UCLA Luskin School of Public Affairs

Luskin Center FOR INNOVATION

Increasing Electric Vehicle Charging Access in Multi-Unit Dwellings in Los Angeles

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About the Report

In fall 2011, our team was invited by the Luskin Center for Innovation, an environmental sustainability research center at UCLA, to pursue a graduate student research project exploring electric vehicle integration into MUDs. Our project was inspired by previous Luskin Center work that highlighted the importance of at-home charging capability in the decision to purchase an EV and the substantial barriers to charging in many MUD settings.

Disclaimer

Neither the University of California nor the School of Public Affairs either supports or disavows the findings in any project, report, paper, or research listed herein. University affiliations are for identification only; the University is not involved in or responsible for the project.

About the Authors

Judith Balmin, Greg Bonett, and Megan Kirkeby are 2012 graduates of the UCLA Luskin School of Public Affairs master's degree program in Public Policy.

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About the UCLA Luskin Center for Innovation

The Luskin Center for Innovation, founded with a generous gift from Meyer and Renee Luskin, unites the intellectual capital of UCLA with forward-looking civic leaders to address pressing issues and translate world class research and expertise into real-world policy solutions. Research initiatives are supported by teams of faculty and staff from a variety of academic disciplines. The Luskin Center supports these initiatives by funding original research, scholars, conferences, technical internships and solution-oriented speaker series.

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Table of Contents

1. Executive Summary

Government bodies at every level have taken action toward transitioning a significant fraction of the personal vehicle fleet to Plug-In Electric Vehicles (PEVs). These policies are part of an effort to achieve socially sanctioned and legally mandated public health, greenhouse gas reduction, and energy independence goals, and are designed to act in conjunction with environmental policies designed to increase the cost of emissions. Despite the strong initial efforts to spur adoption of electric vehicles and installation of complementary charging infrastructure, a key segment has been left out: residents of multi-unit dwellings.

Approximately 54% of Los Angeles residents live in MUDs, however, additional barriers exist for multi-unit dwelling EVSE installations and major policies, like the LADWP charging equipment subsidy, are not designed with these multi-unit dwelling barriers in mind. In Los Angeles, there have been substantially fewer electric vehicle supply equipment (EVSE) installations in multi-unit buildings compared to single-family homes. As a region, we are much less likely to achieve the ambitious targets that we have established[1] if we do not craft policies that specifically address the barriers to at-home charging for multi-unit dwelling residents.

Los Angeles is particularly well positioned to be a leader in fleet transition to Plug-In Electric Vehicles (PEVs). The city has many densely populated areas and many of the city's drivers rely on private vehicles for commutes that are within the battery range of PEVs currently on the market. In addition, the region's poor air quality produces a strong incentive to reduce vehicle emissions because of the severe health problems caused by air pollution including "everything from watery eyes and fatigue to respiratory disease, lung damage, cancer, birth defects and premature death."[2]

Our work aims to identify barriers, evaluate existing policies supporting home EV charging installations, and recommend policy options to address challenges to charging in multi-unit dwellings in the City of Los Angeles. Many of these policy ideas are transferable to any organization trying to create MUD-oriented EVSE programs.

1.1 Methodology

In order to understand the barriers specific to accessing charging in MUDs, we reviewed the existing policies, available academic literature, electrical permit and census data, and documentation developed by the utility corporations. We also conducted extensive interviews with contractors, city representatives, EV advocates, and MUD residents who were able or not able to install EVSE.

1 California Air Resources Board Press Release. "California Air Resources Board Approves Advanced Clean Car Rules." January 27, 2012. http://www.arb.ca.gov/newsrel/newsrelease.php?id=282, A.B. 32: Global Warming Solutions Act.http://www.arb.ca.gov/cc/ab32/ab32.htm, Energy Independence and Security Act of 2007/CAFE Standards: http://www.gpo.gov/fdsys/pkg/PLAW-110publ140/pdf/PLAW-110publ140.pdf.

2 South Coast Air Quality Management District. "About South Coast AQMD." Accessed March 4, 2012.

http://www.aqmd.gov/aqmd/index.html#how

1.2 Barriers to Charging in MUDs

Through this process we identified the most significant barriers as:

- Difficult negotiations between building management and residents about approval of installations. Disagreements can arise when there are legal restrictions or a general unwillingness to allow switching of parking spaces to accommodate a less costly installation. Further, parties may be uncertain about who should assume responsibility for electrical upgrades, maintenance and decommissioning of the equipment.
- Physical limitations more common in large and older buildings, such as inadequate electrical capacity, and substantial distance between electrical panel and designated parking.
- Restrictive subsidies and regulations have slowed or prevented installations. For example, subsidies are not accessible to landlords or Homeowners Associations (HOAs) who would like to make EVSE available to their residents. The main EVSE subsidies, such as LADWP's Charge Up L.A.! program, are only available to drivers who own or lease the electric vehicle. In addition, WiFi is not common or easy to install in underground parking structures, but it is a requirement to utilize the federal charging subsidy.

1.3 Proposed Policies to Address Barriers

Our research into the existing policies and barriers enabled us to create policies that will help increase installations of charging infrastructure in MUDs.

Proposed policies:

- Partially subsidize EVSE installation cost assessments in MUDs
- Expand current EVSE subsidy to cover Level 1 charging equipment in MUDs
- Provide partial subsidy for installs in MUDs by parties that do not own a car, like landlords wanting to add charging as an amenity
- Uncouple the cost of charging equipment from the value of the rebate
- Develop a guide explaining the variety of installation/utilization/cost recovery schemes for MUDs EVSE installations
- Employ an informed mediator to assist with difficult negotiations between residents and building management
- Create an online registry of MUDs that have EV ready parking spaces
- Use real world usage data to establish an EVSE demand factor for use when issuing electrical permits
- Consider expanding and adding flexibility to pertinent Green Building Code requirements
- Convene stakeholders to discuss limiting restrictions on EVSE installations by renters

1.4 Conclusions and recommendations

We divided our proposed policies into three categories.

Tier 1 should be implemented immediately—they perform well across our evaluative criteria. We anticipate they will produce substantial benefits, are not very costly, and other uncertainties are minimal. Included are: Partially subsidizing installations for non-EV drivers, which opens the subsidy up to an entirely new market, has a high potential for learning and network gains since building managers can use their experience with all residents and possibly other properties, and it will require little administrative cost since it is an expansion of an existing program. Subsidizing Level 1 installations in MUDs, which will subsidize charging equipment in cases where there is not adequate electrical capacity for a Level 2 charger—increasing charging access. Create a detailed guide, which will, at a low cost, reduce time spent by EVSE adopters.

Tier 2 policies are also recommended, but they do not perform as strongly under our criteria. Included are: Provide a mediator for difficult negotiations, create an online registry of EV-ready buildings to increase the value of installed EVSE for building management, partially subsidize assessments to identify low-cost installs, and uncouple the value of the subsidy from the cost of EVSE to create incentives to lower installation costs.

Tier 3 policies are promising, but require more research and input from experts, these include: Establishing a demand factor for EVSE to potentially better utilize existing capacity, revisiting the Green Building Code to potentially increase requirement or add flexibility, starting a dialogue to potentially expand S.B. 209/880 to renters.

2. Introduction

"In the next several years, tens of thousands of electric vehicles will be sold right here in Southern California. As the car capital of the world, we plan to seize this opportunity and stand at the forefront of the electric vehicle revolution…The City of Los Angeles is in overdrive to improve our air quality and implement environmentally-friendly programs. We've reached our goal of sourcing 20 percent of our energy from renewable resources and have the largest municipal CNG fleet in the United States. Upgrading our electric vehicles charging infrastructure is yet another opportunity to collectively steer Los Angeles away from pollution, dependency, and waste and to move into the fast lane towards a cleaner, greener future." - Mayor Villaraigosa, May 13, 2011

Government bodies at every level are pursuing the goal of transitioning a significant fraction of the personal vehicle fleet to Plug-In Electric Vehicles (PEVs). Local, state, and federal policies are supporting the transition to "zero emission vehicles", as part of an effort to achieve socially sanctioned and legally mandated public health, greenhouse gas reduction, and energy independence goals. Despite the great opportunity and strong initial efforts to spur adoption of electric vehicles and installation of complementary charging infrastructure, a key segment has been left out: residents of multi-unit dwellings (MUDs).

Approximately 54% of Los Angeles residents live in MUDs, however, additional barriers exist for EVSE installations and major policies, like the LADWP charging equipment subsidy, are not designed with these MUD barriers in mind. In Los Angeles, there have been substantially fewer electric vehicle supply equipment (EVSE) installations in multi-unit buildings compared to single-family homes. In 2011, there were permits for 193 Level 2 EVSE installations in the City of Los Angeles, and our interviews with Los Angeles Department of Water and

Power (LADWP) staff indicate less than one dozen of these were in MUDs. Public and workplace charging may be a solution for some MUD residents and has value as supplemental charging, but at-home charging is essential for motivating widespread EV adoption. As a region, we are much less likely to achieve the ambitious targets that we have established[3] if we do not craft policies that specifically address the barriers to at-home charging for MUD residents.

Los Angeles is particularly well positioned to be a leader in fleet transition to Plug-In Electric Vehicles (PEVs). The city has many densely populated areas, and many of the city's workers rely on private vehicles for commutes that are within the battery range of PEVs currently on the market. In fact, adoption of new clean vehicles has been shown to be greater and more rapid in high density areas, since many potential adopters can be stimulated by positive feedback from early adopters and network effects.[4] In addition, the region's poor air quality produces a strong incentive to reduce vehicle emissions because of the severe health problems caused by local air pollution including "everything from watery eyes and fatigue to respiratory disease, lung damage, cancer, birth defects and premature death."[5]

Our work aims to identify barriers, evaluate existing policies supporting home EV charging installations, and recommend policy options to address challenges to charging in a multi-unit dwelling in the City of Los Angeles. Many of our proposed policy will transfer to any organization trying to create MUD-inclusive EVSE programs.

2.1 Client

The Luskin Center for Innovation is an academic research center at the University of California Los Angeles which seeks to address environmental sustainability issues in Los Angeles by promoting original research across a wide variety of policy areas. They also strive to connect this research, and the resulting policy ideas, with elected officials and other civic leaders.

The Luskin Center is dedicating resources to understanding and shaping the role Plug-In Electric Vehicles play in encouraging environmental sustainability in the Los Angeles area. The Luskin Center believes increased adoption of Plug-in Electric Vehicle will have substantial environmental benefits, and they are interested in identifying public policy and business models that will help realize the full potential of those benefits at minimal social, environmental, and economic cost.[6]

3 California Air Resources Board Press Release. "California Air Resources Board Approves Advanced Clean Car Rules." January 27, 2012. http://www.arb.ca.gov/newsrel/newsrelease.php?id=282, A.B. 32: Global Warming Solutions Act.http://www.arb.ca.gov/cc/ab32/ab32.htm, Energy Independence and Security Act of 2007/CAFE Standards: http://www.gpo.gov/fdsys/pkg/PLAW-110publ140/pdf/PLAW-110publ140.pdf

4 Skerlos, Steven and Winebrake, James. [2009]. "Targeting plug-in hybrid electric vehicle policies to increase social benefits," Energy Policy Journal Issue 38. November 2009: page 707.

5 South Coast Air Quality Management District. "About South Coast AQMD." Accessed March 4, 2012. http://www.aqmd.gov/aqmd/index.html#how

6 Luskin Center for Innovation website, About Us page: http://luskin.ucla.edu/content/about-us-0

2.2 Project Background

In fall 2011, our team was invited by the Luskin Center to pursue a graduate student research project exploring electric vehicle integration in MUDs. Our topic grew out of two previous projects completed by graduate students working with the Luskin Center. Those projects were: (1) A market study examining general trends in the adoption of Plug-in Electric Vehicles (PEVs), which identified several issues that may prevent MUD consumers from purchasing PEVs,[7] and (2) A set of case studies outlining the primary cost drivers and obstacles to charging PEVs in multi-unit residential buildings.[8] These projects highlighted the importance of at-home charging capability in the decision to purchase an EV and the substantial barriers to charging in many MUD settings.

This prior work, along with our own research, has set the stage for us to clarify the benefits of increased charging access in MUDs, further detail the common barriers, and produce a menu of policy options to encourage adoption of electric vehicles in MUDs.

2.3 Importance of Special Planning for Multi-Unit Dwellings in EV Infrastructure Policy

The 2011 Luskin Center market study found increasing access to "home charging will have a substantial impact on EV sales,"[9] and one of the report's key recommendations was to increase charging access in MUDs.[10] Their EV projection model found a "significant demand constraint due to lack of home charging availability for multifamily housing customers" and they found "[b]y alleviating this constraint, the City [of Los Angeles] could increase EV adoption to more than 13% of new car sales by 2020."[11]

This finding is motivated by the substantial presence of MUDs in Los Angeles, where approximately 54% of residents live in MUDs.[12] Despite this, few EVSE installations have occurred in apartment or condominium buildings. Figure 1 shows the locations of EVSE installations in Los Angeles during 2010 and 2011, over the density by block group. These records were made available through records of electrical permit applications filed with the Los Angeles Department of Building and Safety. 218 EVSE permits were pulled for work to be done in single-family housing and 19 were pulled for work in MUDs. Most of these occurred in 2011.[13]

7 Dubin, Jeffrey; et al. [2011]. "Realizing the Potential of the Los Angeles Electric Vehicle Market." UCLA Luskin Center for Innovation and the UCLA Anderson School of Management. May 2011.

