Title
Examining Perceptions and Priorities of Heavy-Duty Transportation Electrification Projects: How Considerations of Justice Can Improve Project Implementation in Environmental Justice Communities

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Publication Date
2021

Peer reviewed|Thesis/dissertation

Examining Perceptions and Priorities of Heavy-Duty Transportation Electrification Projects:
How Considerations of Justice Can Improve Project Implementation in
Environmental Justice Communities

By

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THESIS

Submitted in partial satisfaction of the requirements for the degree of

MASTER OF SCIENCE

in

Energy Systems

in the

OFFICE OF GRADUATE STUDIES

of the

UNIVERSITY OF CALIFORNIA

DAVIS

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2021

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ABSTRACT

Scope/Background

The focus on deployed charging for EJCs[1] has been largely facilitated by Senate Bill 350 (SB 350) or, the Clean Energy and Pollution Reduction Act. SB 350 mandates an allocation of proceeds to projects that provide a benefit to "disadvantaged communities (DACs)" with provisions requiring that these proceeds be given to projects located in EJCs.

Research Gap

Policy alone is not enough for constituents to visualize long-term benefits in a quantitative manner. Currently, there is no clear method for quantifying EJC benefits or evaluating whether money disbursed for EJCs was used for this purpose. This paper dissects the implications of electric vehicle supply equipment (EVSE), particularly charging stations, installed near or within environmental justice communities (EJCs). It also considers possible methods of calculating benefits to EJCs in relation to electrification projects sought by investor-owned utilities (IOUs) and energy regulators.

Research Questions

This paper investigates and offers suggestions to support the actualization of tangible benefits for EJCs through the implementation of TE programs. The associated research questions are:

1. Does the allocation of funds spent through SB 350 target the correct areas of investment necessary to support EJCs?

1. All portions of this paper that refer to materials related to the evaluation and implementation of SB 350 TE projects as well as those used for the completion of the NCST-supported research project refer to the target population as "disadvantaged communities (DACs)" pursuant to the provided legislation. The author has decided to refer to this population as "environmental justice communities (EJCs) in order to use a descriptor that empowers these communities more effectively.

2. How are public and private investments in EJCs informed by the barriers associated with ensuring energy justice, transportation justice, and equity?
3. How do the perceptions and priorities of stakeholders inform the implementation of TE programs?

By considering each of these research questions, this paper also provides additional clarity for policymakers who work closely with EJCs in creating regulations that best serve their needs.

Methods

In order to frame the importance of energy justice considerations in relation to SB 350's focus on EJCs, a literature review was done to connect energy justice to the implementation of transportation electrification (TE) projects and the growth of initiatives centered on heavy-duty EVSE. This literature review was then used to inform the creation of metrics for use in the evaluation of equity implications within SB 350's projects and their consideration of impacts to EJCs.

Key Findings

TE projects focused on HDVs should primarily consider the economic advancement of EJCs and the tangible benefits associated with this advancement.

Key Policy Takeaways

The success of TE implementation is contingent on the success of community engagement and communication across all disciplines and professions that not only sufficiently acknowledges the needs of all stakeholders, but also holds itself accountable through implementation strategies that can be tracked and measured. In this way, the distribution of benefits will be more equitable and socially responsible. Strategies that increase the autonomy of EJCs will be of great benefit to policymakers as this will allow for more nuanced TE implementation that covers all areas of interest that address the most prominent needs of EJCs.

Keywords: EV, EVSE, DAC, EJC, charging stations, adoption, transportation electrification, heavy-duty vehicles, energy justice, transportation justice, equity

Acknowledgements:

I would like to sincerely thank Prof. Alissa Kendall, Prof. Deb Niemeier, and Prof. Jesus M. Barajas for their support and guidance in the completion of this thesis. I appreciate you all for helping me grow as a research scholar. I would also like to thank the Energy and Efficiency Institute (EEI), the Energy Graduate Group (EGG), and the Institute of Transportation Studies (ITS) for supporting me and providing opportunities for both professional and personal growth during my time at UC Davis. I would like to especially thank Prof. Alissa Kendall, Annemarie Schaaf, Ali Loge, and Ben Finkelor for their leadership and support in helping to keep EEI, EGG, and ITS running, connecting students to amazing opportunities, and providing a caring environment. I would also like to thank the people that I was fortunate enough to meet and get to know during my time at UC Davis for their friendship and encouragement. You have all been an inspiration to me, and I cannot wait to see the things you'll all accomplish in the future! Lastly, I would like to thank my family for their continued love, support, and encouragement during this time. You always uplift me and encourage me to keep going for my goals. You all have given me so much strength. I am very thankful to have you all in my life, and I love you all very much!

