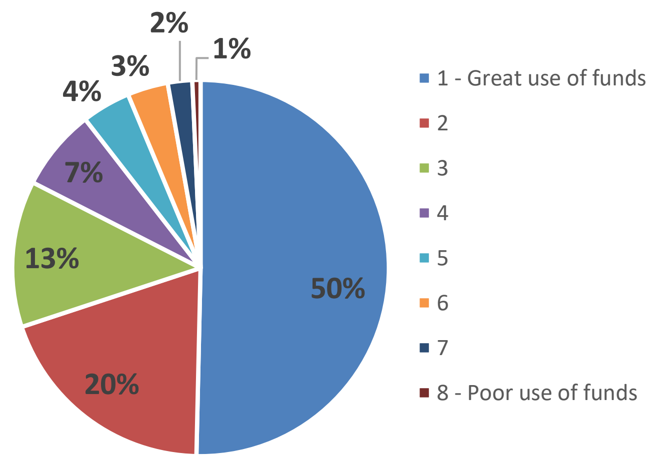
Question two requested the respondents prioritize a municipality's EV action plan. The specific language was:

> *"Please prioritize the following actions a Bay Area municipality with an annual EV budget of $25k, might take to accelerate EV adoption within their community and among their employees. Use 1 for the first choice (great use of public funds) and 8 for the last choice (poor use of public funds.) Attempt to use each number once."*

Again, results are presented in pie chart format following each question:

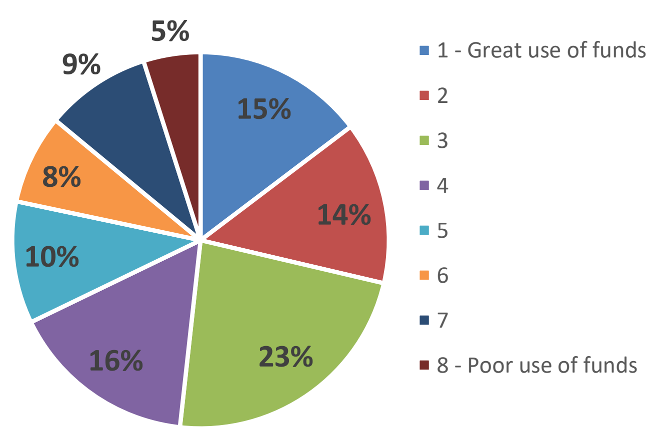
a) Implement municipal codes requiring charging infrastructure installs beyond those of CalGreen/Title 24 (e.g. one charger per new housing unit and at the time of new construction/major renovation, etc.):

Figure 10: Results, Implement Codes Requiring Charging Infrastructure Beyond CalGreen/ Title



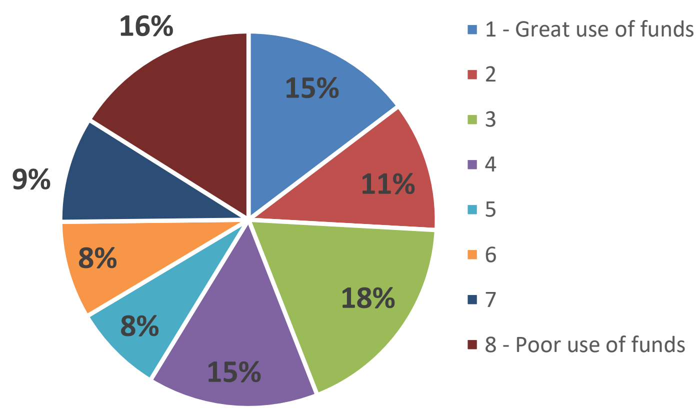
b) Conduct four Ride & Drive events to increase awareness and education about EVs:

Figure 11: Results, Conduct 4 Ride & Drive Events



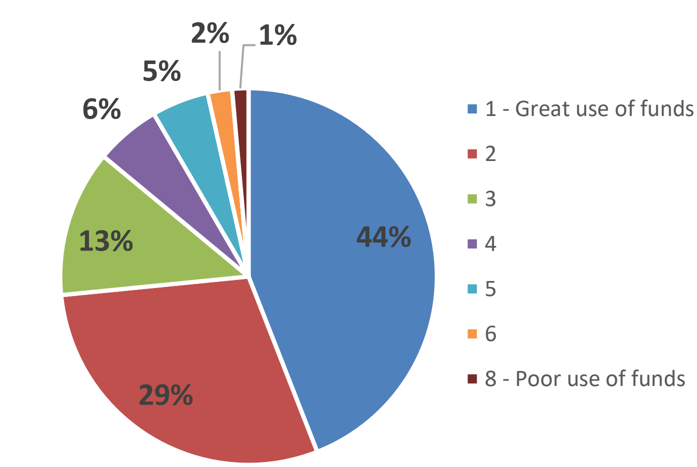
c) Install ten Level 1 chargers for municipal employee use:

Figure 12: Results, Install ten Level 1 chargers for Municipal Employee Use



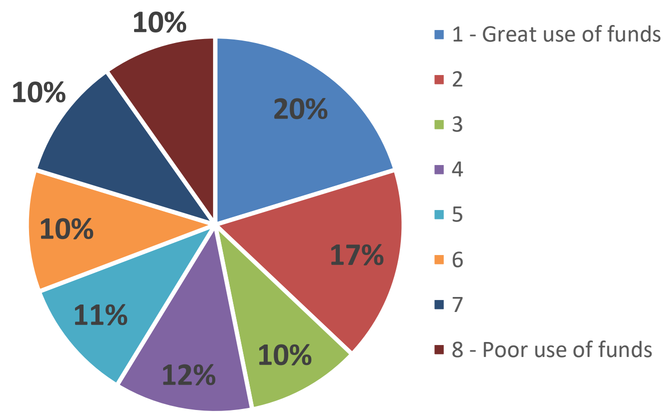
d) Encourage workplaces and multi-unit dwelling (MUD) owners and property managers to take advantage of grants/utility funding to install charging equipment:

Figure 13: Results, Encourage Workplaces & MUDs to Use Grants / Utility Funding to Install Charging Equipment



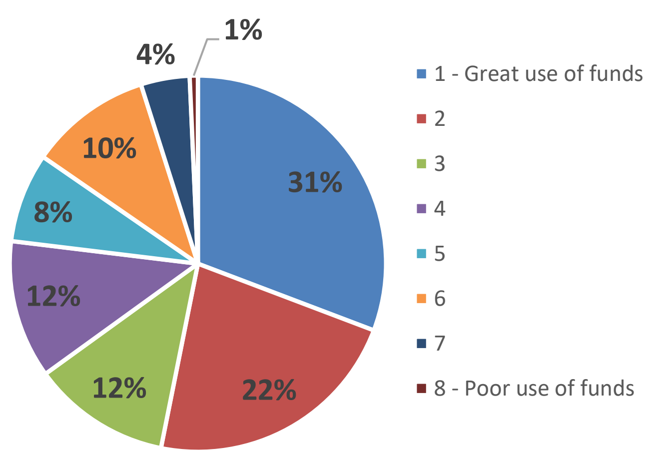
e) Install one dual-port networked Level 2 charger in a public garage:

Figure 14: Results, Install One Dual-Port Networked L2 charger in a Public Garage



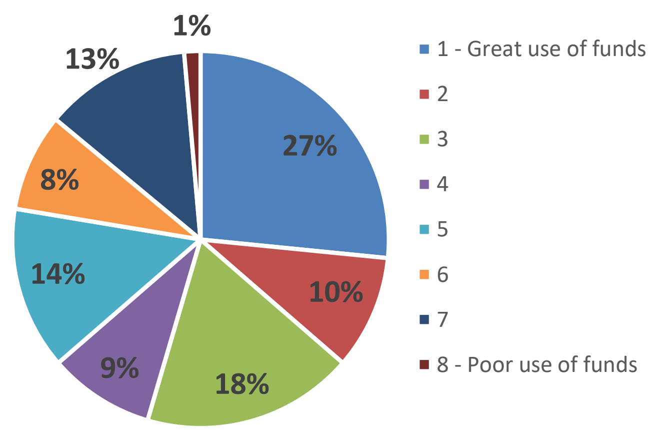
f) Encourage 3rd parties to install 50kW and larger DC Fast Chargers (DCFC):

Figure 15: Results, Encourage 3rd Parties to Install DC Fast Chargers



g) Incorporate two EVs into the city fleet (including employee education):

Figure 16: Results, Incorporate two EVs into the city fleet + EV Education



h) I would like to see a municipality take a different action to accelerate the adoption of EVs:

Over sixty of the respondents answered this question (42%) and their responses have been edited and consolidated for clarity, readability, and uniformity. Responses are classified into incentives, infrastructure and education/outreach as detailed below:

Recommended Incentives:

- Offer targeted rebates for commercial rideshare electric vehicles, including Uber, Lyft, Car2Go, ReachNow, and ordinary taxis
- Funding for multifamily unit dwellings (MUDs) and businesses to install Level 2s and DCFC charging infrastructure
- Incentive or guarantee financing on business properties under existing PACE programs
- Establish partnerships with local dealerships and EV manufacturers; negotiate bulk purchasing discounts for a minimum amount of short-range EVs
- Take advantage of corporate programs such as Tesla's Destination Charger Program, PG&E Charge Network Program, and Volkswagen Electrify America
- Streamline permitting for EV charging stations, solar and battery storage installation
- Collaborate with Community Choice Aggregation (CCA) rate setting authority or local electricity provider to set competitive rates to assure electricity is cost competitive
- Encourage residential EVSE acquisition and installation through subsidy programs

- Shift parking fees to support clean cars and discourage internal combustion engine vehicles as to increase usage of mass transit, car pool, bikes, walking, etc.
- Any incentives for EVs should be limited to 2 or 3 years of purchase (new or used) to prevent saturation of benefits provided, and subsequent loss of value in driving adoption forward. Examples: 1) free charging driving adoption until congestion, 2) discounted parking until EVs hit 5% limit or lot is full

Recommended Infrastructure:

- Build community infrastructure with Open Charge Point Protocol 1.6 open network standards and require vendor interoperability to encourage a more seamless charging experience for EV owners
- To address lack of EV charging in existing buildings install street level charging; similarly, investing in curbside charging programs can leverage excess electricity capacity in light poles and expand charging options
- Adopt EV codes requiring charging stations to be installed and accessible for new construction, MUDs, and new parking structures/lots; requiring remodeled buildings to include access to electricity for future charging stations
- Install Level 2 charging stations at all large venues, shopping centers and malls, public parking lots/garages, and downtown areas
- Where there are more than 25 employees or family units, cities should encourage charging facilities in all multi-family properties and workplaces
- Simplify and homogenize across city and county boundaries, EVSE installation codes and requirements such that permitting and electrician costs can be significantly reduced
- At the municipal level, there are multiple opportunities to increase or jumpstart EV adoption, such as installing free or subsidized charging stations at parks, libraries, schools, or municipal facilities; integrate EVs into a shared vehicle fleet for government employee usage; or focusing on medium and heavy-duty vehicles such as transit and school buses

Recommended Education/ Outreach:

- Local governments can play a more prominent role in communicating and encouraging the adoption of EVs by providing more public information to residents and community members. Social media and direct media channels, sponsoring outreach efforts, incorporating EVs, and proper signage in all city events are avenues of outreach a City can take to increase awareness
- Work with local organizations to organize and support Ride and Drives in all neighborhoods
- Communicate with EV driver community to address progress or adoption barriers and develop an effective outreach program for within the municipality

- Emphasize the full green potential of electric vehicles by incorporating them into last mile options, preferably as ride-sharing vehicles. Consider regional transit cooperation such as integrating EV parking and chargers at transit hubs

In addition to the above, a good deal of additional information and secondary impacts have emerged from the survey. First, only 22% [5] of the EV professionals who responded were actual EV drivers. This suggests that even for people with a large EV knowledge base there are still EV adoption barriers (lack of vehicle type, range, existing vehicle economics, inertia, other priorities, etc.) that prevent them from replacing their internal combustion engine (ICE) vehicle with an EV.