8 Peterson, David, "Addressing Challenges to Electric Vehicle Charging in Multifamily Residential Buildings." June 2011.

9 Dubin, Jeffrey; et al. [2011]. "Realizing the Potential of the Los Angeles Electric Vehicle Market." UCLA Luskin Center for Innovation and the UCLA Anderson School of Management. May 2011: page 4.

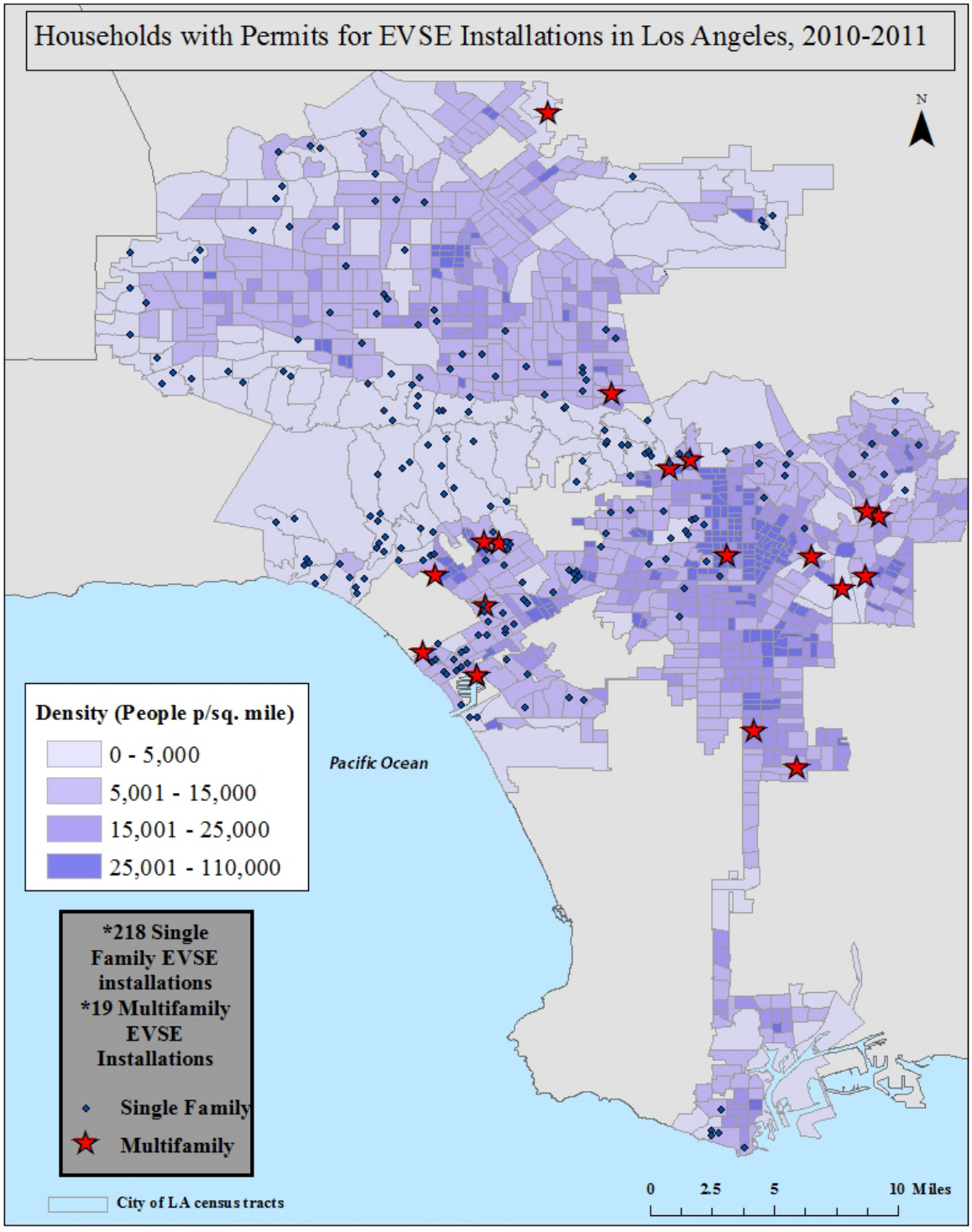
10 Ibid, page 7 and 85. Also, mentioned frequently throughout the report.

11 Ibid, page 7.

12 2006-2010 American Community Survey, U.S. Census, "Selected Housing Characteristics"

13 This data does not capture Level 1 installations since these do not require permits. We have not verified the completion of each of these installations.

Figure 1. Map of permitted EVSE installations in Los Angeles, 2010-2011 and population density



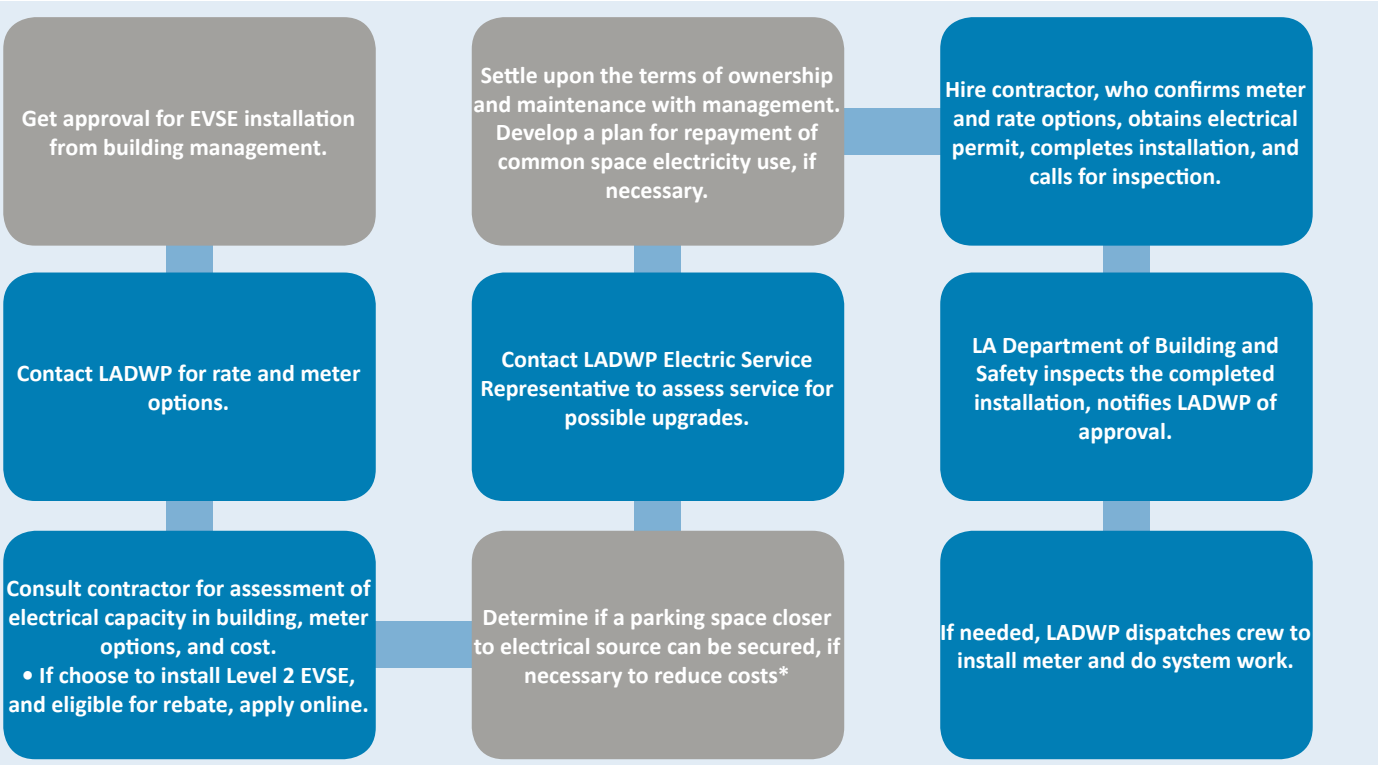
Sources: 2010 U.S. Census, LADBS permit records 2010-11

There are several additional complexities particular to MUDs that have slowed adoption. In contrast with a single-family installation, an installation in MUDs includes more steps, involves more stakeholders, and a larger physical structure.

The extra stakeholder in this process is the building management, typically a landlord, or a Homeowners Association (HOA). When a resident in MUDs has an ownership stake, as in the case of condominiums, and makes improvements to the building, she is able to recapture some of her investment upon the sale of their unit. However, in rental housing, the tenant has no financial stake in improvements to the property when they leave. For this reason, renters may be more reluctant to pay for at-home charging access than MUD homeowners.

The installation can be driver/resident-initiated or management initiated (the variation in their respective installation processes is illustrated in Figure 2). When the resident initiates the process, she will have the additional hurdles of obtaining approval for their installation, negotiating with management and neighbors, as well as surveying rules and laws pertaining to their particular situation.

Figure 2: Multi-Unit Dwellings EVSE Installation Steps in Los Angeles



*If the resident lives in Common Interest Development and wishes to use a common space for charging, this step may involve getting approval from the architectural committee, obtaining homeowners insurance coverage for the EVSE, and entering into a license agreement with the HOA.

Boxes with gray background are additional steps that must be taken if the installation is initiated by a resident of MUDs rather than the landlord or Homeowners Association. The steps in with blue backgrounds are summarized from LADWP's "Residential EV Level II (240V) Charger Installation Steps" [http://www.ladwp.com/ladwp/cms/ladwp014329.pdf] Other guides recommend gauging interest of other residents in EVSE to incorporate their charging needs in installation plans.

The size and condition of the existing infrastructure in MUDs is a much more complicated issue requiring, for example, more involvement with city inspectors and negotiation with neighbors.

These complexities and other more subtle barriers are covered in detail in the barriers section of this report. Measures should be taken to address these special challenges faced by MUD residents. There are a number of appropriate and valid policy levers that can be utilized for this purpose. The next section provides an outline of those tools and why they are justified.

2.4 Reasons that intervention is warranted to promote EV adoption

"Market failures associated with environmental pollution interact with market failures associated with the innovation and diffusion of new technologies. These combined market failures provide a strong rationale for a portfolio of public policies that foster emissions reduction as well as the development and adoption of environmentally beneficial technology."[14] -A Tale of Two Market Failures

The market for private vehicles suffers from several market failures. Without intervention by a government body, these market failures will result in electric vehicle adoption below the socially optimal level.

The most obvious market failure occurs in the market for vehicles powered by an internal combustion engine (ICE). Use of an ICE produces harmful emissions and noise pollution that harm others besides the user. The full extent of these societal costs is not incorporated in the cost of purchasing an ICE vehicle or fuel for an ICE vehicle, so there is little incentive to curb use. This results in a negative externality, inefficiently high amount of pollution and negative health effects.[15]

In addition to these negative externalities produced by ICE, there are a different set of market failures that apply to the low-emissions vehicle market. As an emerging technology, the purchase or production of an electric vehicle produces positive externalities; that is, there are benefits to society as a whole that the purchaser or producer is not compensated for. In the case of early adoption of electric vehicles, these positive externalities are "dynamic increasing returns."

One type of dynamic increasing return produced by EV adopters is "learning-by-using" (LBU), which is the benefit gained from observing, and learning from, the adoption of a new technology by others. A related benefit produced by EV and EVSE firms is "learning-by-doing" (LBD), which is the benefit they produce and share from their experience working with a new technology. New knowledge is a public good and "innovating firms cannot keep other firms from also benefiting from their new knowledge and therefore cannot capture for themselves all the benefits of the innovation."[16] The third type of dynamic increasing returns is the "network externality" wherein a technology becomes more "valuable to an individual user as other users adopt a compatible

14 Jeffe, Newell, Stavine. [2004]. "A Tale of Two Market Failures: Technology and Environmental Policy," Ecological Economics 54, March 2005. pg. 164.

15 The traditional micro-economic approach to correcting for a negative externality is to design an intervention that requires the purchaser to "internalize" the cost of the externality. For example, if the use of a gallon of gasoline costs an additional $2 per gallon in costs the purchaser does not bear, then a tax of $2 per gallon should be collected in order to produce the socially efficient quantity of gasoline. The tax forces the purchaser to bear the whole cost of using the product. Environmental regulations like this serve as a necessary complement to policies supporting emerging environmental technologies.

16 Ibid. pg. 167.

product."[17] EV-adoption produces network benefits by increasing charging access for other EV drivers and supporting services complimentary to EV use, like mechanics and part suppliers.