The research conducted and detailed throughout this paper was made possible in part by the support of the National Center for Sustainable Transportation (NCST) and the California Department of Transportation (Caltrans) through the "Improving Our Understanding of Transport Electrification Benefits for Disadvantaged Communities" research project.

I. INTRODUCTION

Motivation

Initiatives to mitigate greenhouse gas (GHG) emissions in California have been pursued across multiple public sectors. Alongside each of the targeted sectors (e.g., electric utility services, industry, transportation, and commercial and residential buildings), transportation electrification (TE) would have a large impact on the various clean air and GHG reduction goals mandated by the state as it accounts for approximately 34% of national combustion-related emissions (Steinberg et. al, 2017) . GHG mitigation policies and targets are implemented by agencies such as the California Public Utilities Commission (CPUC). Under Senate Bill 350 (SB 350), the Clean Energy and Pollution Reduction Act (Chapter 547, Statutes of 2015), new GHG reduction goals were established for 2030 and beyond. This legislation requires the CPUC to direct utilities to undertake TE activities and to consider the following (De León et. al, 2015):

1. Access for low- and moderate-income communities and environmental justice communities (EJCs[1]) should increase as TE becomes more widespread. increased use of electric vehicles (EVs) will effectively lower GHG emissions and ultimately enhance air quality.
2. Widespread TE may also encourage innovation and competition by giving customers options for electric vehicle service equipment (EVSE). This would also encourage infrastructure investments and job creation.
3. The deployment of EVs should also support grid management, reduced fuel costs, and the integration of renewable energy sources.

1. All portions of this paper that refer to materials related to the evaluation and implementation of SB 350 TE projects as well as those used for the completion of the NCST-supported research project refer to the target population as “disadvantaged communities (DACs)” pursuant to the provided legislation. The author has decided to refer to this population as “environmental justice communities (EJCs) in order to use a descriptor that empowers these communities more effectively.

4. As EVSE is deployed, sales of EVs should increase with accessibility to charging. This should also facilitate the opportunity to use electricity as a cleaner and cheaper alternative to gasoline and other fossil fuels both publicly and privately. The tangible benefits of TE should also include and be distributed equitably amongst all communities. Without such effective measures in place, air pollution from mobile sources would likely continue to worsen under a business-as-usual scenario.

Policy alone is not enough for constituents to visualize long-term benefits in a quantitative manner. Currently, there is no clear method for quantifying EJC benefits or evaluating whether money disbursed for EJCs was used for this purpose. As such, this paper dissects the implications of electric vehicle supply equipment (EVSE), particularly charging stations, installed near or within environmental justice communities (EJCs). It also considers possible methods of calculating benefits to EJCs in relation to electrification projects sought by investor-owned utilities (IOUs) and energy regulators. Both research outcomes have been informed by an extensive literature review that contributes an energy justice and transportation justice context that centers the unique needs of EJCs.

Research Questions

This paper investigates and offers suggestions to support the actualization of tangible benefits for EJCs through the implementation of TE programs. The associated research questions are:

1. Does the allocation of funds spent through SB 350 target the correct areas of investment necessary to support EJCs?
2. How are public and private investments in EJCs informed by the barriers associated with ensuring energy justice, transportation justice, and equity?

3. How do the perceptions and priorities of stakeholders inform the implementation of TE programs?

By considering each of these research questions, this paper also provides additional clarity for policymakers who work closely with EJCs in creating regulations that best serve their needs.

Background

SB 350 is one of a few synergistic climate mitigation policies. SB 350 is an extension of AB 32, also known as the California Global Warming Solutions Act of 2006, which aims to reduce GHG emissions levels to 40 percent of those observed in 1990 by 2030. SB 350 extends the previous bill to reduce emissions to 80 percent below 1990 levels by 2050. Specifically, the TE goals of SB 350 are complemented by renewable electricity procurement targets (i.e., 50 percent procurement by 2030) and integrated resource plan (IRP) requirements. SB 350 also shifts the California Independent System Operator (CAISO) into a regional organization and prioritizes TE (CA.gov, 2017). The TE projects currently being pursued by California utilities are in accordance with both SB 350 and AB 32. In 2018, the CPUC authorized the first TE applications under SB 350 from the state's three largest investor-owned utilities (i.e., Southern California Edison (SCE), Pacific Gas & Electric (PG&E), and San Diego Gas & Electric (SDG&E)), approving 15 "Priority Review" pilot projects with a combined budget of $42 million (CPUC, 2018).

