
INCREASING ELECTRIC VEHICLE CHARGING ACCESS AT MULTI-UNIT DWELLINGS: WORKSHOP SUMMARY REPORT

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ABOUT THIS REPORT

This report summarizes a virtual workshop with top academic, non-profit, industry, and governmental leaders convened with the aim of identifying barriers to increasing electric vehicle charging access for multi-unit dwellers in California and proposing ideas for solutions to those barriers. The event was co-hosted by Energy Innovation and the Plug-in Hybrid & Electric Vehicle Research Center at the University of California, Davis Institute for Transportation Studies (ITS-Davis) on August 31, 2020.

The contents of this report are solely a product of Energy Innovation and do not necessarily reflect the views of all individual workshop participants, reviewers, and/or ITS-Davis. Furthermore, the workshop participants engaged under Chatham House Rule. As such, the workshop contents are reflected here without attribution, unless specifically authorized by the speaker.

EXECUTIVE SUMMARY

California's transportation sector emits the greatest share of the state's climate and conventional air pollutants.ⁱ California has ambitious targets and programs to address transportation emissions, but despite these efforts, its transportation sector emissions have increased every year since 2012.ⁱⁱ

Transportation must transform to provide affordable, easy, and clean ways for Californians to get around. And, while a large, concerted effort is needed to increase viable, affordable, and zero-emission mobility options outside of passenger vehicle use, improving access to electric vehicle (EV) charging infrastructure is essential to achieve the state's transportation decarbonization goals. Today, electrification is the most technologically feasible and affordable method of decarbonizing the transportation sector, as reflected in California's goal to reach 5 million zero emission vehicles on the road by 2030. But the inability to reliably charge EVs inhibits many Californians from purchasing or leasing EVs, thus impairing decarbonization and EV adoption

goals. While home to the United States' largest EV market, access to home charging is still a significant determining factor for whether or not someone will purchase or lease an EV. Nearly 50 percent of Californians reside in multi-unit dwellings (MUD) and about 20 percent of the state's light-duty vehicle fleet is located at these residences, so we need solutions to scale this decarbonization solution to include MUD residents.

Studies show that single-family home residents have overwhelmingly more access to EV charging than MUD residents.ⁱⁱⁱ Equity is at the core of this challenge, as many multi-unit dwellers live in disadvantaged communities and/or at low- and moderate-income levels. The state faces challenges ensuring electric mobility solutions reach all Californians, not just those who have the easier path to EV adoption.

Energy Innovation and ITS-Davis designed and hosted a workshop on August 31st, 2020 to investigate this issue with leading in-state and national experts. The first half of the workshop focused on identifying barriers to EV charging at MUDs, featuring presentations on EV market and infrastructure landscapes, as well as the equity implications of these barriers. The second half of the workshop focused on solutions, with presentations and breakout discussions on financing, incentives, regulatory policy, local government efforts, cross-sector collaboration, and research needs.

The workshop presentations explored California's EV market as it relates to multi-unit dwellers, findings from a statewide survey on EV charging access perceptions and reality, and the equity issues inherent to transportation electrification. The EV market analysis showed that multi-unit dwellers, especially renters, are going to be a significant segment of market growth after 2025 and that California cannot meet its transportation decarbonization goals without accommodating this key market segment. The survey results presented found that even with increasing awareness of ability to charge a vehicle on a Level 1 charger (using a 120-Volt outlet), shifts in parking behavior, and new electrical installations, access to charging at MUDs does not exceed 40 percent. Lastly, the presentation focused on equity revealed there is no equity silver bullet, and that equity needs to be more of an on-going practice than a commitment. Concrete steps to integrate equity into policy were introduced to make earnest progress on equity.

Discussion of MUD charging barriers highlighted several challenges to increasing EV infrastructure access at MUDs, including on-site challenges, strained public funding, and the need for more private capital investments, as well as low consumer awareness, interest, and technology access perceptions. The workshop discussion also identified solutions and approaches to reduce said barriers, which include regulatory levers, building codes, streamlined permitting, technology solutions, incentives and financing, as well as improving governmental and stakeholder processes to become more comprehensive and inclusive. Lastly, the workshop identified several research needs that warrant further exploration to fill gaps in understanding about the EV and MUD markets, including whether potential innovative new solutions could scale to support MUD residents.

The workshop was a useful forum for convening experts to better understand this issue and share information. Now, we must make a collective and comprehensive effort to reduce barriers of EV charging access at MUDs so they do not continue to make electric mobility inequitable, and hinder broad EV adoption in the years to come.

ABOUT ENERGY INNOVATION AND ITS-DAVIS

Energy Innovation: Policy and Technology LLC is a nonpartisan energy and environmental policy firm. We deliver high-quality research and original analysis to policymakers to help them make informed choices on energy policy. We focus on what matters and what works.

The Institute of Transportation Studies at UC Davis (ITS-Davis) is the leading university center in the world on sustainable transportation, hosting the National Center on Sustainable Transportation since 2013 (awarded by the U.S. Department of Transportation) and several focused research centers, including the Plug-In Hybrid & Electric Vehicle Research Center. We have a strong commitment not just to research, but interdisciplinary education and engagement with government, industry, and non-governmental organizations.