Examples of dynamic increasing returns in case of PEV:

- **Learning-By-Using:** A LEAF owner is approached by interested people who ask technical questions about the vehicle's operation, maintenance, and charging scenarios. The owner spends time indulging curious individuals and allows them to inspect the vehicle. Or, more specific to at-home charging in MUDs, prospective EV drivers see other people in their building successfully charging with a 120V outlet and extension cord and learn they could do the same. Or prospective EV drivers see their neighbors successfully taking advantage of the EV Project subsidy.
- **Learning-By-Doing:** An adventurous building manager tries out different electricity repayment systems until they develop one that is agreeable for all parties–time and money must be spent to develop this best system. The building owner can now implement this with other tenants, and other building owners might hear about it and employ the system without their own tedious trial-and-error process.
- **Network Benefits:** Prospective EV adopters will be more likely to do so if their friends have at-home charging that they can use if necessary; Mechanics are likely to learn to service EVs if more people in an area are driving them.

In order to accelerate diffusion and reach the socially efficient level of PEV use, adoption policies, such as subsidies, should be implemented to internalize the benefits their producers and consumers are creating.

3. EVSE Technology and Installation Basics

This section introduces some of the technical aspects of EVs and EV charging in MUDs, such as: types of charging equipment, charging times across vehicles, and electrical capacity requirements for EVSE.

3.1 Different types of charging equipment

There is considerable diversity in cost and electrical requirements among different types of EVSE. EVSE can be broadly separated into three groups, with further distinctions within each group. The broad groups are: Level 1, Level 2, and DC Fast Charge. Many EV policies provide a rebate specifically for the installation of Level 2 charging equipment, though, in many multi-unit buildings, Level 1 charging may be a more affordable option due to electrical capacity limitations.

With Level 1 and Level 2 charging, an alternating-current (AC) power source is connected to the car with a standardized J1772 connector. In these cases, the car handles the DC power conversion necessary to charge the batteries. However, with DC Fast Charging, the charging equipment–rather than the car–converts the power from an AC electrical source to the DC power supplied to the vehicle through a CHAdeMO connector.[18]

17 Ibid. pg. 167.

18 Proposed, but not yet adopted as a standard.

DC Fast Charging is significantly more expensive because of this additional function and the much larger power requirements; it unlikely to see widespread use in residential settings.

Most residential charging will be Level 1 and Level 2. Level 1 charging typically provides 12 amps of current at 120V, while Level 2 charging will supply about 16 or 28 amps at 240V, depending on the vehicle's capability and the current available from the electrical circuit. Most models of electric vehicles on the road today support a maximum current of 16 amps at 240V, but new models, available this year, like the Ford Focus EV, will support the faster Level 2 charging rate.[19]

In some cases, installing Level 2 charging may be only slightly more expensive than installing Level 1 charging. However, in other cases, the power demands of Level 2 charging will require other components of the electrical system to be upgraded, making a Level 2 installation significantly more expensive than a Level 1 installation. A Level 2 charger draws between two and four times as much power as a Level 1 charger. Therefore, many electrical systems will adequately supply a Level 1 charger while being inadequate for Level 2 charging. If Level 1 charging is accessible for extended periods every evening, it should be provide an adequate charge for the commute distances of most Los Angeles drivers.

However, utility companies, such as LADWP, are promoting Level 2 charging because the longer charge time of Level 1 charging may prevent drivers from exclusively charging during nighttime hours. Off-peak, nighttime electricity use "reduces the strain on grid and maximizes the use of clean, green, wind energy, which is abundant at night."[20] LADWP offers a $0.025 discount per kWh off of their Time-of-Use (TOU) rates for PEV drivers through their Electric Vehicle Program to encourage nighttime charging.[21]

TOU rates are an alternative to the standard flat rate. While the standard flat rate remains the same regardless of the time of day, TOU prices are based on when electricity is actually used: the rates are higher when demand for electricity is higher. In order to access TOU rates, the utility customer must have a time-of-use meter that can record electricity use at different times.

It is sometimes helpful to think about charging rates in terms of miles of range per hour of charging. In these terms, Level 1 charging restores about five miles of range per hour of charging. If a driver can charge for approximately 10 hours each evening, this would result in 50 miles of range for daytime driving, adequate for the round-trip commutes of 80% of Angelenos.[22]

19 Ford Focus EV website, FAQs about charging. Accessed March 10, 2012. http://www.ford.com/electric/focuselectric/2012/faq/

20 "Residential Customer Incentives and Rates" - Electric Vehicle Program. http://www.ladwpnews.com/external/content/document/1475/952931/1/EV%20Incentive%20and%20Rates%20Final.pdf

21 LADWP Time-of-Use Rates - http://www.ladwp.com/ladwp/cms/ladwp004844.jsp

22 U.S. Census Bureau, LEHD Origin-Destination Employment Statistics, Los Angeles city, 2009. See Table 2.

Table 1. Available and Upcoming Battery Electric Vehicle and Plug-in Hybrid Electric Vehicle Characteristics[23]

Release Date	Vehicle	Battery Size	Approximate Electric Range	Level 1 Charging Time in Hours	Level 2 Charging Time in Hours	Cost Before Incentives
Available	Nissan LEAF	24 kWh	73 miles	20	7	$35,200-$37,250
Available	Chevrolet Volt	16 kWh	35 miles	10	4	$40,280
2012	Prius Plug-In	4.4 kWh	11 miles	3	1.5	$32,000
2012	Mitsubishi iMiEV	16 kWh	62 miles	22.5	7	$29,125-$31,125
2012	Ford Focus EV	23 kWh	76 miles	20	4	$39,995
2012	Coda Sedan	31 kWh	88 miles	36	6	$37,250

Commute data indicate that most residents of Los Angeles would find the range of current PEVs to be sufficient, with 90% of residents commuting less than 100 miles per day. Further, nearly 80% commute less than 50 miles per day, and nearly 50% commute less than 20 miles per day.[24] This puts many drivers within the electric range of the currently available PEVs (see Table 1), 80% of who could charge sufficiently on Level 1 in a ten-hour period to accommodate their daily commute. While there more clean air are benefits captured as drivers with high "vehicle miles traveled" (VMT) transition to electric propulsion, both low and high VMT drivers can produce the dynamic increasing returns discussed in the previous section, particularly in densely populated areas,[25] where multi-unit dwellings dominate.

Table 2. One Way Commute Distances for Los Angeles City Residents[26]

Distance from Work Census Block to Home Census Block	Percent	Hours necessary to charge for daily commute on Level 1
Less than 10 miles	48.4%	<4 hours
10 to 24 miles	30.0%	4 to 10 hours
25 to 50 miles	11.8%	10 to 20 hours
Greater than 50 miles	9.9%	>20 hours

23 The battery size, charging times, and costs are collected from the manufacturers' respective websites. The approximate electric range from U.S. Department of Energy New & Upcoming Electric Vehicle Fuel Economies. Accessed on March 1, 2012. http://www.fueleconomy.gov/feg/evnews.shtml

24 Ibid.

25 Skerlos, Steven and Winebrake, James. [2009]. "Targeting plug-in hybrid electric vehicle policies to increase social benefits," Energy Policy Journal Issue 38. November 2009: page 707.

26 U.S. Census Bureau, LEHD Origin-Destination Employment Statistics, Los Angeles city, 2009.

3.2 Electrical capacity limitations

Electrical capacity can also be an issue in single-family EVSE installations, but it is more likely to be an issue in MUDs. The sheer size of the electrical system, the fact that many people are served by the electrical system, and the discrete sizing of electric service contribute to this. Further, electrical capacity issues are more complex in MUD settings because the provision of sufficient electrical capacity is normally under the responsibility of building management. If a resident needs additional electrical capacity for EVSE, the building management may respond that the capacity is sufficient for normal usage and the resident should be responsible for all upgrades related to EVSE.

There are several scenarios where electrical capacity may be an issue when preparing to install EVSE. Here are common cases when this might occur, though this list is not exhaustive:

- A transformer is running near capacity. In this case, the utility would indicate that adding new transformer capacity may be necessary. If a new, private on-site transformer is necessary, the customer must initially pay the full cost, but will be reimbursed if the transformer is used at 50% capacity for 48 of the subsequent 60 months after the transformer is installed.[27]
- The electrical service, the total amount of amps available to the utility customer, is not adequate to supply an EVSE in addition to the existing connected loads. In this case, the local Department of Building and Safety will be reluctant to supply a permit unless the service capacity is increased. The customer will likely be responsible for these costs. Alternatively, the electrician/contractor may try to show that there is excess capacity by performing load monitoring, where the electricity use is monitored for thirty days. This is time consuming and costly, but may allow the customer to install EVSE without upgrading the service capacity.
- Finally, there may be adequate electrical service capacity, but the electrical panel is out of room to add more circuits. In this case, the size of the panel will need to be increased or an additional panel will need to be added. Again, the utility will not cover these costs.

One way of determining the necessary size of the electrical service is to do load calculations for all the appliances running off the service. This reflects that all appliances are not used simultaneously and continuously. A demand factor, or percentage of maximum power consumed, is applied to some appliances to discount their weight in the load calculation. If an overly conservative demand factor is used for EVSE, the building inspector may require an upgrade when it is not really necessary.

Major utility-side electrical grid upgrades can be delayed by efficient, careful use of available capacity, but eventually, when EV adoption is more widespread, it will be necessary to upgrade utility-side infrastructure and integrate Smart Grid technologies.[28] California is already planning for this eventuality—S.B. 626 (Kehoe, 2009) mandated that the California Public Utility Commission make necessary preparations and have electrical infrastructure in place that can support an increase in demand.

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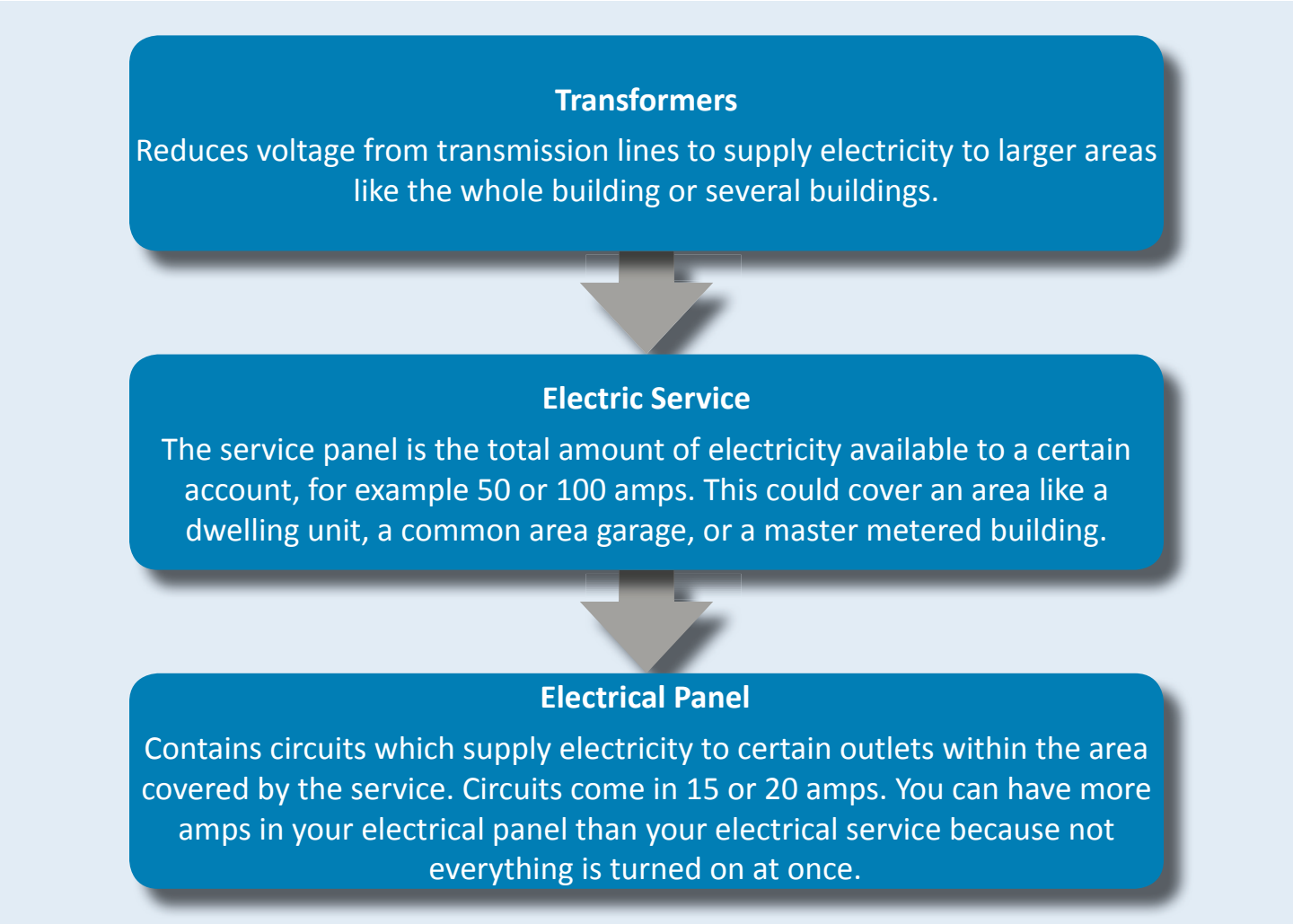
27 LADWP General Provisions on Electrical Rates, Section M. "Transformer Charge." http://www.ladwp.com/ladwp/cms/ladwp002256.jsp. There is no explicitly state rule for cases where a transformer must be upgraded, but a new, private on-site transformer is not required, it is not clear who will be responsible for the cost.