In addition, largely through the numbers of thoughtful recommendations we received, both groups obviously recognize that there are adoption barriers and took the survey seriously in their efforts to identify policies and programs to accelerate EV adoption.

Finally, the survey went viral, reaching EV stakeholders in Sacramento, Los Angeles, and San Diego. In part because of this, the Sacramento Electric Auto Association has requested the survey data, and it is planning to include them as part of their recommendations for Sacramento's expanding city-owned EV charging infrastructure. The survey data have also been used in the Clean Coalition' PAEC's verbal support for Menlo Parks' proposed EV ordinance.

Full Survey data is located in Appendix A.

VII. Communication with Municipal/ County Sustainability Managers

In addition to and apart from the survey, we have also gained insight from a number of Bay Area municipal and county sustainability managers. These managers, who deal with both short- and long-term policies and programs for sustainability at varying levels, offered two important points to our report.

First, they unanimously agree that there has been a paradigm shift within the past twenty-four months as related to the necessity for public Level 2 charging; long range EVs are making public Level 2 infrastructure less important than strategically placed DCFC. Second, they made it clear that they were not willing to install public chargers in the absence of

[5] Given the increased proliferation of the survey, it was expanded to include asking recipients to classify themselves as EV professionals, EV driver, neither, or both to better capture participants' roles in the EV discussion. This additional question garnered 91 responses out of 143.

significant external funding. That is, they were open to the installation of public chargers, but only if the majority of funding came from outside sources.

Additionally, municipal sustainability managers have indicated that their staff does not necessarily have the funding or time to support ongoing operation of public EVCI. While theoretically a charging services company, such as ChargePoint, should be able to offer a complete service option the reality is that if someone is having an issue with a charger at a public location such as a library, the EV driver will ask library staff for assistance. This absorbs staff time and is a challenge that all public EV installations face. Another issue is limited parking spaces at public buildings. In growing municipalities, parking is competitive and at times it can be a challenge to find parking. If 10 new EV chargers are installed, and signage indicates that the spaces are "EV only" it is likely that during some times of the day several chargers will be empty while ICE vehicles struggle to find parking. However; if signage indicates "EV preferred" and ICE vehicles are parked in the EV charging spaces, EV drivers using a service such as PlugShare to find charging may try to charge somewhere only to find that there are available chargers, but the parking spaces are occupied by ICE vehicles. This leads to frustration from the EV driver and also additional staff time from the site host to deal with and attempt to resolve this issue.

Given the above research, the results of the EV survey, and information drawn from sustainability managers, the Clean Coalition is making the following specific macro and micro level recommendations.

VIII. Macro-Level Recommendations

To continue to accelerate EV adoption while addressing the increasing number of long-range EVs, local governments and agencies should re-evaluate their EVCI deployment plans, their education/outreach efforts, and their EVCI code requirements. More specifically, we recommend six forms of macro-level steps a jurisdiction could take to further the adoption of EV:

1. Strengthen building codes to require EVCI installations for new builds and renovations above and beyond that required by California's CalGreen Code. As detailed in the EV survey, respondents were uniform in their support for strong codes, particularly for one charger per residential unit.

   In additional support for strong EVCI codes, implemented in 2014, the City of Palo Alto has one of the most forward EVCI codes for new construction essentially requiring one charger per residential unit plus requirements for hotels and commercial developments. In a recent email to Menlo Park in support of their EVCI ordinance, Palo Alto notes the following in support for the 1-charger per residential unit requirement. "

"To date, my Department has had no pushback from developers regarding the ordinance's residential component and limited pushback on the commercial side, primarily due to new California Americans with Disabilities Act adding additional parking space requirements. If Menlo Park was only to enact one component of our ordinance (residential or commercial) I would prioritize the residential requirement of one charger per residential unit because a) this is where vehicles spend most of their time b) the great majority of EV users prefer to charge at home versus a commercial setting and c) both home charger install and operational costs are generally less than the commercial costs."

The full email is included in Appendix B and the specific Palo Alto code is included in Appendix C. This language can serve as an example template for other jurisdictions. Additional recommended policies can be found in the Clean Coalition's PAEC *Task 2, Best Practices Report*.

2. Sponsor EV ride-and-drives and related educational activities. Ride-and-drive events have proven to be extremely cost-effective as a means of increasing interest in EVs and educating potential buyers about the benefits of EV ownership. In general, as prices drop and ranges increase, consumer awareness remains perhaps the last barrier to widespread EV adoption. To in part address this, Palo Alto has partnered with Stanford University to sponsor a free, open to the public, biannual class entitled *"Is an Electric Vehicle Right for You?"* which has proven very successful in terms of ICE to EV conversion rates. The flyer for this class is included in Appendix D and likewise serves as an example template for other jurisdictions.

3. Encourage third party direct current fast charging (DCFC) infrastructure ownership, installation, and operation. While it is unlikely to be cost-effective for local governments to install DC fast chargers in public spaces, for various reasons, private companies have emerged and are doing so. DCFC is critical to enabling long distance travel in an EV. Further 3rd party ownership, particularly DCFC stations has none of the issues for a city employee of addressing charger maintenance or use (parking space versus EV charging space) issues as they are clearly not the city/ county's responsibility. Further as 3rd party providers in general get paid for use, they have an incentive to keep the stations well maintained and maximize EV throughput. This is best seen with 3rd party pricing structures. For example, Tesla's "idle fee" at their superchargers which encourages the EV user to leave the station once charged. As detailed in Section X of this report, PAEC partner, the City of East Palo Alto is currently permitting a series of Tesla Super Chargers at the Ravenswood Plaza and has invited Electrify America to likewise install CCS and CHAdeMo chargers.

4. Focus on low-cost EVCI installations via grants and utility programs outlets. At present, should a municipality in the greater Bay Area wish to add public EVCIs, they should utilize the Bay Area Air Quality Management District's Charge! program or PG&E's Charge Network program. Municipalities with their own utilities are also

encouraged to implement their own EVCI incentive program. For example, as noted in Appendix E, Palo Alto's utility has developed their own EVCI installation grant program which can be used as a template and as CCA's evolve, they likewise should also encourage EV adoption via infrastructure grant programs.

5. Increase public signage for EVCIs. Signage satisfies two needs with respect to EV infrastructure: 1) it incrementally helps current EV owners to find existing charging stations more easily; and 2) it publicizes for non-EV owners the extensive network of chargers at their disposal. Given that concern over the availability of charging stations is a well-known concern of potential EV buyers, local governments can quickly allay much of this fear with a strategic investment in signage.

6. Adopt codes requiring some level of EVCI for existing multi-unit dwellings and workplaces. The two major barriers to EV adoption is 1) consumer awareness and 2) the lack of available charging infrastructure at one's residence and place of work. This is less of an issue for those who live in single-family dwellings, but those who live in apartment complexes or condominiums can find themselves with no option for charging, whether at home or at their place of work. Amending municipal and county codes to require an appropriate level of EVCIs in such sites can do much to address both adoption barriers.

All of these recommendations are tools that can be used by Municipal/County Sustainability Managers and those in similar positions to accelerate EV adoption.

IX. Situational Micro Level Recommendations

In addition to macro-level measures, we recommend three micro-level initiatives. These recommendations stem from our review of existing and potential EVCI installations in Redwood City, East Palo Alto, Menlo Park, Burlingame, San Carlos, and San Mateo County. The recommendations are as follows:

1. Install EVCIs as part of parking lot retrofits and/or lighting and energy upgrades. A significant percentage of the cost associated with EVCI installation stems from trenching and or onsite-electrical upgrades. By coordinating EVCI installation with previously scheduled infrastructure upgrades, local governments can reduce costs significantly. The case study addressing this using the San Mateo CalTrain Station is included in Appendix F.

2. Use existing pay-for-parking systems to collect EVCI charging fees and enforce payment. While networked EVCIs allow users to pay via the EVSE device itself, they also require local governments to pay an annual network-fee plus these chargers are significantly more expensive from an acquisition and maintenance perspective then non-networked chargers. A more cost-effective strategy may be to install non-

networked chargers and use existing parking payment infrastructure to collect EVCI charging fees (separate from parking fees) and enforce payment. Case studies addressing this at the Redwood City Library and at several locations in Burlingame slated for future EVCI installation is likewise included in Appendix G.

3. Utilize PG&E's Charge Network program for Level 2 workplace and multi-unit dwelling charging, and as site appropriate, utilize Tesla and or Electrify America's programs for DCFC infra structure. Several sites in Redwood City and the City of East Palo Alto have been identified as appropriate locations to take advantage of these programs. Summaries of these three programs are included in Task 6, *Potential Locations for the Electric Vehicle Charging Infrastructure Master Plan (EVCI-MP) Evaluation and Recommendations* and in Appendix H, EVCI Funding Opportunities of this report; additional details on the sites is found in the EVCI-MP section of this report.

X. EVCI-MP, Redwood City Horseshoe & SW East Palo Alto

Based on the results from the Task 6, *Potential Locations for the Electric Vehicle Charging Infrastructure-Master Plan (EVCI-MP) Evaluation and Recommendations*, the Redwood City horseshoe was selected as the lead geographic area for the EVCI-MP. To demonstrate replicability, the southwest side of the City of East Palo Alto was selected as a secondary location.

Initial outreach and education was conducted with city and county sustainability managers and a number of sites were evaluated using Google Maps, Google Earth, PG&E's Integrated Capacity Analysis (ICA) map, guideline documents for various funding sources, site walks and on-site outreach and education with facility managers or those in similar positions. The first barrier to EVCI installation was financing and its timing (as detailed below) and then the specific charger location. For example, at one site, it was determined that the PG&E minimum number of chargers (10) combined with the new California ADA requirements for chargers would significantly reduce the number of parking spaces available to other vehicles and create additional traffic problems within an already constrained employee parking area; as a result, the site opted not to participate.

This same approach was taken with the largest school in the Redwood City horseshoe and the Ravenswood Shopping Plaza in the southwest side of East Palo Alto and have yielded successful outreach and feasibility assessments. EVCI outreach and education was also conducted and is continuing now that funding for EV installations via the PG&E Charge Network is more certain.

In evaluating the host sites from an electrical perspective unless otherwise noted, there was enough capacity for both the PG&E feeder lines and interconnection hosting that the new installation would not require and expensive upgrades of utility distribution infrastructure to accommodate the new load. Likewise, there was no significant repairs or upgrades necessary to install the EVCI or photovoltaic (PV) system. Cost estimates for the installations were performed by a licensed electrician and are included in Appendix I.

Further, in selecting the specific EVCI locations, all are understood to meet California and Federal rules for locating EV chargers, including Americans with Disabilities Act requirements though this will have to be confirmed by the local permitting agency.

In conducting the EVCI-MP Outreach and Education it was relatively easy to convince City & County of importance of EVCI as they have 1) existing EV ambassadors (Sustainability Managers) 2) greenhouse gas emissions reductions and associated climate goals 3) In general already recognize that EVs are going mainstream. In contrast, workplaces may not have staff in a role that is equivalent to a City Sustainability Manager and MUDs typically do not; and or the site simply may not have the parking spaces to support the PG&E 10-port minimum. For example, in conducting outreach, Property Managers at several MUDs were simply not interested, even when explained that the chargers, their installation and maintenance would be essentially free (per the PG&E program, Sponsor Model). It was evident that the Managers were not familiar with electric vehicles and did not have the time and or interest to evaluate something outside of their standard duties.

In conducting workplace outreach, there were similar issues to the Property Managers and with a number of sites, limited parking so meeting the PG&E 10-port minimum and associated ADA requirements would have been (from their perspective) extremely difficult. Further, as noted below, the PG&E workplace program left between an estimated $1,150-$2,350 per port (the "participation payment" as the responsibility of the workplace or at a minimum, a $11,500 outlay for an employee benefit that might not be fully utilized for several years.

