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Enabling Access to EV Charging

Catharine Brookes[1], Adam Mohabbat

[1]*EVgo, 11835 W. Olympic Blvd Ste 900E, Los Angeles, CA 90064*

catharine.brookes@evgo.com, adam.mohabbat@evgo.com

Summary

As the electric vehicle (EV) charging industry continues to scale to meet the demands of EV adoption, public-private and not-for-profit partnerships continue to deliver opportunities to accelerate the transition to transportation electrification and increase access to the benefits of electrification across socioeconomic strata. By providing public fast charging and leveraging the support from community partners, programming catered to the particular needs of diverse communities can provide critical infrastructure to enable electric vehicle (EV) access, along with the commensurate air quality improvements and other economic benefits made possible through support for emerging mobility innovation.

This paper examines EVgo's implementation of the Equal Access Charging Hub (EACH) program and other charging infrastructure programs in California developed with goals to spur the adoption of EVs in neighborhoods disproportionately impacted by pollution. This paper will also address key learnings and policy implications with a focus on delivering infrastructure and mobility options that align with state and local government climate action plans.

Keywords: DC fast charging, deployment, policy

1. Accessible Charging Infrastructure Underpins Electric Vehicle Adoption

Driven by state-level governments leveraging private sector investment, policy actions coupled with adoption of stricter automobile regulations and private capital have driven unprecedented investment by automakers in electric vehicle production, with projections as high as $255 billion invested globally in EVs. [1] With greater model availability, increasingly competitive affordability, and a growing secondary market of EVs, consumers have become more and more interested in electric vehicles and adopting at accelerating rates; however, the perceived availability of EV charging infrastructure remains a key barrier to adoption. The need for accessible, reliable, and visible public fast charging infrastructure remains critical for prospective drivers, especially for residents of multi-unit dwellings (MUD) and other drivers without access to home charging.

1.1 California Shows Policy Matters

California leads the country the country in transportation electrification, representing close to half of total EV sales in the United States, reporting greater than 700,000 electric vehicles sold through Q4 2019. [2] With the transportation sector accounting for more than 40% of greenhouse gas emissions, it is by no coincidence

that California has invested deeply in policy and program funding that is conducive for enabling both EV sales and infrastructure deployment. Stemming from the top, a goal-setting executive order from former Governor Jerry Brown and continued by his successor, Governor Gavin Newsom calls for 1.5 million battery-electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV) in operation by 2025 with a 5 million goal by 2030. To support these vehicles, Governor Brown also called for 250,000 publicly available chargers by 2025, including 10,000 DC fast chargers; Governor Brown and Governor Newsom have both called for and enabled statewide coordination and investment from California state agencies as they work to enable and leverage private sector dollars.

Perhaps the most visible policy spearheaded by the state has been the creation of the Zero-Emission Vehicle program by the California Air Resources Board, in which automakers are required to sell zero-emission vehicles (ZEV) in California and in the 10 other states who adopted the program via memorandum as of late 2019.[3] Additional non-infrastructure related policies that have been important include leadership around utility rate design and support for make ready infrastructure, materially benefiting the proliferation of electric vehicle supply equipment (EVSE) deployment through improved economics of EV charging.

The California Public Utilities Commission's (CPUC) leadership in utility rate reform has encouraged the state's Investor Owned Utilities (IOUs) to take up rate design for residential rates as well as commercial EV rates. As of March 2020, two of the IOUs adopted commercial rates that will eliminate or lower demand charges for electric vehicle supply providers (EVSP); a crippling economic factor for operating public fast charging stations that experience low use, especially impactful for locations in the early stages of EV adoption. SCE has adopted 5-year demand charge holiday and PG&E offers tiered-subscription rates.