28 Srivastava, Anuragl Annavathina, Bharath; Kamalasadan; Sukumar. [2010] "The Challenges and Policy Options for Integrating Plug-In Hybrid Electric Vehicles Into the Electric Grid." The Electricity Journal. Vol. 23, Issue 3: April 2010. Page 24-28.

Figure 3. Electrical Capacity Components



4. Barriers to EV charging in Multi-Unit Dwellings

Barriers can range in difficulty and cost for different parties, but across all MUD installations there are two main complicating factors not present in single-family homes: Issues stemming from the involvement of multiple stakeholders (difficult negotiations), and increased capital costs resulting from the size of the structure and its electrical system (physical limitations).

An additional barrier that could be considered a third complicating factor is the lack of targeting MUD scenarios in policies designed to support home-charging (restrictive existing subsidies and regulations). Currently, only EV drivers are allowed to access the EVSE subsidies, but building management could play a key role in providing EVSE access for residents since they may be able to achieve economies of scale with multiple installs, and in rental scenarios, the landlord is better positioned to capture the value add of the EVSE installation.

Through our interview process we were able to speak with people who experienced a wide variety of EVSE in-

stallation scenarios ranging from smooth and informal to difficult and convoluted. These interviews, along with our other research, informed the following detailed account of the barriers that impede MUD installations (See Appendix III for profiles of interviewed residents and accounts of their individual experiences).

4.1 Barrier I: Approval for installation from building management

In most multifa cases, the resident requires approval from the landlord or HOA to carry out the installation. Some residents fear repercussions if they push too hard for permission. Landlords and HOAs are often deterred from approving EVSE installations and charging by the complicated technical aspects, details regarding responsibility for removing the equipment, and uncertainty around payment for electricity.

Residents we spoke with had a variety of experiences. One resident was on an HOA committee and had good standing with building governance. The building manager gave her a convenient parking space next to the electrical room without any formal process. In contrast, a resident form a different interview viewed her HOA as political and vindictive. She was so inhibited by her previous experiences with the HOA that she did not even want to ask for permission. Another resident's negotiation involved numerous meetings and correspondences that continued for over a year before she received permission to install. And yet another resident was asked to stop using an extension cord to charge her EV that connected to an outlet in her own unit, because it was unsightly.

One electrician we spoke with, William Korthof, who has provided several EVSE installations in MUDs, commented that, from his own experience with these residents, the "technical problems are dwarfed by the political problems." These stories support that claim. He also noted that many of the people whom he has seen complete successful installation were members of their HOA boards.

There is still a general lack of knowledge about costs related to EVSE installation, electrical capacity, and code compliance that is a significant hurdle for parties wishing to install EVSE in MUDs to overcome. This notion was strongly reinforced in all of our interviews.

4.2 Barrier II: Determining party responsible for equipment and installation cost

The addition of new access to charging through the installation of EVSE or an outlet near a parking space clearly benefits the EV driver, but it can also be a benefit to future residents if drivers leave the equipment and electrical upgrades behind when they change residences. Condo owners have some opportunity to capture the value of these improvements when they sell their homes and parking spaces, but renters leave behind the full value of any improvements they make. This dynamic complicates the process of determining which party should pay the costs associated with the installation and purchase of equipment.

In addition to payment for the installation, equipment ownership is not always clear. Building management may be skeptical of taking ownership of the charging unit if this means they are responsible for maintaining and decommissioning the unit at the end of its useful life. Another possibility is that building management may be unwilling to relinquish a claim to ownership if the resident attempts to take the equipment when they move, leaving behind useless or unsightly electrical wiring.

Some EV drivers, including one of the condo owners we interviewed, have proposed that their building pay

for the installation of multiple charging stations to be used by current and future residents as needed. This would also allow the building to take advantage of economies of scale. It might be perceived as unfair for the HOA fund to pay for the installation, equipment and maintenance since the amenity will only be useful to EV drivers. However, other expensive building amenities, such as a gym or pool, similarly do not serve the entire population, but rather just the residents who choose to use them.

All of the residents we have spoken with thus far initiated their EVSE installation and covered the costs without contribution from the building owner or HOA, though two HOAs are still considering adding EVSE as an amenity.

4.3 Barrier III: Determining payment system for electricity usage

The value of the electricity used by electric vehicles is non-trivial and developing arrangements to account and bill for these costs will be important for EV adoption. The central issue here is whether electricity used to power the EVSE can be charged directly to the user, and if not, whether there is an easy and agreeable method for compensation for common space electricity usage. The optimal scenario for the resident is for the EVSE to be connected to the residents' existing electricity service or a new meter to be added for the specific outlet or dedicated circuit where charging will occur. In this case, the resident can be billed directly by the utility company, but these options are often not available. The alternative is for the EVSE to be connected the building's common area utility bill.

Usage can be measured using a submeter, the EVSE, or the vehicle itself, so that the cost of the electricity can be repaid. To measure use precisely, access TOU rates and facilitate billing, an official LADWP submeter can be used. In contrast, many successful arrangements so far have been informal and imprecise; for example, a flat fee for access to EV charging per month. Creation and approval of such arrangements often benefit from existing positive relationships between the resident and the management, and involvement in building governance. For example, one resident was trusted to estimate her approximate electricity cost using her annual mileage and simply repay at the end of the year.

Congenial relations between management and residents are not ubiquitous. With informal arrangements, HOAs and building owners may fear that they will not be fully compensated for common use charging. On the other hand, some residents fear being grossly overcharged by the building for their usage. Though informal agreements make the installation process easier and less time consuming at first, in the long run explicit agreements are best. If the building management revokes permission, or there is a dispute about billing, the resident may be stuck in the unfortunate position of having a PEV and no charging access. See Appendix I for possible electrical payment schemes and their advantages and disadvantages.

4.4 Barrier IV: Insurance coverage for EVSE

On January 1, 2012, S.B. 209 (Corbett) went into effect prohibiting HOAs from enforcing rules that prevent EVSE installations in a common space, provided tenants meet a checklist of requirements. These requirements included an "umbrella liability coverage policy" in the amount of $1 million to be taken out by the EV owner. S.B. 880 (Corbett)[29] improved this to read "homeowners liability insurance", in addition to changing numerous

29 http://www.leginfo.ca.gov/pub/11-12/bill/sen/sb_0851-0900/sb_880_bill_20120229_chaptered.html

other aspects of S.B. 209.[30] The insurance requirement may deter some potential EV adopters and there may be confusion to who is actually required by law to have insurance coverage. One resident was asked to obtain insurance by her building manager who wrongly believed that it was legally mandated. See Appendix II for further discussion.

4.5 Barrier V: Distance from assigned parking to electrical circuit or panel

EVSE installation is significantly more expensive if the parking spot is not close to a circuit on an electrical panel with available capacity. In single-family homes the distance from the electrical panel or existing wiring to the desired charging area is not likely to exceed more than a few dozen feet, but in large parking structures a parking space can be hundreds of feet from the electrical panel.

One survey study found that only about 17% of their respondents who lived in apartments could find an outlet within 25 feet of their home parking spot, as opposed to approximately 60% of their respondents who live in detached homes (single-family dwellings). This survey found that detached homes with parking in attached garages to have "highest home recharge potential".[31]

From an engineering perspective, an ideal solution is to re-assign parking spots to place electric vehicle parking as close as possible to the electrical panel. However, many MUDs, particularly condominiums, have inflexible parking arrangements, such as parking stalls deeded or bundled with the unit. Unless residents in these situations are willing to make informal parking spot trades with other residents, or utilize a common space for EVSE installation, the installation in their private space can be many times more expensive than installation in a parking space in the ideal location.

4.6 Barrier VI: Electrical capacity

As discussed in the "Technology and Installation Basics" section of this report, installing EVSE can be costly if the electrical system must be upgraded to handle the increased load. Upgrades can be made even more costly if structural modifications are necessary.

In order for LADBS to issue an electrical permit for new equipment, the building inspector will check that the outlets, conduit, circuit breakers, electrical panel, and electrical service have sufficient capacity. If the inspector doubts that the system has sufficient capacity, she may require components be upgraded. To avoid costly upgrades the electrician may suggest load calculations or more detailed load monitoring be done to prove that sufficient capacity exists.

Because Level 2 charging requires more power than Level 1, it is more likely for Level 2 installations to require upgrades to other components of the electrical system. Since many equipment subsidies only offer a rebate for Level 2 equipment, a driver may be faced with choosing between a costly Level 2 installation or forfeiting the subsidy.

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30 S.B. 880 was passed, chaptered, and signed by the Governor on February 29, 2012.

31 Axsen, Jonn; Kurani, Kenneth [2008]. "The Early U.S. Market for PHEVs: Anticipating Consumer Awareness, Recharge Potential, Design Priorities and Energy Impacts" UC Davis Institute of Transportation Studies, 1 July 2008: Page 16

4.7 Barrier VII: WiFi may not be available in underground parking area

Eligibility for the federally funded EV Project and ChargePoint America subsidies is contingent on the ability to collect vehicle usage and charging pattern data via an Internet connection from the EVSE. Internet connectivity is not always possible in MUD parking areas. One resident we spoke with was able to secure a connection in her garage, but had to haggle with the Internet company for a reasonable price for a connection that would have such little usage.

4.8 Barrier VIII: Subsidy only available to driver

Currently, EV ownership or leasing is a requirement to be eligible for most EVSE subsidies. This is the case with the LADWP EVSE rebate and EV Project/ChargePoint America participation. As previously discussed, residents may be hesitant to pay for electrical upgrades that some buildings require for EV charging cannot because it is a big investment that the EV owner forfeits when she moves. This discourages tenants from making these investments. This problem suggests that the building owner may be best situated to make the purchase, but without access to government equipment subsidies, fewer than optimal are willing to do so.

5. Existing Policies

Federal, state, and local governments have recognized at-home charging as a critical component to EV adoption and, in addition to subsidizing the purchase of the vehicle, have provided substantial subsidies for charging infrastructure. However, these policies have failed to address the difficulties specific to MUDs. Without more support for access to at-home charging in the MUD setting, those living in multi-unit homes will continue to fall behind in EV adoption.

Below, we summarize the existing policies related to charging access and demonstrate why they are problematic with regard to MUDs.

Main policies impacting MUD charging access in Los Angeles:

- Local: LADWP Charge Up L.A.! rebate program
- Local: City of Los Angeles' Green Building Code
- State: SB 209/880 (Corbett)
- Federal: U.S. Department of Energy granted $230 million to ECOtality, an investor-owned company, to manage the EV Project and Chargepoint America

5.1 Local Policies

The LADWP Charge Up L.A.! Electric Vehicle Home Charger Rebate Pilot Program is a utility sponsored demand side management program. It provides a $2000 rebate for Level 2 EVSE and installation for EV drivers in the City of Los Angeles.[32] To qualify for this rebate, recipients must install a TOU meter. LADWP began accepting rebate applications May 1, 2011. To access this rebate you must own or lease the vehicle, install a Level 2 EVSE, and be willing to install a separate electricity meter. If a TOU meter is installed you can also access lower EV TOU electricity rates (2.5 cent discount for off-peak). As of December 27, 2011, the program approved 85 rebates and paid out $169,718.76 to customers.[33] This means that the average amount paid out was just below the maximum possible amount - $1996.69. Approximately five of the 85 approved rebates went to EV drivers in MUDs.[34] The program expires when the $2 million in dedicated funds are exhausted or on June 30, 2013, whichever comes first.

Problematic areas for MUD access

- Requires you to own or lease the vehicle to access the subsidy—this prevent landlords or HOAs from using the subsidy to provide charging for their residents.
- Requires a TOU meter—in many cases the electric service in the parking garage for a multi-unit dwelling will be on the building's common area electric bill and it may be difficult to switch the meter.
- Requires Level 2 EVSE—this program does not cover the installation of Level 1, which can be substantially more achievable in MUDs, because of physical limitations and higher costs for electrical work in larger, older buildings

The City of Los Angeles Green Building Code was put into effect January 1, 2011. The code is administered by the Los Angeles Department of Building and Safety (LADBS). This code requires new multi-unit buildings (with more than two units) to be EV-ready. Low-rise buildings (less than seven stories) achieve compliance by either providing (A) 240V 40 amp outlets in 5% of parking spaces, (B) panel capacity and conduit terminating in the parking area to service 240V 40A charging for 5% of parking spaces, or (C) service capacity, conduit, and space for meters to service 5% of parking spaces with 240V 40A capacity. High-rise buildings achieve compliance by providing 240V 40A outlets for 5% of parking spaces.[35]

According to data compiled by RAND, 3,576 new multi-unit dwelling units were constructed in the City of Los

32 Charge Up L.A.! Program website: http://www.ladwp.com/ladwp/cms/ladwp000801.jsp. Accessed 26 February 2012.
33 Internal LADWP report, "Semi-Annual Report - Charge Up L.A.! Rebate Program" December 27, 2011.
34 Interview with Marvin Moon, January 5, 2012.
35 2011 Green Building Code. http://ladbs.org/LADBSWeb/LADBS_Forms/PlanCheck/2011LAAmendmentforGreenBuildingCode.pdf

Angeles in 2010. Between 1990 and 2010, an average of 5,162 new units of MUDs were constructed each year.[36] If the construction continues at the average pace, this would result in an additional 268 electrified parking spaces annually.