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INTRODUCTION

California's transportation sector emits the greatest share of California's climate and conventional pollutants.^{iv} The state has ambitious targets, including 5 million zero-emission vehicles on the road and 250,000 charging stations installed by 2030.^v Several state programs, including the recently passed Advanced Clean Trucks rule along with significant financial incentives,^{vi vii} are helping reduce transportation emissions. California is home to the United States' largest EV market^{viii} – approximately half of domestic sales. Despite these strong efforts, California's transportation sector emissions have increased every year since 2012.^{ix}

Transportation must transform to provide affordable, easy, and clean ways for Californians to get around. And while a large, concerted effort is needed to increase viable, affordable, and zero-emission mobility options outside of passenger vehicle use, improving access to EV charging infrastructure is essential to achieve California's transportation decarbonization goals. Electrification is the primary method of decarbonizing the transportation sector, but the inability to reliably charge EVs at MUDs inhibits many Californians from purchasing or leasing EVs, thus impairing decarbonization goals.

Access to home charging is a significant determining factor for whether or not someone will purchase or lease an EV. Lack of charging access, including the ability to use a 120-volt plug, is particularly acute for MUD residents, who are more likely to lack dedicated parking, and are also unable to control charging access and/or potentially afford charging infrastructure investments. Nearly 50 percent of Californians reside in multi-unit dwellings (MUD) and about 20 percent of the state's light-duty vehicle fleet is located at these residences, so we need solutions to scale this decarbonization solution to include MUD residents. In a 2018 report, the California Air Resources Board found a gap of between 66,000 and 79,500 charging stations to meet the expected demand for MUD charging by 2025.^x

Enabling EV charging access for MUD residents will support more equitable distribution of public- and ratepayer-funded programs, while likely increasing EV adoption and reducing pollution in communities across the state. Without ensuring charging access for MUD residents, state EV incentives are likely to continue disproportionately benefitting wealthier Californians.^{xi} Ultimately, California will fall short of its decarbonization goals without reaching and transforming the MUD market segment.

The International Council on Clean Transportation (ICCT) found that 92 percent of charging ports used in metropolitan areas across the U.S. are located at the residence. EV owners in single-family detached homes are more likely to charge at home compared to MUD residents, who are more likely to use public charging infrastructure by a significant margin. 94 percent of detached home EV-owning residents primarily use home charging, while only 48 percent of MUD resident EV owners charge at their residence.^{xii} Availability of home charging determines other charging infrastructure needs, such as workplace and public charging, but it should be noted that those alternatives are not necessarily considered equal substitutes to drivers who are considering purchasing or leasing an EV.

The California Public Utilities Commission (CPUC) is tackling this problem in its Transportation Electrification Framework (TEF) proceeding.^{xiii} In particular, the CPUC has recognized lack of access to home charging as an equity issue, because it impacts both the price of fueling and feasibility of owning an electric vehicle. Despite utility pilots and programs to address this gap, California homeowners are three times as likely to own an EV as those who are not homeowners.¹⁰ For multi-unit dwellers with an EV, charging options are often more expensive than those with single-family home charging access, while average income is lower.

THE MUD CHARGING WORKSHOP

Energy Innovation and ITS-Davis designed a workshop to investigate this issue with leading experts, who provided insights into the top barriers and solutions to electrify vehicles used by MUD residents. The three-hour workshop on August 31st, 2020 convened approximately fifty academic, non-profit, industry, and governmental leaders. The workshop was broken into two parts: assessing barriers to MUD EV charging (Part I) and solutions to this barrier to help achieve widespread transportation electrification (Part II). The convening featured an introductory panel, a solutions roundtable discussion, and two breakout sessions designed to foster discussion and participant contributions. This report summarizes the discussions and high-level workshop insights.

CALIFORNIA'S EV AND EV INFRASTRUCTURE LANDSCAPE

The first workshop panel was a series of presentations providing information on California's current and projected EV and EV infrastructure landscape, as well as equity implications surrounding extant barriers to widespread transportation electrification.

The first presentation from ITS-Davis provided background on the MUD-specific California EV market. Highlights of the presentation include:

- Nearly 25 percent of vehicles in California are located at MUDs;
- MUD households are not typically early adopters of EVs;
- MUD households are more likely to purchase used cars;
- MUD households most often have one vehicle; and
- Multi-unit dwellers, especially renters, will compose a significant segment of EV market growth after 2025.

The second presentation offered key takeaways from a residential EV access survey, administered jointly by the California Energy Commission (CEC) and the National Renewable Energy Laboratory (NREL). The survey reinforced that residents of single-family homes have greater access to EV infrastructure and perceive themselves as such. The survey found that even with increasing awareness of ability to charge a vehicle on a Level 1 charger (using a 120-Volt outlet), shifts in parking behavior, and new electrical installations, access to charging at MUDs does not exceed 40 percent. Because perceived access to EV charging is a major influencer of

individual decisions to purchase or lease EVs, addressing this real and perceived lack of charging access is key to electrifying the vehicles driven by MUD residents.