To pursue electrification projects, prepared testimonies and Statements of Qualifications must be presented by utilities for approval by the California Public Utilities Commission (CPUC), as these projects involve modifications to their facilities. The CPUC is then tasked with assessing the potential harm or benefit to the public and utility ratepayers. This includes considerations of power production, environmental stewardship, and land use (CA.gov, 2021a).

These fall under two proceedings; a general proceeding and an environmental evaluation, which may occur simultaneously.

The general proceeding is led by both an Administrative Law Judge (ALJ) and a CPUC Commissioner who facilitate subsequent pre-hearing conferences, evidentiary hearings, and public participation hearings. Following the pre-hearing conference, scoping memos are created by the ALJ to list issues that were raised, and schedule dates to address those obstacles. The evidentiary hearing allows for the presentation and questioning of prepared testimonies in which the ALJ and the CPUC Commissioner can collect information needed to better understand and judge the case. If public interest is significant, public participation hearings will also be held to allow for the opinions of the general public to be considered (CA.gov, 2021a). At the completion of the proceedings, the proposed decision-prepared by the ALJ-is then evaluated and/or adjusted by all CPUC Commissioners. Finally, the full Commission votes to conclude the case (see Figure 1 below).

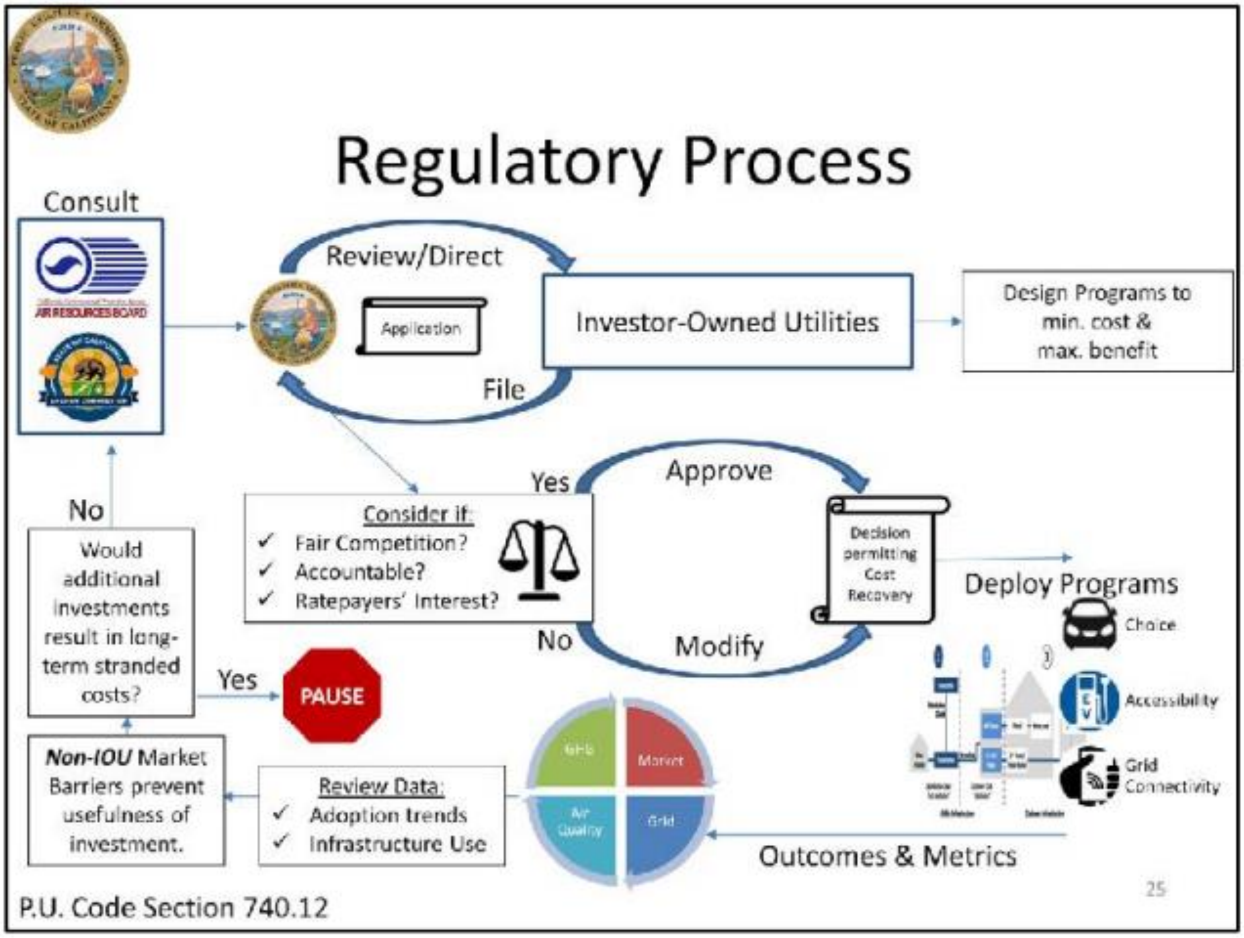

Figure 1: CPUC Regulatory Process for TE Programs (Crisostomo et al., 2016)

Each utility has different initiatives underway/proposed to support the climate goals set by the state. SDG&E's Residential Charging Program entails installing, operating, and maintaining 90,000 L2 charging stations. PG&E's DC Fast Charging Make-Ready Program proposed design includes meeting part of PG&E's estimated need for a maximum of 916 fast chargers by 2050. It also includes reducing driver range anxiety and increasing access to home charging. Both PG&E and SCE proposed medium and heavy-duty vehicle charging programs. PG&E's Fleet Ready Program proposes a budget of $210 million and targets make-ready infrastructure (i.e., the wiring, conduit, distribution lines, and transformers needed to connect the charger to the grid) in support of MD/HD fleets. This program provides utility-owned make-ready infrastructure at 700 sites for up to 8,800 charging points, customer education and outreach on EV benefits, and operation and maintenance of installed infrastructure. Likewise, SCE's Medium- and Heavy-Duty Vehicle Charging Infrastructure Program proposes using a $554 million budget to operate, install, and own the electric infrastructure to service charging equipment. This comes with a rebate to account for the costs of the charging equipment as well as installation. Assumptions made within their cost estimates assumed 18,234 vehicles at 930 sites with 10,491 charge points (CPUC, 2018).