Table 1 details interested host sites, the number of chargers (L2 and or DCFC), number of parking spaces, EVCI cost, PV potential, and cost.

Table 1: Interested Host Sites, RWC Horsehoe and SW-East Palo Alto

EVCI / PV Host	L2-Port Count	Existing Parking Spaces	EVCI Cost, $k	PV Potential, kW-DC	PV Cost, $k
Hoover School, RWC*	10	86	$199	864	$3,024
Boys & Girls Club, RWC*	10	40	$189	100	$350
RWC Yard*	10	85	$209	329	$1,152
Sobrato, RWC, Required	127	2030	$1,090	1,036	$3,626
Sobrato, RWC PAEC Proposal	613		$3,916		
Stanford, RWC, Required	52	1067	$594	1,167	$4,084
Casa Redwood Apartments, RWC, MUD	10	30	$144	9	$41
Kaiser Permante, RWC	21	744	n/a	n/a	n/a
Avenue Two Apartments, RWC, MUD	126	140	$835	750	$2,500
EPA City Hall/ Library*	10	166	$194	Completed	n/a
Boys and Girls Club, EPA*	10	45	$199	107	$428
Ravenswood Shopping Plaza*	60	1100	$1,020	1,000	$3,800
Ravenswood Shopping Plaza (Electrify America)	6 DCFC		$360		
Cummings Park HOA, MUD	46	60	$455	100	$400
Family YMCA, EPA*	10	50	$186	300	$1,140
Ravenswood Family Health Center*	10	160	$226	500	$1,900

*These workplace hosts are unable to provide PG&E's "Particpation Payment"

g. EVCI Deployment Funding Strategy

Due to funding constraints, the majority of hosts are unable to provide any level of self-funding for EVCI installations and the associated maintenance and networking fees. Hence, to enable EVCI installation and operation, the Clean Coalition recommends the following two-fold funding strategy:

1) To cover 90-100% of the installation, charger acquisition, maintenance, and networking fee costs, the Clean Coalition strongly recommends that site hosts utilize Pacific Gas and Electric's (PG&E) EV Charge Network Program. The Clean Coalition has spent significant time with potential hosts reviewing PG&E's program, including the requirement of 10-charging ports per site, the "participation payment" potential

ADA requirements and the option to pass all of the electricity costs through to the EV drivers - the charger users.

In disadvantaged communities like the Redwood City horseshoe and the southwest side of East Palo Alto, PG&E's Charge Network program under the Sponsor Model essentially covers all of the installation and operational costs except for the one-time participation payment. The participation payment as shown by Figure 17 is based on the cost of the specific charger model selected (from an as yet to be released list of qualified charger vendors) less a rebate from PG&E. The rebate amount depends on the use case of the charger; the rebate for workplace is $1,150 per port and $2,300 per port for MUD sites. PG&E has intimated that they expect program qualified EVSE vendors to provide chargers at pricing roughly between $2,300 and $3,500 per port, which means that a workplace would be expected to provide at a minimum $11,500 in participation payment for the 10-port install. By PG&E, the list of approved charging vendors and their pricing should be known by mid-to late February.

Figure 17: PG&E Charge Network, Participation Payment Schedule

PARTICIPATION PAYMENTS

	Disadvantaged community	Other PG&E service areas
Multi-unit dwelling	Participant makes one-time participation payment equal to the cost of the chargers selected, less $2,300 per port.	Participant makes one-time participation payment equal to the cost of the chargers selected, less $1,150 per port.
Workplace	Participant makes one-time participation payment equal to the cost of the chargers selected, less $1,150 per port.	N/A – this segment is not eligible for this ownership option.

2) To address the participation payment, the Clean Coalition is currently examining the potential of other funding sources as the majority of our host organizations have indicated that they are unable to provide the participation payment. At present, there are two funding options; a Bay Area Air Quality Management (BAAQMD) Charge! grant or a follow-on CEC implementation grant. In evaluating the Charge!

grant option, the Clean Coalition finds that the costs of preparing the individual applications (per host) combined with the grant recordkeeping and reporting requirements plus the risk that chargers would not be used enough to meet mandatory use thresholds requirements (with the host then having to return a portion of the grant) plus the limited funding amount ($3k/charger) and other requirements render this option a non-starter.

In regard to a follow-on CEC implementation grant, it is the Clean Coalition's interpretation that PG&E's costs associated with the necessary electrical work to install the chargers, the chargers themselves plus the ongoing maintenance and networking fees would be considered as third-party match and that the participation payment would likewise be considered an allowable cost. As seen in Table 2, the typical cost to install and obtain a single-Level 2 port at an existing workplace site plus ten years networking fees and maintenance[6] is approximately $22,431 (Value/Port). Using PG&E's program, the utility would provide the majority of the above costs less a $1,150 participation payment representing a ~95% match. Understanding that the workplace hosts are unable to provide the participation payment, the Clean Coalition strongly encourages the CEC to solicit a follow-on implementation grant that would permit PG&E costs to count as third-party match and that the participation payment would likewise be an allowable cost.

[6] Networking fees and maintenance are estimated to be $280 & $100 per year-port

Table 2: PAEC EVCI Value Analysis

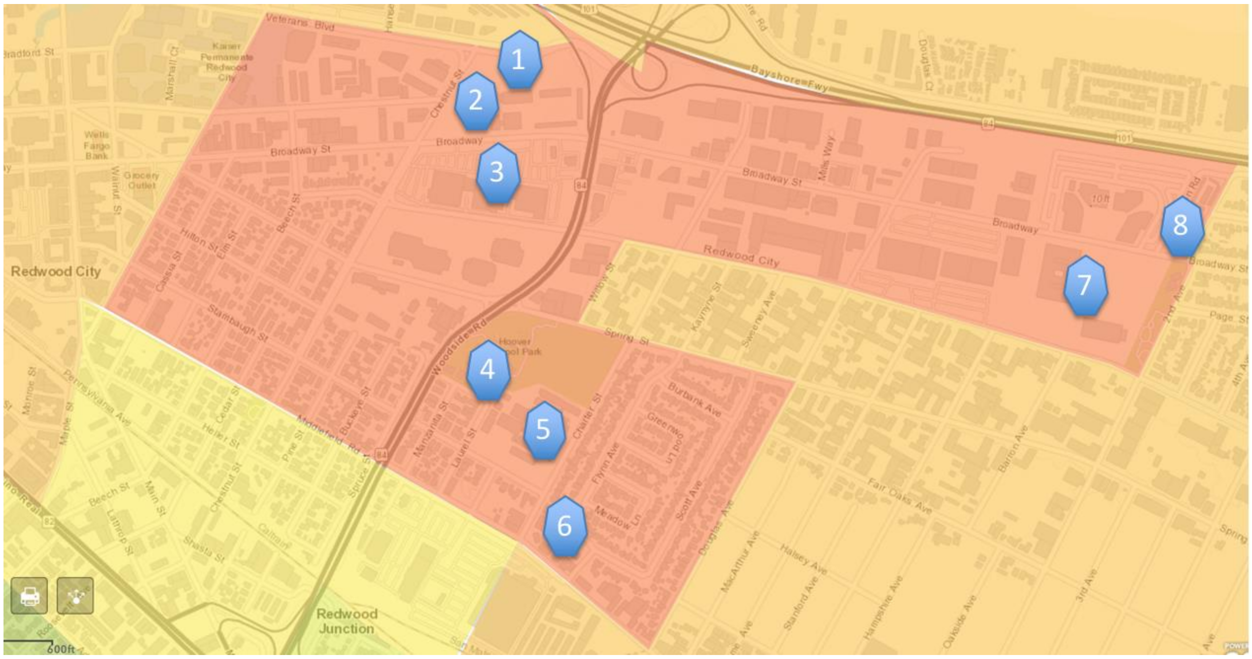
Proposed Workplace Installations	
L2 Charger Count:	130
Install & EVSE Cost:	$2,422,000
10-Years Network+ Maint	$494,000
Total Value:	***$2,916,000***
Value/ Port	$22,431
PG&E's Participation Paymen	$149,500
Proposed MUD Installations	
L2 Charger Count:	795
Install & EVSE Cost:	$5,350,000
10-Years Network+ Maint	$3,021,000
Total Value:	***$8,371,000***
Value/ Port	$10,530
Participation Payment	~$0
DCFC Units	6
Install & Charger Cost:	$360,000
10-Years Network+ Maint	$46,800
Total Value:	***$406,800***
PAEC EVCI Value:	***$11,693,800***

Table 2 also notes that If the EVCI-MP is implemented as recommended, it will yield ~$11.7M in EVCI at an external cost of ~$150,000.

h. Redwood City Horsehoe & East Palo Alto

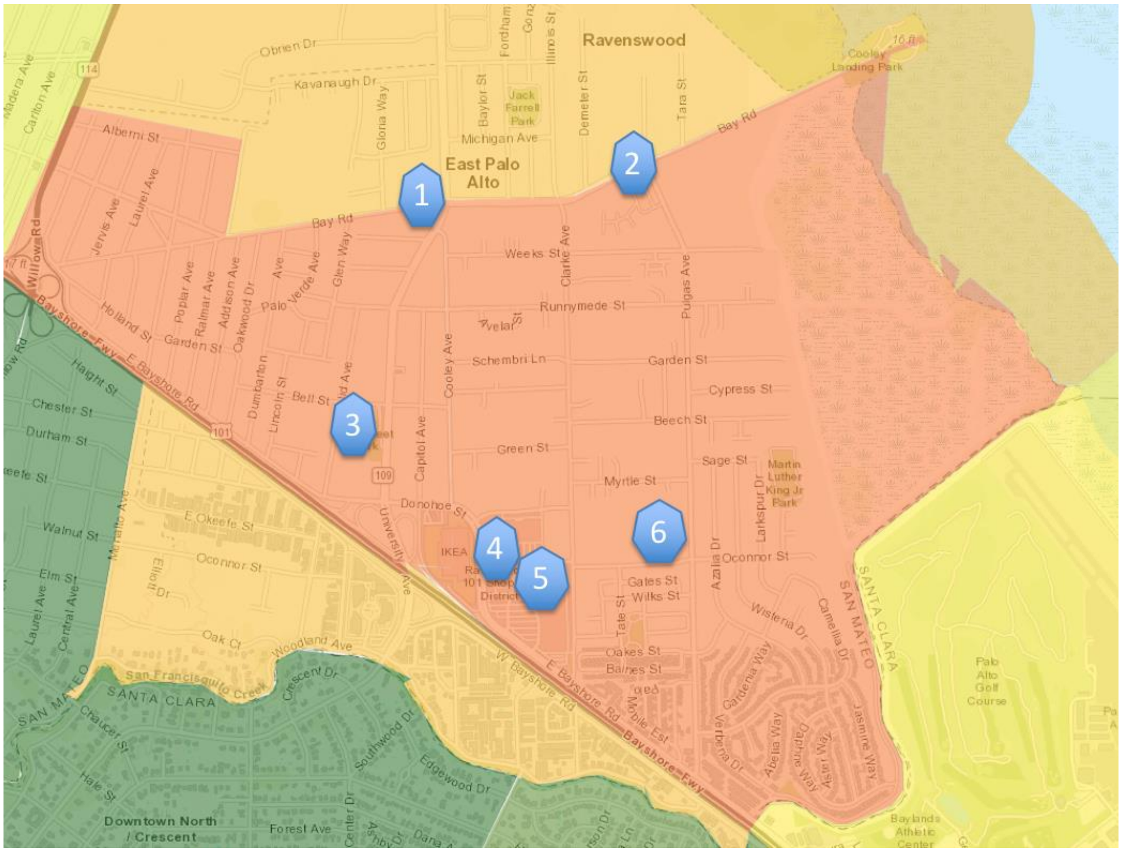
As noted by Figure 18 and 19, the Clean Coalition has identified a number of example sites to host and form the anchor of an ever-increasing EVCI base in the Redwood City Horseshoe and the southwest side of the City of East Palo Alto.

