Plug-In Electric Vehicle

READINESS ASSESSMENT AND PLAN

January 2014

SOUTH BAY CITIES
COUNCIL OF GOVERNMENTS

SOUTHERN CALIFORNIA
ASSOCIATION of GOVERNMENTS

Plug-In Electric Vehicle Readiness

Assessment and Plan for South Bay Cities

Prepared for the South Bay Cities Council of Governments

By

Walter Siembab

Aaron Baum

Mohja Rhoads

Dan Sturges

Jeff Weckstein

Jacki Bacharach
Executive Director
South Bay Cities Council of Governments

Contributions By

J.R. DeShazo
Director
Luskin Center for Innovation, UCLA

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Introduction

In 2012-13, the California Energy Commission (CEC) funded the Southern California Association of Governments (SCAG) to commission the first ever *sub-regional plans for PEV Readiness*. PEV deployment is an important component of the State's ZEV initiative, AB 32 and also SB 375 in mature suburbs like the South Bay.

The sub-regional Readiness Plans complement the Southern California PEV Readiness Plan and Atlas produced by SCAG and UCLA's Luskin Center for Innovation. The regional plan was funded by a U.S Department of Energy grant that was jointly acquired by SCAG and the South Coast Air Quality Management District (SCAQMD).

SCAG selected two sub-regions as the locations for the efforts to develop a prototype sub-regional readiness plan – Western Riverside County and South Bay Cities in Los Angeles County. These sub-regions were selected in part because of their past involvement in some form of electric drive initiative, their current interest in participating and the fact that they represented two dramatically different development patterns with associated transportation patterns and distances. The Luskin Center was retained to assist the subregional councils of government (COGs) assess the readiness of their respective territories and develop a plan for improving readiness. The assistance consisted of tools developed for the regional effort (such as the Atlas of maps for each sub-region that presented the spatial distribution of day and night time demand for electric fueling) plus specific resources such as ranked lists of employers and multi-unit dwellings (MUDs) that would be the place for the COGs to begin a more detailed assessment.

The term *PEV readiness* has yet to be clearly defined. For the purposes of this report, PEV readiness means that the ecology of electric vehicles is prepared to absorb an influx of vehicles over the next few years without inhibiting the marketplace and perhaps to even encourage a rapid absorption of PEVs that would exceed projections. This project focused on the electric fueling system. While there are many players in that system, the Luskin Center advised focusing on multiple unit dwellings (MUDs), employers, and local governments. Others such as retail malls, new and used auto dealers, Southern California Edison (SCE), the Auto Club, and more were not explicitly included.

Potential customers were perhaps the most important group not studied for their readiness. Yet customer readiness may prove to be the biggest challenge because entirely new fueling practices and home-based infrastructure will be required. As SCE points out, "Customers will have to make several informed decisions with significant cost implications, including metering arrangements, rates, charging equipment and installation" (SCE, 2013, p. 3).

The objective of this study - with its focus on MUDs, employers and cities - is to identify the state of "readiness;" and, where possible, to develop a plan that will help the system become more ready.

MUDs: Home is the dominant location for electric fueling. Single family houses are not without problems when adding electric fueling capacity to the garage or driveway, but the challenges encountered are relatively easy to address. Apartment buildings and condos generally have more complex parking arrangements and widely varying electrical infrastructure in the parking areas. The questions include how many MUDs are currently or nearly equipped to support electric fueling; whether those that are have a pattern in terms of age or size; how willing are the owners of those not currently equipped to make the investment to become capable; and what plans, policies or procedures would they use to manage the multi-user fueling environment?

Employers: The workplace is the next most likely place for PEVs to re-fuel. Dwell times of 6 to 10 hours are typical, providing ample opportunity to re-fuel even at 110 voltage. The questions are which employers currently provide electric fueling options for their employees and by what arrangements; how willing are the bulk of the employers to consider offering electric fueling; and what plans, policies or procedures would they use to manage the multi-user fueling environment?

Cities: The front line issues are the cost and ease of applying for electrical permits and the timeliness of inspections to certify the changes. Policy issues like zoning amendments and elective initiatives like public education are less immediately important but will require attention within a short time frame

One aspect of this attempt to determine the extent to which MUD owners, employers, and cities are capable and inclined to install EV charging stations is how not being ready -- of being unprepared -- plays out. Do MUD owners and employers reject the idea of electric fueling infrastructure on their property? Do they respond but not in a timely fashion moving too slow to avoid damaging the market? Do they adopt solutions that prove unsatisfactory to the vehicle owners or to themselves with the result that the investment is lost through lack of use or because it is withdrawn?

South Bay Context and the SSBS

The South Bay is a relatively dense, transit poor sub-region with about 1 million residents and 500,000 jobs. In 2010, the South Bay Cities Council of Governments adopted a strategy for coordinating changes to the development pattern with innovations in mobility systems in order to reduce GHG emissions, criteria pollutants, and household mobility costs. This is the Sustainable South Bay Strategy (SSBS), also known as the South Bay Neighborhood Strategy.

The SSBS has two major components, each with multiple initiatives:

- Fostering a multi-modal zero emission transportation culture (this includes advancing PEV readiness)
- Developing new neighborhood spatial patterns

Fostering a multi-modal zero emission transportation culture is the first implementation priority because it can proceed more quickly and affordably than changes to the development pattern. In addition, the existing development pattern is that of a mature suburban subregion so that most trips are less than three miles in length. This relative compactness of origins and destinations is compatible with bicycles and range limited battery electric vehicles, including slow speed zero emission vehicles -- all currently available in varying degrees through the marketplace. Gradual changes to the development pattern in the long run will lead to more walking and circulator transit trips.

Converting the 600,000 fossil-fueled vehicle passenger fleet in the South Bay to some form of electric vehicle is the core of the mobility innovations. Today this electric drive market consists of plug-in hybrids (PHEV) such as the Chevrolet Volt, pure battery electrics (BEV) such as the Nissan Leaf and specialty BEVs like the GEM, Segway and electric bike designed for the short trips that are common to compact subregions. Fuel cell electrics may become a viable option sometime in the future.

The vision of future mobility consists of driving some form of BEV for the many short distance trips and PHEVs for the less frequent long distance trips. To succeed, this vision will need to be supported by a robust set of mutli-modal options such as car sharing, ride sharing, bike sharing, van pools, demand responsive public transit, and a high speed regional transit backbone.

Electric fueling at home will need to accommodate more than one vehicle at a time in those households with two or more vehicles, unless the multi-modal options are successful in reducing the need for so many private vehicles.

With the vision of transitioning 600,000 fossil fueled vehicles to some form of electric drive in as short a time frame as possible, the “readiness” of the South Bay to support “electric fueling” on a large scale is crucial. Any sub-region not PEV ready as this market develops will inhibit sales and incur the economic and environmental consequences.

Findings Summary

The SBCCOG has taken the first step in what will be a long journey toward being able to assess and advance PEV readiness in the South Bay. This initial sub-regional

planning effort, supported by significant contributions from the Luskin Center, was still modest in relation to the scope and complexity of the challenge.

For the most part, rudimentary data were collected and used to describe some aspects of the current situation. No useful patterns were identified – such as MUDs built during the 1950s that have similar infrastructure; or a type of employer with a propensity to install Electric Vehicle Supply Equipment (EVSE). We are a long way from having a handle on how to assess or improve readiness, and a very long way from actually doing anything about it.