Additionally, EJCs are defined and serviced through legislation - primarily by their classification within CalEnviroScreen 3.0. According to this screening tool, EJCs represent the top 25 percent of Cal EPA's CalEnviroScreen 3.0 census tracts scores - developed per SB 535 - and calculated on a service territory or state-wide basis. SB 535 directs that 25% of proceeds from the GHG Reduction Fund (i.e., cap-and-trade) be allocated to projects that provide a benefit to EJCs. Similarly, AB 1550 also requires that 25% of proceeds from the fund be spent on projects located in EJCs. This assists CalEPA's membership in prioritizing cleanup and resources and targeting cap-and-trade investments. Scores are based on socioeconomic, health, and environmental factors. This platform identifies communities that are disproportionately impacted by numerous sources of pollution and is commonly utilized by utilities and agencies (CA.gov, 2017). These communities also have population characteristics that leave them more susceptible to pollution (CA.gov, 2021c).

II. A LITERATURE REVIEW OF ENERGY JUSTICE, TRANSPORTATION JUSTICE, AND ASSOCIATED BARRIERS

SB 350 includes mandates and provisions requiring TE projects to benefit EJCs. However, these requirements only concern the placement of projects (i.e., as a function of EJC designation according to CalEnviroScreen 3.0) and not the realization of tangible benefits that have a positive impact on the well-being of EJCs and local community members. Likewise, this legislation and the resulting TE projects pursued by utilities do not explicitly address the unique needs of EJCs and the barriers that impede the services required to meet them. To provide additional context, this literature review will discuss conceptualizations of energy justice and transportation justice that effectively recognize the inequities and disparities faced by EJCs and provide recommendations to improve the implementation of TE programs that directly benefit EJCs through tangible means.

Conceptualizations of Energy Justice

As a multidisciplinary initiative, energy justice recognizes the necessity for social science in the study and understanding of energy systems and applies principles of justice to climate change, energy policy, energy activism, energy security, energy production, and energy consumption. The three tenets of energy justice (i.e., the philosophical foundations of energy justice) are distributional justice which calls for an adequate identification of the problem or concern, recognition-based justice which calls for the identification of who the problem or concern affects, and procedural justice which calls for democratic and equitable involvement of all stakeholders in energy-related decisions (Jenkins et al., 2016; Lee et al., 2019). Unlike environmental justice, which energy justice is often compared to, energy justice does not only concern the distribution of impacts, but also encompasses the services required to ensure equitable energy access.