Figure 18: Sites interested in Hosting EVCI, RWC-Horseshoe



Site #	EVCI Host
1	Kaiser Permanente
2	RWC Yard
3	Sobrato, RWC
4	Boys & Girls Club, RWC
5	Hoover School, RWC
6	Casa Redwood Apartment, RWC
7	Stanford, RWC
8	Avenue Two Apartments

Figure 19: Sites interested in Hosting EVCI, East Palo Alto



Site #	EVCI Host
1	EPA City Hall/ Library
2	Ravenswood Family Health Center
3	Family YMCA, EPA
4	Ravenswood Shopping Plaza
5	Cummings Park HOA
6	Boys and Girls Club, EPA

In Redwood City, the Hoover School, the Boys & Girls Club and the RWC Yard would install chargers for their employees with the potential to allow the local residents to utilize the EVCI during non-working hours. Figures 20-22 illustrate proposed charger locations at each site. Note that the Hoover School is reworking its primary parking area, whereas chargers for the Boys & Girls Club and the RWC Yard would be installed in existing parking lots. As these are workplace chargers, PG&E will cover all costs except for the participation payment. Given extremely tight budgets of these site hosts and that these employee EV chargers are not mission critical, the respective organizations are unable to justify using limited funding to cover the participation payment and would need external funding to install the chargers.

Figure 20: Hoover School, RWC Potential EVCI Location

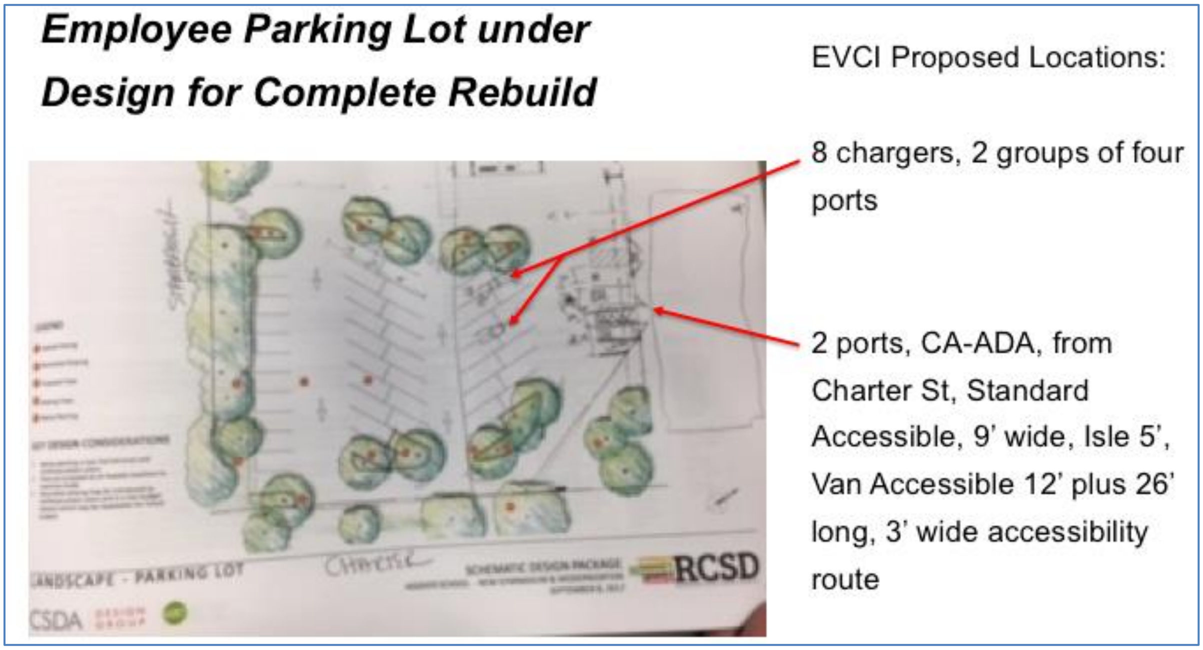


Figure 21: Boys and Girls Club, RWC Potential EVCI Location

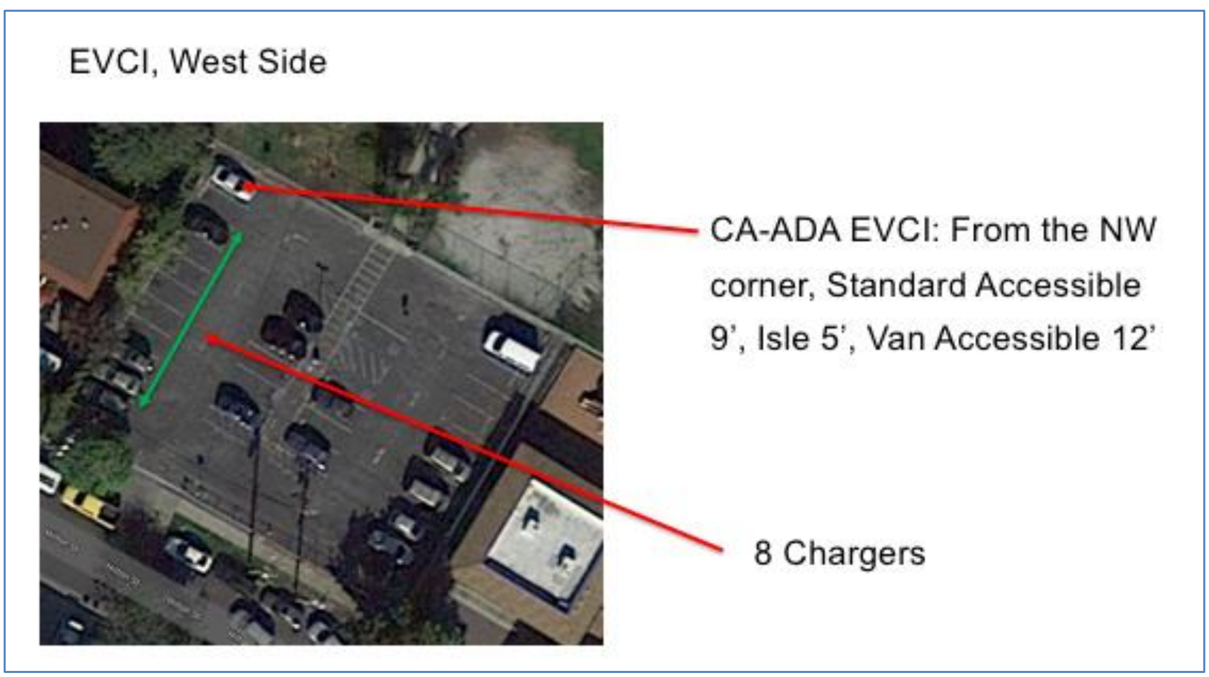
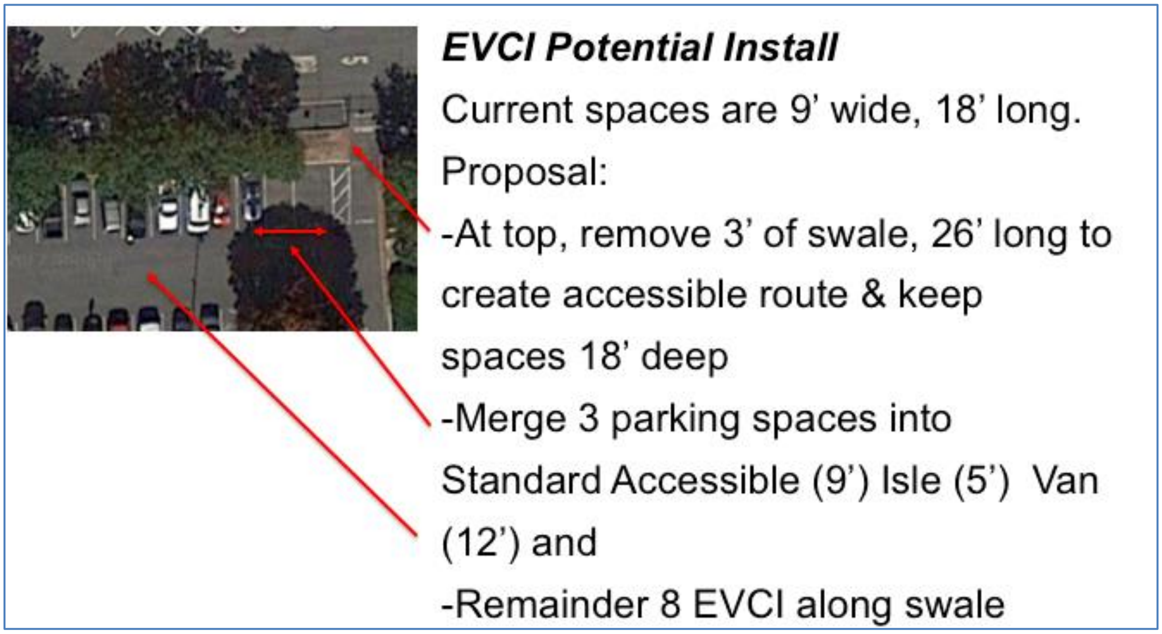


Figure 22: RWC Yard, Potential EVCI Location



Kaiser Permanente, as part of its overall sustainability programs has a corporate initiative to install chargers at a number of their California facilities. Kaiser Permanente is planning to install 21 chargers at this location with their EV charging infrastructure partner EVGo. Kaiser Permanente is not utilizing outside funding for this specific installation but is supportive of any employee EV outreach and educational efforts as sponsored by the CEC or other entities.

Stanford and Sobrato are both planned projects at differing levels of scoping and planning completion. The Stanford site is 100% workplace and is following the current CalGreen requirements. In discussions with Stanford, they feel that this is an adequate number of chargers based on multiple factors including recognizing the shift to long range EVs; the current EV charging load at their main Stanford, Palo Alto campus and that amending the current plans may slow the entire permitting process. Stanford has also opted not to participate in the PG&E Charge Network due to Stanford's construction schedule. Sobrato Redwood City is a new mixed-use development with both residential and workplace units. They are likewise following the current CalGreen requirements, though the Clean Coalition is attempting to increase the number of chargers for the residential units (or MUD) to one charger per unit and as paid for by the PG&E Charge Network program. The cost of installing chargers, one per residential unit is also noted in Table 1.

The Casa Redwood Apartment complex at 550 Charter Street, Redwood City, a MUD, would dedicate 10 chargers to specific apartment units within the complex. As the PG&E program covers the entire cost for MUDs located in disadvantaged communities which this is (provided the MUD selects the base EVSE) Casa Redwood Apartments is actively going forth with the PG&E program. And if this should prove successful, the complex owners have already indicated that they may use the PG&E program to install chargers at their other complexes in PG&E service territory. Further, they have also volunteered to serve as a MUD case study for the PG&E Charge network program.

The Avenue Two Apartment complex at 1107 Second Avenue Redwood City, is planning on fully participating in the PG&E Charge Network program and dedicating one charger per unit (126 units). Further, Equity Residential, the corporate owner is also planning on using the PG&E program to install chargers at their Berkeley location which is also in a disadvantaged community. Finally, they are also considering using the PG&E program to install EVCI at their other 48+complexes in the greater Bay Area. Should Equity Residential do so, this would entail the addition of roughly 5,000 Level 2 chargers into the MUD market.

On the southwest side of East Palo Alto, all the sites are considered workplaces for purposes of participation in the PG&E Charge Network program. The City Hall, Boys and Girls Club and YMCA sites, similar to those in the Redwood City horseshoe all have extremely tight budgets, and as these employee EV chargers are not mission critical, the respective organizations are unable to justify using limited funding to cover PG&E's participation payment and would likewise need external funding to install the chargers.

The Ravenswood Shopping Plaza, for purposes of participating in the PG&E Charge Network is considered a workplace location, and as it's owned partially by the city, likewise has a similar funding issue. As noted in Table 1, given the size of the parking lot, it has been scoped with 60 L2 units which meets the EVCI 2016 CalGreen non-residential standard.