It is also worth mentioning that California has been a leader of leveraging opportunities for coordinated investment in transportation through two large settlement agreements focused on multiyear electric vehicle charging infrastructure deployments, a $102.5 million obligated investment from NRG-affiliated entities and an $800-million-dollar commitment from Electrify America, a company borne out of the VW "Dieselgate" settlement intended to mitigate air pollution impacts through infrastructure investments primarily along transportation corridors. However, despite the promise and real-time results these investments and suite of progressive policies have had on bolstering the industry, California agencies are projecting a shortfall in needed infrastructure. According to the California Energy Commission's staff update for the 2020-2023 Clean Transportation Program Investment Plan, the CEC projects a shortfall of 3,600 DCFC connectors and 78,000 L2 connectors. [4] This includes all state agency investments, IOU programs, as well as the aforementioned obligated investments and other private sector commitments from EVgo and other charging network companies.

State agencies are increasingly seeking to spur the growth of competitive EVSE markets in order to support growing EV adoption and as a means of achieving their greenhouse gas emission reduction targets. Through EV adoption, the next markets outside of California's expected to expand include the metropolitan areas of New York City, Seattle, Denver, Washington, D.C., Boston, and Chicago. [5] This paper will address key learnings and industry trends experienced by EVgo, the nation's largest public fast charging network, and outline program design and policy considerations in order to optimize infrastructure investments and serve the maximum number of drivers to accelerate market growth.

2. Cracking the Code to Equitable EV Proliferation through Public Fast Charging

Installing charging infrastructure, particularly DC fast chargers, is critical to enabling mass adoption of EVs. While Level 1 and 2 chargers provide access to infrastructure on a "one car, one charger" basis, public fast charging quickly increases access to a "one charger, one neighborhood" premise. The benefit, as Lutsey and

Nicholas note in their paper, *Lessons Learned on Early Electric Vehicle Fast-Charging Markets*, is that the necessary increase in fast charging is not required to be proportionate, but is influenced by whether new EV owners lack access to home charging or other options, as is often the case in urban areas. [6]

2.1 Different Charging Power Levels, Different Uses

To deliver the ecosystem of charging for EV drivers, a variety of power-levels and access points are required. The table below provides a high-level distinction to describe the relationship between the power-level, the use-case, and number of EVs enabled.

Table 1. Power Levels for Charging, EV's Enabled and Use Case

Charging Level	Power	# of EVs Enabled	Use Case
Level 1	1.2-1.4 AC	1:1	Long Term Parking, Residential, Workplace, Airports
Level 2	6-12 kW AC	1:1	Long Dwell Time Uses, Workplace, Overnight Residential, Amusement Parks, Destinations
Level 3: DCFC	50kW +	7-30	Short Dwell Time Uses, Retail Locations, Restaurants, Grocery Stores, Light Duty Fleet Charging, Rideshare, Serving MUDs

Level 1 charging refers to use of a typical 120V outlet to charge an EV. The adaptor provided in a PEV can be connected to a wall-outlet to deliver a charge. Charging on a home outlet can take a full day to charge a BEV.

Level 2, similar to Level 1 charging, is best focused on long dwell times, with residential and workplace settings being the most common uses cases. Installed in both private and public settings, Level 2 charging also commonly requires upgrades to the electrical circuitry as it runs from a 240V service. In private or workplace use cases, these chargers usually only allow for 1:1 vehicle charging. When Level 2 chargers are available for the public in a retail environment, optimal placement should match the dwell time for destination locations, including movie theatres and amusement parks. With high vehicle turnover, minimal mileage is added on a per vehicle basis (14 to 35 miles of range offered per hour).

Level 3 or DCFC charging typically has a power rating of 50 kW and up. Publicly accessible DCFC offers a many-to-one relationship as dwell time can be matched with a retail environment, such as grocery store, pharmacies, or mixed-use commercial buildings. In addition to providing essential charging infrastructure to those who do not have access to at home charging, this charger also offers refuelling as a convenience while they shop, allowing a customer to add a material amount of range, up to 90 miles of range in 30 minutes. According to internal EVgo customer surveys, drivers consistently rank speed, location and reliability as their top reasons to patronize EVgo. Higher-power level charging, 100kW + is also relevant as BEV models with larger batteries and acceptance of higher charge rates are increasing the new base level. Level 3 charging is also a requirement for transportation corridors which will be used by consumers for long-distance travel and will increasingly be a requirement for medium- and heavy-duty vehicles as their fleets electrify. While Level 3 charging on transportation corridors was once believed to be the key to unlocking the EV market, as EV saturation grows, it becomes even more valuable to deploy DCFC not just along corridors but also in urban and suburban areas, especially to enable communities without easy access to home charging to take advantage of the benefits of EVs.