Conceptualizations of energy justice acknowledge that environmental and social inequities are commonly derived from and reflected in discrepancies in energy consumption. Differences in energy consumption are primarily driven by human behavior, which is in turn driven by spatial and socio-economic factors, including infrastructure, economics, and culture. For instance, energy consumption increases at the ZIP code level with age (i.e., a median age of 40-55), educational attainment and income, and is more prevalent in owner occupied single-family dwellings and ZIP codes with a majority female population (Elnakat et al., 2016). Hence, it is important to understand the correlation between behavior, energy conservation, and consumption, and the effect they have on the implementation and design of energy policies . Ignoring these differences impedes the progress necessary to achieve the basic human right to energy, which includes: "the right to a healthy, sustainable energy production; the right to best available energy infrastructure; the right to affordable energy; and the right to uninterrupted energy service" (Reames, 2016b). These differences, or ignorance of these differences, perpetuates issues related to the equitable distribution of energy services including inequalities in technology energy efficiency, energy burden, and energy prices. To ensure that these differences are adequately accounted for, provisions that allow people of all socioeconomic and cultural backgrounds to utilize energy services without significant barriers should be included within energy policies and programs. Inclusive participation in energy conservation and related activities requires affordable and socially accepted energy-efficient technologies, programs, and policies that can be accessed by the most marginalized communities. Not only does this manifest itself differently between households, but within households as well (Reames et al., 2018).

Energy justice frameworks often emphasize the importance of social practices and relations that inform energy use and decision-making in the context of “community.” This includes an awareness of the broader social context that leaves people culturally and economically place-bound and how this results in identifiable clusters of social deprivation. By accounting for the differences in the lived experiences of and the challenges that need to be overcome by different communities, improvements to both energy justice and equity can be made without having to rely on broad and homogenous program implementation (Reames, 2016a). This would also assist in ushering in an equitable and just energy transition that pushes for affordable energy for all, evenly distributed benefits, and sustainable technologies. Affordable energy would facilitate good governance, due process, intra-generational equity, spatial equity, and finance resilience (Forrester, 2020).

Additionally, the linkages between energy justice and equity can be considered through the lens of procedural equity (i.e., inclusion), distributive equity (i.e., access), and intergenerational equity (i.e., obligations to future generations) (Brown et al., 2020). Procedural equity - which refers to the transparency and fairness of processes that allocate resources, resolve conflicts, and divide benefits and burdens - relates to legal and administrative proceedings as well as non-legal contexts as EJCs have exercised their autonomy in ensuring that initiatives focused on renewable energy and energy efficiency account for their needs. For instance, coalitions of advocacy groups spanning from affordable housing, energy, the environment, and low-income communities have collaborated to ensure that statewide policies prioritize the implementation of strategies in communities with the greatest need. This can be seen in initiatives to improve grid reliability and resilience for EJCs spearheaded by the California

Environmental Justice Alliance (CEJA) and Community Choice Aggregators (CCAs) (i.e., purchasers of energy led by local and county governments) (CalEJA.org, 2021).

Similarly, distributive equity - which limits the influence of privileges and prioritizes those with the highest need - encourages the development of programs and policies that fairly distributes benefits and burdens (Brown et al., 2020). Challenges to distributive equity have been seen in energy-efficiency programs that are paid in part by low-income ratepayer funds but do not have proper provisions that allow for low-income ratepayers to take part in them, leading to unintended consequences. To avoid negative outcomes, calls for targeted universalism (i.e., the establishment of universal goals that are achievable through targeted approaches) have been encouraged as it necessitates the recognition of each EJCs unique barriers and needs by applying an equity lens (Curti et al., 2018).

Lastly, intergenerational equity - which considers the obligations of communities to future generations - prioritizes actions and decisions that further rather than limit the developmental opportunities of future generations. Particularly for clean energy, the reduction of GHG emissions is considered a positive contribution to intergenerational equity and is a major component of statewide legislation. However, this approach provides much less emphasis on the potential for negative economic and social externalities faced by EJCs (Brown et al., 2020).

Barriers to Energy Justice

Energy justice seeks to bring about actionable solutions to counter them holistically. Of the existing barriers, energy poverty, fuel poverty and energy burden are the most detrimental and deeply intertwined with socio-demographic traits such as race, income, and education. These barriers apply primarily to the residential sector - and not the transportation sector - but still hold significance in conceptualizations of energy justice. By proactively ensuring equitable access, approaches for understanding and addressing these barriers (e.g., outreach and engagement, independent research, establishing minimum standards, etc.) can be developed and improved (Ambrose et al., 2019).