In addition, because the Plaza is next to Highway 101, with easy highway access and a large parking lot, Tesla is in the process of obtaining permits to install a number of their proprietary superchargers in the north western area of the parking lot. This is a win for East Palo Alto as Tesla, the 3rd party owner/operator, will be 100% responsible for these chargers; and, has a vested interest to maximize their use. In addition, the Clean Coalition, with the city's approval and encouragement, has invited Electrify America to evaluate installing CHAdeMo and CCS fast chargers at the Plaza. Similar to Tesla, should Electrify America install chargers, they will be the 3rd party fully responsible for them. Finally, the shops in the Plaza are likewise winners as these charging stations will draw customers who might not otherwise pause at the plaza. As estimate to install 6 DCFC (as would Electrify America) is included in Table 1. These fast charger installations are in complete alignment of the Clean Coalition's recommendations.

The Clean Coalition is continuing to conduct additional EVCI outreach and educational efforts in in the horseshoe area of Redwood City and the southwest side of the City of East Palo Alto. Should other sites join the EVCI-MP before the end of the PAEC grant period, we will file an addendum to the final report.

XI. Conclusions and Recommendations

1) The introduction of affordable long range EVs is causing a disruption in the EV Charging Landscape.

The electric vehicle (EV) charging landscape is rapidly evolving due to the advent and adoption of mainstream affordable long-range battery electric vehicles. While the availability of residential and workplace charging remains key to EV adoption by first time EV users, the paradigm associated with publicly provided charging is shifting from Level Two (L2) charge rates with significant deployment densities (commonly found in retail settings) to third party direct current fast charge (DCFC) charging rates with less deployment densities. In essence, as EVs have longer ranges, matching that of internal combustion engine (ICE) vehicles, the public charging ecosystem is also evolving to partially match that of the gasoline station model. As such, we recommend focusing on installing level 1 and 2 EVCI in residential units (single family and MUD) followed by the workplace and also strategically placed urban DCFC stations and along highways plus en route to remote destinations.

2) Municipalities should prioritize implementing strong EV Ready Codes over other programs designed to accelerate EV adoption.

EV ready codes for new construction particularly those requiring one-charger per unit in multi-unit dwellings (MUDs) are the most cost-effective installations particularly when compared to public installations at existing structures. Not only are these codes more cost effective, but they also sidestep obfuscation by over worked or recalcitrant Apartment Complex Managers and Condominium Board Associations as frequently seen at existing MUDs when tenants or owners request to install chargers. Finally, as EVs typically spend the greater part of their stationary and potentially plug-in time at the residence, (versus the workplace or other local) the opportunity for and benefits from intelligent charging is greatest.

This conclusion and recommendation was clearly seen in the PAEC EV survey results where roughly 150 EV professionals and EV drivers ranked EV ready codes as absolutely the best use of public funds to accelerate EV adoption.

3) San Mateo Sustainability / Transportation Professionals are most likely to recommend installing additional public charging if the cost to a given Bay Area municipality is near to or zero.

With the introduction and success of long range cost effective EVs (the Chevy Bolt with 200+ miles of range is second only to the Tesla Model S in 2017 sales) combined with the city and county staff time necessary to support publicly owned EVCI, San Mateo Sustainability and Transportation professionals are questioning the need for additional public L2 chargers. In that the primary purpose of public L2 charging is to address range anxiety from "commuter" EVs with ranges of 100 mile and less and provide an opportunity to top up. Further, the consensus was that there are more cost-effective actions to accelerate EV adoption including outreach and educational efforts, installing chargers (L1 and or L2) in the workplace and multi-unit dwellings, DCFC, signage and as noted above, most importantly, strong EV ready codes. However, it was agreed that should the public chargers be provided at no or very little cost to the municipality (e.g. installed and operated by a third party) then the chargers would be accepted.

4) Outreach and Education are still key to EV Adoption and EVCI Installation.

Even in the Bay Area, there are still swaths of populations that have no or limited experience with EVs. Particularly for Apartment Managers, and Home Owner Association Board Members, introductions from city officials, and combined with face-to-face meetings are a critical part of obtaining a "yes" to installing EVCI.

5) Without 100% Funding, Some Institutions are not able to Install or Operate EVCI.

As seen in this EVCI-MP, there are a number of institutions including cities and non-profits that would like to install EVCI for their employees. However, without essentially 100% funding, they are unable to do so due to budget limitations.

Appendix A: EVCI Survey Details

Survey Demographics

Total participants: 143

EV Ownership Among Respondents	Count	%
Own EVs	122	85%
Do not own EVs	21	15%

Type of EV Owned	Count	%
Short range, commuter/ plug-in hybrid EV with sub 100-mile range (e.g. Leaf, Chevy Volt E-golf, etc.)	69	48%
Long range EV (e.g. Tesla S, X, 3, Chevy Bolt, 2018 Leaf)	16	11%
I have one of each	37	26%
I do not have an EV	21	15%

Respondent Classification	Count	%
EV Professional - Someone who addresses EVs as part of their profession, e.g. works for a Utility, OEM, charging company, does EV policy/programs, etc.	25	27%
EV Driver - Someone who regularly uses an EV as means of transport	39	43%
Both EV Professional and EV Driver	20	22%
Neither EV Professional nor EV Driver	7	8%
Total	91	

Survey Results for Question 1 Addressing the Changing Landscape of EV Charging

Respondents were asked to rate how strongly they agreed (or disagreed) with the following position on a scale of 1-5 with a series of five statements.

> Please read the background information below and answer the following survey questions.
>
> The electric vehicle (EV) charging landscape is rapidly evolving due to the advent and adoption of mainstream affordable long range (150+ mile) battery electric vehicles. As a result, we see the 3-10 year future of EV charging as a combination of

residential/ workplace charging (L1 and L2) and strategically placed direct current fast charger (DCFC) stations along highways and in route to remote destinations.

The current paradigm has been that publicly provided Level Two (L2) charging with significant deployment densities is necessary so that short range EV drivers will not get stranded. With the increase of affordable long range EVs, this paradigm is shifting to DCFC chargers with less deployment densities. However, availability of residential and workplace charging (L1 and L2) remains critical to EV adoption.

Given the above paradigm shift, municipalities should focus on encouraging EV adoption by supporting EV education and outreach activities such as Ride and Drives; implementing municipal codes supporting dense charger installation for new construction and major remodels, particularly at multi-unit dwellings; and essentially only installing public charging infrastructure when the infrastructure can be paid for by grants and other funding sources (e.g. Air District, Utility programs, 3rd parties, etc.) They should also encourage the installation of DCFC, particularly high power DCFC.

Statement 1: Presently residential and workplace charging (private L1/L2) is key to EV adoption

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total Count
104	32	3	2	2	143

Statement 2: Presently, public L2 charging supports short range EV drivers

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total Count
29	80	14	14	6	143

Statement 3: Presently, public L2 charging supports long range EV drivers

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total Count
16	40	29	37	21	143

Statement 4: In 3-10 years DCFC will be more useful and relevant than public L2 charging

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total Count
53	39	35	15	1	143

Statement 5: In 3-10 years public L2 charging will be useful and relevant

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total Count
25	65	31	15	7	143

Survey Results for Question 2 Addressing Prioritization of a Municipality's EV Action Plan

Respondents were asked to prioritize 8 municipal actions given an annual EV budget of $25k, with 1 for the first choice (great use of public funds) and 8 for the last choice (poor use of public funds).

a) Implement municipal codes requiring charging infrastructure installs beyond those of CalGreen/ Title 24 (e.g. one charger per new housing unit and at the time of new construction/ major renovation, etc.);

1 - Great use of funds	2	3	4	5	6	7	8 - Poor use of funds	Total Count
72	28	18	10	6	5	3	1	143

b) Conduct four Ride & Drive events to increase awareness and education about EVs

1 - Great use of funds	2	3	4	5	6	7	8 - Poor use of funds	Total Count
21	20	33	23	15	11	13	7	143

c) Install ten Level 1 chargers for municipal employee use

1 - Great use of funds	2	3	4	5	6	7	8 - Poor use of funds	Total Count
21	16	26	21	11	12	13	23	143

d) Encourage workplaces and multi-unit dwelling (MUD) owners and property managers to take advantage of grants / utility funding to install charging equipment

1 - Great use of funds	2	3	4	5	6	7	8 - Poor use of funds	Total Count
63	42	18	8	7	3	0	2	143

e) Install one dual-port networked Level 2 charger in a public garage

1 - Great use of funds	2	3	4	5	6	7	8 - Poor use of funds	Total Count
29	24	14	17	15	15	15	14	143

f) Encourage 3rd parties to install 50kW and larger DC Fast Chargers (DCFC)

1 - Great use of funds	2	3	4	5	6	7	8 - Poor use of funds	Total Count
44	32	17	17	11	15	6	1	143

g) Incorporate two EVs into the city fleet (including employee education)

1 - Great use of funds	2	3	4	5	6	7	8 - Poor use of funds	Total Count
38	14	26	13	20	12	18	2	143

h) I would like to see a municipality take a different action to accelerate the adoption of EVs

1 - Great use of funds	2	3	4	5	6	7	8 - Poor use of funds	Total Count
31	17	9	22	6	12	8	38	143

As a bonus question, respondents were invited to share any thoughts or comments they had regarding increasing EV adoption and the role municipalities should play.

Finally, the following list comprises participants who agreed to have their names included on the survey report.

Abdellah Cherkaoui
Abraham Yacobian
Adam Nelson
Alan Glass
Alex Sereb
Amanda Myers
Amanda Scarborough
Angelo Festa
Anne Schmitt
Bill Hilton
Catherine Alston
Chadwick Wyler
Charles Botsford
Colin Murphy
Cosmin Dumitrescu
Dale W. Miller
Dan Lieberman
Daniel Leevy
Dave Jewett
David Arkin
David Patterson
David Schlosberg
Denae Wagner
Diane Bailey
Dolf Joekes
Dorian Vargas-Reighley
Elizabeth Pirrotta
Fanny Yang
Guy Hall
Hannah Goldsmith
Henry Ho
Isaac Lund
James Robinson
Janelle London
Jason Jungreis
Jeral Poskey
Jim Barbera
Joe Siudzinski
John Blair
John Love
John Mikulin
John Niles
Jon Ziegler
Justine Burt
Karen Janowski
Katrina Sutton
Kendra Hathaway Fadil
Kevin Armstrong
Kitty Adams
Laura Bone
Laura Stuchinsky
Lawrence Rhodes
Lee Brokaw
Leslie Baroody
Linda Henigin
Mahlon Dormon
Malini Kannan
Marc Geller
Marc Kenig
Mark Erickson
Mary Lunetta
Matt Smith
Maya Sun
Meg Williams
Megan Gardner
Michael Masquelier
Michelle Goree
Nicholas Carter
Nick Pilch
Paul Scott
Peter Brown
Peter Mackin
Peter Van Deventer
Phil Pluckebaum
Phillip Kobernick
Preston Roper
Rachael Londer
Rachel DiFranco
Rafael Reyes
Randy Bryant
Ray Lev
Rebecca Parnes
Rick DeGolia
Roger Pierno
Ron Freund
Ronald Gremban
Sally Ahnger
Sherry Boschert
Stacey Reineccius
Steve Heckeroth
Steve Marshall
Steve Schmidt
Steve Weiss
Sybil Cramer
Ted Rees
Tom Driscoll
Vanessa Warheit
Vicki Sherman
Vinay Krishnan
Vincent Barletta
Waidy Lee
Warren Atherton

Appendix B: The Palo Alto Experience In Creating and Enforcing an Electric Vehicle Ordinance

Gmail Sven Thesen <sventhesen@gmail.com>

The Palo Alto experience in creating and enforcing an Electric Vehicle Ordinance
6 messages

Pirnejad, Peter <Peter.Pirnejad@cityofpaloalto.org> Thu, Feb 8, 2018 at 11:09 AM
To: "dmchow@menlopark.org" <dmchow@menlopark.org>, "rjlafrance@menlopark.org" <rjlafrance@menlopark.org>, "rllucky@menlopark.org" <rllucky@menlopark.org>
Cc: "Jacobson, Melanie" <Melanie.Jacobson@cityofpaloalto.org>, "oripaz@menlopark.org" <oripaz@menlopark.org>, "jlondon@stanfordalumni.org" <jlondon@stanfordalumni.org>, "SvenThesen@gmail.com" <SvenThesen@gmail.com>, "Hodge, Bruce" <hodge@tenaya.com>

Dear Ms. Chow, Mr. Lafrance, and Ms. Lucky,

I was talking to a mutual acquaintance, Sven Thesen, also good friend, and he mentioned Menlo Park was considering an Electric Vehicle ordinance of some kind. As the Director of Development Services, I am pleased that the City of Menlo Park is advancing a new electric vehicle (EV) charging infrastructure ordinance for multi-family and commercial developments and would like to share my Department's experience to the extent that it may help you.