The initial picture, in general, is that employers, municipal governments, and MUD owners and managers are neither ready nor preparing to get ready to accommodate a rapid influx of plug-in electric vehicles. Their interest in getting ready is waiting for demand to increase.

As in the SBCCOG's NEV Demonstration, there is a chicken-egg relationship between PEV sales and PEV readiness.

According to the Luskin Center, there were about 1,000 PEVs in the South Bay in 2012, among a total fleet of over 600,000 vehicles. This is just above .1% of the sub-region's passenger vehicles, and they are concentrated in just 4 cities. That the interest in becoming PEV ready is so low should be no surprise.

The challenge is that Luskin Center forecasts a minimum of 88,000 PEVs in the South Bay by 2022. The high estimate is 155,000 PEVs. That means at least 8,700 and perhaps as many as 14,400 additional PEVs per year for the next decade will need to be fueled at home, work or someplace else. We hope that through various market stimulation initiatives that the high end of the range can be achieved. At the same time, the SBCCOG is attempting to acquire vehicle registration data specific to the South Bay that will allow us to recalculate the initial forecast and then make corrections based on market performance going forward.

While the 87,000 to 155,000 PEV forecast does not quite constitute a tsunami of change, it is substantial and readiness will need to improve quickly so that the first wave of mid-market adopters do not have experiences that will discourage the market from developing.

The following sections summarize the findings from the various research activities. Additional detail is included in the Appendix.

MUD Readiness

About half of the housing units in the South Bay are in some form of MUD – either rental apartments or condominium units – making their ability to host electric fueling important to a developing PEV marketplace. As the Luskin Report describes the situation, "While most early PEV adopters reside in single-family homes due to the lower physical and institutional barriers associated with single-family charging, MUDs could present substantial middle-market PEV demand." (DeShazo, Ben-Yehuda, Wong, & Turek, 2013, p. 18).

The challenge to this potential is described by SCE:

"Our research also shows that despite high interest among condo/townhome owners and renters in purchasing a PEV within five years, fewer than 5% of building owners or condominium associations are even considering installing the necessary infrastructure. We understand that the main obstacles are related to the complexity and widely varying costs of PEV installations for this segment." (SCE, 2013, p. 5).

The short term challenge should be in the six cities that have some level of multi-family housing and are where the early purchasers of PEVs reside. They have the following multi-family unit totals:

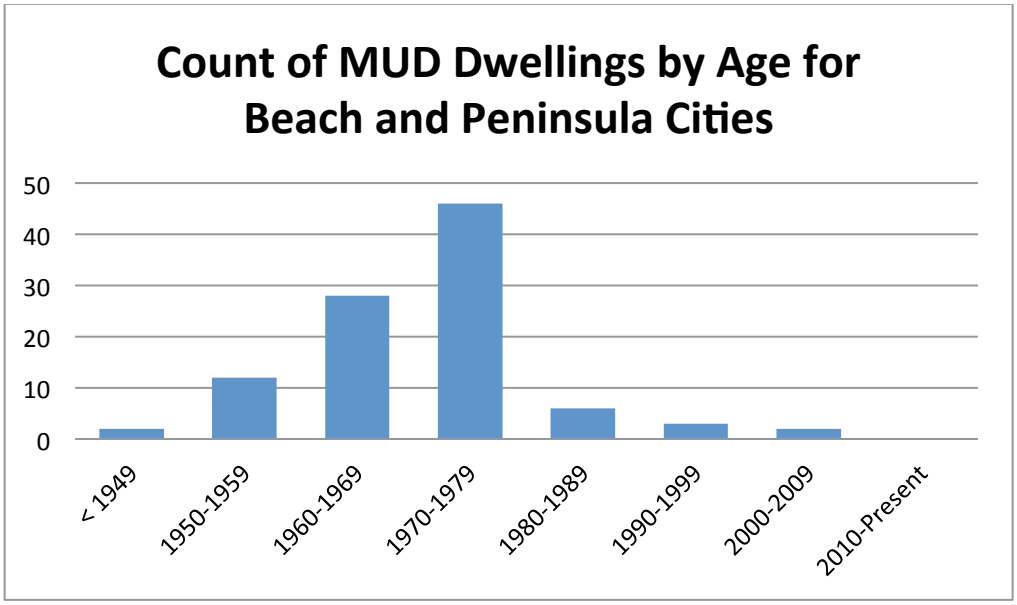
Redondo Beach	19,384 (4,043 in condos)
Hermosa Beach	6,125 (877 in condos)
Manhattan Beach	4,576 (1,346 in condos)
Rancho Palos Verdes	3,511 (1,155 in condos)
Rolling Hills Estates	752 (596 in condos)
Palos Verdes Estates	444 (76 in condos)
Beach cities total	30,085 (6,266 in condos – 20.8%)
Beach cities/PVP total	34,792 (8,093 in condos – 23.3%)

The Luskin Center's perspective is that the HOAs of the many condominiums have the potential to go either way, more or less likely to install electric fueling infrastructure depending on which characteristics dominate. "Whether the MUD is a condominium could indicate Institutional barriers to installing PEV charging due to deeded or assigned parking. However, condos experience less turnover than rental properties and unit owners may be more likely than landlords to install hardware for their long term use.

Higher unit values could also indicate higher demand for PEV charging." (DeShazo, Ben-Yehuda, Wong, & Turek, 2013, p. 18). Anecdotal evidence, discussed briefly below, suggests that institutional barriers may prevail and condos may be more of a challenge than apartment buildings.

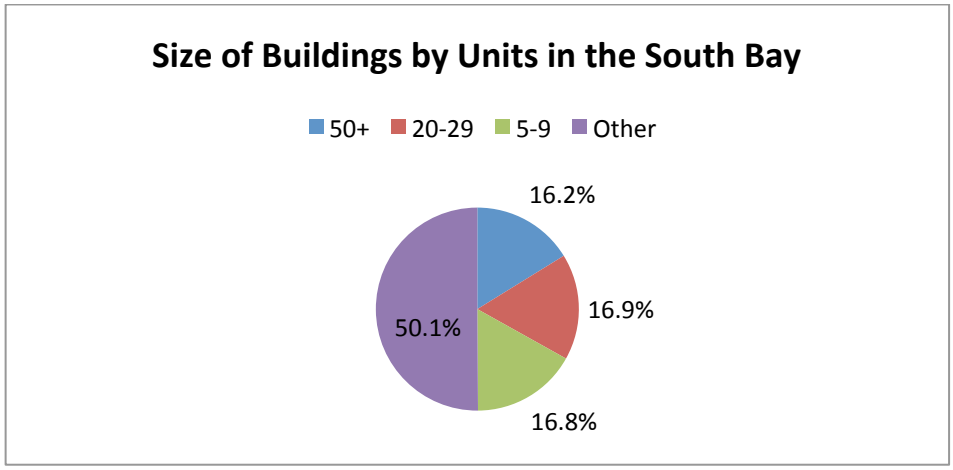
Age may be a factor in readiness, and according to the Luskin Center, it probably is. "Knowing the age of a building, in conjunction with other attributes such as size of the electrical panel and parking configuration, can help planners assess the hard and soft costs involved in providing charging at that MUD. Building age may be correlated with panel size and the distance between the electrical panel and where vehicles are parked. Building age may also indicate the likelihood of a MUD not having any on-site parking as well as other parking, construction or electrical features that may be typical of MUDs built in a city at a certain point in time. An understanding of MUD building vintages may help planners consider potential permitting and installation streamlining measures that may be needed" (DeShazo, Ben-Yehuda, Wong, & Turek, 2013, p. 18).