2.2 Public Fast Charging Helps Unlock New Market Segments of EV Drivers

Without a reliable public fast charging network, many residents of MUDs or renters will be completely locked out of the EV market. Several studies mark the importance of public fast charging to these market segments, and cast dispersions on the early assumption that DCFC would be used primarily to enable long-distance travel along highway corridors. When looking at residents without access to home charging the reliance on public charging is highest among residents in apartments or multi-unit dwellings (MUDs), at 52-81% of battery electric vehicle drivers.

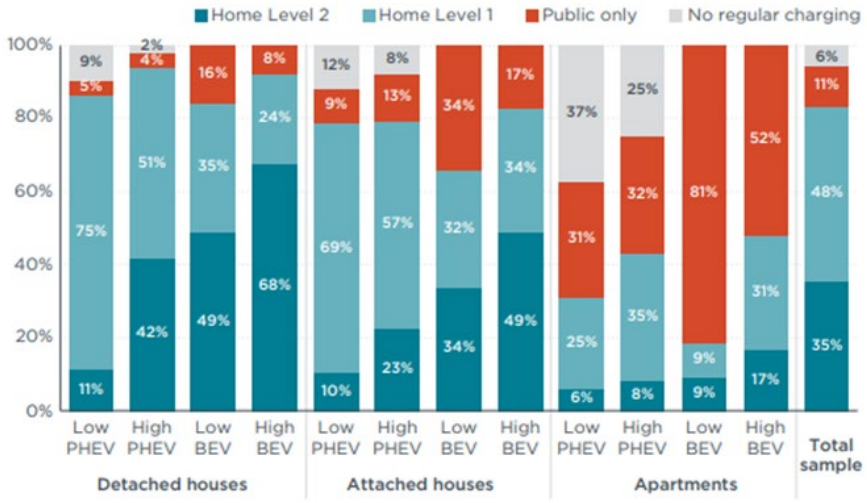

Figure 1: Percentage of electric vehicle households that use home and public charging in detached homes, attached homes, and apartments by vehicle type. [7]

Furthermore, a study of fast-charging stations in California, displayed below, found that 30-50% of drivers are fast charging within a 5-mile distance from their home, dispelling assumptions that the use case for fast-charging is to enable long-distance travel.

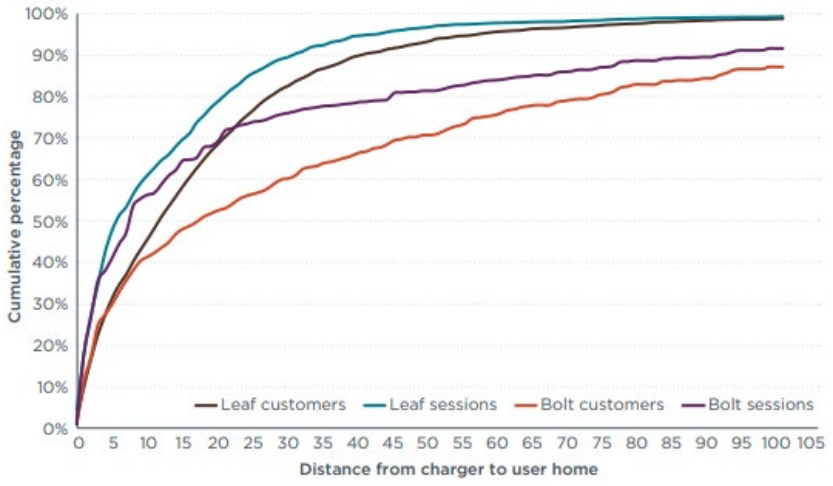

Figure 2: Percentage of fast-charge sessions and unique customers as a function of distance from charger to home [8]

Even in California, EVgo's largest market, the network has experienced high saturation and queuing at public fast chargers in San Diego and the San Francisco Bay Area. [9]