The last presentation from Greenlining Institute focused on equity issues surrounding access to EV charging and emphasized there is no silver bullet. Equity needs to be an on-going practice rather than solely a commitment, and the presenter offered four steps to make earnest progress on equity:

1. Define a specific kind of equity being proposed, and the population it is intended to address.
2. Create a process that involves the perspectives of the population being addressed.
3. With consultation, deploy implementation strategies that meaningfully and directly address needs.
4. Measure progress over time.

The presenter urged decisionmakers to work against the tendency to cater to early adopters and instead prioritize bringing clean technology to harder-to-reach population segments.¹ This approach requires upfront coordination and alignment of stakeholders to address challenges and barriers, but ultimately helps scale these technologies faster and helps address health and cost burdens on the most impacted and vulnerable communities. Decisionmakers must bring more equity expertise in-house and not just rely on resource-strained, equity-focused NGOs. Furthermore, community consultation needs to be consistent and long lasting. Additionally, the goal should not be to get every MUD resident their own personal EV; instead, solutions should emphasize expanding the suite of cleaner, more affordable, and more accessible mobility options.

IDENTIFIED BARRIERS TO ACCESSING EV CHARGING AT MUDS

During the first breakout session, groups were asked to identify the top two or three barriers to MUD residents accessing and utilizing EV charging (and thus adopting EVs). Reports from these smaller groups revealed several consistent themes and barriers, including the following.

ON-SITE CHALLENGES

Obstacles to Installing EV Infrastructure at Existing MUDs

Existing MUDs present unique challenges to increasing EV charging access. The two most prominent include outdated or insufficient electrical service, and the risk of triggering building code updates if EV chargers are installed and permitted.

Participants pointed out that the MUD's age and electrical infrastructure may impact the ability to install EV chargers without triggering the need for electrical capacity upgrades. Similarly, the MUD's location on constrained areas of the grid may trigger the need for distribution system

¹ Note that surveying charging access in disadvantaged communities might not properly capture charging access for disadvantaged community members. For example, workplace charging in disadvantaged communities does not necessarily serve disadvantaged community residents.

upgrades to accommodate chargers. Electrical upgrades can be quite costly, especially when the ground needs to be dug up for trenching to lay raceway and wiring, which is more common in older buildings.

Another unique challenge is that property owners can be hesitant because installing EV charging can trigger requirements to bring the building up to code in ways unrelated to EV charging itself, which can make a project financially infeasible.

Participants signaled that addressing equity concerns in this space will likely require more investment per unit of charging in cases of retrofits at existing buildings, because the projects will often be at older buildings with outdated electrical service, and historically disadvantaged communities have had less infrastructure investment. Many participants acknowledged additional equity challenges in this space.

Split Incentives

When those responsible for paying for utility bills are not the same as those responsible for capital upgrade or investment decisions, split incentives make it difficult for either party to justify the investment. MUD residents do not make purchasing decisions for their buildings – the building owner, building manager, or third-party property management typically handles these decisions. All things being equal, building owners will want to spend less capital to provide adequate living quarters for residents. This is a common problem for renters, who face similar challenges with energy efficiency measures and other improvements.

In addition, for capital constrained building owners and managers working under tight budgets, the dollars to install EV chargers compete with other building improvements. For those able to utilize financing to make building upgrades, it is unclear if EV charging infrastructure can be included in financing other building upgrades or retrofits.

The workshop discussion emphasized difficulties that governments, utilities, and tenants face when trying to engage owners who may not see the benefit of charging infrastructure. Incentives between charging providers and owners are also misaligned; property owners often get little to no return on investment for enabling upgrades, even at low cost. Participants identified a need to develop ways of sharing charging revenue with the owner to align incentives between EV drivers and building owners. This cost splitting could take the form of a fixed charge, akin to a “pet fee” or other monthly bill adder. The primary challenge with this approach is maintaining tenant affordability.

Lastly, tenants may not have access to the building decisionmaker in large buildings to make the ask – it can be a bureaucratic maze and tenants might not know with whom to engage on the issue.

While renters have the most acute issues in this realm, homeowner associations can put up similar barriers to EV charging access for condominium owners.

Parking Issues at MUDs

The availability of parking at MUDs – and throughout many California cities – is a primary challenge to EV charging, because where people park is a big determining factor as to whether they can easily and conveniently access charging. As a starting point, MUD residents cannot install chargers or plug in to an outlet that is connected directly to their meter. Additionally, many MUD residents have assigned parking spots, which makes it difficult to create an equal opportunity for charging without installing chargers at each parking stall (which would likely be cost prohibitive for most MUDs). Furthermore, residents may be reluctant to change their assigned parking space and their space may not easily accommodate EV charging.

Charging infrastructure may be easier to install in common areas or shared parking, assuming proximity to electrical service, but is less reliable to the drivers if the chargers are available on a first-come, first-served basis. It is possible that not all drivers can be reasonably accommodated, particularly as more people adopt EVs. Participants noted that maximizing charging station utilization might justify installing multi-use chargers at MUDs, but multi-use stations come with some uncertainty for drivers, since they cannot count on charging their vehicle when needed.

Participants noted that where space is limited, EV charging infrastructure might compete with more parking places. In addition, charging spots do not count towards parking space minimums, typically.