This graph shows that almost 90% of the MUD buildings in the cities where PEV registrations have been concentrated (Palos Verdes Estates, Rolling Hills Estates, and Rancho Palos Verdes on the Palos Verdes Peninsula and the 3 Beach cities), are over 35 years old. While some of them have probably upgraded some aspect of their electrical infrastructure, the fact remains the bulk of the multi-unit buildings are unlikely to have the characteristics suitable for supporting even a small number of PEVs. Anecdotal evidence suggests that some building owners fear that upgrading the electrical panel may trigger requirements for addition, potentially costly upgrades throughout the property to bring it up to code.



Building size is also a likely factor in PEV readiness. Again, the Luskin Center's perspective was included in the South Bay PEV Deployment Plan: "Larger MUDs are better candidates for hosting more PEV charging, given that they have more parking spaces (including visitor spaces)" (DeShazo, Ben-Yehuda, Wong, & Turek, 2013, p. 18).

Buildings with 50 units or more account for only 16.2% of the MUD units in the South Bay. At 16.9%, the largest percentage of buildings are those with 20-29 units. Closely behind are buildings with 5-9 units at 16.8% of the total. Like age, size may be something that will make PEV readiness more difficult to achieve in the South Bay.



Just looking at secondary data on the MUD housing stock, the picture of PEV readiness in those areas of the South Bay currently leading PEV registrations, does not look especially bright.

- Housing stock is mostly older than 35 years when electrical standards were much lower.
- There are relatively few large buildings, where the potential for cost sharing is greater.
- Units in condominiums make up over 20% of the MUD units, where installing electric infrastructure could be more complicated than in apartment buildings.

MUD Assessment

With these considerations as background, we embarked on the field work intended to determine readiness among MUDs in the South Bay. The Luskin Center provided a spreadsheet listing the 20 largest MUDs in each South Bay city. The bulk of our work

involved adding detail to the MUDs in the beach cities and PVP cities plus El Segundo and Torrance. Onsite observation was the primary method of data collection.

The original data from Luskin Center included the street address and zip code, number of units in the building, condo yes or no, year built and average value per unit (higher values correlate with higher incomes and propensity to purchase new vehicles, especially PEVs).

Our aspirations were ambitious. We wanted to ascertain readiness but also understand the barriers to becoming more ready, especially the costs. The "observational" data we hoped to collect in addition to management's level of interest and their plan, policies and procedures included the following:

- Power available from the pole to the building
- Power available from the electrical panel for distribution to the building (200 amperes of service usually does not require upgrade)
- Metering arrangement – meters for the "house" and/or for individual units
- Distance between electrical panel to parking stalls
- Existing outlets in the parking area – 110v and 220v (and how they are metered)
- Type of parking – none, surface, car port, pedestal, subterranean (gated or not)
- Number of dwelling units and number of parking spaces
- Spaces are deeded, assigned, or common (first come, first served)
- Laundry room in parking area with 220 or 110 outlets or service
- Elevator in parking area (indicating the probability of 220v power availability)

The process evolved through the following steps:

- A door to door survey of on-site managers in the 20 buildings in El Segundo as a test of a field visit approach.

Sixteen of the twenty buildings on the Luskin list were visited with limited success. An on-site manager was available at only 4 buildings; none of them were knowledgeable about electrical services or infrastructure. None had received tenant inquiries about electric fueling and had not contemplated offering it. Condos list only the unit occupants; there were no clues about the HOA. A detailed memo on this experience is included in the Appendix.

- Acquire owner name and address from Assessor records

Because onsite managers were scarce and not especially helpful even when present, the next step was to contact offsite owners directly. Name and address of the building

owners (excluding condos) for each building was acquired by a physical visit to the County Assessor's Office in the LA Civic Center.

- Identify owners of multiple properties for interviews

Contacting individual building owners proved time consuming and unproductive. After a few unresponsive phone calls, the tactic turned to identifying those entities that own multiple properties. The data base was re-sorted to identify those owners and several were contacted about participating in our study. Interviews with two firms resulted. A detailed memo of the interviews is available in the Appendix.

The first firm manages or owns 48 apartments or HOAs in the South Bay, many in El Segundo. Size ranges from duplex to a 97 unit apartment complex for seniors The manager was aware from trade press that electric fueling would become an issue sometime in the future but had not yet come up in his apartment buildings. If approached, the manager "would not make any changes" in response because a response would "present too many issues." One issue mentioned was the potential for building management to be perceived by tenants are giving special treatment to PEV drivers by providing them with expensive electric fueling infrastructure. Manager would not allow a tenant to simply plug into an available 110v outlet because it would be impossible to price by identifying the charges to the "house meter." The issue has come up in some condo HOAs but nothing came of it. According to this manager, HOA's are notorious for being fiscally conservative. He cited an example where his HOAs have consistently opposed proposals to replace inefficient lighting with cost-effective LEDs with a payback period of just a few years. Electric fueling will require a huge leap beyond changing light bulbs.

The second firm owns and manages 100 residential facilities on the west coast, from Seattle to Southern California with one located in the South Bay. Properties have a minimum of 100 units. This firm is known as a leader in the area of sustainability for older apartments and encourages green technology in their buildings and for the lifestyles of their tenants. Although the firm has not yet been approached by a single tenant, they intend to test the idea of providing electric fueling in specific neighborhoods as a building amenity in order to attract professional middle to upper middle class tenants. The firm has identified a building in Seattle as a pilot test for a Level 2 charging station in an outdoor parking lot. With an operational target of spring, 2014, policies and procedures had not yet been established at the time of the interview. A pilot of the same idea may be tested in Southern California by the end of 2014.

- Inquired into Apartment Association of Greater Los Angele (AAGLA) for possible joint outreach.

Another alternative to proceeding building owner by owner was to try to reach them as a group through AAGLA. It turned out that the organization had little interest in pursuing a joint educational initiative but proposed a mailing to membership at a fixed cost per address. This option was premature as it would best fit into some subsequent broad educational effort.

- Recruited electrical help for cost estimates.

The obvious need for technical assistance for assessing the cost and complexity of adding electric fueling to a MUD led to a recruitment of city electrical inspectors and contractors. Several provided valuable insights but it was a participant in the South Bay Drive the Future (BEV demonstration) Project who worked most closely with us.

- Conducted building by building field surveys in six cities.

With little input from owners and managers (other than the two large firms described above) we simply visited each building on the Luskin Center list in order to record whatever characteristics that could be observed from the exterior of the building or from inside the parking lot when it was not gated. The buildings, parking area, electrical outlets, electrical panels and whatever else was available were photographed and used to create a visual data base. In the latter stages of field work, we took to posing as a prospective tenant inquiring about the prospect for electric fueling since onsite management, when present, was not comfortable answering questions of a researcher.

This experience resulted in the conclusion that there may not be useful patterns by age or size among MUDs. There is considerable variety in where the panel is located in a building – near the laundry room, at the far end of the parking area, even on an outside wall. Construction costs grow as distances from the panel increase because bigger wires and conduit are needed to compensate for the voltage drop issues. The threshold beyond which costs increase is about 100 feet. Complexity increases with the number of spaces to be equipped in relation to their distance from the panel. Panel capacity also varies although a pattern may exist. An electrician or a better trained field person would be needed to inspect a number of panels in order to draw a conclusion – and inspecting panels would require permission from building owners as onsite managers were reluctant to share much information. Even if 110v outlets were available at every parking spot, there is some threshold number of vehicles beyond which charging will exceed the panel capacity. Of course, accessing SCE's special rates for PEV charging would require a new meter.