2.3 Unintended Outcomes for Focus on Level 2 Infrastructure Deployment

Access and visibility of charging infrastructure underpins mass EV adoption and remains one of the top-ranked consumer concerns for purchasing an EV. [10] Therefore, documented barriers to large scale Level 2 infrastructure deployments, unrelated to funding opportunities, exhibit a hinderance for the market growth potential for EVs. As an example, the 2012 Settlement between the California Public Utilities Commission (CPUC) and certain NRG-affiliated entities, which required a $102.5 million investment toward deployment of EV charging infrastructure, outlined a $40 million budget for "make-ready" Level 2 infrastructure. At the time, this marked the largest state-wide investment to deploy a state-wide network of electric vehicle charging infrastructure. The challenges cited as barriers for installing make-ready infrastructure at multifamily housing included required updates to electrical infrastructure, navigating homeowners' associations and multiple decisionmakers, and deeded parking spaces. The budget was formally amended in 2017, allowing up to $12.5M of the make-ready budget to be redirected for the installation of high-power charging plazas, deploying fast charging for census tracts with high concentrations of residents living in multi-unit dwellings (MUDs). [11]

While there is more room to evaluate the EV readiness in the existing housing stock, a survey conducted by the US Energy Information Administration found that at least 43% of US households would need to install new wiring to enable home charging. The survey highlighted that 52% of households do not park within 20 feet of an electric outlet, of those, 28% were in single family homes. [12] This study highlights that residents of multifamily homes are not alone in the challenge of upgrading and installing home charging. The CPUC observed that this challenge is further complicated by the distinction of owners vs renters, with a homeowner being three times more likely to own an EV. [13]

3. Emerging Trends: Public Fast Charging Enabling Transportation Network Companies (TNCs)

Electrification of emerging vehicle use cases disrupting the classic vehicle ownership model, like carshare and rideshare, have shown great reliance on robust DCFC infrastructure; TNC drivers log 3 to 7 times higher vehicle miles travelled (VMT) than personal-use drivers on average, and thus electrifying this market segment has huge potential. This is evidenced in the framework detailed by the CPUC below, identifying electrification as a critical element to reducing light duty vehicle emissions.

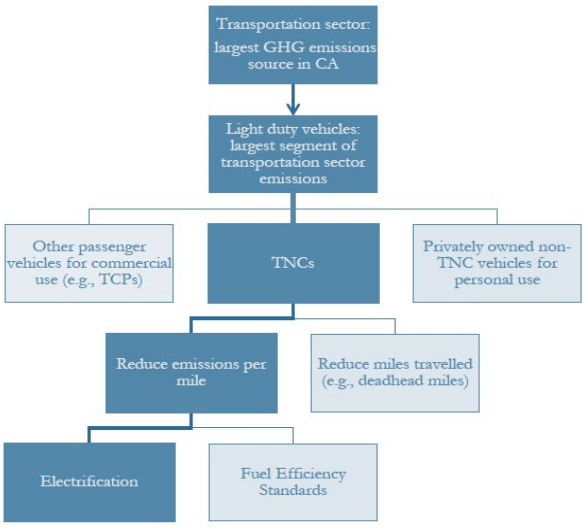

Figure 3: Electrification of TNCs as a source of GHG emissions reduction strategy

The public fast charging network deployed by EVgo has enabled light duty vehicle (LDV) fleet electrification, comprised of rideshare, carshare, and delivery vehicles. Charging by these vehicles represented one-third of energy delivered in 2018 and represented the most significant driver for increased utilization on the EVgo network in 2018. [15] In recognition of the value of fast charging for high-mileage drivers, GM-subsidiary, Maven, specializing in carsharing services, announced a partnership with EVgo in 2018 to provide dedicated fast charging stations for use by Maven Gig drivers. Maven reported that Bolt EVs in the Maven fleet have driven nearly 9 million all-electric miles. [16] To address any question related to the driver confidence of Bolt drivers, Maven Gig reported that members drive more than half the vehicle range every day (EPA-estimated range of 238 all-electric miles), with approximately 9 percent of daily trips exceeding the car's range. [17] This helps build confidence among lower mileage drivers that they, too, could drive an EV. Lyft has also made commitments to offering BEVs in their fleet through Express Drive. In Seattle and Atlanta, and more recently in Denver (November 2019), they are piloting "Green-Mode", which allows customers to hail a hybrid or electric vehicle, as part of their commitment to reduce air pollution. [18]