Interconnection Processes

Interconnection delays can impact many clean technology projects, and EV chargers are no exception. Getting interconnection approval through the utility takes time and can add cost and hassle, if the process is not efficient, affordable, and streamlined. If a project triggers electrical service upgrades on the grid to accommodate additional load, then that leads to increased cost and delay. In particular, DC fast charger projects tend to encounter more interconnection issues due to the higher power needs.

LACK OF PRIVATE CAPITAL AND SUITABLE EV CHARGING BUSINESS MODELS

Participants acknowledged efforts by various public entities throughout the state to create funding opportunities that generally address electric mobility, including EV charging infrastructure at MUDs. Participants also noted limits to the extent these programs can help reach the scale needed to meet state climate and public health goals. In several workshop discussions, participants highlighted the need for more private capital in this space, as well as suitable EV charging business models to reliably bring EV charging technology to MUDs. To make this work, utility regulation needs to allow for these third-party actors, including robust opportunities for third parties to participate as vendors in utility programs, which is currently the state of play in California.

One financing expert suggested that stakeholders need to think about this whole issue differently. Rather than thinking of specific places and conditions, or use cases, for EV infrastructure, decisionmakers need to think about effective policy solutions at the multibillion-

dollar scale. Multiple participants mentioned that public spending on EV charging programs has achieved mixed results to date. While continued public spending was viewed as valuable, many participants agreed solutions that use private capital at scale are more sustainable models for unlocking EV charging access at MUDs, and elsewhere.

CONSUMER AWARENESS AND PERCEPTION CHALLENGES

The workshop participants posed several “chicken-and-egg” questions, such as: Will a building owner want to build charging access if no tenants demand it? Will tenants buy EVs without convenient building or public charging access? These questions indicate the newness of the technology and the required buy-in from various entities associated with the transition to zero-emission vehicles.

Although emphasis is growing on the need to serve the MUD population to ensure equity, participants pointed out consumer interest remains relatively low (due, in part, to the perception that they cannot access charging). Many MUD building owners and residents are still unfamiliar with EVs and have not considered them as a viable option yet, thus limiting demand for charging infrastructure.

For residents, other improvements or repairs may be higher priority, including those that impact indoor air quality or public health, or that help save money or improve comfort, such as energy efficiency. For affordable housing residents, EV charging access is likely not a top-of-mind issue or concern. Additionally, participants cited that MUD residents are unsure about the predictability and reliability of charging pricing and the impact of those building management decisions on long-term affordability.

In addition, building managers and owners are busy people with limited time and bandwidth to navigate complex and costly processes. As aforementioned, they often do not have huge budgets to work with (particularly in affordable housing developments), and EV chargers likely fall lower on the list of priority improvements. Existing utility EV charging programs provide funding or incentives for adoption, but site hosts are not always interested. For a building owner managing multiple properties, this effect is compounded by the number of upgrades and improvements already on the to-do list. On top of all of that, installing EV charging is perceived as a costly, time-intensive process that is not worth the hassle to service non-existent resident demand. In sum, on-site EV charging is seen as an optional upfront cost with uncertain payoff or value.

Even where incentives exist, heightened engagement and education is needed around the value proposition and longer-term benefits of increasing onsite EV charging access. MUD residents can benefit from lower transportation costs, but interest and access are prerequisites.

INITIAL SOLUTIONS FOR INCREASING MUD EV CHARGING ACCESS

During Part II of the workshop, participants were asked to identify the top solutions that can help provide charging opportunities for MUD residents. The participants acknowledged on-site charging at MUDs as the primary option but also emphasized the importance of alternatives,

such as multi-use charging locations, publicly owned chargers, workplace charging, and charging infrastructure installed for specific purposes (e.g. shared mobility services), and noted that further research needs to be conducted to understand how reliably these alternatives can serve as substitutes to on-site MUD charging.

The facilitated breakout discussions during the second half of the workshop were organized by themes: incentives and financing solutions, utility EV charging solutions, local government policy solutions, research needs, and cross-sector collaboration. The solutions reflected here are a start to a bigger conversation and do not represent all possible policy solutions or approaches to solve the MUD EV charging issue. The initial brainstorming of the workshop participants revealed much more attention on developing and prioritizing MUD-specific solutions would be valuable (and a ripe topic for a future workshop).

UTILITY SOLUTIONS

Given the workshop's time and scope, the breadth of utility barriers and solutions were not fully explored and warrant more consideration in the context of any future policy or regulatory approaches to address MUD EV charging access. One presenter noted that utility-run charging programs and investments across the country in a mostly experimental phase – there is a lot of learning by doing needed. Additional issues such as EV-applicable rate design, metering issues, interconnection processes, accurate hosting capacity analyses, grid modernization, and others will have an impact on the ease and affordability of MUD EV charging and should be taken more fully into account in future iterations of this discussion.

Distribution Planning

The bulk of the utility solutions breakout group focused on the utility's role supporting charger deployment. In a highly electrified future, distribution planning will need to account for EV charging, as load will increase across the board. Even now, it is advantageous for DC fast charging and many fleet charging installations to be sited where there is available capacity, and access to three-phase power. Utilities have a role identifying locations that can more readily support fast charging capability and investing to make that a reality. Widespread electrification, including others sectors such as buildings and industry, as the optimal decarbonization route is predicated on smart planning by utilities to keep costs and emissions (through avoiding dirty power plants) minimized, and eventually, eliminated.