Energy poverty connects challenges related to energy inequality (i.e., energy injustice) and energy justice and highlights the particular barriers for low-income households (Xu et al., 2019). Energy poverty often arises from a combination of energy-inefficient housing, inefficient heating appliances and systems, low income, and high fuel costs. Because it derives from these multitudes of causes, a measurable definition is not available. The effects of energy poverty may include accumulated debt, poor indoor air quality, and temperatures that negatively affect household health (Ambrose et al., 2019; Reames, 2016a). Although energy poverty and fuel poverty are often used interchangeably, proposed definitions have been created to distinguish the two terms. Energy poverty is seen to occur within households that rely only on electricity and gas whereas fuel poverty is a result of a broader collection of energy sources. Apart from economics, fuel poverty also refers to the lived experiences of the fuel poor. Although fuel poverty is a symptom of distributional injustice (i.e., the rejection of the idea that all of society has a right to equal treatment and a fair distribution of outcomes), its prominence is also a result of a broader inability to recognize the energy needs of vulnerable populations and the procedural injustice that keeps them from having a significant role in decision-making, access to information, and access to legal processes needed to challenge unfavorable decision-making processes (Reames, 2016b).

In this case, the share of income used for utility-related expenses is often disproportionate and unaffordable, exceeding 6-11% of a household's annual gross income according to the U.S. Department of Health Services, and often with unbalanced impacts on minority and low-income households (Xu et al., 2019). This also affects mobile homes and households in rural areas, Indian reservations, island territories as well as households with children, elderly residents, and disabled occupants that have higher energy costs. This highlights the common correlates and causes of energy burden which include behavioral factors, location and geography, socio-economic characteristics, housing characteristics, and energy prices and policies (Brown et al., 2020). The aforementioned metric is based on the premise that a household should allocate no more than 30% of its income on housing expenses, and that utility costs should not be more than 20% of these expenses. However, this has been parsed further to distinguish between “energy stressed” households (4-7%), “energy burdened” households (7-10%), and “energy impoverished” households (10%+) by some scholars (Brown et al., 2020).

Analyses of energy burdens are often incomplete and fail to account for the complexities of such evaluations.The common use of aggregate statistics - while useful in the development of policies and programs - often shadows the array of energy users and their specific challenges, leading to a lack of equity considerations (Reames, 2016b). While they do include total household spending on energy bills (e.g., home energy services, heating, cooling, etc.), they often do not account for spending on transportation energy. Household budget and income are also represented by different markers of poverty and wealth, such as the Supplemental Poverty Measure (SPM), State Median Income (SMI), Federal Poverty Level (FPL), and Area Median Income (AMI). These various definitions can lead to different valuations of energy burden which can consequently influence the energy savings of a program (Brown et al., 2020). As such, residential energy efficiency programs face an arduous task in that they not only have to provide adequate relief from energy burden, energy insecurity, energy access, and energy poverty but that the methods they implement must also include solutions to these challenges based on the various lived experiences of their target customers. However, while these concepts highlight the need for energy justice in the residential sector, this concept does not directly apply to investments in charging infrastructure and TE initiatives at large.

Energy Justice in Transportation Electrification

Transportation justice serves as the intersection of energy justice and its impact on our transportation systems. It demands equal access to transportation in cities and a reduction in localized environmental harm that prioritizes both reliability and affordability (Canepa et al., 2019). Mobility justice is a term that is sometimes used interchangeably but is primarily concerned with the control of movement and the ways in which this governance/political power is used to shape patterns of immobility and unequal mobility. It also implores us to question who promotes and benefits from EV adoption and how politics is engrained in assumptions about EVs (Henderson, 2020). Basic concepts of mobility justice include the assumption that each person holds moral value as an individual, that this assumption should be reflected socially, politically, and economically, and that equal treatment is not indicative of equitable treatment (Mullen et al., 2016).

Barriers to Energy Justice in Transportation Electrification Programs

Electric vehicles only account for 2% of the American vehicle market with California standing out as one of the states pursuing equity in TE access among EJCs, low-income communities, and those who disproportionately face burdens as a result of higher levels of pollution exposure and other forms of environmental harm (Howard et al., 2021). Much of the currently available literature discusses TE programs specific to light-duty EVs as the heavy-duty EV market is still in its infancy by comparison. In the U.S., the medium- and heavy-duty vehicle markets account for 25% of transportation-related emissions (Maddrey et al., 2020). So while legislation, regulation, and executive action towards the light-duty EV market has substantially increased the adoption and proliferation of this vehicle type, policy must focus on electrifying the totality of the transportation sector (Howard et al., 2021). However, there must be careful consideration of the implementation of TE programs, policies, and initiatives and the potential for negative externalities that can manifest as barriers to true equity, because these barriers are not uniform for all EJCs across demographic, geographic, cultural, and economic factors (Tilley, 2019).