Fast charging is critical for TNC drivers, who face a higher-opportunity cost for time spent charging, which can equate to time lost for generating revenue in the form of paid-trips. Additionally, these drivers tend to be wholly reliant on public charging, underscoring their reliance specifically on public DCFC. Fleet electrification's benefits are two-fold, by providing passengers first-hand experiences with electric vehicles, as well as outsized GHG emission reduction benefits, with rideshare drivers driving three to seven times as many miles annually as personally owned vehicle drivers. GHG emissions reductions scale similarly. TNC drivers and other high mileage drivers receive the benefit of the lower total cost of ownership; a study released by ICCT noted "frequent, high-volume drivers have the most to gain from electrification." Growing models for shared and electric vehicle use offer increased exposure and access and lowers the entry point for EV trial or temporary use.

4. Optimizing Investment Through Thoughtful Program Design

Early deployments can be measured against their policy objectives for insights, including ability to reach the intended audience and accelerating EV adoption. Some of the largest challenges to date in infrastructure deployment through the lens of public access and policy is how to materially increase access to charging for renters, residents of MUD, low-income, and disadvantaged communities. EVgo's Equal Access Charging Hub program set out to do just that; the case study below reflects EVgo's implementation of the Equal Access Charging Hub program through exploration of the prime program objective of reaching a new market segment and policy lessons learned therein.

4.1 Equal Access Charging Hubs (EACH)

In solving for ways to increase access to EVs, and to target neighborhoods disproportionately impacted by pollution, EVgo partnered with nonprofit Shared Use Mobility Center (SUMC) to provide technical guidance and development of the EACH program to deliver public fast charging in California neighborhoods disproportionately impacted by pollution, support carsharing business models, and expose more residents of underserved communities to electric vehicles.

EVgo developed seven EV fast charging hubs equipped with four 50kW dual-standard DC Fast Chargers located in disadvantaged communities (DAC), as measured by, CalEnviroScreen, a screening methodology that can be used to identify census tracts with the highest burden by multiple sources of pollution. Outlined below are some of the primary considerations in the development of this program for developing public fast charging infrastructure.

Introducing Public Fast Charging Through an Owner-Operator Model:

From initial site development, utility and construction coordination all the way to monthly electricity bill management, maintenance, and customer service, the investment requirement and technical expertise of installation is best supported under an owner-operator model. As of March 2020, 80% of DCFC stations installed following the owner-operator model were owned by three companies: Tesla, EVgo and Volkswagen/Electrify America (VW/EA).[19] Providing public fast charging to a DAC ensures equitable investment and the benefits of being part of a network that connects drivers and communities, encouraging entering and driving to communities rather than simply driving through them. The EACH program delivered the first DCFC in the City of Inglewood, City of Compton and in National City (in San Diego). In Inglewood and City of Richmond, the addition of public fast charging without any infrastructure costs to the city was viewed as a significant public benefit. [20]

As previously stated, visibility and access to public charging infrastructure is one of the underlying barriers for EV adoption in any population. Deploying zero-emissions technologies in populations with the highest pollution-burden, which often overlaps with low-income communities, is especially important in communities that have faced historic under-investment. Providing equitable access to charging infrastructure is a first step in broadening the base of EV drivers.

Facilitate Access to Shared Electric Vehicles

Vehicle costs remain a barrier to entry despite the state's support of an electric future through the Clean Vehicle Rebate Program, which offers up to $7,000 for the purchase or lease of zero and near zero-emission vehicle, and the Clean Vehicle Assistance Program, which offers low-income Californians grants of up to $5,000 for BEVs in addition to assistance with vehicle financing. SUMC offered an updated landscape of electric and shared mobility service active in California as an opportunity to partner to serve as mobility hubs. The EACH program sought to facilitate partnership with electric carshare models by including additional parking spaces allocated to carshare or electric rideshare where possible.