- Data and anecdotes from the NEV/BEV demonstrations

Several discreet data bases have been developed out of the SBCCOG's previous PEV initiatives and transportation/land use research. Some of them provide useful insights

into the prospect for electric fueling in MUDs. Our *Drive the Future* demonstration of BEVs, which is almost at its mid-point, is one of them.

Case study of a BEV participant living in a MUD

One of our participants is a tenant in a Redondo Beach apartment building. Participation means that she will drive our BEV for 2 months. Her building has more than 20 townhome rental units and dates from the 1960s or 70s (it was not on the Luskin Center list of 20 largest MUDs in Redondo Beach). Subterranean garage has 37 spaces, 1 spot per unit and an option to rent an additional space at $50 per month.

Surprisingly, two other tenants in the building drive their own PHEVs and had arranged to share a 110v outlet near the panel and connected to the house meter, meaning the landlord pays for the electricity drawn from that outlet. The landlord was charging each tenant an arbitrary amount of $20 to use that 110v outlet and so offered the same rate to our BEV driver. However, our BEV needed to be parked within 18 feet of the outlet and an extension cord could not be used. The three tenants worked out access and charging hours among themselves. The final observation is that a laundry room with 220v outlets is near the same area such that 220v service could have been made available to the PEVs cost-effectively. None of the tenants made that request because the landlord “does not like to spend extra money.”

While not a case study, we recently heard the following anecdote from a planner in one of the South Bay beach cities. An apartment tenant acquired a BEV and threatened to move if the building owner didn't install an outlet for his new electric vehicle. It was going to be about $1,500 just to run a 240v circuit with the EVSE cost on top of that. Instead, the ow9ner installed a 120v outlet which satisfied the tenant.

Charging preferences of our participants

Our *Drive the Future* participants are routinely asked about their charging preferences after their two month experience driving a BEV. The following table summarizes the responses of participants to date:

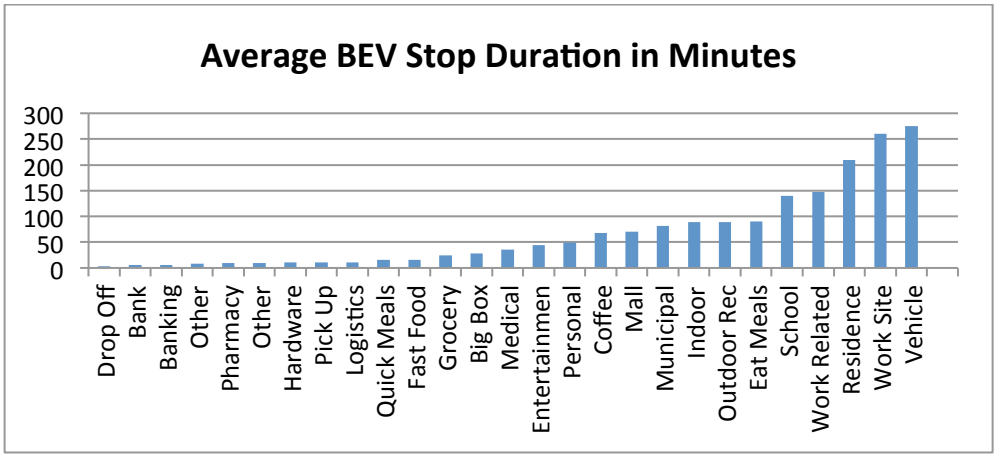
Summary	
Participants who exclusively used L1 when charging at home	21
Participants who had L1 at home but chose to charge primarily using other L2 charging options	2
Participants who choose to install and change from L1 to L2 Home charging	2
Participants who used/tried other charging options outside of the home charging	9
Participants who felt home L1 charging - only at night - was sufficient or met their needs for their EV use (i.e. going/taking the trips they planned)	16
Participants that saw the value of L2 Home Charging - would consider installing L2 if they purchased an EV	8
Total Respondents	23

Essentially, most drivers are happy to rely on 110v charging at home. Some of that is possible because of 220-240v opportunities elsewhere allowing them to opportunity charge during the day. Perhaps one in 3 would consider upgrading to 220-240v at home with cost being the key variable.

Dwell times

Our *Drive the Future* demonstration monitors BEV usage with GPS. Assuming 2 hours is a minimal charge time, there are only 5 destinations outside the home that occupy our drivers long enough to get a minimal charge. Dwell times do not necessarily imply that the vehicles were actually refueling, only that they could refuel based on time the vehicle was at rest.

- Vehicle services – when each vehicle is taken to the dealer for a check-up as part of our lease agreements -- had the longest average time. Most likely the dealer did in fact plug the vehicles in during that period.
- Work site, as expected, was the most frequent regular destination with significant dwell time – about 270 minutes or about 4.5 hours. This suggests that our participants drove the vehicle at lunch which breaks up the 8 hour day.
- Our participants stopped for around 3.5 hours when visiting a friend or family member. This does not provide an actual alternative to residential charging since it is a residence, just someone else's.
- Work related –a category of for-work errands such as a consultation with an accountant or travel agent – was next at a little less than 2 hours per stop. That combined with the 6th longest dwell time destination, eating a meal, suggest that some mixed commercial centers with a variety of destinations, could usefully provide refueling options.
- School destinations averaged a little under 2.5 hours per stay. It will take closer inspection of these data to determine the time of day of the visit. For example, if visits occur during the day, a few charging stations might be justified to serve school employees (eventually once mid-market demand develops) as well as visitors.



In summary, the process developed a detailed data base as a foundation for subsequent work (see Next Steps Section below). The owners name and address was added to buildings in all cities. The following observational data were added to buildings in 6 cities – availability of street parking, street parking restrictions, parking in the building yes or no, type of parking structure, secured parking yes or no, number of spots per unit, 110-120v outlets available, 220-240v outlets available, and other comments. Photos of each building form a visual data base. Following are examples of the type of photos and property information recorded.

1304 Parkview


- Manhattan Village Senior Villas
- Dwelling Units: 100
- Parking: 150 and 200 Aux. Lot
- Type of Parking: Gated surface lot
- Spaces: Common
- EVSE Potential: Newer facility. Laundry / Dryer facilities located near parking lot
- Manager was mainly uninformed. Pauline Madera: 310/546-4062

3400 N. Valley Terrace


- Dwelling Units: 48
- Parking: 48
- Type of Parking: Gated underground
- Spaces: Assigned
- EVSE Potential: Spoke with Manager Cheryl (310-545-5063).Two locations of electrical panels down near parking. Expected to support EVSE, but panels not seen.

In conclusion, it appears that the SCE observation is correct – very few building owners or managers have thought about the prospect of providing infrastructure for electric fueling. Those that have may be disinclined to respond to a tenant request for electric fueling infrastructure due to the cost and complexity related to the many process unknowns.

The cost of the infrastructure and the complexity of the process may vary extensively between buildings. Determining the range of costs and providing a guide to the complexities of various situations will require an onsite visit to a number of buildings by an electrician who can make a detailed assessment of each situation.