As you may know, in 2014 the City of Palo Alto adopted EV charging requirements with essentially the following requirements:

- **Multi-family residential** – one Level 2 charging outlet and/ or one EVSE for each housing unit, plus install electric wiring for 25% of visitor spaces.
- **Hotels** – all new builds must accommodate EVs at 30% of public spaces. This accommodation can be either a 120V outlet or actual charging equipment, but all parking must have at least 1 in every 10 spaces set up to include *installed* EVSEs.
- **Commercial Development** – 25% of all spaces must accommodate plug-in vehicles, with at least 5% of all spaces equipped with charging equipment.

I estimate that this ordinance has increased construction costs by less than 0.5% and I know from experience that it is considerably more expensive (10-100 times more) to add charging infrastructure post construction than pre-construction. To date, my Department has had no pushback from developers regarding the ordinance's residential component and limited pushback on the commercial side, primarily due to new California Americans with Disabilities Act adding additional parking space requirements. If Menlo Park was only to enact one component of our ordinance (residential or commercial) I would prioritize the residential requirement of one charger per residential unit because a) this is where vehicles spend most of their time b) the great majority of EV users prefer to charge at home versus a commercial setting and c) both home charger install and operational costs are generally less than the commercial costs.

Palo Alto and Menlo Park have some of the highest purchasing rates of EVs, yet multi-family dwellings that lack charging infrastructure remain a major barrier to accelerating EV adoption. I appreciate the efforts of Menlo Park and other cities throughout the region to support EVs as an effective way to cut greenhouse gas and air pollution.

In summary, it is my opinion that Palo Alto's 2014 EV charging requirements have been a major success. Feel free to contact my office if there is anything I can do to support Menlo Park in adopting a similar measure. If you have technical questions about our ordinance the best person to talk to is Melanie Jacobson, copied in this email

Sincerely,

Dr. Peter Pirnejad

Director of Development Services

Appendix C: Palo Alto EVCI Code Language

Code Language: https://www.cityofpaloalto.org/civicax/filebank/documents/43818

Ordinance No. 5263
Ordinance of the Council of the City of Palo Alto Adopting Section 16.14.380 of the Palo Alto Municipal Code to Adopt Local Amendments to the California Green Building Standards Code and Related Findings

The Council of the City of Palo Alto does ORDAIN as follows:

SECTION 1. Findings and Declarations.

The adoption and amendment of Section A4.106.8 of the California Green Building Standards Code is justified on the basis of local topographical and geographical conditions. Failure to address and significantly reduce greenhouse gas emissions could result in rises to sea level, including in San Francisco Bay, that could put at risk Palo Alto homes and businesses, public facilities, and Highway 101 (Bayshore Freeway), particularly the mapped Flood Hazard areas of the City. The aforementioned conditions create hazardous conditions for which departure from California Green Building Standards Code is required.

SECTION 2. Section 16.14.370 of the Palo Alto Municipal Code is amended to read as follows:

16.14.370 Section A4.106.8 Electric Vehicle (EV) Charging.

Section A4.106.8 of the California Green Building Standards Code is added and amended to read:

A4.106.8 Electric Vehicle (EV) Charging for Residential Structures. Newly constructed single family and multifamily residential structures, including residential structures constructed as part of a mixed use development, shall comply with the following requirements for electric vehicle supply equipment (EVSE). All parking space calculations under this section shall be rounded up to the next full space.

A4.106.8.1 Definitions. For the purposes of this section, the following definitions shall apply:

(a) Level 2 EVSE. "Level 2 EVSE" shall mean an EVSE capable of charging at 30 amperes or higher at 208 or 240 VAC. An EVSE capable of simultaneously charging at 30 amperes for each of two vehicles shall be counted as two Level 2 EVSE.

(b) Conduit Only. "Conduit Only" shall mean, at minimum: (1) a panel capable to accommodate a dedicated branch circuit and service capacity to install a 208/240V, 50 amperes grounded AC outlet; and (2) raceway or wiring with capacity to accommodate a 100 ampere circuit; terminating in (3) a listed cabinet, box, enclosure, or NEMA receptacle. The raceway shall be installed

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so that minimal removal of materials is necessary to complete the final installation.

(c) EVSE-Ready Outlet. "EVSE-Ready Outlet" shall mean, at minimum: (1) a panel capable to accommodate a dedicated branch circuit and service capacity to install a 208/240V, 50 amperes grounded AC outlet; (2) a two-pole circuit breaker; (3) raceway with capacity to accommodate 100-ampere circuit; (4) 50 ampere wiring; terminating in (5) a 50 ampere NEMA receptacle in a covered outlet box.

(d) EVSE Installed. "EVSE Installed" shall mean an installed Level 2 EVSE.

A4.106.8.2 Single Family Residences. The following standards apply to newly constructed detached and attached single family residences.

(a) <u>In general.</u> The property owner shall provide Conduit Only, EVSE-Ready Outlet, or EVSE Installed for each residence.

(b) <u>Location.</u> The proposed location of a charging station may be internal or external to the dwelling, and shall be in close proximity to an on-site parking space consistent with City guidelines, rules, and regulations.

A4.106.8.3 Multi-Family Residential Structures. The following standards apply to newly constructed residences in a multi-family residential structure, except as provided in section A4.106.8.4.

(a) Resident parking. The property owner shall provide at least one EVSE-Ready Outlet or EVSE Installed for each residential unit in the structure.

(b) Guest parking. The property owner shall provide Conduit Only, EVSE-Ready Outlet, or EVSE Installed, for at least 25% of guest parking spaces, among which at least 5% (and no fewer than one) shall be EVSE Installed.

(c) Accessible spaces. The percentage calculations and substantive requirements imposed by this section shall be applied separately to accessible parking spaces. Parking at accessible spaces where an EVSE is installed shall not be limited to electric vehicles.

(d) Minimum total circuit capacity. The property owner shall ensure sufficient circuit capacity, as determined by the Chief Building Official, to support a Level 2 EVSE in every location where Circuit Only, EVSE-Ready Outlet or EVSE Installed is required.

(e) Location. The EVSE, receptacles, and/or raceway required by this section shall be placed in locations allowing convenient installation of and access to EVSE. In addition, if parking is deed-restricted to individual residential units, the EVSE or receptacles required by subsection (a) shall be located such that each unit has access to its own EVSE or receptacle. Location of EVSE or receptacles shall be consistent with all City guidelines, rules, and regulations.

A4.106.8.4 Exception – Multi-Family Residential Structures with Individual, Attached Parking. The property owner shall provide Conduit Only, EVSE-Ready Outlet, or EVSE Installed for each newly constructed residence in a multi-family residential structure featuring: (1) a parking space attached to the residence; and (2) a shared electrical panel between the residence and parking space (e.g., a multi-family structure with tuck-under garages).

SECTION 3. Section 16.14.380 of the Palo Alto Municipal Code is amended to read as follows:

16.14.380 Section A5.106.5.3 Electric Vehicle (EV) Charging for Non-Residential Structures.

Section A5.106.5.3 of the California Green Building Standards Code is added and amended to read:

A5.106.5.3 Electric Vehicle (EV) Charging for Non-Residential Structures. New non-residential structures shall comply with the following requirements for electric vehicle supply equipment (EVSE). All parking space calculations under this section shall be rounded up to the next full space.

A5.106.5.3.1 Definitions. For the purposes of this section, the following definitions shall apply:

(a) Level 2 EVSE. "Level 2 EVSE" shall mean an EVSE capable of charging at 30 amperes or higher at 208 or 240 VAC. An EVSE capable of simultaneously charging at 30 amperes for each of two vehicles shall be counted as two Level 2 EVSE.

(b) Conduit Only. "Conduit Only" shall mean, at minimum: (1) a panel capable to accommodate a dedicated branch circuit and service capacity to install at least a 208/240V, 50 amperes grounded AC outlet; and (2) raceway or wiring with capacity to accommodate a 100 ampere circuit; terminating in (3) a listed cabinet, box, enclosure, or NEMA receptacle. The raceway shall be installed so that minimal removal of materials is necessary to complete the final installation.

(c) EVSE-Ready Outlet. "EVSE-Ready Outlet" shall mean, at minimum: (1) a panel capable to accommodate a dedicated branch circuit and service capacity to install at least a 208/240V, 50 amperes grounded AC outlet; (2) a two-pole circuit breaker; (3) raceway with capacity to accommodate a 100-ampere circuit; (4) 50 ampere wiring; terminating in (5) a 50 ampere NEMA receptacle in a covered outlet box.

(d) EVSE Installed. "EVSE Installed" shall mean an installed Level 2 EVSE.

A5.106.5.3.2 Non-Residential Structures Other than Hotels. The following standards apply newly constructed non-residential structures other than hotels.

(a) In general. The property owner shall provide Conduit Only, EVSE-Ready Outlet, or EVSE Installed for at least 25% of parking spaces, among which at least 5% (and no fewer than one) shall be EVSE Installed.

(b) Accessible spaces. The percentage calculations and substantive requirements imposed by this section shall be applied separately to accessible parking spaces. Parking at accessible spaces where an EVSE is installed shall not be limited to electric vehicles.

(c) Minimum total circuit capacity. The property owner shall ensure sufficient circuit capacity, as determined by the Chief Building Official, to support a Level 2 EVSE in every location where Circuit Only, EVSE-Ready Outlet or EVSE Installed is required.

(d) Location. The EVSE, receptacles, and/or raceway required by this section shall be placed in locations allowing convenient installation of and access to EVSE. Location of EVSE or receptacles shall be consistent with all City guidelines, rules, and regulations.

A5.106.5.3.3 Hotels. The following standards apply newly constructed hotels.

(a) In general. The property owner shall provide Conduit Only, EVSE-Ready Outlet, or EVSE Installed for at least 30% of parking spaces, among which at least 10% (and no fewer than one) shall be EVSE Installed.

(b) Accessible spaces. The percentage calculations and substantive requirements imposed by this section shall be applied separately to accessible parking spaces. Parking at accessible spaces where an EVSE is installed shall not be limited to electric vehicles.

(c) Minimum total circuit capacity. The property owner shall ensure sufficient circuit capacity, as determined by the Chief Building Official, to support a Level 2 EVSE in every location where Circuit Only, EVSE-Ready Outlet or EVSE Installed is required.

(d) Location. The EVSE, receptacles, and/or raceway required by this section shall be placed in locations allowing convenient installation of and access to

EVSE. Location of EVSE or receptacles shall be consistent with all City guidelines, rules, and regulations.

SECTION 4. If any section, subsection, clause or phrase of this Ordinance is for any reason held to be invalid, such decision shall not affect the validity of the remaining portion or sections of the Ordinance. The Council hereby declares that it should have adopted the Ordinance and each section, subsection, sentence, clause or phrase thereof irrespective of the fact that any one or more sections, subsections, sentences, clauses or phrases be declared invalid.

SECTION 5. The Council finds that this project is exempt from the provisions of the California Environmental Quality Act ("CEQA"), pursuant to Section 15061 of the CEQA Guidelines, because it can be seen with certainty that there is no possibility that the ordinance will have a significant effect on the environment.