In 2018, EVgo reported that charging by electric vehicle fleets, like those of transportation network companies like Uber and Lyft, represented one-third of energy delivered and represented the most significant driver for increased utilization on the EVgo network. New models for carsharing exhibit great potential, especially when paired with public fast charging infrastructure. While a number of providers offer battery electric carsharing, including short-term vehicle rentals through Maven Gig, Waive, BlueLA, Envoy, and AAA Gig, their deployments remain limited, and constrained to geographic regions (San Francisco, Los Angeles, and Sacramento). These hubs provide the opportunity for future expansion and maturation of those businesses.

Public Outreach and Community Engagement

Partnership with community-based organization was critical to educate and expose residents of DACs to electric vehicles. Organizations like Social Justice Learning Institute of Inglewood, GroundWork San Diego, GreenForAll and STEAM the Streets created events to introduce and connect drivers to local/state incentive programs, as well as to look at, feel, and in some cases test drive an electric vehicle. By partnering with regional community-based groups across the state, the program has been able to adapt methods for local outreach that are curated for the stakeholders of each community.

Establishing Evaluation Metrics

The EACH program's overarching goal is to ensure that there is charging infrastructure available to traditionally underserved communities, as well as community engagement and outreach through partnerships with local community-based organizations to share the benefits of transportation electrification and new mobility options. Evaluation metrics that can be measured over time include:

- Improved accessibility to electric vehicles and services

- Improved accessibility to infrastructure
- Direct environmental impact and GHG reduction
- Secondary effects on vehicle ownership, mobility

EACH Project as a Case Study

As new public fast charging programs and investments are made, state and local governments can look to models like the EACH deployment to seek ways to maximize the social and air quality benefits of infrastructure and to expand access to electric and shared mobility. Lowering barriers of entry to BEVs and EVSE infrastructure is a growing and necessary trend in program design. In recognition that developing programs to accelerate EV adoption for EV adoption and clean transportation services need not be overly prescriptive. Two California state agencies, the Air Resources Board and the Energy Commission have developed (or are developing) rebate programs: Clean Mobility Options (CARB) and Reliable Electric Mobility Infrastructure (CEC, currently in development). These voucher programs were developed out of concern that the funding was not able to reach the low-income or disadvantaged communities that they sought to benefit with those funds.

5. Additional Program Considerations

Though different from community-centric programs like EACH, states can also spearhead infrastructure investments or utility investment programs to support the buildout of EVSE networks and attract private capital.

Infrastructure Investment Program

An example of an infrastructure investment program that is developed to accelerate the deployment of EVSE is CALeVIP, which is funded by the CEC. In 2019, CALeVIP made $70 million available for programs designed for L2 ($20 million) and majority DCFC investments ($50 million). We will highlight elements of the DCFC programs that are beneficial for accelerated deployment.

In advance of the program's deployment, the CEC outlined the eligible counties, proposed funding level and the timing for the program's launch date. This provides developers a path to plan future investments by securing interested hosts. This program works as a rebate that encourages 3rd party investment. Qualified applicants can be reimbursed upon energization of the charger. The rebate is set at a value of $70,000 per DC fast charger or 75% of total project cost, whichever is less, and in a DAC the rebate is set for $80,000 per DC fast charger or 80% of total project cost. Setting a higher rebate level for DAC is also an important incentive to encourage development in the most pollution-burdened communities. The CEC has set several qualifying location criteria, encouraging 24-hour access, well-lit locations with amenities like retail shopping, or public locations like a library or police station near urban and retail amenities. These criteria are not overly prescriptive and allow developers to select locations that will receive high utilization, rather than restricting the program to be corridor-only or setting location requirements that exclude many viable and strategically important sites. Increasingly, however, locations with gates, like a grocery store at a mixed-use commercial building or a public parking facility, could be prime locations for drivers excluded by public funding investments for DCFC. One additional critique of this program lies in its effort to widen the net for applicants: its barrier to entry is too low and locations without the intention or ability to install will stay in the project queue for a full year before there is applicant turnover. An easy addition to ensure that only serious applicants and shovel-ready locations are awarded would be to require a utility assessment as part of the application. This baseline utility coordination would ensure that the location has the capacity or potential to have a DCFC station installed. EVgo applauds this block-grant program in its efforts to further streamline and accelerate the deployment of DCFC and believes that with a few modest modifications it would be primed to more fully achieve that goal.