Condos look like a special problem because their HOAs are very difficult to identify, let alone contact. The best approach may be to identify and work with the professional organizations who contract with HOAs to provide building management services.

Ideal readiness in 2014 would mean some percentage of MUDs would have 110v charging access at 5% of the parking spaces, or would at least have a plan to respond once a tenant request is received.

Employer Readiness

"Workplaces present a significant, and largely untapped, opportunity for PEV charging. After residences, they are the single most important environment for electric refueling. " (South Bay Cities Plug-in Electric Vehicle Deployment Plan, Luskin Center for Innovation, June, 2013, page 14) The reason is the dwell times at the workplace, while not as long as the residence, are often long enough to completely recharge batteries. Extensive workplace charging will have the effect of doubling commute distances for BEVs and potentially ensure that PHEVs travel on electric rather than gasoline power.

The South Bay contains several large concentrations of employers, many in technology, aerospace, or logistics. Employees of high tech companies as well as those with higher incomes and more education tend to be early adopters of PEVs. Some employers located in the South Bay are certainly good candidates for early investment in electric fueling infrastructure. The first challenge is finding them.

The Luskin Center provided tables of the top 40 workplaces in the commercial neighborhoods estimated to have a high and medium density of PEVs parked during workdays between 6AM and 9AM (suggesting they might be parked there during the entire workday).

This was in addition to lists of the 30 or so largest employers in each South Bay city, rated according to their likelihood of employing early PEV adopters (e.g., a high tech industry with predominantly white collar employees). Number of employees was an

important criterion because a large number suggests the employer may have an easier time recovering costs from the investment in electric fueling infrastructure due to the potential for more users.

While this information provides a good start in theory, practice proved more difficult. Many firms on the list were not accurately characterized, a warehouse rather than a technology firm for example. While large firms are best positioned for cost-recovery, they also are organized in specialized departments making the "right" person to discuss parking and electric fueling issues very difficult to identify. And most large businesses also deploy interactive voice response systems as the front line for public telephonic inquiry with the result that leaving voice mail for an unconfirmed target was the closest we could come to actually talking to someone.

Given the lack of success with the initial Luskin Center list, we began identifying additional companies to contact through the SBCCOG's Vanpool Commuter Program List. The vanpool list provided contact information for staff in many of the larger South Bay companies. While company staff working on commuter issues were not necessarily the right person to talk with regarding EVSE issues, those that responded to our inquiries were often helpful in finding the right person in their company.

We also reached-out to one Chamber of Commerce in the sub-region. After initial indication the chamber would assist in contacting a few leaders of area companies (hospitals), unfortunately nothing much materialized in the end.

All of this was supplemented by a windshield survey of industrial parks and other employment centers in El Segundo, Torrance and Carson. Promising sites were approached through the lobby.

The results from these activities resulted in a contact list of 122 firms. Of those 122, the responses were as follows:

- Not a target: 48 (39%)
- Unresponsive: 45 (37%)
- May be interested in the future: 11 (9%)
- Responded but not Interested**:** 8 (7%)
- Installed EVSE already: 10 (8%)

Those that may be interested in the future all had essentially the same response. The company is open to installing EVSE but only when the employees ask them for it.

Those not interested were typically smaller firms, and they confirmed a clear finding from the CALSTART research into workplace charging -- the cost to the employer for installing EVSE is by far the number one concern for these companies,

Those with installed EVSE were located in 3 cities:

El Segundo – DirecTV, Raytheon, Aerospace; British Telecom, Northrup and Mattel

Torrance – Herbalife, Honda, and Lisi Aerospace

Carson – British Petroleum

(After the formal survey of employers was complete, we subsequently learned of two more EVSE sites - Toyota in Torrance and Boeing in El Segundo.)

Attempts to identify the employer's motivations and policies among those companies that had installed electric fueling infrastructure followed the same pattern as the initial inquiries into readiness. Employers don't like to disclose information about their employee policies and practices. Defense contractors are impenetrable.

Additionally, a few companies indicated they did not own the property where they were located and the matter was up to the actual owner.

The South Bay Cities sub-region is also home to large oil / energy companies, such as British Petroleum (6,000 employees) and Chevron. Only one oil company returned our call, BP, and they have already installed EVSE at one of their locations (2 car pedestals).

The following are two employers with EVSE that divulged some of the details:

Herbalife - Herbalife has 2 EVSE pedestal L2 chargers with 4 ports (able to charge 4 cars at once). The charging is complimentary for employees and there has developed a good etiquette - where employees move their cars so others can charge. The plug sharing takes place on an electronic calendar the employees share. Employees have requested that more charging be installed, but the company is not planning to add more for the next year. No indication of the strength of the demand for expansion was given.

Aerospace - The lead facilities manager said the company was not interested in providing EVSE, even though he had a Volt as a loaner car for sometime the year before and was well aware of the issues around PEV charging. Now, Aerospace is close to signing a deal with eVgo. They like the fact eVgo will install the infrastructure and charge the employees and not the employer. A company-wide survey about PEV charging was recently sent to 3,000 employees. The response was said to be very strong, in that 459 employees returned the completed survey. A main question is would the employee be willing to pay the eVgo service plan prices, roughly $40/month. Nearly every responding-employee felt the eVgo pricing was OK, and not an issue. According to the company, only a few were not interested in the eVgo plan. Aerospace would not

share all of the aspects of the survey, but internally, they felt it showed strong support for PEVs and EVSE at the company.

As with MUDs, a SBCCOG data base produced through a previous study can provide some additional insights about PEV readiness. In 2009, the SBCCOG studied user-perceived changes that would improve Pacific Coast Highway (PCH) as a commute corridor for employees of the El Segundo employment center.

The consultant worked with the now defunct El Segundo Employers Association to conduct an online survey of employees working somewhere in the office cluster east of PCH, north of El Segundo Blvd and south of Imperial Highway. Information was collected from 16,878 employees, about 2/3 of all employees of the area at the time. Residential location was one of the date fields collected.

This table shows the number of employee-respondents living within 5 miles of the worksite, in 1 mile increments. Five miles one-way is well within the range of a neighborhood electric vehicle (NEV) and almost 13% of the respondents live that close. NEVs use 110v charging at home and would not need work place charging at all.

Category	Number
All employees living < 1 Mile	490
1-2 Miles	845
2-3 Miles	35
3-4 Miles	656
4-5 Miles	132
Total Within 5 Miles	2158 12.8%
Total Employees	16,878

The next table shows the number of respondents who live somewhere in the South Bay close to the PCH corridor. The furthest distance is 25 miles between Rancho Palos Verdes (RPV) and El Segundo. Assuming a BEV with an 80 mile range and a full charge at home, none of the South Bay residents who use the PCH corridor to drive to an El Segundo worksite would need to refuel at the worksite, even for the 50 mile roundtrip from RPV.

El Segundo employees living in the South Bay that can commute via the PCH				
Zip Code	Zip Code Location	Number of El Segundo Employees	Distance To El Segundo (Miles)	Total VMT per day (Miles)
90245	EL SEGUNDO	490	1	980
90254	HERMOSA BEACH	325	4.8	3,120
90266	MANHATTAN BEACH	380	2.7	2,052
90274	PALOS VERDES PENINSULA	185	13.5	4,995
90275	RANCHO PALOS VERDES	416	25	20,800
90277	REDONDO BEACH	554	6.7	7,424
90278	REDONDO BEACH	753	5.7	8,584
90503	TORRANCE	610	7.6	9,272
90505	TORRANCE	436	10	8,720
90710	HARBOR CITY	89	14.6	2,599
90717	LOMITA	137	12.2	3,343
	Total	**4,375**	**103.8**	**71,888**

4375 out of 16,878 – 25.9%

In conclusion, the South Bay's compact development pattern makes most trips short, even the journey to work. This makes the South Bay an excellent BEV market if consumers choose mobility options consistent with their needs.