Existing grid planning methodologies, forecasting, and hosting capacity analyses are key to ensuring statewide EV market growth is sufficiently accounted for and reflected in grid plans. Ensuring these planning processes consider vehicle electrification broadly, and more specifically plans to ensure equitable charging access to MUD dwellers, will be essential to the success of both efforts.

One of the key questions for MUD charging access is how well charging sited elsewhere, including public, workplace, etc. is a viable second choice to MUD on-site charging access (see research needs below). The grid impacts of each option should be part of this discussion, but will only be possible with much more in-depth and transparent grid planning tools. An accurate

assessment of the least-cost path to providing adequate access to MUD residents not only depends on behavioral research, but also understanding which technology pathways are most costly to utility consumers as a whole.

Barriers addressed: grid upgrade costs; interconnection processes

Make-Ready Investment

Make-ready investments refer to anticipating and installing electrical infrastructure in new construction or retrofits at existing buildings that streamlines future EV charging installations to help alleviate the cost of EV charging investments for utility ratepayers, EV customers, and third-party charging providers. These upfront investments can also mitigate some of the split incentive for building owners and renters and streamline utility and local government permitting process. By providing “up to the stub” infrastructure, utilities can support EV infrastructure in new MUDs and some retrofits. As with any utility investment, regulators need to oversee the measures and test before scaling to make sure ratepayer funds are being properly used.

Barriers addressed: high building upgrade costs; triggering building code requirements; customer affordability and equitable access

Pricing Predictability

There is uncertainty on the part of both MUD owners, and MUD residents with regard to the day-to-day, month-to-month, and year-to-year pricing of electricity and EV charging management systems. On the part of the MUD owner/manager who may be considering installing EV charging, having a utility-designed recommendation of possible pricing solutions would be based on their true rate structure (commercial vs. residential, TOU, etc.), inclusive of charging solutions both with and without back-end charging management fees. Having clearly laid out options would ease their uncertainty and assist with their installation decision process.

From the perspective of MUD residents, knowledge upfront of EV charging pricing structures may help them decide to purchase an EV. However, they have no control of the EV pricing structure set by management, who can choose to change it, sometimes based on new information gained only after having installed the chargers. Having pricing recommendations provided by a utility to MUD owners will not only help them to set fair prices, but will also help MUD dwellers comparing housing options, and know whether the prices set at their unit is fair.

Barriers addressed: customer affordability and equitable access

LOCAL GOVERNMENT POLICY SOLUTIONS

Building Codes

For new construction, the adoption of a more stringent EV-ready building code could help transition more MUD building stock to support EV charging. This can be done through the state CALGreen code or local reach codes. For example, Berkeley recently adopted a reach code mandating EV-capable measures at 20 percent of parking spaces at all new buildings (up from 10 percent required by the state). For MUDs, Berkeley requires the other 80 percent of parking

spaces to have raceway installed at new construction to eliminate the need for costly trenching later on, and to better accommodate assigned deeded or dedicated parking.

In addition to increasing the percentage of parking spots that require EV-capable or EV-ready measures, the state and cities can boost readiness by implementing install requirements and applying measures to existing buildings when cost-effective, such as during major renovation or updating the building's electrical service. San Francisco's reach code is an example that includes measures that apply to existing buildings. To overcome the assigned parking obstacle, the code can provide more clarity and guidance on specifying shared parking versus deeded and dedicated parking requirements to accommodate the highest number of EV drivers at the lowest cost. Participants suggested incentives for MUDs to help meet code – particularly relevant if these measures applied to existing buildings. Although it was clarified that incentives should not apply towards compliance with legal minimums, especially for market-rate MUDs.

Proactive building code measures are a solution to this problem. However, getting existing buildings up to code was identified in the first half of the workshop as a barrier – getting older buildings that were built in compliance with then-current codes up to current code in the interest of adding EV chargers may be infeasible in many cases. To address this challenge, one participant recommended a moratorium on requiring unrelated code updates for those MUDs seeking to install EV chargers.

Barriers addressed: parking issues at MUDs; triggering building code requirements; high building upgrade costs

Streamlined Permitting

At the local government level, permit approvals for EV charging installation tend to be time-intensive, which adds cost and difficulty. Participants cited streamlining permitting processes as an opportunity to reduce obstacles, improving the chances that building owners might install chargers on-site. One city representative commented that the process for improving permitting is continuous and iterative. Their city recently successfully removed the discretionary zoning element out of the permitting process, reduced the fee associated with the permit application, and created a same-day online submittal system to reduce time and counter visits. It now takes about one week to permit EV chargers at MUDs in that city.

Barriers addressed: high building upgrade costs

Removing or Modifying Parking Minimums

Parking minimums are (typically) zoning laws that dictate how much off-street parking needs to be available at different types of buildings. California differentiates parking spaces from charging spaces for many reasons, including the state's Americans with Disabilities Act EV charging policies and to allow local law enforcement to ticket and tow internal combustion vehicles in charging spaces, but this also means that charging spaces compete with and often lose to these requirements in space-constrained and/or areas with expensive land. As the vehicle fleet in the state converts to electric, this will become a larger sticking point as more spaces will need to

have chargers installed. Furthermore, parking minimums are often considered to create perverse incentives, such as decreasing housing density as well as undermining walkability.