Problematic areas for MUD access

- The rate of construction of new buildings has slowed dramatically since the housing crisis, so the rate of new Green Building units and electrified parking spots may be slower than optimal to keep up with expectations for EV fleet conversion.
- Compliance does not necessarily create an easy path to EVSE installation and easy billing arrangements for the electrical usage.
- The requirement to install 240V outlets may not be necessary for many drivers who have shorter commutes. Developers could have four times more 120V outlets installed using the same amount of power. Also 120V can be used to charge with the trickle charger that is provided with the vehicle, while additional equipment must be used to charge with a 240V outlet.

5.2 State Policies

California State Senator Ellen Corbett authored both S.B. 209 and 880. S.B. 209 was put into law July 25, 2011 and added an exemption to Section 1363.06 of the Civil Code, preventing Community Interest Developments (CIDs) from restricting installation of EVSE in common spaces, provided that residents meet a checklist of requirements including: covering the cost of the electricity and installation, hiring a licensed contractor, complying with architectural standards, and obtaining insurance coverage. It also stipulated that the resident must obtain an "umbrella liability insurance coverage" naming the CID as an additional insured party. S.B. 880 was an emergency clean-up bill that recently went through to correct flaws in 209. The insurance term it named has a specific meaning within the industry that is not appropriately suited to this use. For this reason, insurance agents have had difficulty pricing these policies. S.B. 880 changed the language to "homeowner liability coverage policy" and make other small changes.[37]

36 RAND Los Angeles Building Construction. [http://ca.rand.org/stats/economics/cityconst.html]. The original source of the data is the Construction Industry Research Board.

37 S.B. 880 was passed and signed February 29, 2012.

Problematic areas for MUD access

- There is no equivalent legislation for renters.
- An insurance requirement may increase the cost of owning EVSE.
- S.B. 880 is a complex law that may be difficult for some to interpret.

5.3 Federal Policies

U.S. Department of Energy granted $114.8 million in American Recovery and Reinvestment Act funds to ECOtality, an investor-owned company, to manage the EV Project—an effort to provide qualified parties with Blink EVSE and up to $1200 for the installation.[38] Coulomb Technologies was also awarded a $15 million DoE grant for administration of their ChargePoint America program and another $22 million from other agencies, including the California Energy Commission.[39] ChargePoint America only provides equipment and does not reimburse for installation costs.

Problematic areas for MUD access

- The program has specific requirements that may preclude MUD residents from qualifying for eligibility, such as Internet connection to the EVSE for data collection purposes, which can be difficult and costly in some parking arrangements.

6. Criteria for evaluating policy responses to barriers

Our research has made it clear that changes can be made to the existing EVSE policies that will increase the rate of EV charging equipment installations in MUDs and decrease the average cost. Our goal is to accomplish this by proposing policies that improve upon or complement existing policies. Our policies expand eligibility to currently excluded groups, correct information deficits, remove perverse incentives, and leverage private capital. We evaluated our proposed policy options with the following three criteria.

38 DoE Energy Efficiency and Renewable Energy News. June 23, 2012. http://apps1.eere.energy.gov/news/news_detail.cfm/news_id=16115

39 ChargePoint America press release. May 13, 2011. http://chargepointamerica.com/blog/chargepoint-america/department-of-energy-celebrates-chargepoint-america-milestone/

6.1 Increased access to night time charging in MUDs

Access to night time charging at-home is important for two reasons. First, market studies have concluded that most potential adopters need to have at-home charging access to move forward with their transition to electric vehicles.[40] Second, as discussed previously, nighttime charging uses electricity when demand is at its lowest, power is produced from cleaner sources, and is less expensive for resident subscribed to LADWP's TOU rates.

For each policy, we will consider how effectively the policy encourages at-home charging access. We will explore the mechanism by which it functions and the population it will affect. For example, policies that reduce costs or information deficits for EVSE adopters will increase access.

6.2 Cost impacts

Due to the scarce availability of funding, we are interested in comparing the implementation costs across policies. For each policy, we will estimate the cost impact for the implementing agency in relation to the status quo. This will include both a discussion of funds that must be newly allocated, and the effect on the use of existing funds. Policies that make more effective use of existing funds, or require only modest allocation of new funds for a substantial gain, will be recommended.

6.3 Other considerations (included, where applicable)

- Distributional Effects: In cases where an identifiable group will be substantially affected by a policy, we will consider who bears the costs and who reaps the benefit of the policy.
- Policy Interactions: The policy options we consider will interact with current regulations and subsidies, as well as with the other policy options we suggest. When considering the amount of increased adoptions likely to arise from a policy, we considered whether the policies would be used in conjunction or separately. We also considered whether the proposed policy might result in increased or lessened participation in any other programs.
- Political Feasibility: We have assessed our proposed policies by examining the likely political support from the implementing agencies and stakeholders. Implementing agencies will vary in their willingness to consider new policy ideas or adjustments. Based on our conversations with agency officials and other experts, we consider whether the implementing agency would be inclined to support such a policy
- We also consider how stakeholder groups will likely respond to the various policies. For example, HOAs and landlords will likely oppose policies that limit their control over the property.

Individually, the satisfaction of any single criterion is not sufficient to justify a policy. We will strongly recommend policies that have a balance of these characteristics:

Increases access to nighttime charging for MUD residents, has low or no additional costs, promotes equity, functions well in conjunction with other policies, and is politically feasible.

40 Dubin, Jeffrey; et al. [2011]. "Realizing the Potential of the Los Angeles Electric Vehicle Market." UCLA Luskin Center for Innovation and the UCLA Anderson School of Management. May 2011: page 4.

7. Proposed Policy Options

The following are our proposals for new policies and adjustments to existing policies. The policies are sorted by the agency we recommend implement them.

7.1 Los Angeles Department of Water (LADWP)

Below are programs that can be implemented by LADWP. Some of the following are proposed changes to the existing LADWP Charge Up L.A.! program. It is set to expire June 30, 2013, but so far has been under-subscribed. An immediate adjustment that would facilitate more rapid use of these funds would be ideal. The Board of Water and Power Commissioners voted to approve this pilot program. It will be evaluated for further development when it expires. That will be a good opportunity for the Board to consider these changes. We have suggested changes to subsequent EVSE rebate programs in order to shift the ratio of rebates that go will go to single-family homes and to multi-unit buildings and increase MUD charging access generally. Many of these policy ideas would be transferable to any organization trying to create MUD-oriented EVSE programs.

7.1.1 Proposed Policy I: Partially Subsidize Assessment

Allow Charge Up L.A.! funds to subsidize the cost assessment of an EVSE installation at 50% up to $75. In order to claim the subsidy, the electrician must go through a check-list of options and possibilities in addition to providing cost assessment (i.e. discuss parking arrangements, electrical capacity, whether or not Level 1 would be sufficient for commute distance, check for simple conservation opportunities). Consider including the cost of the assessment in the $2000 maximum rebate amount.

Rationale:

This policy addresses the lack of knowledge among building owners and residents about the cost of adding charging capability. Though some install scenarios are prohibitively expensive, there are many install scenarios that can be done at relatively little cost. Subsidizing assessments will help reveal the lowest cost adoptions and spur more installations. Apartment dwellers may then sort into these low cost settings. Evaluation of other site-specific information diffusion policies have shown this strategy to be effective.[41] This information may also be valuable for state actors designing policy.

Impact on access to nighttime charging:

Many landlords, HOAs, and residents assume that EVSE installations are out of reach, but subsidized assessments would make known site-specific information about the true costs. Subsidized assessments will encourage the least costly installations to occur. Cost assessments would also reveal which parking spaces in the building were located in areas with low cost installations (i.e. those near the electrical panel). This will open a dialogue about adjusting or selling parking arrangements to facilitate the lowest cost installation.

41 One study (Morgenstern, 1998) reported that a utility provided site-specific information diffusion program had a statistically significant upward influence on the number of adoptions for an analogous technology, high efficiency lighting in commercial office buildings. The effect was stronger for parties who had already previously done energy-efficient retrofits.

Cost Impact:

Cost assessments currently range widely in cost. We found one electrician that offers free bids, but other local companies are offering bids starting from $500.[42] We think a 50% subsidy up to $75 is a fair reimbursement for the service described above. For context, with a $75 rebate, 26 cost assessments could be rebated for the same cost of subsidizing one EVSE rebate. Some assessments are likely to result in no discovered EV charging solution, some will result in Level 1 charging with new or existing infrastructure, and some will result in a MUD customer taking advantage of the EVSE rebate. There would also be an administrative costs associated with creating the checklist form for the electrician and the separate processes necessary to confirm eligibility and issue reimbursements.

Other considerations:

This policy interacts well with our other proposed policies, such Proposed Policy II, which allows the rebate to cover Level 1 charging arrangements for people in MUDs. An assessment may reveal that Level 1 is adequate and/or substantially more affordable, and would thus facilitate an installation. Also, it would interact well with Proposed Policy III, which allows non-drivers, i.e. building management, to access the Charge Up L.A.! program, since an assessment may reveal the economies of scale of doing multiple installations to be very high.

> ***Takeaway:***
>
> Partially subsidizing the cost will encourage the use of assessments by parties interested in installing EVSE, at a low cost per assessment. Greater use of these assessments will identify more low cost installations, increasing the number of installations and decreasing their average cost.

7.1.2 Proposed Policy II: Subsidize Level 1 installation

Expand current LADWP subsidy to reimburse Level 1 EVSE (120V) installation, up to $2000, for MUDs.

Rationale:

As mentioned in "Technology and Installation Basics," Level 1 requires four times less power and can be installed when less electrical capacity is available. This policy would benefit highly motivated EV adopters to plan and install their own private charging arrangements by facilitating a relatively inexpensive charging setup that is less likely to exceed the existing electrical capacity. This may circumvent the need for costly electrical load monitoring and electrical capacity upgrades.

Impact on access to nighttime charging:

As we have discussed, Level 1 charging is adequate for most commuters in Los Angeles. By loosening restric-

42 A group from the UCLA Anderson School studying costs related to EVSE in MUDs was quoted this amount when enquiring about building assessments. Upon completion of their study, this cost could be updated to include their findings.

tions on the LADWP subsidy for MUD residents, Level 1 installations can occur in cases where Level 2 is too costly, thus increasing access to charging. However, depending on driving habits, the charging event cannot always be fully contained in off-peak hours, therefore promoting Level 1 charging would also likely increase daytime charging.

Cost Impact:

This policy is a change to the LADWP Charge Up L.A.! program. By expanding eligibility, this policy will increase the rate at which funds are used from this program. Since Level 1 installations can be less expensive than Level 2, more installations will occur with the same amount of funds, or put another way a single installation may occur with less than $2000 of subsidy. Despite the fact that Level 1 installations are typically less expensive than Level 2, it is possible that a Level 1 charging installation could still exceed the $2000 rebate limit simply because electrical work can be time consuming and expensive in big buildings. Thus, even though is it is very likely this will decrease the average subsidy per installation we cannot guarantee this will be the case.

Other considerations:

Contractors may provide beyond what is required or simply overcharge, in order to take advantage of the full amount of the subsidy.[43] For this reason, proposed Policy IV suggests "uncoupling" the subsidy from the cost of installation. This provides an incentive to the EVSE adopter to hire an electrician who offers the best value.

Level 1 charging, which can accommodate up to 50 miles of driving on one ten-hour nightly charge, is adequate for many drivers within LA and there are substantial environmental benefits to be gained from these commutes. However, commuters with high daily vehicle miles traveled (VMT) will produce the greatest environmental gains when they transition to EV, and Level 1 may also be an attractive option for drivers with very low VMT. However, low VMT drivers do create other important benefits, such as "learning-by-using" and network gains, particularly those who live in MUDs (see earlier section "Importance of Special Planning for MUDs in EV Infrastructure Policy").

> ***Takeaway:***
>
> In cases where installing Level 2 charging requires a costly electrical system upgrade (in excess of the subsidy), Level 1 charging may not require such an upgrade. Expanding Charge Up L.A.! to cover Level 1 EVSE in MUDs will promote the installation of charging equipment when Level 2 equipment is prohibitively expensive, though there are drawbacks to this mode of charging.