Employers in general are not paying attention to the electric fueling needs of their employees, but are still running ahead of MUD owners. Our sample of employers found that 8% had already installed EVSE VS 0% for MUD owners. It makes sense that employees who purchase PEVs will work for employers who are themselves relatively sophisticated and more capable technology decision-makers than MUD owners.

Although it is worth verifying in subsequent research, 110v fueling may provide the most cost-effective option for employers. NEVs, electric bikes, and other slow speed, short range vehicles don't accept 220v and over 12% of El Segundo employees are candidates to drive such vehicles; over 1 in 5 drivers who use just the PCH corridor wouldn't need to refuel at work at all; and 4 to 8 hours of 110v charging will get most drivers home.

Parking Lots

Parking lots are another point of entry into the electric fueling conversation. Many lots are not owned by an employer yet some employees may park there. They are not part of a residence but residents park there as customers. Those lots offer the possibility of providing dual or triple use fueling services. Lots with electric fueling infrastructure that are adjacent to both employers and apartments can accommodate employees during the work day and residents at night. Lots such as the one in the middle of Riviera

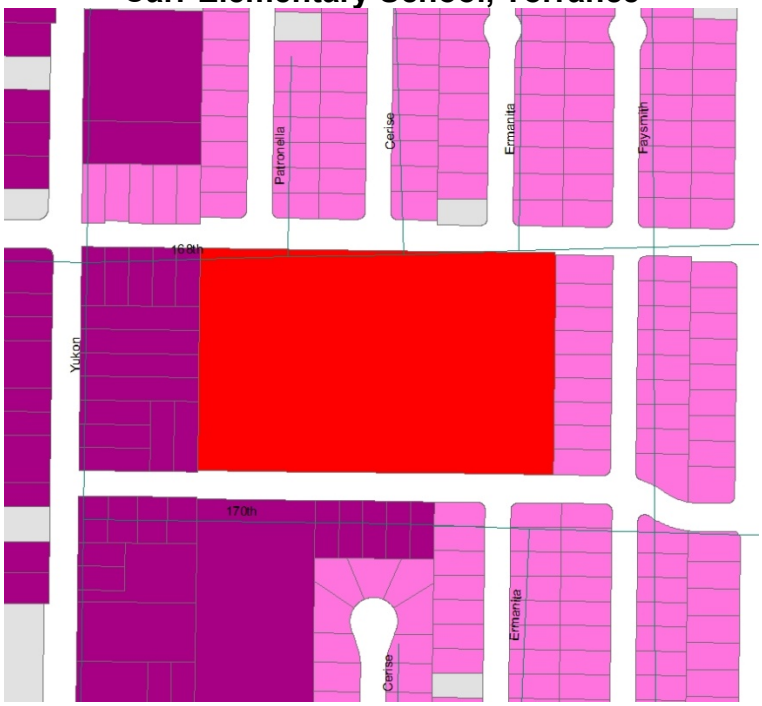
Village in south Redondo Beach can accommodate employees and customers during the day and residents of the nearby apartments at night.

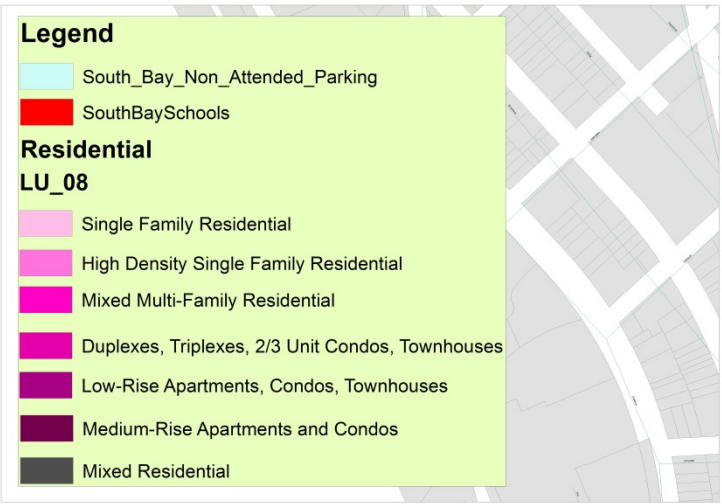
Based on this logic, we began a preliminary investigation of parking lots and their adjacent land uses. The following map and table identifies the parking lots in Hermosa Beach. Similar maps and tables were developed for Manhattan Beach and Redondo Beach as well.