Barriers addressed: parking issues at MUDs

TECHNOLOGY SOLUTIONS

Level 1 or Low-Power Level 2 Charging

Most drivers do not drive more than forty miles per day. Level 1 charging uses a regular 120-volt outlet, and eight to ten hours of overnight Level 1 charging is likely adequate for most EV drivers. One city representative noted that the cost per Level 1 charging access point in a MUD is about one-sixth the cost of Level 2 charging access. This could also mitigate impacts on grid infrastructure as well as building electrical throughput capacity.

Level 1 charging or low-power (up to 3.3 kW) Level 2 charging that is not connected to a pricing or authentication mechanism also addresses a technology barrier for low- and moderate-income residents – equitable access to Wi-Fi and smartphones. Level 2 chargers that require payment and/or authentication generally require some sort of internet or cellular connection, often through Wi-Fi, and many affordable and low- and moderate-income housing developments do not have reliable Wi-Fi service to accommodate this technology. Without a back-end billing system connected to the charger, building owners/managers can institute a simple monthly charging fee to recoup electricity costs. Additionally, locating and using connected Level 2 charging with these features typically necessitates, or at the very least is designed around, smartphones. It cannot be assumed that everyone can afford or has access to a smartphone.

Barriers addressed: grid upgrade costs; interconnection requirements; customer affordability and equitable access; high building upgrade costs

Load Management

Load management technology, via software or hardware, was identified as a solution to avoid costly electrical panel or utility service upgrades. This technology helps balance the load of a group of chargers in-use simultaneously, which effectively stretches the electrical capacity across more plugs, reaching more vehicles. This is particularly useful for existing buildings.

Barriers addressed: grid upgrade costs; customer affordability

INCENTIVES AND FINANCING

Participants recognized increasing EV charging access at MUDs across the state of California will require considerable capital outlays, beckoning the need to efficiently leverage state, local, utility, and private investments.

Leveraging Private Capital

Policies and programs need to focus on addressing real barriers and ensuring equitable financing options to ensure all MUD housing types are sufficiently served, leveraging and scaling private capital to do so. It was noted that the CPUC just launched a new proceeding focused on finance, R2008002 - Order Instituting Rulemaking to Investigate and Design Clean Energy Financing

Options for Electricity and Natural Gas Customers. This is similar to the Climate Catalyst Fund concept in Governor Gavin Newsom’s budget before the COVID-19 crisis, reflecting state support for leveraging the financial sector to scale clean energy solutions.

For example, MUD building owners need sufficient incentives to pursue an EV charger at their buildings in order to justify the upfront cost of installation and the time and energy to go through the process. Due to chicken-and-egg barriers, MUD owners are not currently likely to view charging availability as a way to attract tenants or justify higher prices. Participants noted that it may be worth exploring ways to leverage existing private financing options typically used for building retrofits and upgrades, such that EV charging installations can be combined with other building upgrades to help with project economics. The financial sector should be involved in future discussions on possible approaches and strategies to scale EV charging in the MUD sector.

Developing multi-purpose charging approaches for MUDs could help optimize the economics and attract private investors. For example, prioritizing public curbside chargers or fast-charging stations located strategically adjacent to MUDs could help mitigate the need to have all charging needs be met on-site at the MUD. However, this approach must consider the viability and attractiveness of parking at a public charger station overnight and/or for long durations, or else address affordability challenges of high-speed charging. Pilots underway in Los Angeles, Berkeley, and Sacramento may offer valuable insights on the overall effectiveness of Level 2 curbside charging.

Workplace charging may also be a viable option for MUD residents, but more research is needed to determine if sufficient correlations exist between expanded workplace charging and MUD EV adoption. It was noted that expanding workplace charging does not solve the MUD challenge explicitly, but it is part of a suite of options to electrify transportation as a whole. Dedicated programs and approaches to solve the MUD challenge are still needed.

Lastly, pairing existing EV and car sharing programs with EV infrastructure programs would help optimize efficiency and expand use among MUD residents and owners. In addition, existing programs could be a good starting point to learn more about MUD resident needs, for example running an EV pilot with existing “replace your ride” customers.

Barriers addressed: lack of private capital and suitable EV charging business models; split landlord/tenant incentives

Allocating Public Incentives Effectively

To ensure EV charging programs are indeed equitable and serve a diversity of MUD residents, programs subject to cost-benefit analyses could allow for marginally more expensive installations located in lower-income and underserved communities. Conducting research using a random sample of MUD buildings to assess the costs (identifying low, high, and average costs) could better inform which projects merit additional funding.

In terms of funding sources, Volkswagen Settlement funds could be a good source for state and local governments to take advantage of to help fill the EV charging gap for MUDs. In addition, CEC grant funding could be a good source for local governments, developers, and MUD owners to tap into. Utility and community choice aggregator programs could be, and are in many cases, a source for incentive programs. Participants noted that the Low Carbon Fuel Standard is intended to create funding for electric mobility, but the funding is difficult to access. State policymakers can amend the program such that MUD building owners can access funding to create return on investment on EV infrastructure, or can create better education and awareness of how MUD can benefit more from the program. Evaluation of current programs would be a good starting point to better understand the challenges and adjustments needed for MUDs. Grants and incentive programs should be administratively simple and streamlined to avoid additional barriers to adoption (particularly those targeting MUD building owners).