In California, there are five counties who have consistently had the poorest air quality in the nation every year since 2014 according to the USEPA Air Quality Index (Giuliano, 2021). With this in mind, the monitoring and analysis of pollutant exposure is a key component in accounting for the impacts of pollution exposure on EJCs. However, these studies can oftentimes be flawed in their methods and run the risk of underestimating the relative burden for specific populations (Tilley, 2019). This variability in both temporal and spatial impacts is often falsely distributed by static models that suggest everyone along a corridor experiences similar amounts of pollutant exposure at all times when in actuality there are spatial and temporal variabilities along corridors and within urban areas (McAllister, 2018). The static and aggregated pollutant exposure data does not reflect changes in traffic volumes, nor realistic exposure scenarios (i.e.., daily commutes, changes in weather, etc.), and minimizes the significance of results. The averaging of these measurements can cause exposure levels to be screened as being below criteria thresholds even with moments of notably high exposure.

While EVs are proven to provide environmental, and in some cases social, benefits relative to the internal combustion engine, they are also capable of facilitating exclusion and allowing existing wealth gaps to widen which raises concerns of distributional justice and recognition justice. Factors that can potentially contribute to these disparities include: regional distribution patterns as a result of shifts in pollution from tailpipes to power plants, perceptions of EVs as luxury items, and the health impacts of private vehicle ownership versus public transportation (Jenkins et al., 2018).

Additionally, while subsidies and rebates are necessary for making EVs cost competitive (alongside reductions to battery costs), funding mechanisms often benefit those of a higher income and are not always effective in accounting for differences in commuting behavior, range needs (i.e., the number and types of cars owned), access to charging networks, grid impacts and pricing associated with the location of chargers, and knowledge of consumer characteristics (e.g., education, income, appreciation/knowledge of technology, and their level of environmentalism) (Coffman et al., 2017; Singh, 2019). Discussions of consumer characteristics often prioritize the lived experiences and preferences of early adopters. Cited surveys show that early BEV adopters were often male, well-educated with a higher income, between the ages of 18 and 34 years old, and loosely defined as environmentally sensitive (Coffman et al., 2017). This disconnect between notions of environmentalism and the preferences of mass EV adopters - as opposed to early adopters - can also take the form of the “attitude-action gap” (i.e., the difference between the stated preferences and actions of consumers and their actual actions and revealed preferences) (Coffman et al., 2017) or the concept of “willingness to pay” (i.e., the value of the public charging infrastructure availability to consumers apart from usage fees) and its connection to familiarity and consumer education (Greene, 2020).

An additional barrier to EV adoption comes in the form of the “chicken or egg” problem or the reluctance of consumers to buy EVs when accompanied by both a lack of charging infrastructure and the hesitance of fuel suppliers to build out infrastructure without an adequate amount of vehicles available to make a profit (Greene et al., 2020). Without the intervention of policies to stimulate market development, the benefits of EVs alone are often not enough to encourage increased purchase and utilization of the necessary equipment. In order to encourage the installation of charging infrastructure to support EJCs, additional work must be performed to address the associated barriers. In California, factors that are stifling technology adoption include costs that are reflective of direct economic competition (i.e., those that are influenced by efficiency, fuel consumption, and the longevity of equipment), infrastructure availability, affordability, and the implementation of major electrification standards related to the various climate goals (Mai et al., 2018). While these factors are not exclusive to EJCs, they risk damage to the effectiveness of statewide policies and programs if unaddressed.

When considering the entirety of the market, technology adoption can only succeed when accompanied by outcome-, fuel- or technology-based regulation that includes incentives for both the producer/supplier (e.g., government funding for research and development and tax credits) and consumer (e.g., rebates and tax credits). The incentives that accompany this regulation should acknowledge the cultural, social, spatial, and economic context of the market of interest. Incentivized initiatives also spur demand that—while beneficial for sales and revenue—also carry inherent impacts related to the economy, energy/land use, and health within the environment (Yeh, 2007). Depending on the magnitude of the effect caused by these factors, EJCs that are dependent on government action may be left at a disproportionate disadvantage that may overshadow any intended benefits.