Type	Lot	Address	Notes	Total # of Spaces	Adj. To MUD & Comme-rcial?	Parking Time	Parking Cost	Adjacent Land Uses
Public	1	1101 Hermosa Avenue	Northwest corner of 11th Street	116	N	24hrs daily	$1.25/hr	Hermosa Beach Pier/Restaurants Hermosa Ave Retail, The Strand
Public	2	59 13th Court	West of Hermosa Avenue, behind Bijou Building	35	N	3hr public parking, vehicle must vacate after 3hrs	Meter parking 25 cents/12mins	Hermosa Beach Pier/Restaurants Hermosa Ave Retail, The Strand
Public	3	Municipal Parking Structure	Between Hermosa Avenue and 13th Street	300	N	24hrs daily	$1.25/hr	Hermosa Beach Pier/Restaurants Hermosa Ave Retail, The Strand
Public	4	Hermosa Ave	East/West side	1100	N/A		Meter parking 25cents/12 mins	On-Street parking - adjacent to retail, restaurants, homes, etc.
Public	5	Civic Center Front & Adjacent Lot	Pier Avenue and Valley Dr	68	N	36 spaces- 2hr parking between 7am-6pm, 32 spaces- City Employee parking M-Th 6:30am-6:30pm	Free	City Hall, Public Library, Fire&Police Depts, Pier Ave Shopping/Dining
Public	6	East side of Ardmore Ave/ South of Pier Ave		34	N/A	Unlimited except Wed 10am-2pm	Free	On-Street parking - adjacent to HB Skate Park, near City Hall, etc.
Public	7	Community Center	Pacific Coast Hwy and South of Pier Ave	124	N	2hr parking 7am-7pm along 11th place, long term parking near tennis courts	Free	Skate Park, Tennis Courts, HB Playhouse
Public	8	1035 Valley Dr	South of 11th Street (Clark Stadium)	51	N	12hr public parking, Friday: Farmer's market vendors parking (9am-5pm)	Free	Tennis Courts, Clark Field, Community Services, Housing, Greenbelt
Public	9	Hermosa Greenbelt (East side of Valley Dr)		78	N	12hr public parking	Free	Tennis Courts, Clark Field, Community Services, Housing, Greenbelt
Public	10	City Yard (6th St/West of Valley Dr)		15	N	Long term public parking on weekends, holidays and evenings. City employee parking 6:30am-5pm(M-F)	Free	City Yard, Greenbelt, Housing, Light Industrial
Public	11	South Park	West side of Valley Dr, North of 2nd st	27	N	12hr public parking except 2am-6am daily	Free	South Park, Beach Cities Self Storage, Housing
Public	12	West side of Valley Dr, North of 2nd St		15	N	Unlimited parking except Wed. 8am-12pm	Free	Multi-Family Residential
Public	13	West of Pacific Coast Hwy/North of 2nd St	Behind commercial building	24	Y	2hr parking between 7am-6pm, No parking Wed 9am-11am	Free	Strip Retail/Restaurants on PCH, MF Buildings west of PCH
Public	14	800 Block of 4th St	Between Pacific Coast Hwy and 4th St	10	Y	2hr parking	Meter parking 25 cents/12 mins	On-Street Meters serving strip retail and MF dwellings
Public	15	West of Valley Dr/South of Gould Ave	Kiwanis Club	35	N	6hr public parking	Free	Valley Park, SF and MF dwellings
Public	16	Upper Pier Ave	Between Valley Dr & Hermosa Ave	129	N	101 spaces- 2hr parking, 28 spaces-3hr parking	Meter parking 25 cents/12 mins	On-Street - Pier retail, 2 on-street spaces with EVSE
Public	17	Kiwanis Club		26	N	6hr public parking		Valley Park, SF and MF dwellings, Greenbelt
Public	18	Greenwood Park	Corner of Pacific Coast Hwy and Artesia Blvd	23	N	2hr parking		Can't identify this one on Google Earth - the City map and the address here are different
Public	19	Lot D	Corner of Manhattan Ave and 14th St	19	Y	12hr parking		MF dwellings, street/pier retail
Private	1	Plaza Hermosa	715 Pier Ave	300+	Y	Plaza Hermosa Parking Only	Free	Plaza Hermosa is a shopping center with a Vons, CVS, bank and outparcel restaurants/retail, adjacent to a top 20 MUD (1600 Ardmore)
Private	2	Hope Chapel Center	SE Corner of Artesia/PCH	~200	Y		Free	Shopping center, with a shuttered Albertson's, strip retail and Hope Chapel (adjacent to 2411 Prospect MUD)
Private	3	Big Lots Center	~1193 Aviation	~150	N		Free	Big Lots, Strip Retail, SF/MF Dwellings, Fast Food, Car Wash
Private	4	Park Pacific Shopping Center	NE Corner of Aviation/PCH	~120	N		Free	SC Anchored by Ralphs, nearby Strip Retail
Private	5	Beach Cities Christian Fellowship	W of PCH between 11th Pl and 11th St	50	N	BCCF Only	Free	Arco, McDonald's Park, Street Retail
Private	6	Our Lady of Guadalupe Church	320 Massey St	~120	N	Church Parking	Free	SF & MF Dwellings
Private	7	CVS	SW Corner of 2nd & PCH	~60	N		Free	Street Retail, MF Dwellings

Public schools adjacent to MUDs are a special case of the dual-use arrangement. The following is one of 23 schools with adjacent land use images.

Carr Elementary School, Torrance





Municipal Readiness

A local government ready for and actively encouraging PEV adoption would have the following characteristics:

- Online guidance and hard copy pamphlet at the counter and at auto dealerships
- PEV savvy front counter personnel that can efficiently guide PEV adopters through the permit and inspection process
- Online permit applications that are straightforward, clear and easy to get 'right' the first time
- Same day approval of permit applications
- Online inspection scheduling
- An inspection checklist available to applicants/contractors prior to installation that will lead to more first inspection 'successes'
- Next day inspection guarantee
- No requirement that the contractor be present at inspections (for simple installations)
- Low/no permit fees
- Updated zoning codes that permit PEV charging as an accessory use
- Building codes that require installation of PEV infrastructure in new construction and extensive remodels for all building types (single-family, multi-family and commercial/industrial), and that clearly outline the requirements
- Flexible installation guidelines for retrofits in existing developments

Municipal policies and practices intersect with PEV adoption in seven areas which we grouped into three general categories:

Front Line Services

- Permitting:

Many PEV purchasers must make small to sometimes major changes to the home's electrical infrastructure. Installing a 220v outlet in the garage or even simply moving a 110v outlet to a more convenient location requires an electrical permit from the city. One dimension of municipal readiness is the degree to which the city assists the new PEV owner to make the necessary changes and to make the process simple and easy.

- Inspection:

The installation of electrical infrastructure requires one to two inspections by the city inspector to make sure the work was performed correctly and to city standards depending on the complexity of the work performed. One dimension of municipal readiness is the degree to which the city has a clear and efficient inspection process to minimize the time and cost of inspections.

Policy Issues

- Zoning & Parking Requirements:

Deployment of electric vehicles introduces a radical change to the conventional fueling model. Instead of doing their fueling at a service station, electric vehicle owners will be 'refueling' by charging their vehicles at home. However, under the traditional model, 'fueling' is not a permitted use in residential zones. One dimension of municipal readiness is the degree to which the city has updated its zoning and parking requirements to reflect this new reality.

- Building Codes:

Building codes provide minimum standards regulating and controlling the design and construction of buildings and structures. One dimension of municipal readiness is the degree to which the city has mandated PEV readiness by including provisions in the building code requiring the installation of wiring for PEV infrastructure or requiring the installation of charging stations in new construction.

Elective Initiatives

- Local Outreach:

Early adopters of PEVs have been the most motivated to seek out information on PEVs and the special considerations related to charging required when deciding whether to purchase a PEV or not. One dimension of municipal readiness is the degree to which the City is prepared to help educate the next wave of potential PEV adopters who may be looking for more information on PEVs but do not know where to start looking for it.

- Local Incentives:

The soft costs of purchasing a PEV (electrical upgrades, charging equipment and permit and inspection costs) are a disincentive to purchasing a PEV as these costs must be paid upfront in a lump sum as opposed to the vehicle itself which is often financed with monthly payments. One dimension of municipal readiness is the degree to which the city helps reduce these soft costs either through subsidy or waiving of fees & requirements.

- Fleet Composition

In addition to looking to the city for a greater degree of support, second and third wave adopters will also be looking to the city for leadership. A great way to signal support for the continued growth and emergence of the PEV segment is a city's willingness to invest in the technology itself. One dimension of municipal readiness is the degree to

which the city has converted, or plans to convert, its fleet to electric vehicles where appropriate.

A survey of cities as to their current position on these 7 dimensions of readiness was distributed in the summer of 2013. Fourteen of the 15 south Bay cities responded. The following table ranks our interpretation of their responses

SBCCOG Ladder of Readiness Based on PEV Readiness Survey Responses

Readiness Level:	**# Cities**
1: Not yet interested in planning for PEV Readiness	7
2: Embracing the idea of Municipal PEV Readiness and PEV Planning	3
3: Utilizing COG and/or other City Resources to draft policies/procedures addressing the Municipal Readiness cornerstones	3
4: Adopting PEV/EVSE specific policies/procedures	1
5: Implementing policies/procedures	0

While none of the South Bay cities are high on the ladder of readiness, neither are the ways in which they are not high on the ladder likely to inhibit PEV adoption. In general, municipal readiness can be improved more easily than with employers or MUDs. Increasing demand can be expected to result in reasonably swift responses to the front line services of permits and inspections. We were not aware of cities receiving complaints, probably consistent with the PEV adoption at about .1% of total vehicles. Priorities of political leaders in the cities vary with the result that elective activities such as local outreach and incentives will vary significantly. The more environmentally conscious will be more aggressive providing public education and incentives. Hermosa Beach for example, offers a full rebate once work completion can be verified.