Barriers addressed: lack of private capital and suitable EV charging business models; high building upgrade costs; split landlord/tenant incentives

INCLUSIVE STAKEHOLDER PROCESSES AND CROSS-SECTOR COLLABORATION

Interagency and Intergovernmental Collaboration and Information Sharing

Participants identified the need for improved and enhanced interagency and intergovernmental collaboration. At the state level, interagency meetings on transportation are already taking place between the CPUC and CEC, but there may be value in better defining the roles of the different agencies to optimize efficiency and minimize redundancy. Local governments have their own processes, objectives and issues, and may not be apprised of all the efforts underway at the state level. Convenings or forums focused on intergovernmental collaboration may be helpful in identifying solutions to the MUD charging gap and other transportation electrification challenges.

At all levels of government, siloes prevent internal collaboration and coordination. As such, efforts to encourage more cross-pollination across departments and among staff would likely result in more efficient implementation of transportation policies and programs, including those focused on addressing the MUD charging gap. For example, one participant representing a city expressed that they prioritized internal staff education across different departments on their transportation electrification initiatives, to help ensure all local government staff were aware of the city-wide efforts focused on increasing access to EV charging to more residents. Although these efforts took staff time and bandwidth, they proved critical to ensuring greater buy-in of the city initiatives and increasing program efficacy.

Barriers addressed: effective use of public funds

Diversity- and Equity-Informed Program Design and Implementation

The diverse stakeholder perspectives within the MUD sector should be considered when developing programs or policies, particularly because they may conflict with one another and need to be balanced when considering different approaches for expanding MUD EV charging. State and local government agencies (perhaps in partnership with community organizations)

could identify additional strategies to engage and solicit input from MUD residents, landlords, building managers, and real estate developers. Public comment forums already exist as means to solicit input from the public, but these forums have limitations:

- They tend to attract and be more suitable for individuals or organizations who are already informed, engaged, or able to attend or weigh in;
- The input received may not necessarily reflect all the relevant MUD stakeholders' perspectives;
- The nature of public feedback tends to be a higher level versus more detailed, which may be less helpful for informing programs more nuanced, complex, and technical in nature; and
- There may be disconnects between what has been legislatively mandated and what the public cares about. Addressing public comments and stakeholder concerns in a meaningful way may be difficult given the overarching objective.

Although the group did not have the chance to expand further on effective public engagement approaches, there was consensus that this needed to be considered as part of any future effort to address the MUD charging gap.

Soliciting feedback from a diversity of communities and consumers is key to developing equitable programs that effectively address distinct resident circumstances and barriers to access. For example, a higher-income owner-occupied condominium seeking to install EV charging is likely to have different barriers than a 20-unit affordable housing apartment building. Such distinctions among MUD housing types, community income levels, and resident demographics are extremely relevant to program design and implementation and should be accounted for at the outset (versus after the fact).

Similarly, and building on the above point regarding effective public engagement strategies, participants agreed focusing on equity means practicing equity in the process. For example, asking people to take time out of their workday to provide feedback in public forums may result in an inequitable representation of perspectives. Agencies seeking input may consider providing some level of compensation to offset the economic inconvenience. In addition, providing childcare at the meeting can help ensure families can participate. Holding meetings in the community versus asking people to come to government buildings can also mitigate transportation challenges for certain people. Other effective strategies exist to ensure a balanced representation of perspectives to inform program and policy design.

Finally, any efforts focused on soliciting input should be followed by efforts to provide progress updates, as well as continued work on the development of solutions to identified barriers or concerns. A public listening session without any follow up does not send the message that the input and time spent by attendees is actually valued. Rather than merely check the stakeholder engagement box in the process, policymakers should take time to build relationships with those that are ultimately being served by the policy/program.

Barriers addressed: effective use of public funds; consumer affordability and equitable access; consumer awareness and perception challenges

ADDRESSING RESIDENT CONCERNS AND MITIGATING ADVERSE IMPACTS

Although it may go without saying, programs and policies focused on addressing the MUD EV charging gap should ensure they do not substantially worsen community ills or exacerbate MUD residents' concerns. For example, the fear of gentrification and displacement are real. Lower income residents and communities may view the increase in EV charging as a harbinger of gentrification, which may lead to higher income housing development and other shifts in urban planning that may ultimately displace them from their own homes. Building trust is an important first step, but there needs to be a broader discussion and focus on how to invest in places and people without displacing or alienating them. Considering the bigger picture and other factors at play, such as land use and planning considerations, can be an informative exercise when developing programs and policies.

In addition, more emphasis on the on-the-ground education process and allowing time for handholding is key for addressing fears and concerns. For lower income residents especially, the most common fears are raising rent and raising energy bills, so programs should be cognizant of the impacts EV charging may have on both in any MUD, but also educate potential EV adopters about the lower cost of ownership of EVs and how that can benefit them.

In terms of cross-sector collaboration, leveraging the organizations and groups that are most familiar with these challenges, bringing their insight to the table, and ensuring equity as a practice in the process can help address concerns in a proactive and transparent manner.