SECTION 6. This ordinance shall be effective on the thirty-first day after the date of its adoption.

INTRODUCED: June 16, 2014

PASSED: August 4, 2014

AYES: BERMAN, BURT, HOLMAN, KLEIN, KNISS, PRICE, SCHARFF, SCHMID, SHEPHERD

NOES:

ABSENT:

ABSTENTIONS:

ATTEST:

for City Clerk

Mayor

APPROVED AS TO FORM:

Deputy City Attorney

APPROVED:

City Manager

Director of Development Services

Director of Administrative Services

5

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Appendix D: Stanford and City of Palo Alto Sponsored EV Class Flyer

IS AN ELECTRIC VEHICLE RIGHT FOR YOU?

- Come hear from a panel of local, long-time EV drivers and experts on their experiences.
- Get your questions answered on the difference between all-electric and plug in hybrid EVs; EV charging (home, work and the public space); range anxiety misconceptions; battery longevity; buying vs. leasing; and environmental, economic, and personal benefits.
- As a bonus, a number of EVs to explore inside and out, likely including Nissan Leaf, Kia Soul EV, Fiat 500-e, Ford Focus EV, VW e-Golf, Tesla, and new all-electric Chevy Bolt, with 238 mile range!

Instructors:

Sven Thesen, founder of Project Green Home in Palo Alto, chemical engineer, shared 2007 Nobel Peace Prize for IPCC climate guidelines, known as "ev-angelist" for spirited work in promoting electric vehicles

Jim Barbera, Systems Engineer, ChargePoint (prominent local charging company) versed in all aspects of charging station installation & settings

Marc Geller, founder/member of Board of Directors, Plug In America; and Vice-Chair, Board of Directors of the Electric Auto Association.

Jane Rosten, MSW, LCSW, Manager of Stanford HIP's Environmental Behavior Change Program

THURSDAY, OCTOBER 12

5:30-7:30 PM classroom + time before (4:30-5:20) and after to see cars

Stanford medical campus; class size limited. Register: cityofpaloalto.org/workshops

HIP Health Improvement Program Stanford University

CITY OF PALO ALTO

Appendix E: City of Palo Alto EVCI Utility Program

Palo Alto's EV Charger Rebate for Multi-User Facilities

The City of Palo Alto Utilities (CPAU) is offering Electric Vehicle (EV) Charger rebates to eligible customers that own or operate a school or non-profit, as well as multifamily and mixed use properties. Qualifying organizations in the CPAU service area can receive up to $30,000 for installing Electric Vehicle Supply Equipment (EVSE), also known as EV Chargers, that will be available to multiple users.

Installing EV chargers not only helps EV drivers, but also provides many benefits for the facilities that host them. Learn how your facility may benefit from having EV chargers installed.

Organizations in Palo Alto that install Electric Vehicle Chargers can receive

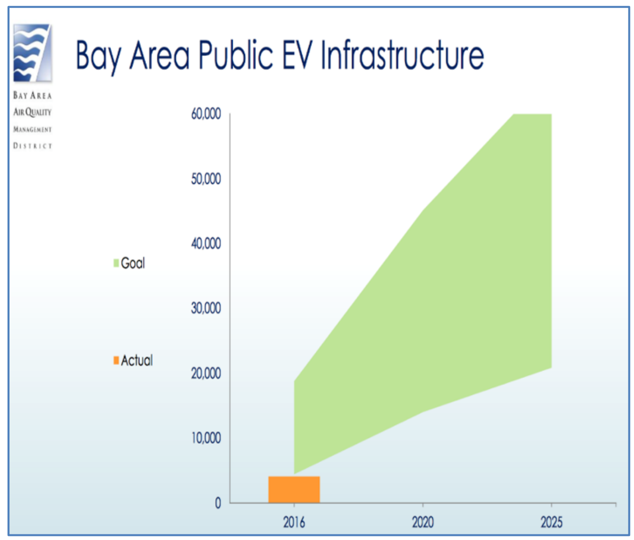
Up to $30,000 in rebates

Start Application Now

Appendix F: Case Study, San Mateo CalTrain Station

Case Study: Electric Vehicle Charging Infrastructure Pilot: San Carlos Caltrain Station

Sven Thesen
Consultant to Clean Coalition
Peninsula Advanced Energy Committee (PAEC)



Problem: Expensive EV Charging Infrastructure

Additional electric vehicle charging infrastructure (EVCI) is necessary to meet climate change emission reduction, air quality, and other goals. However, adding networked EVCI at existing facilities is extremely expensive.

Solution: Utilize Existing Electricals & LED Upgrade

In conjunction with the San Carlos Caltrain station LED lighting upgrade, add 110v electrical outlets at the base of four light posts using existing accessibility covers. Recover electricity costs by collecting an additional small parking fee to those parking in the EV charging spaces.

Details

The existing light posts have a ~2”x4” accessibility cover just above the concrete base.

Simultaneous to the planned San Carlos Station public parking lot LED lighting:

1. Confirm circuit is appropriately rated, has its own circuit breaker, and replace access cover with a single 110v outlet ($5) or Level 1 J1772 cordset ($500). Depending on the type of electric vehicle, this provides an approximately 4-5 mile per hour charge rate.

2. Add the following signage at the pole: “EV Charging Only—Level 1; regular parking fees apply plus an additional $2.5 per day for electricity.” Modify existing signage or install new signage at EV spaces.

3. Modify the Caltrain payment machines to collect additional $2.5 per day for “electrified” spaces

Potential Obstacles:

1. Non-EVs may access power, potentially camping overnight. However, lot already prohibits camping and loitering. Recommend addition of signage at spaces stating, "EV Charging Only."
2. Additional revenue may not cover electricity cost. Cost estimates assume PG&E rates of $0.25/kWh, 1.2kW outlet and charge times of 8 hours per charge session. For example, an EV would use an estimated $2.4 of electricity to recharge 44 miles over an eight-hour period.
3. Charging would be at L1 (~ 1.2 kWh/hr). For example, it would take an estimated 8 hours for an EV to recharge 44 miles and for some long commute EV drivers this may not be sufficient.
4. Adding EV charging and signing them as "EV charging only" reduces the number of parking spaces for simply parking and may antagonize non-EV drivers.

Conclusion:

Adding an EV charger to five light posts in Caltrain parking lot will cost an estimated $2,500.

Appendix G: Case Studies, Redwood City Library and Burlingame

Case Study: Simplification and Savings Electric Vehicle Charging Infrastructure Pilot: Redwood City Main Library, 1044 Middlefield Road, Redwood City, CA

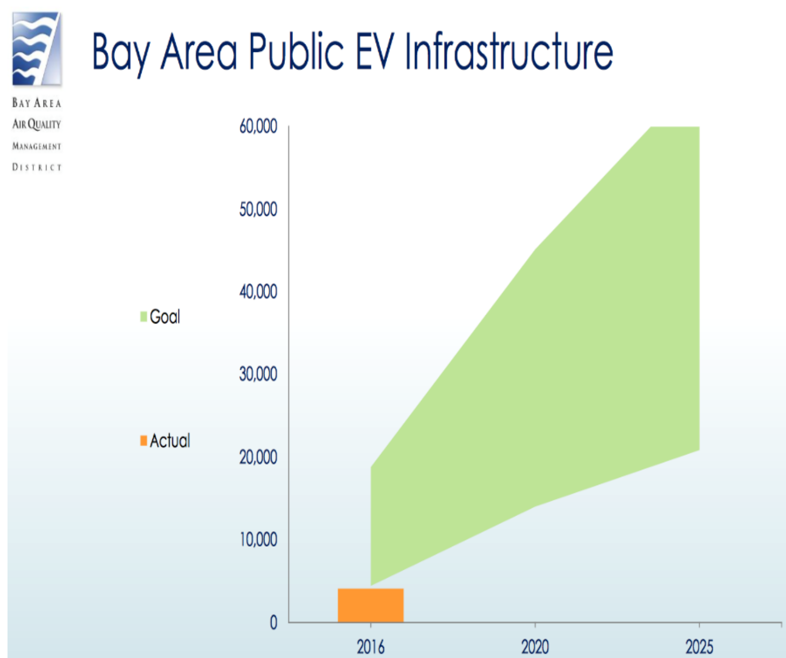
Sven Thesen
Consultant to Clean Coalition
Peninsula Advanced Energy Committee (PAEC)

Problem: Expensive EV Charging Infrastructure

Additional electric vehicle charging infrastructure (EVCI) is necessary to meet key goals such as climate change targets, emission reduction, and air quality control. However, there are multiple kinds of chargers, and the benefits of more expensive chargers may not merit their price tags. Specifically, the "smart" EVCI currently provided at certain locations, such as the Redwood City Library, is expensive and may be unnecessary.

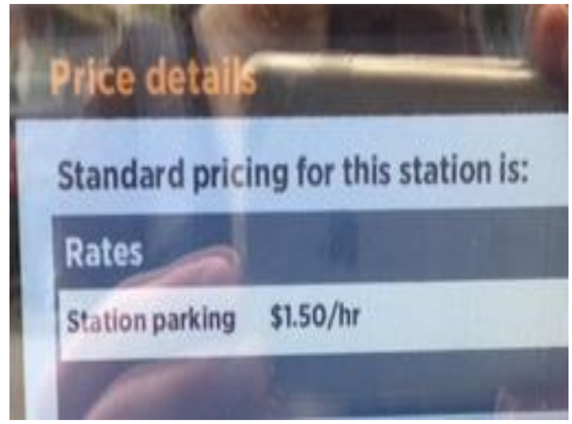
Solution: Utilize Existing Systems

To solve the problem of high initial and yearly costs, existing "smart" ChargePoint chargers can be relocated or sold and replaced with "dumb" or "semi smart" ClipperCreek chargers. Existing parking fee systems, such as parking meters, can be used for EV charge station billing. Installation of simple metering to track electrical use or utilizing library WiFi as the communication system can replace "smart" charger networking.



Problem Details

Current Implementation Analysis:



There is currently a dual-head ChargePoint EV charging unit behind the Redwood City Library programmed to collect $1.5/ hour. Signage behind the charger indicates that payment is *also* due at the pay-by-space meter serving the same parking lot, which charges $1/ hour to park in the lot. This means that to initiate charging here, an EV driver must:

- Pay first at the ChargePoint charger by swiping an RFID card or by calling an 800 number and providing a credit card number
- Pay again for parking at the traditional lot parking meter

If the driver does not pay the parking meter, the driver will receive a ticket, regardless of whether the driver is already paying to charge via the ChargePoint unit.
Therefore, to charge, the EV driver pays $1.5/hour for charging and $1/hour for parking, completing the *two* transactions at *two different* machines.

Current Cost Analysis:

Due to onboard communication and billing systems, the ChargePoint unit costs:

- An annual networking fee of $550
- A capital cost (new) of $6,000 to $7,000

Therefore, the total cost over 5 years for the ChargePoint charger, including initial cost, is $7,500.
Replacing the ChargePoint charger with a ClipperCreek charger as detailed below would result in a total cost over 5 years of $2,000. This represents a *reduction in cost of $5000*.

Solution Details

Projected Implementation Analysis:

To reduce / eliminate these costs (and decrease confusion):
1) Purchase a pair of ClipperCreek charging units to replace the current ChargePoint unit. Add a pair of electrical meters or an eMotorWerks Wi-Fi-enabled charger and employ the library's existing Wi-Fi to communicate and record charger electrical use.
2) Program the parking meter to collect $2.50/hour from the 2 EV spots. As necessary, program meter to collect $1.5/ hour during "free-parking" periods.
3) Install signage notifying users of these changes.
4) Relocate the ChargePoint unit to a new site or sell the unit.