7.1.3 Proposed Policy III: Partially subsidize EVSE for non-EV drivers

Provide a partial subsidy for residential EVSE installation to parties that do not own an EV. Pay for half of the cost (up to $2,000) of equipment and installations by landlords/HOAs who want to install EVSE as a value-add.

43 Interview with William Korthof

Rationale:

Only partially subsidizing the cost would ensure that the landlord would only install EVSE if she believes her tenant demographic is consistent with those of likely EV adopters and the equipment would be used. This would provide charging access to populations, such as renters, for whom it is typically not practical to pay for their own equipment.

Impact on access to nighttime charging:

Loosening restrictions on existing EVSE subsidies will allow more subsidized installations to occur. A partial subsidy will incentivize some landlords and HOAs that identify their residents as potential adopters to invest in EVSE, an amenity that could attract new residents and increase value of property. This would increase access for present and future PEV adopters who would otherwise be unwilling to purchase and install EVSE.

Cost Impact:

A partial subsidy may bring more private sector money toward EVSE installations, reducing the amount of average subsidy per installation. Some rebates would be less than $2000 which would allow Charge Up L.A.! funds to cover more than 1000 rebates.

There may be some cost associated with developing a separate process for non-EV drivers.

Other considerations:

Unlike the existing EVSE rebate, partially subsidizing landlord initiated installations are not guaranteed to have perfect utilization, because there is not a confirmed one-to-one EV driver-to-charger ratio. For instance, a landlord may install EVSE before they have a tenant ready to use the equipment.

This rebate would be given to landlords and commercial entities, both of which can provide charging access for those living in MUDs. It will reduce the amount of funds available to EV drivers directly. The subsidy of an amenity which adds value to a commercial property may be contentious, though it indirectly benefits renters who would otherwise have limited or no options.

> ***Takeaway:***
>
> Subsidizing the installations of EVSE by landlords will increase charging access for renters. A partial subsidy leverages private resources and ensures that people taking advantage of the subsidy see value in installing the equipment.

7.1.4 Proposed Policy IV: Uncouple subsidy from cost of EVSE

Uncouple the cost of charging equipment from the amount awarded by the subsidy. In other words, give the EV owner $2000 for their qualified EVSE installation regardless of its cost.

Rationale:

There is currently no incentive for people taking advantage of the rebate to do an EVSE installation costing less than the subsidy amount. This may be driving up the market cost of charging equipment and the installation. Of the 85 rebates issued in 2011, the average reimbursement was $1996.70 dollars ($3.30 less than the maximum credit of $2000). This is not surprising because there is no incentive to find an install that costs less than $2000.

With the subsidy uncoupled, the recipient has an incentive to save money during installation. Money saved during installation is effectively an additional subsidy for purchasing the vehicle, rather than a windfall for equipment manufacturers and electricians. This incentive may reduce market costs, which will make EVSE more accessible for everyone, including people who are not eligible for subsidies.

Impact on access to nighttime charging:

EV drivers who take advantage of the rebate and find cheap ways to install EVSE will see the difference between the $2000 and the cost of the installation as an additional credit associated with the purchase of the EV, making an EV purchase more attractive. Uncoupling the subsidy from the equipment and install costs should lower the market price of these goods and services, which will benefit EVSE adopters outside the eligibility and funding constraints of the subsidy, and thus increase the number of installations.

Cost Impact:

This policy change is essentially revenue neutral compared to the status quo. Providing the full subsidy for all 85 rebated installations in 2011 would only have cost an additional $281. There would be no new administrative costs or processes incurred in making this adjustment to the existing policies.

Other considerations:

In order to receive the subsidy, the recipient should provide proof of having installed new equipment and documentation of the cost of installation, which is already a step in the existing process. This cost data should be used to set the level of subsidy for subsequent programs. National subsidies should be uncoupled for the same reason.

This policy could reduce the pay for local electricians installing EVSE and equipment manufacturers.

Takeaway:

Providing the full $2000 rebate for installed EVSE creates an incentive seek out the lowest possible cost for an installation. Because the average rebate is nearly $2000, this policy is essentially budget neutral. Recipients will prefer an uncoupled subsidy and such a subsidy may reduce the market price of EVSE installations.

7.1.5 Proposed Policy V: Create a detailed guide

Develop a guide for interested residents or building management explaining the variety of EVSE installation, utilization, and cost recovery schemes. The guide should demonstrate electricity payment arrangements that have been successful for other MUD residents such as separate metering, submetering, flat rate fees, hourly charges, or charging by kWh. The guide should clarify the utility rules on reselling electricity and other pertinent laws outlining rights and obligations.[44] The guide could also present best practices for decreasing the cost of installations, such as allowing the sale or trade of parking spots to allow the EVSE to be installed near an electrical panel. It could also provide sample agreements assigning responsibility for maintenance, ownership, equipment decommissioning, and payment for electricity.

Rationale:

Many utilities have created general guides that address the steps necessary to install EVSE, stating whom to contact, and in what order. These facilitate smoother interactions between the utility, city agencies, and the customer, however, they do not address the most challenging barriers that MUD residents face. Many of our interview subjects were most inhibited by the complexity of negotiating with their landlord or HOA about the installation, utilization, and electricity payment arrangements. These issues have largely been ignored or insufficiently addressed in previous guides. Presenting arrangements that have worked in previous MUD cases will pave the way for new installations.

Impact on access to nighttime charging:

The guide may calm the fears of people interested in installing EVSE in their multi-unit dwelling. The guide will also streamline negotiations between building management and residents since they will not be challenged with deriving an original scenario. This should reduce the time costs to both parties, thus encouraging installations that are at the margin to move forward.

Cost Impact:

Collecting the information for such a guide will involve interviewing residents and building managers. It will also be necessary to conduct interviews with experts on current scenarios and the legal framework surrounding them. One option is for LADWP to create the document internally, but research organizations, such as the Luskin Center, might be willing to undertake such an effort.

Optimally, the majority of the guide could be created with donated time, but interviews with relevant experts at the LADWP will be necessary to insure the quality of the guide. The effort necessary to create such a guide will vary based on the level of detail, but as a first-order approximation, the amount of work that it would take to produce such a document would be roughly equivalent to one Capstone-style project.

In order to ensure the guide is as effective as possible, efforts should be made to outreach to local EV dealers and EVSE contractors. There would also potentially be costs associated with physical distribution and web hosting of the guide.

44 During our research we encountered many parties who understood that LADWP prohibits the resale of electricity. Though this is true, a special exception has been made for electric vehicle charging. Due to the amount of confusion that we encountered, it will be useful to prominently advertise the exception.

Other Considerations:

Nothing requires that this guide be fully created or paid for by one entity. The findings of this report, for example, will be useful in building a best practices section of a guide. Further, graduate students in the UCLA Anderson School of Management are currently authoring a report on payment and cost recovery models for public and MUD charging. Once the Anderson report is complete, their findings can be extremely valuable in supporting the payment and billing options section of the guide.

> ***Takeaway:***
>
> New EV adopters in MUDs are spending considerable time discovering the applicable laws and best arrangements for charging. These costs could be avoided by publishing a definitive guide to EV charging in MUDs.

7.1.6 Proposed Policy VI: Provide a mediator for difficult negotiations

Employ an informed mediator to aid MUD residents who are impeded by negotiation problems with their building managements. The mediator will meet with building management as an impartial party (not motivated by profit, unlike the electrician/installer) and explain legal considerations, billing arrangements, other common solutions to hurdles, and help draft a plan for moving forward.

Rationale:

In our interviews we found negotiations with landlords and HOAs to be a major challenge to installing EVSE in MUDs. Since EVSE is a new technology, it is common for building management to have fears resulting from their lack of knowledge about what infrastructure changes will be necessary and how the installation will affect the building's electrical system. A professional mediator who is knowledgeable of EV laws, code, and common arrangements can help overcome this challenge.

Impact on access to nighttime charging:

If this policy is done in conjunction with a MUD guide, the mediator could be reserved for "hard cases", and then use her expertise to update the guide. For each case the mediator's involvement would either move the installation forward or not. A previously hesitant landlord or HOA might decide to install additional charging stations after better understanding the process. However, even in cases where the installation did not move forward, the parties, both residents and management, would leave with a greater understanding of the possibilities surrounding EVSE. This is knowledge the parties could pass on to others, which could lead to more installations in the long run.

Cost Impact:

Implementing this program will require hiring and training a professional mediator. The number of installations

this person could facilitate would be limited by their time, not likely to exceed several dozen per year. For context we examined the public list of LADWP salaries for comparable positions: Legal Secretaries earn $80,000, Public Relations Specialists earn $84,000, and Customer Service Representatives earn between $32,000 and $65,000.[45]

The Electric Service Representative, sometimes referred to as the Service Planner, currently provides some aspects of this service, but mainly communicates with electrician.[46] A designated mediator could further communicate with residents and building management. LADWP Electric Service Representatives earn between $75,000 and $82,000.

Other Considerations:

We are aware that, at one time, Chevrolet contracted with a third party to provide a similar service.[47] If car manufacturers continue to provide this service, it would relieve LADWP from needing to fund and hire a mediator. However, the connection to a car manufacturer may make some parties doubt their impartiality. Some of our interview respondents reported that their HOAs did not trust experts whom they perceived to have financial interests.

> ***Takeaway:***
>
> An LADWP mediator will directly address cases that are only stymied by information deficits and the political negotiation barriers. It would require hiring a new employee and the appropriation of new funds.

7.1.7 Proposed Policy VII: Create a registry of EV-ready buildings

Create a registry of buildings that are EV-ready for prospective home renters/buyers. Include a mechanism to verify that EVSE is available at the building.

Rationale:

This would increase the value of providing charging access to residents and encourage investment in EVSE by private landowners and decrease search times for EV owning tenants.

Impact on access to nighttime charging:

This should increase the incentive for landlords to install EVSE for use by their residents by creating a new venue for reaching a growing, niche segment of home-seekers who have prioritized charging-access as a required characteristic of the building where they will choose to live. This incentive will increase the number of installations.

45 Los Angeles Department Water and Power employee salaries as of Sept. 11, 2007. Online database hosted by LA Daily News, http://lang.dailynews.com/socal/ladwpsalaries/.

46 Interview with William Korthof

47 Shad Balch, Assistant Manager of Environment, Energy, and Policy for GM at "Electric Vehicles and Policy" discussion Feb 21, 2012.

Cost Impact:

If maintained efficiently, this could be a very inexpensive method to increase EVSE installation. This website could be linked from the Charge Up L.A! website and building owners could contact LADWP to have their locations added or, alternatively, add the location themselves. There would be an initial cost of a web designer's time to create the page and the cost to maintain the website. This second time cost could be mitigated through the use of "crowdsourcing" technology, such as a wiki-style page where people seeking living situations with EVSE access update and correct information as they visit the sites.

Other considerations:

This policy may interact with other EV programs, if the database effectively increases the value of an apartment with EV charging, utilization of other EV resources (like LADWP subsidy) will increase.

Some types of EV charging and EVSE do not require electrical work that would necessitate permits to be obtained. This would also add to LADWP's bank of information about the location of charging equipment, which may be incomplete despite their permit requirements.

This policy would complement Policy Proposal III (Partially subsidize EVSE for non-EV drivers). Since this policy makes installing more attractive for building management it would increase use of the Charge Up L.A.! subsidy once it was open to non-EV drivers.

> ***Takeaway:***
>
> Ultimately, EVSE in MUDs will likely be installed as an amenity valued by residents. This database will capture the value of this equipment.

7.2 Los Angeles Department of Building and Safety (LADBS)

The LADBS enforces the building and electric code, including the Los Angeles Green Building Code. The Green Building Code requires new MUDs to have electrical infrastructure to allow charging of electric vehicles. Changes to this policy may change the costs imposed on real estate developers who must build in compliance with the Los Angeles Green Building Code.

Previous reports have recommended radical changes to the Green Building Code. We considered a requirement for building owners doing alterations valued over $200,000 to comply with the same EV readiness standards as newly constructed buildings. While this would theoretically increase EV-readiness, it would impose substantial costs on building owners doing alterations unrelated to parking or electrical system. After talking with an LADBS employee familiar with the Green Building code, Osama Younan, we understood that this change would not be politically feasible and do not include it in our proposed policies.

Mr. Younan is interesting in incorporating thoughtful adjustments that would result in more completed EVSE installations. The current rules were not designed with any barriers in mind aside from available capacity and

electrical infrastructure. We suggest the following ideas for adjustments to the Code that would result in increased charging access, having taken into consideration what is reasonable to impose on building developers.

7.2.1 Proposed Policy VIII: Establish a demand factoring standard for EVSE

When determining the necessary size of an electrical service, a demand factor, designated by the National Electric Code, is assigned for appliances in load calculations (explained in "electrical capacity limitations"). The demand factor reflects the assumption that all appliances are not used simultaneously and continuously.

The National Electric Code is updated every three years and an accurate demand factor that adjusts for the use of single or multiple chargers should be implemented in the next revision. Since EV is such an important goal for LA, LADBS could take the initiative to encourage this revision. They should consider the findings of the EV Project load monitoring effort to determine the correct demand factor.