We did not look at policies regarding municipal parking lots. Anecdotally, Hermosa Beach offers curbside electric fueling in 2 locations and Manhattan Beach has considered offering electric fueling options in a municipal parking lot.

In conclusion, there are two relatively significant problems:

- Five cities contract with the County of Los Angeles for permit management, requiring residents to travel to County offices in Alhambra to file permits. This will be hard to change.
- One city charges a fee for an electrical permit that could be considered a barrier to purchase. This is an inland city where sales are not expected to increase immediately for other reasons and the situation will be easy to correct when the time comes.

One significant contribution to PEV readiness would be a standard permit form. However, as mentioned, 5 cities contract with County Building and Safety and do not have control over permitting and inspection of electric fueling infrastructure. On the positive side, the County is positioned to lead a standardization initiative.

Moving toward online permit applications would also improve friendliness. Realistically, it seems that creating the capacity for online permitting would be most cost-effective if all city permits were included, not just those for EVSE.

Role of SBCCOG and Cities in PEV Planning

The resources provided by the Luskin Center regarding COG and municipal readiness were in the form of a model for how to pursue PEV Planning. Sub-regional COGs "have an important role to play in PEV Planning." "[COGs] can provide technical assistance to local governments and even implement PEV plans in the absence of dedicated staff at the local level. They can maximize the benefits of PEV planning to local drivers by leading efforts to standardize, share knowledge, and extend PEV planning to groups of neighboring cities." (South Bay Cities Plug-In Electric Vehicle Deployment Plan, pages 2-3)

The Luskin Center recommended the following "Ladder of PEV Planning activities:"

- Information Support
- Prioritize zoning, building, permitting parking reforms according to dominant land uses
- Target technical assistance, workshops and outreach for workplaces, MUDs single-family
- Demonstration Projects

This in general is a valuable template for cities and COGs. However, the biggest challenge in climbing the ladder is availability of resources/budget. Developing an EVSE deployment plan in preparation for a growing fleet of PEVs is not in any COGs or city's annual work plan. Even in the South Bay Cities COG, which has a formally adopted mobility strategy based on fleet electrification, attention to the issue has been bootstrapped or externally supported. Significant advancements on fleet electrification have been supported by grants – NEV Demonstration by the AQMD, BEV Demonstration by the AQMD and this initial PEV Readiness Plan by SCAG/CEC.

A related problem is that COG Boards of Directors consist of mayors and councilmembers from the cities that, according to our survey, are essentially waiting for

the market to drive their readiness reforms. They are unlikely to assign a high priority to PEV readiness for their COG.

The following activities might be within the current capabilities of the SBCCOG and South Bay cities without additional funding:

- Tracking and monitoring vehicle registrations and some level of EVSE deployment
- Responding to questions from interested municipalities
- Informing the public

Cities

- Providing publicly available charging infrastructure
- Investing in PEV municipal fleets
- Improving some frontline services
- Making plans and programs transparent thereby contributing to better public understanding

In conclusion, municipal readiness is adequate to meet the current challenge and can improve incrementally over time. The SBCCOG or the individual South Bay cities will require external funding in order to adopt more substantial readiness initiatives than those listed above.

Next Steps

This first attempt at assessing PEV readiness at the sub-regional scale fell considerably short of developing a plan for improving readiness. Perhaps the most significant contribution of this project is illuminating the magnitude of the challenges and the array of possible responses.

The initiatives described below are driven by the challenges. Realistically, these are recommended next steps that are contingent on finding an external source of funds to pursue them. Over 90% of the SBCCOG's budget comes from grants which support specific programs. The core funding supports very few special programs on its own.

Many useful initiatives can be defined. This list reflects the highest priorities as of January, 2014.

- Monitoring

The single most cost-effective activity going forward is to acquire archived "Polk data" in order to revise the adoption curve and PEV registration forecast specifically for the South Bay cities; and current "Polk data" in order to monitor the registrations in the South Bay from 2014 to 2016 and beyond. Assessing progress toward reaching the

goal is fundamental to evaluating the various programs that will be developed in support of electric fueling deployment in the coming years. These data are readily available and relatively inexpensive.

- Research and Demonstration

A number of MUDs should be recruited for onsite inspections by an electrician in order to identify the range of contexts and possible approaches to cost-effectively making Level 1 and/or Level 2 electric fueling available to some percentage of the parking spots. This will require the participation of the building owners. These renovation scenarios and cost data are essential inputs to the MUD owner's education campaign described below. This initial readiness project enhanced the MUD data base to the point where interesting buildings for detailed study can be identified with surgical precision.

Dual-use parking lots should be evaluated as a strategy for relieving the pressure on both MUDs and work site parking as the location of electric fueling. A data base of parking lots in the beach cities and school parking lots with adjacent MUDs has been established. The next step should be to identify the two or three best opportunities to conduct a pilot project of dual-use electric fueling – employees and customers during the day and MUD residents overnight. New EVSE subsidy programs could be used in our pilot projects.

- Education

The wide spread disinterest in preparing for electric vehicle fueling among both MUD owners and employers suggests that the best approach may be to simply make the information about the various planning approaches available online for the day when the need to prepare is recognized. Since cost and hassle are the two main barriers, model business cases for different scenarios and standard recipes for how to proceed would seem to form the foundation of an effective education program. It may be possible to solicit partners like chambers of commerce and AAGLA.

- Local Government

It is fundamental that local government practices and policies should be continuously monitored by the SBCCOG. The highest priority initiatives identified so far that could benefit from SBCCOG leadership are moving to a standard electrical permit application –including standard low fees if possible – and moving the whole system online. The fact that 5 cities currently contract electric permitting with the County of Los Angeles may help in the effort to standardize and move online, assuming the County will participate and essentially lead the initiative.

In the longer run the SBCCOG can develop standard language for amending zoning ordinances to allow electric fueling in residential parking areas. Other policy issues such as residential parking requirements, building codes, and electric vehicles in municipal fleets should be monitored for growing local interest.

- Electric Fueling Demand Management

As in many policy areas, the most cost-effective approach is usually through managing demand rather than endlessly expanding supply. Although this strategy is new to the altogether new field of electric fueling infrastructure planning, the seeds were planted by the SBCCOG's NEV Demonstration Project. Slow speed, short range vehicles can satisfy 80%-90% of all trips. Virtues of these vehicles include 1) their small size which requires less space required for parking and, in this context, 2) their small battery packs refuel through 110v service. These characteristics converge when several PEVs need to refuel at one time and distance from the panel is a critical cost factor. More of them can be parked closer to the panel than full sized vehicles. And Level 1 service is nearly ubiquitous especially in comparison with Level 2. All of this means that PEV readiness can be partially addressed through the many initiatives proposed to advance the deployment of NEVs and other zero emission local use vehicles.

Some things have a way of working themselves out by just "muddling through. " Employers and cities have shown some capacity to do just that. MUD owners may eventually muddle through, but the power of a plan would lead to faster adoption and more efficiency with fair pricing and full use of the capacity added. Sub-regional COGs are positioned to provide the leadership to replace muddling with planning. But only if the training and resources are available – and especially only if the COGs are motivated. That motivation will likely come from recognizing the serous environmental challenges and the potential economic opportunities rapidly expanding virtually in front of our eyes.

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