Projected Cost Analysis:

Replacing current ChargePoint charger with ClipperCreek chargers results in a total cost of:

- Less than $2000 for ClipperCreek charging units and installation

In savings, replacement of the ChargePoint results in:

- Elimination of ongoing $550/year networking fees: savings of approximately $2500
- Possible resale of ChargePoint unit: savings of up to $5000

This means that, without considering ChargePoint resale value, the elimination of the networking fees for the ChargePoint charger by replacing it with ClipperCreek chargers equals the cost of the ClipperCreek chargers plus their installation within 5 years. After 5 years, the ClipperCreek chargers are cheaper regardless of ChargePoint resale value.
Considering ChargePoint resale value, the resale of the ChargePoint (on top of the elimination of network fees) results in total savings of up to $5000.

Conclusion:

The current ChargePoint charger at the Redwood City Library requires users to pay at two different meters and costs the city a total of $7500 over a 5-year period.
Replacing the ChargePoint charger with ClipperCreek chargers will simplify usage, eliminate networking costs, and cost the city only $2000 over a 5-year period, resulting in savings of approximately $5000.

Clean Coalition
Making Clean Local Energy Accessible Now

Burlingame
Electric Vehicle Charging
Infrastructure
Simplification & Savings.

Peninsula Advanced Energy Community (PAEC)

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Clean Coalition
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Making Clean Local Energy Accessible Now 2 March 2017

Problem: Expensive EV Charging Infrastructure

Clean Coalition

Electric vehicle charging infrastructure (EVCI) is necessary to meet climate change emission reduction, air quality and other goals.

However, intelligent EV charging equipment is expensive, sometimes x2+ the installation cost and may not always be necessary.

Making Clean Local Energy Accessible Now 2

Solution: Utilize Existing/ Known Systems

Clean Coalition

Problem: Due to onboard communication and billing systems, current intelligent EV chargers cost ~$550/year in networking fees & ~6,000 in capital cost.

Solution: 1) Install simple low cost EV chargers (~$1,000/ unit and no ongoing networking fees)

Making Clean Local Energy Accessible Now 3

Solution: Utilize Existing Systems

Clean Coalition

Solution (continued):

2) Partner the charger with the same parking meters currently used by the city and use the parking meter's billing features to collect monies for charging and monitor compliance.

3) Install signage to reflect above (using parking meters in this manner is an innovative technique and EV drivers will not be familiar with process.)

Making Clean Local Energy Accessible Now 4

2/1/18

Solution: Utilize Existing Systems

Clean Coalition

Solution (continued):

4) Install a simple meter to track kWh use and correlate to parking meter billing data. If WiFi is available, install a low cost WiFi capable charger with built in kWh metering.

Making Clean Local Energy Accessible Now 5

3

Appendix H: EVCI Funding Opportunities

EVCI Funding Sources. The Clean Coalition has identified and evaluated four different funding sources for EVCI as summarized below:

A) Bay Area Air Quality Management District, Charge! Program: $3k/ level 2 charger; $18k/ direct current fast chargers (DCFC); Given the high ratio of paperwork necessary to complete the application and ongoing record keeping & reporting requirements plus kWh use requirements to the funding per charger, the Clean Coalition does not recommend participation in this program at this time.

B) Tesla Motor Corporation: Proprietary DCFC which can only be used by Tesla vehicles. Minimum of 10 DCFC and several L2 chargers per site. Given that Tesla covers 100% of the equipment installation and operation costs, Tesla should be encouraged to scope installations at both city owned and privately-owned sites.

C) Electrify America: Minimum of 6 DCFC and Level 2 chargers per site with an emphasis on DCFC. Similar to Tesla, Electrify America covers 100% of the equipment installation and operation costs, and likewise should be encouraged to scope installations at both city owned and privately-owned sites.

D) Pacific Gas & Electric Company (PG&E), EV Charge Network: Program only addresses MUDs and workplaces with emphasis and added incentives for disadvantaged communities. Minimum of 10 Level 2 chargers per site. While the participation paperwork is intensive, with the exception of a "Participation Fee" the program offers significantly low to no installation and operational costs.

   This program was detailed multiple times in conducting EVCI outreach and educational activities and critical in getting entities to participate in the EVCI-MP.

Appendix I: Electrical Contractor Quotes, RWC & EPA

ESTIMATE

661 Sinclair Frontage Rd
Milpitas CA 95035
1-408-657-3332
sales@soledenergy.com
www.soledenergy.com
408-859-7409

SoLED Energy, Inc.

Estimate

For: Sven Thesen
sventhesen@gmail.com
314 Stanford Ave Palo Alto, CA 94306

Estimate No: 1100
Date: 1/31/2018

Ship To: Multiple Sites, See Attachment

Tracking No
Ship Via
FOB

Code	Description	Quantity	Rate	Amount
Chargepoint	Chargepoint Dual Head 30A L2 EV Network Chargers on Pedestal			
EV-Labor	Installation by SoLED electrician. CA Licence #993228 Site Walk Notes: Feeder lines and interconnection hosting capacities are sufficient; Existing main switching gear has sufficient capacity to host 10 L2 EV Ports given potential placement location + PV as detailed below Scope: Install 10, L2 charging ports of type noted above; Prepare, submit and obtain all necessary permits; Ensure site compliance with CA and Federal rules for locating EV chargers, including Americans with Disabilities Act requirements; Install all associated signage and parking lot striping.			
EV-Labor	Engineering- Stamp plans ready for submittal			
Sunpower	PV Roof flush mount or Canopy Sunpower 450w solar panels system with Fronius Inverters with engineering, materials, permits and labor			

1 / 3

Code	Description	Quantity	Rate	Amount
	EV Estimated Timeline: Sign contracts 1 week Engineering & design 1 months Apply for permits 2 months Initiate construction & staging 1 week Install chargers, striping & signage 1 month Close out permits 1 month Go live 1 week PV Estimated Timeline : Sign contracts 1 week Engineering & design 2 months Apply for permits 4 months Initiate construction 2 months Install 4 months Close out permits 1 months Utilty PTO 3 months Go live 1 week			

See following spreadsheet for individual site details.

Comments

Estimate Accepted and Signed

____

Date___________________________

_ Print Name

____

Client's signature

Title (if applicable)

____

SoLED Energy, Inc.

EVCI / PV Host	L2-Port Count	EVCI Cost, $k	PV Potential, kW-DC	PV Cost, $k
Hoover School, RWC*	10	$199	864	$3,024
Boys & Girls Club, RWC*	10	$189	100	$350
RWC Yard*	10	$209	329	$1,152
Sobrato, RWC, Required	127	$1,090	1,036	$3,626
Sobrato, RWC PAEC Proposal	613	$3,916		
Stanford, RWC, Required	52	$594	1,167	$4,084
Casa Redwood Apartments, RWC, MUD	10	$144	9	$41
Kaiser Permante, RWC	21	n/a	n/a	n/a
Avenue Two Apartments, RWC, MUD	126	$835	750	$2,500
EPA City Hall/ Library*	10	$194	Completed	n/a
Boys and Girls Club, EPA*	10	$199	107	$428
Ravenswood Shopping Plaza*	60	$1,020	1,000	$3,800
Ravenswood Shopping Plaza (Electrify America)	6 DCFC	$360		
Cummings Park HOA, MUD	46	$455	100	$400
Family YMCA, EPA*	10	$186	300	$1,140
Ravenswood Family Health Center*	10	$226	500	$1,900

HelioScope photovoltaic analysis were completed for each potential site with the exception of the EPA City Hall/ Library since this site already has a large PV array. Given the page length of each HelioScope analysis, only the EPA Boys and Girls Club analysis was provided as an example. The remainder are available on request.

HelioScope — Annual Production Report produced by Dean Trinh

Rooftop EPA Boys & Girls, 2031 plugas ave, east palo alto, CA 94303

Report

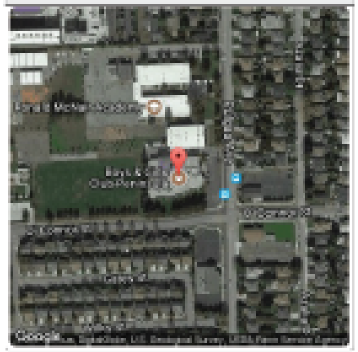
Project Name	EPA Boys & Girls
Project Address	2031 plugas ave, east palo alto, CA 94303
Prepared By	Dean Trinh deant@soledenergy.com

SoLED SOLUTIONS

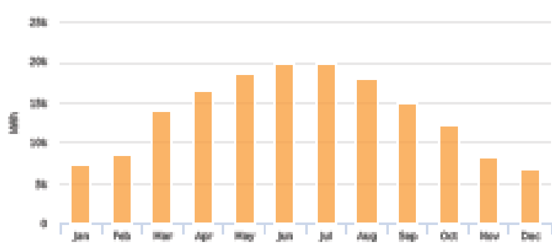
System Metrics

Design	Rooftop
Module DC Nameplate	107.2 kW
Inverter AC Nameplate	96.0 kW Load Ratio: 1.12
Annual Production	165.3 MWh
Performance Ratio	77.3%
kWh/kWp	1,542.6
Weather Dataset	TMY, 10km grid (37.45,-122.15), NREL (prospector)
Simulator Version	ca608dc177-3213c058a0-cb0ff9cef-a730d74b96

Project Location



Monthly Production



Sources of System Loss

Annual Production

	Description	Output	% Delta
Irradiance (kWh/m²)	Annual Global Horizontal Irradiance	1,851.8	
	POA Irradiance	1,990.2	7.5%
	Shaded Irradiance	1,990.2	0.0%
	Irradiance after Reflection	1,926.1	-3.2%
	Irradiance after Soiling	1,887.6	-2.0%
	Total Collector Irradiance	1,887.6	0.0%
Energy (kWh)	Nameplate	202,168.5	
	Output at Irradiance Levels	199,253.6	-1.4%
	Output at Cell Temperature Derate	181,481.9	-8.9%
	Output After Mismatch	178,250.5	-1.8%
	Optimal DC Output	178,012.7	-0.1%
	Constrained DC Output	178,012.4	0.0%
	Inverter Output	166,133.9	-6.7%
	Energy to Grid	165,303.2	-0.5%
Temperature Metrics			
	Avg. Operating Ambient Temp		15.7 °C
	Avg. Operating Cell Temp		36.5 °C
Simulation Metrics			
	Operating Hours		4657
	Solved Hours		4657

Condition Set

Description	Condition Set 1
Weather Dataset	TMY, 10km grid (37.45,-122.15), NREL (prospector)
Solar Angle Location	Meteo Lat/Lng
Transposition Model	Perez Model
Temperature Model	Sandia Model
Irradiation Variance	5%
Cell Temperature Spread	4° C
Module Binning Range	-2.5% to 2.5%
AC System Derate	0.50%

Temperature Model Parameters

Rack Type	a	b	Temperature Delta
Fixed Tilt	-3.56	-0.075	3°C
Flush Mount	-2.81	-0.0455	0°C

Soiling (%)

J	F	M	A	M	J	J	A	S	O	N	D
2	2	2	2	2	2	2	2	2	2	2	2

Module Characterizations

Module	Characterization
SPR-X22-470_COM (SunPower)	Sunpower_SPR_X22_470_COM.pan, PAN

Component Characterizations

Device	Characterization
Fronius IG 300 (Fronius)	Default Characterization

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HelioScope

Annual Production Report produced by Dean Trinh

Components

Component	Name	Count
Inverters	Fronius IG 300 (Fronius)	4 (96.0 kW)
Home Runs	500 MCM (Copper)	8 (151.7 ft)
Home Runs	1/0 AWG (Aluminum)	8 (178.3 ft)
Combiners	1 input Combiner	8
Combiners	5 input Combiner	4
Combiners	8 input Combiner	4
Strings	10 AWG (Copper)	52 (2,927.1 ft)
Module	SunPower, SPR-X22-470_COM (470W)	228 (107.2 kW)

Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	12	3-5	Along Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
Field Segment 1	Flush Mount	Portrait (Vertical)	10°	180°	2.0 ft	1x1	228	228	107.2 kW

Detailed Layout

 2/2 December 11, 2017