Rationale:

Currently, some inspectors assign a demand factor of 1 for EVSE, assuming the EVSE is running constantly for the purposes of determining the necessary electrical service size. This may not accurately reflect its usage, particularly in cases where multiple chargers are being installed.

Upgrades that require expanding electrical capacity, either at the electrical panel, or the electrical service level, can be costly. Accurately accounting for the additional demand of EVSE will avoid unnecessary upgrades to a building's electrical system.

Impact on access to nighttime charging:

Accurate guidelines will allow installations that would not have occurred, to go forward.

Cost Impact:

The costs of implementing this include staff time to evaluate a proper demand factor and then lobbying for changes to the code. There are costs associated with publication and dissemination of the new guidelines, but since the code is already updated every three years these would not be additional costs.

Other Considerations:

It is possible that 1 is the correct demand factor and that inspectors are already correctly estimating the demand factor of EVSE.

Takeaway:

EVSE adopters may be losing opportunities for low cost installations on account of an overly conservative demand factor. Developing an evidence based demand factor for EVSE will eliminate that possibility.

7.2.2 Proposed Policy IX: Review the Los Angeles Green Building Code

Adjust the Los Angeles Green Building Code in any of the following ways: increase the minimum number of outlets accessible from the parking area; allow flexibility between Level 2 or a larger number of Level 1; consider having higher electrical service capacity requirements to accommodate future expansion.

Rationale:

The cheapest way to install electric vehicle charging infrastructure is to do it during the time of construction. Several thousand new units of multi-unit residential housing are constructed each year, leading to a significant number of "EV ready" parking spots.

Impact on access to nighttime charging:

This policy ensures that the electrical capacity and infrastructure are in place for a substantial amount of electric vehicle charging. If the coming years see an amount of construction consistent with the 20 year average (~5000 units per year), this policy "electrifies" (or nearly electrifies) a minimum of approximately 250 parking spaces per year.[48] However, if parking is bundled with units, there may be poor matching between these new electrified spaces and current/future EV drivers.

Cost Impact:

The costs of installing additional electrical capacity and conduit are lowest during construction. The cost of insuring code compliance should be comparable to other code requirements verified during construction.

Other Considerations:

This policy adds an expense to new construction (though this expense may turn out to be an asset in the future). The expense is directly paid by the party doing the construction, but if a restrictive building code discouraged new construction, the cost may be borne by all renters in the form of higher rents.

Making informed recommendations about the building code requires knowledge of how building codes affect construction decisions and costs, and we do not feel comfortable recommending a specific increase in the percentage of the spots to be electrified. In order to make these recommendations we would need to know more about the price elasticities and decision making involved in the construction of MUDs.

48 Rand website: http://ca.rand.org/stats/economics/cityconst.html

Takeaway:

Building code requirements may be an effective way to increase charging access and requiring more infrastructure may be appropriate. However, we do not have the data or expertise to make a strong recommendation. We suggest further research.

7.3 California Law

7.3.1 Proposed Policy X: Expand S.B. 209/S.B. 880 protections to renters

Expand S.B. 880 through further legislation. Consider a similar rule requiring landlords to approve EVSE installations if specific terms are met. At minimum, convene stakeholders to discuss preparation for a rental market that demands EV charging infrastructure, so that EVSE access can be obtained in a way that is minimally disruptive and most advantageous for all parties.

Rationale:

For many of the same reasons that homeowners should not be unduly prevented from installing EVSE, renters should enjoy a similar right to install EVSE at their own cost. In other policy realms, an analogous ruling made it illegal to impose unreasonable restrictions on renters regarding the installation of direct-to-home satellite dishes, TV antennas, and wireless cable antennas.[49] The same way that the right to install satellite dishes is protected, the right to install EV charging equipment should also be protected.

Impact on access to nighttime charging:

Negotiations with landlords are often the most significant barrier to installation. This will ensure that highly motivated EV-drivers, who are willing to pay the entire cost of installation and liability insurance, would not be prevented from having at-home charging access because of the landlord's hesitancy. However, as discussed previously, since a renter has no financial stake in the property once they leave, EV drivers who wish to self-finance installations in a rental setting will likely be a smaller group.

Cost impact:

Convening stakeholders, whether in the interest of a bill or simply starting a dialogue, will require time and resources from all parties including, but not limited to apartment associations, tenants rights groups, and legislative staff.

Other considerations:

This issue was raised during the drafting of S.B. 880. Senator Corbett's staff felt it prudent it to move forward with a bill that focused on owners in CIDs because they more discussion was necessary before expanding the

49 Federal Communications Commission. "Over-the-Air Reception Devices Rule." Accessed March 1, 2012. http://www.fcc.gov/guides/over-air-reception-devices-rule

bill to include renters. Landlords will likely be strongly resistant to policies that lessen their control of common areas. It will be necessary to craft these rules in conjunction with highly impacted stakeholders, such as the Apartment Association.[50]

> ***Takeaway:***
>
> At the moment, securing rights for renters to self-finance installations of EVSE appears politically infeasible. However, through dialogue and negotiations we may find compromises that will give highly motivated renters a path to EVSE access.

8. Conclusions

Through our research, we determined the barriers that must be addressed to allow early adopters, enterprising landlords and HOAs to install charging equipment. This will increase at-home charging access and promoting more widespread adoption of electric vehicles. Early installations will have increasing dynamic returns, paving the way for middle market adoption.

We have separated our proposed policies into three tiers:

- Tier 1 policies should be implemented immediately. They perform well across our various criteria. We anticipate they will produce substantial benefits, are not very costly, and other uncertainties are minimal. Included are:
  - Partially subsidizing installations for non-EV drivers opens the subsidy up to an entirely new market, has high likelihood for learning and network gains since building managers can bring their new knowledge to bear with all residents and possibly other properties, and it would require little administrative cost since it would be an expansion of an existing program.
  - Subsidizing Level 1 installations will subsidize installations in MUDs in cases where there is not adequate electrical capacity for a Level 2 charger—increasing charging access.
  - Create a detailed guide, which will, with some investment, reduce time spent by EVSE adopters determining if and how an installation and subsequent arrangements can take place.
- Tier 2 policies are also recommended, but they do not perform as strongly under our criteria:
  - Providing a mediator for difficult negotiations has strong potential to move forward stalled negotiations and would create spillover benefits, but directly benefits only a limited number of people and would pose a new cost.
  - Creating a registry of EV-ready buildings will increase the incentive for building managers to install EVSE and help residents find buildings with charging access, but it may take time to build the registry and LADWP may be reluctant to take responsibility for maintaining a new web service.
  - Partially subsidizing assessments will spread more accurate information about what is required to install EVSE, but the effectiveness of this service may be highly dependent upon the performance of

50 Interview with Seyron Foo, staffer for California Senator Ellen Corbett

each individual electrician, which may vary widely.

- Uncoupling the subsidy from the cost of EVSE will be an additional incentive for people taking advantage of the subsidy, rather than a boon for equipment manufacturers and installers, but it may meet resistance from ratepayers see it as a handout.

- Tier 3 policies are promising, but require more research and input from experts:
  - Establish demand factor for EVSE to potentially better utilize existing capacity.
  - Revisit the Green Building Code to potentially increase requirement or add flexibility.
  - Start dialogue to potentially expand S.B. 209/880 to renters.

For a city like Los Angeles, with predominantly multi-unit dwellings, policies must be designed with these residents in mind if they are to achieve their full potential. In order to address the urgent energy and environmental challenges we face, emerging technology policies must not exclude large and important parts of the population. In addition to thoughtfully designed electric vehicle policies, a full package of environmental and energy policies that lead to a cleaner grid mix and internalize the societal costs of gasoline is necessary to reach these goals. Together, these policies can achieve the ambitious environmental and public health goals that inspired them, and LA should lead the charge!

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Appendix I. Billing options under the LA Green Building code

The Los Angeles Green building code requires that new high-rise residential construction be equipped with outlets on 208/240V 40A circuits for 5% of the parking sports. This requirement may limit the feasible billing arrangements for electricity used at these outlets, because in many cases the outlets will be connected to the building's common area meter.

There are several approaches that could be employed in charging with common metered outlets, each with advantages and disadvantages:

I. Flat Rate

All electricity use is billed to the landlord and tenants pay a monthly flat rate for access to EVSE the outlets.

Advantages: The cost can be lumped in with existing rent transactions. Equipment purchased by residents can be taken when they move. This arrangement allows for purchase of inexpensive EVSE.

Disadvantages: It may be hard to coordinate multiple users. There is no TOU incentive. A flat rate offers no incentive to reduce use, because the cost to fuel the vehicle does not change with less or more driving. Users may suffer from adverse selection, since the system is more attractive for heavy users, which will increase the average cost.

II. Third party facilitates billing

An Electric Vehicle Service Provider (EVSP) develops and provides a billing mechanism that must be used with the equipment they have provided.

Advantages: Such a system can work with equipment connected to the common area meter. The cost to access the EVSE can accurately reflect kWh and TOU rates. Multiple EV drivers could share one EVSE and be billed separately. The third party has an incentive to attract and retain users, so equipment will likely be well maintained and services will be high quality.

Disadvantages: Third parties may overprice for metering and billing services because they have a local monopoly. TOU incentives might not be reflected in their pricing. Also, EVSPs may choose not to install equipment in buildings low adoption.

III. Resident pays for new TOU meter

The resident establishes new service exclusively for charging the EV. This requires the power/outlet to be disconnected from common space meter and connected to the new TOU meter.

Advantages: The resident gets the cheaper electricity rate available for EV charging. The TOU rates incentive is in place. The electricity usage is billed directly to the resident.

Disadvantages: The resident must bear the additional cost meter, panel, and modification to existing wiring. The resident may surrender the value of the new meter and panel if they move.

Appendix II. Background for S.B. 209 and 880 (Corbett) and interview with staffmember

Introduction to S.B. 209 (Corbett):

S.B. 209 was passed and signed on July 25, 2011 and went into effect January 1, 2012. This bill added Section 1353.9 to the Civil Code in the section related to Common Interest Developments. Its main purpose was to add EVSE to the list of items and activities about which HOAs cannot make legally binding prohibitions. Other existing laws void CID decisions and rules to prohibit solar energy systems, low water-use plants, and display of the American flag.

In summary, S.B. 209 mandated that CCRs that effectively prohibit or "unreasonably" restrict installation or use of EVSE are "void and unenforceable".51 "Reasonable restrictions" are those that do not "significantly increase the cost or decrease its efficiency…"52 Approval or denial of a request to install or charge, if approval is necessary, must be provided within 60 days.53

If the EVSE is to be installed in a common space or an exclusive use common space, the resident will seek approval from the CID and the CID should approve if the resident agrees in writing to comply with the CID's architectural standards, use a licensed contractor, pay for the electricity, and obtain "umbrella insurance coverage" in the amount of $1,000,000 naming the CID as an additional insured. The resident is also responsible for all costs associated with maintaining and removing the EVSE and for informing prospective buyers that they will be responsible for the same.54 "Exclusive-use common space" does not have a single standard definition. The definition varies with each housing development CCR. The typical definition is a parking space designated for exclusive use by a particular resident, but not deeded to the property.55

Violation of this law would make the CID liable for a civil penalty of up to $1,000.56

Aftermath:

Governor Brown signed S.B. 209 with a statement indicating that he had only done so with a promise from Senator Corbett that she would introduce cleanup legislation to amend language that he perceived as inadequately protecting the right of CIDs "to make reasonable rules for any use of common areas for charging."57

Additionally, a number of insurance company representatives contacted Senator Corbett's office when S.B. 209 was put into effect asking about the "umbrella insurance coverage" stipulation. It became apparent that this term refers to a specific insurance type that is inappropriate for the intent of this legislation. Another complaint posed by a community association advocacy organization noted that this bill conflicts with a current law requiring a 2/3 HOA vote to grant exclusive use of a common area.58

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51 California Civil Code Section 1353.9 Section 1 (a)
52 California Civil Code Section 1353.9 Section 1 (b)(2)
53 California Civil Code Section 1353.9 Section 1 (e)
54 California Civil Code Section 1353.9 Section 1 (f) (1-2)
55 Interview with Seyron Foo
56 California Civil Code Section 1353.9 Section 1 (g)
57 Governor Brown July 25, 2011 S.B. 209 signing message. [http://gov.ca.gov/docs/SB_209_Signing_Message.pdf].
58 Community Associations Institute "Hot Bills – End of Session Update." September 8, 2011. [http://www.caicalif.org/HOT-BILLS~259881~16678.htm]

Senator Corbett's office introduced emergency cleanup S.B. 880 to address these issues in September 2011 and it was passed and signed February 29, 2012.