Barriers addressed: consumer awareness and perception challenges

ADDITIONAL RESEARCH NEEDS

Limited data exists on the demographics and travel trends of MUD residents; thus, it is unclear how much charging infrastructure is really needed to serve them and how it will grow relative to the growth of the EV market. The availability of public workplace, curbside, or DC fast charging may obviate the need for more chargers at the MUD site. However, more data is needed to better understand whether these alternatives actually serve MUD residents.

Consumer driving trends are changing as a result of COVID-19, including the availability of alternative transportation modes and remote work options. Undoubtedly, these trends will inform the volume and locations of EV chargers, but they are relatively new and not yet well documented or understood.

Forecasting consumer driving habits and future charging needs is often based on very antiquated data (for example the EVI-Pro Analysis uses 2012 California Household Travel Survey). More sophisticated and updated methodologies as well as more reliable data inputs are needed to better inform the forecasts.

In addition to these research gaps, the breakout group participants identified a substantial list of additional research questions that might be worth exploring:

- Are curbside charging, car-sharing, mobility hubs and/or other innovative potential solutions scalable to provide wide-spread access to electric mobility for MUD residents?
- For whom is workplace charging working, and why?
 - How congested is workplace charging? How reliable is it?
 - Is workplace charging significantly increasing EV adoption by MUD residents who otherwise would lack access to charging?
- Under what conditions is DCFC a solution for an MUD resident?
- What size charging would make fast charging a “gas station” solution? Where should it be located?
- What level and how often can DCFC be used without degrading a battery?
- How can we optimize deployment of EV chargers?
- Are there optimal ways to integrate infrastructure EV charging into building design to get more DCFC and other EV chargers?

What are the cost impacts of integrating charging requirements into building codes, such as applying local codes intended to provide at least basic “EV readiness” at every parking spot feasible on a broader level (i.e. costs for both upfront installations and retrofits)?

CONCLUSION

Limited access to EV charging at MUDs is a primary barrier to transportation electrification, and therefore represents a barrier to achieving California’s climate goals equitably. Enabling broader EV adoption will significantly reduce harmful emissions and improve public health outcomes related to air quality. This workshop successfully identified a set of initial solutions and approaches to address obstacles and challenges that make this issue difficult to tackle. Despite their difficulty, a concerted effort needs to be made to reduce these barriers and ensure electric mobility is accessible to all Californians.

ENDNOTES

ⁱ “GHG Current California Emission Inventory Data,” California Air Resources Board, last modified November 6, 2019, <https://ww2.arb.ca.gov/ghg-inventory-data>.

ⁱⁱ Tony Barboza, “California’s planet-warming emissions declined in 2017, even as its biggest pollution source keeps rising,” *Los Angeles Times*, August 12, 2019, <https://www.latimes.com/california/story/2019-08-12/california-greenhouse-gas-emissions-fell#:~:text=Transportation%20pollution,%20which%20has%20been,40%25%20of%20the%20state's%20total>.

ⁱⁱⁱ Michael Nicholas, Dale Hall, and Nic Lutsey, “Quantifying the Electric Vehicle Charging Infrastructure Gap Across U.S. Markets,” The International Council on Clean Transportation, last modified January 2019, https://theicct.org/sites/default/files/publications/US_charging_Gap_20190124.pdf.

^{iv} California Air Resources Board, “GHG Current California Emission Inventory Data.”

^v “Governor Brown Takes Action to Increase Zero-Emission Vehicles, Fund New Climate Investments,” Office of Governor Edmund G. Brown Jr., last modified January 26, 2018, <https://www.ca.gov/archive/gov39/2018/01/26/governor-brown-takes-action-to-increase-zero-emission-vehicles-fund-new-climate-investments/index.html>.

^{vi} “Advanced Clean Trucks,” California Air Resources Board, accessed September 3, 2020, <https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks>.

^{vii} “Rebates and Incentives,” Center for Sustainable Energy, accessed September 3, 2020, <https://cleanvehiclerebate.org/eng/ev/incentives>.

^{viii} Russ Mitchell, “Electric vehicle sales are up sharply in California, mostly due to Tesla,” *Los Angeles Times*, September 11, 2019, <https://www.latimes.com/business/story/2019-09-10/ev-electric-car-sales-california-tesla>.

^{ix} Barboza, “California’s planet-warming emissions.”

^x “Electric Vehicle (EV) Charging Infrastructure: Multifamily Building Standards,” California Air Resources Board, last modified April 13, 2018, <https://ww3.arb.ca.gov/cc/greenbuildings/pdf/tcac2018.pdf>.

^{xi} Sammy Roth, “California’s clean energy programs are mainly benefiting the rich, study finds,” *Los Angeles Times*, June 25, 2020, <https://www.latimes.com/environment/newsletter/2020-06-25/will-the-rich-continue-to-be-the-main-beneficiaries-of-californias-clean-energy-future-boiling-point>.

^{xii} Nicholas, Hall, and Lutsey, “Electric Vehicle Charging Infrastructure Gap.”

^{xiii} “Transportation Electrification Framework,” California Public Utilities Commission, last modified February 3, 2020, <https://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442463904>.