Utility Investments Program

Utilities across the country will be key stakeholders and partners for EV charging service providers to build out charging infrastructure. In addition to partnership in the planning and interconnect processes, the make-ready utility investment model can be an effective model for utility investment that fosters in fostering a competitive and collaborative market. The make-ready model enables utilities to channel their core competencies, creates more load for utilities to serve, and perhaps most importantly, shifts the economics by reducing capital costs for third party charging networks in a manner that allows for the acceleration of the private investment. For private operators, the opportunity then opens up to bring expertise in ownership of charging infrastructure, marketing, customer service, operation, and maintenance.

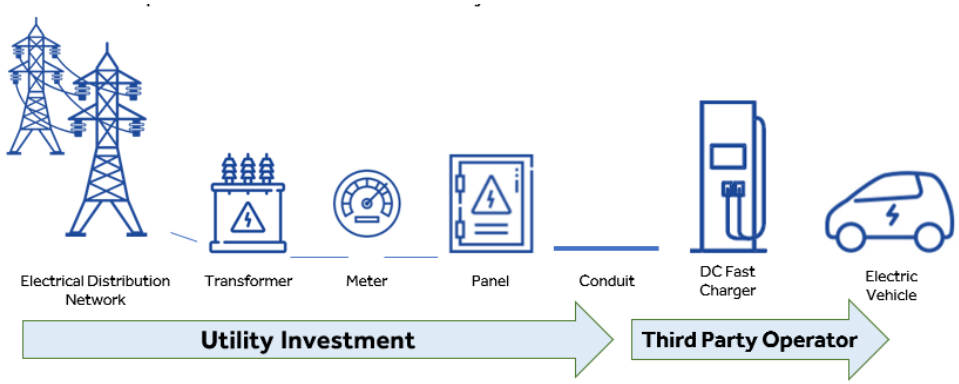

Figure 4: This illustration displays the concept of utility make-ready infrastructure investment.

When implemented well, the make-ready model is also an important first step for addressing equity concerns. By prioritizing areas that have traditionally been hardest hit by environmental impacts, there is opportunity to achieve equitable outcomes by designing the program to prioritize these communities. A good example of this the Pacific Gas & Electric application approved by the California Public Utilities to apply $22.4MM towards a make-ready DCFC program. [21] The program has a goal to support 234 DCFC and has a required percentage of the project to take prioritize disadvantaged communities. The program also provides the site hosts in disadvantaged communities – often the customer of record on the charger's electricity bill – a rebate toward the cost of the DCFC in addition to the make-ready investment by the utility.

Additional examples of pending or approved make-ready programs include but are not limited to ConEdison, National Grid Massachusetts [22], Eversource Massachusetts [23], Southern California Edison [24], and Pepco [25].

6. Conclusion

When looking at greenhouse gas emissions by sector, transportation remains the plurality, representing 29% GHG emissions in the United States. [26] In California, the country's largest state economy, the transportation sector represents an even larger 40% of greenhouse gas emission, of which 28% of emissions are from passenger vehicles. [27] T he electrification of the light duty vehicle segment continues to offer huge opportunities for states to meet their GHG reduction targets. While the need for public investment in publicly available charging infrastructure remains critical to materially ramp up EV adoption across the country, not all programs will achieve commensurate results. As it stands, states have the opportunity to support DC fast charging infrastructure deployments that serve more drivers and optimize public investment by providing the benefit of unlocking new segments of drivers and enabling the electrification of energy mobility services.

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Author

Catharine Brookes is a Program Manager at EVgo, focused on infrastructure deployment in California. Catharine manages implementation of major programs including $102MM NRG Settlement with the California Public Utilities Commission and delivery to state and agency grants. In 2019, EVgo increased its California network by 40% from year-end 2018, opening more than 200 new fast chargers.

Catharine brings 8 years of experience to EVgo in energy management and project management from Bright Power Inc, based in NYC and Johnson Matthey, LLC based in London, UK.

Catharine holds a B.A in Environmental Studies and Economics from Connecticut College.