Changes in S.B. 88o

S.B. 880 created additional stipulations making it so that if a CID resident wishes to install EVSE in a common space

(1) the EVSE must be available for use by all members of the association and must agree in writing to comply with the aforementioned checklist of actions necessary for CID approval. In this case "the association shall develop appropriate terms of use for the charging station."59

Or

(2) the resident can install EVSE for their exclusive personal use in a common area only if installation in the resident's designated parking space is "impossible or unreasonably expensive." In this case, the resident must enter into a "license agreement" for use of the space and also comply with the aforementioned checklist.60

The bill also changes the insurance requirement to "homeowner's insurance coverage" and introduces a number of other new provisions. It excludes standard alternating current power plugs (wall outlets) from the insurance coverage requirement.61

Aside from insurance concerns, it also allows the association to create a new parking space where one did not exist to facilitate installation of EVSE, which previously would have required a vote.62 It then adds two exceptions to related Section 1363.07, which requires an HOA vote to grant exclusive use of common areas. One, a vote is not required for EVSE in private garages or designated parking spaces "where the installation or use of the charging station requires reasonable access through, or across, the common area for utility lines or meters"; and two, to install and use an EVSE through a license granted by the association.63

Continuing Concerns

Several problems and questions persist even after the thoughtful adjustments made in this legislation:

- The language still leaves space for confusion about what parking situations are subject to the checklist requirements.
- Renters are unaddressed by this legislation.
- "License agreement" is unclear, as is what should be considered "reasonable" in its various uses through the law.
- It is not clear whether new electrical outlets are exempt from the checklist requirements.

Clarifications about bill intent and limitations

59 California Civil Code Section 1353.9 Section 1 (h)
60 California Civil Code Section 1353.9 Section 1 (g)
61 California Civil Code Section 1353.9 Section 1 (f)(4)
62 California Civil Code Section 1353.9 Section 1 (i)
63 California Civil Code Sections 1363.07 Section 2 (3)(G)(i-ii)

We were able to interview one of the staffmembers that assisted with drafting this legislation.64

In regard to our main question, Foo clarified that any resident who installs and uses EVSE in their private or exclusive-use designated parking is not subject to the checklist requirements, including the insurance coverage requirement. He told us that new electrical 120V outlets installed for EV charging arguably are also not subject to these requirements, even though the language only protects existing outlets. 240V outlets would be more difficult to defend if they were challenged. Also, importantly, there is no enforcement mechanism included in this bill. None of the requirements and restrictions need be activated unless the building governance resists the installation and use of the EVSE. In the case of one resident we interviewed who had installed charging equipment in a common space assigned to her for that purpose prior to the introduction of the law, the building management has the right to ask her to obtain insurance, being that the space she was given for charging was in a common area, however, there was no intent in the legislation to compel them to do so.

Foo further said that a "license agreement" is a written agreement that could possibly entail a fee or rent of some kind. It is intentionally non-specific to allow associations and EV-owners to make arrangements agreeable to both parties. The repeated use of the terms "reasonable" is also intentionally vague to account for the variation in willingness and ability to pay. These points could be argued in court. The intention is to avoid a situation in which expensive and disruptive upgrades are done when a simpler solution is available. The authors used vague language to account for as many different situations as possible.

In regard to the absence of similar provisions for renters within this legislation or otherwise, Foo reported that they had considered it, but determined that S.B. 880 is not a politically feasible vehicle for such action. Apartment Associations and the CA Department of Housing and Community Development (HCD) would strongly oppose such as bill. He noted that the HCD is the agency that would be engaged with this kind of rulemaking. Also, planning for EV charging for renters is likely to occur mostly in new housing developments, because "California's housing stock for renters ranges in ability to accommodate EV chargers." However, he did note that if they chose to move forward with similar legislation geared toward renters, it would be have to be in collaboration with stakeholders in order to draft a plausible bill with the necessary buy-in.

Conclusion and Recommendation

This law was crafted in a way that offers great protection to people in condos who are meeting resistance from their building governance around the issue of installing EVSE and charging. However, in our handful of interviews with residents in multi-unit dwellings, two of them personally experienced misapplication of this law. In addition to the situation previously mentioned, another resident was able to successfully leverage S.B. 209 to reverse a denial of his request to install EVSE in his designated parking space, but he was asked to comply with the checklist, which he should not have been according to our findings. This report recommends several mechanisms to diffuse information about laws like these that can easily be misunderstood. A comprehensive guide for stakeholders in multi-unit dwellings that fully details each party's rights and obligations could be particularly effective. The interpretations in the guide should be vetted by HOA advocates and lawmakers.

64 Interviews with California Senate Staffer, Seyron Foo on January 9, 2012 and March 1, 2012

Appendix III. Interviews with Residents of Multi-Unit Dwellings

Resident Profiles

	Building Type and Location	Building Size	Parking	Billing	Charging Type (and cost)	Date of Interview
Resident #1 (2 adults)	HOA governed condo in LA	450 unit high-rise, built in 2003	Underground, 900 tenant spaces, 10 guest spaces.	Parking area electricity paid by HOA fees	Level 1 - extension cord to 120V outlet (paid for wall mounted extension cord)	1/31/12
Resident #2 (1 adult)	HOA governed condo in LA	90 unit high-rise	Underground, valet parking,	Whole building master metered	Level 2 - EV Project EVSE (free equipment and install)	1/26/12
Resident #3 (1 adults)	HOA governed condo in SM	27 units, low-rise buildings	Car ports and a few private garages	Garage power tied to unit's meter	Level 2- trickle charger modification by EVSEupgrade.com ($1900 total)	1/13/152
Resident #4 (2 adults, 2 children)	HOA governed condo in LA, historic building	610 units, low-rise buildings	Private garages	Electricity in garages paid with HOA fees	Did not install Level 2 or purchase EV	1/30/12
Resident #5 (1 adult)	HOA governed condo in SM	72 units, 3 buildings	Deeded parking in a parking structure	Outlet tied to unit's meter	Level 1, 120V outlet installed for charging ($1350 before expected 30% tax credit)	1/30/12

We also interviewed an electrician who has provided many EVSE consultations and contractor services. He told us about a number of MUD installation scenarios that he has encountered:

William Korthof

- Independent EVSE Installer/Electrician
- Has installed 50 Level 2 EVSEs and 50 Level 1 EVSEs (120V outlets)
- 10 successful installations in MUDs and provided assessments for another 6
- Interviewed 2/8/12

Resident experiences with Barrier I, Approval for installation from building management:

Resident #3 obtained permission to install Level 2 EVSE as a condition of purchasing his condo. He did not do so immediately. He chose rather to charge with his 120V trickle-charger using an extension cord run from his unit located immediately above his car port. The HOA send him a letter asking him to remove the extension cord, because it violated HOA rules. He fought with them for allowance to continue to use the cord until he successfully installs Level 2 EVSE.

Resident #2 and #5 were both on governing boards of their buildings and had no trouble obtaining permission

to install. Resident #5 is in the process of convincing his HOA to install a public charger in their common space. He claims that they are receptive.

Resident #1 is currently engaged in a multi-year process to negotiate EVSE installations with his HOA that has involved lawyers, multiple meetings, and lengthy correspondences. The HOA granted permission for Level 2 EVSE installation in the resident's private stall, but he hopes to do work that will facilitate future installations of EVSE, because a private installation would only provide charging for them and create problems down the line for the next residents who will also want access to charging. The HOA has been unwilling to entertain easy, low cost plans to do this that have involved rearranging parking assignments, even though parking spaces are not deeded at their building.

Resident #4 characterized his HOA as "petty" and "political" with "a tendency to disallow for no reason." He felt that even with California law preventing his HOA from disallowing an installation in common space, he would be subject to repercussions from the HOA of the "non-legal kind." His case also introduces another layer to this barrier, which is the heavy time cost of negotiations with the HOA/building management. Resident #4 was the only resident we spoke with who had children and a full-time job. He was unwilling to commit time and resources to negotiations unless they were very likely to result an installation, so he abandoned his efforts. Other residents had and continue to dedicate countless hours to communications and negotiations related to their EVSE installation plans.

Resident Experiences with Barrier II. Determining party responsibility for equipment and installation cost:

Some EV owners, such as Resident #1, have proposed that their building pay for the installation of multiple charging stations to be used by current and future tenants as needed.

Resident #5 is in the process of convincing his HOA that they should install an EVSE in the common space for the use of all residents. He reports that they are receptive.

Resident Experiences with Barrier III. Paying for electricity usage:

Resident #2, reported having good standing with her building management, and she was a member of the HOA's architectural committee. She made an informal agreement to calculate her electricity usage at the end of the year. In an effort to maintain positive relations with the building management she was planning to over-estimate her usage and electricity costs so the building would have no doubt that their costs were covered.

Resident #4, who eventually decided against purchasing an EV, had a poor relationship with his HOA and suspected that they would like to "build up their reserve funds" by charging him $100 per month for access to common space electricity used for EV charging.

Resident experiences with Barrier IV. Insurance coverage requirement for EVSE for people CIDs:

Resident #2 was asked to obtain insurance coverage after she had already installed EVSE and was charging in a suitable parking space that was provided to for her. Her building's governance believed that the insurance was mandated, though the authors of the bill did not intend it that affect.65 Her insurance gave her a price quote

65 Phone call with Seyron Foo, Staffer for California State Senator Ellen Corbett, 1 March 2012.

of about $100 per year for the extra coverage, which she did not find prohibitive.

Resident Experiences with Barrier V, Distance from assigned parking to electrical panel:

Resident #4 has a good relationship with his neighbor who parks near an electrical panel in the laundry room, but he knows that his neighbor enjoys the spot and he would not want to compromise their good relations by asking him to trade spots. Resident #4 did not complete an EVSE installation because he had anecdotal information that another resident with a parking situation similar to his own had received a prohibitively high $12,000 estimate for a Level 2 EVSE installation.

Resident #2 was allowed to install her Level 2 ECOtality EVSE in a common space directly adjacent to the electrical room without any special negotiation or fees.

Resident #5, he indicated that he preferred to charge in his own private parking space even though the installation was more costly, because he enjoys the location.

Resident Experiences with Barrier VI. Electrical capacity:

Resident #4 was also hesitant to move forward with any installation that would involve construction, because his building is "historic" and the HOA has a responsibility to maintain its appearance and structure in a particular way. This makes it more difficult to overcome Barrier V.

From our interviews, we learned about installation experiences where residents of multi-unit buildings were unable to get approval from city inspectors, because the inspector was concerned that the electrical system's available capacity was inadequate to accommodate Level 2 charging.66 In the case of Resident #5, he knew that his electricity usage was particularly low because he has a special interest in energy conservation. Though his low usage left more than enough headroom to allow him to charge his EV (a judgment his electrician agreed with), he was unable to convince the city inspector who would not issue a permit. Resident #5 was faced with two options, to have is electrician conduct a month long load study and hope the results would persuade the city inspector, or to install a Level 1 charger that required much less power. Resident #5 chose to install a Level 1 charger and the city inspector was willing to issue a permit.

In cases like these, when the city inspector doubts there is available capacity for EVSE, but the electrician/installer is confident the capacity is more than sufficient, the electrician/installer can use a few different methods to prove her case. This step would be necessary in order to get an approved permit for the installation.67 This can be expensive, time consuming, and difficult. It may involve load calculations, load studies, and multiple visits from service planner. The different types of load studies range in cost from several hundred dollars to well over $1000. A 30-day load study using the E-Mon D-Mon device costs $500 and would involve limited disruption the building (only need to shut off the building's electricity once).68

Another route, a "light audit", would determine if electrical capacity could be made available without expensive upgrades simply by switching to more energy efficient lights in the building, could range in cost from

66 Interview with William Korthof, 7 February 2012.
67 Ibid
68 Ibid

several hundred dollars to over $1000.69 If the audit does not reveal sufficient energy efficiency measures to provide additional capacity, then upgrades to the building's electrical service or a utility transformer may be necessary.

Resident Experience with Barrier VII. WiFi may not be available in underground parking area:

Two residents we spoke with told us about their experiences attempting to obtain WiFi connections in their underground garages. Resident #2 negotiated with her current Internet provider to have a second connection put in the garage. They had not previously provided Internet for exclusive EVSE use and they told her it would cost an additional $25 per month to add another line. Once she explained to how limited the use would be and that she already pays $80 for the connection in her unit, she was able to get the WiFi connection in the garage for no additional monthly cost.

Resident #1 considered getting a "signal booster" to extend the lobby WiFi connection to the garage, but he felt sure that his HOA would object. He report that his inability to secure a WiFi connection for the EVSE increased the cost getting the equipment through ECOtality from $4900 to $6500, which he decided was not a reasonable price.

Appendix IV: Glossary/Abbreviations

BEV: Battery Electric Vehicles (pure electric, no combustion)

CARB: California Air Resources Board

GHG: Green House Gases

HEV: Hybrid Electric Vehicles (old Prius)

PEV: Plug-In Electric Vehicles (inclusive - BEV and PHEV)

PHEV: Plug-In Hybrid Electric Vehicles (Volt)

TOU: Time-of-use; Utility companies incentivize night time electricity usage by charging different rates for the kWh at different time intervals during the day.

MUDs: Multi-Unit Dwellings

IOU: Investor Owned Utility

MOU: Municipally Owned Utility

VMT: Vehicle Miles Travelled

69 Ibid

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