In addition to the challenges of EV adoption, the literature also suggests that several inefficiencies exist that are associated with focusing solely on EV deployment make TE strategies and the rate at which they have been pursued that may strengthen existing social inequalities insufficient on their own. For instance, EV investments made by the public sector have primarily been accrued by the wealthy. Since 2006, researchers found that in California, 83% of EV rebates were given to residents with annual incomes over $100,000, with Hispanic and Black majority census tracts less likely to receive rebates regardless of income (Blynn, 2018; Canepa et al., 2019). This highlights the risk of an inequitable distribution of costs and benefits if policies do not sufficiently address distributional inequities. Other critiques centering mobility justice suggest additional injustices may occur with the growth of the EV market. These include critiques of dependency on cars and escalated driving, lack of consideration for the global supply chain and life-cycle emissions, exhaustion of planetary resources from the production and consumption of EVs, increases in electricity demand and power generation, and competition for land and public funding for infrastructure that may contribute to the displacement of populations residing in urban cores (Henderson, 2020).

Transportation Electrification in Policy

Policies targeting the promotion and implementation of TE projects fall under five categories including incentives (i.e., utility incentives and financial support for purchases), rate design (i.e., utility pricing structure alternatives), mandates (i.e., quotas for the number of EVs sold), targeted efforts for EJCs (i.e., new or used EV purchase incentives, electric bus programs, and shared EV programs) , and infrastructure (i.e., the build out of EVSE and charging infrastructure by many organizations) (Tilley, 2019).

Within California, areas such as the San Joaquin Valley as well as the greater Los Angeles area have been classified as significant air quality nonattainment areas by the U.S. Environmental Protection Agency (EPA) (CA.gov, 2021b). As nonattainment areas, they have repeated violations of the National Ambient Air Quality Standards. The EPA oversees the performance of transportation conformity analyses in accordance with State Implementation Plans (SIPs) or air quality plans. Transportation-related plans that have received federal funding or approval must meet federal clean air standards and provide improvements to public mobility and health (CA.gov, 2021e).

With similar goals in mind, CARB has enforced the Zero-Emission Vehicle (ZEV) program under their Advanced Clean Cars package. According to the program's guidelines, long-term improvements in air quality can be achieved with the growth of battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and hydrogen fuel cell vehicles in light-duty vehicle fleets. Under the ZEV regulation, manufacturers must produce a specified number of ZEVs and PHEVs per year out of the total number of vehicles sold in California by each manufacturer. As the driving range of the EVs produced increases, the credits they receive increase. These credits can then be sold, banked, or traded as preferred. 22 percent of credits must be in accordance with the program by 2025. The ZEV program also estimates that 8 percent of new vehicle sales in 2025 will include PHEVs and ZEVs (CA.gov, 2021d). Governor Newsom's Executive Order N-79-20 also includes an ambitious TE goal endeavoring for 100 percent of state sales of new passenger vehicles to be zero-emission by 2035. This also applies to the sales of 100% zero-emission MD/HD vehicles by 2045 and drayage trucks by 2035. A similar goal has been put in place for zero-emission off-road vehicles and equipment by 2035 where feasible (Gov.CA.gov, 2020).

Recommendations for Improving the Implementation of Transportation Electrification Programs

The following are recommendations from research scholars, advocacy groups, non-profit organizations, and consulting firms that offer strategies to improve the implementation of TE programs. These strategies have a pointed focus on community engagement that allows for a sufficient understanding of the needs of EJCs - that do not only involve technological improvements - and the ways in which their viewpoint can be prioritized and incorporated in planning.

State IOUs, non-utility companies, the CPUC, and the CAISO as well as the California Energy Commission inform one another and have varying roles in regards to encouraging EV adoption in and furthering TE in EJCs. Due to the necessity of both financial (e.g., tax incentives) and non-financial incentives (e.g., preferred parking and access to high occupancy vehicle lanes), these regulatory entities have the responsibility of crafting policies that balance these incentives with the preferences and regional needs of consumers (Coffman et al., 2017; Klass, 2019; Giuliano, 2021). The literature provides several recommendations as to how policymakers can best accommodate the medium- and heavy-duty EV sector as well as the TE sector as a whole.

For instance, the CPUC should support the E-truck & bus market by acknowledging the unique needs of this segment, recognizing its environmental and grid benefits, separately submetering charging infrastructure where appropriate, and remaining technology and business model neutral. Other recommendations include changing current policy to mitigate costs of charging infrastructure, adapting utility rate structure to accelerate cost effectiveness of TE, expanding and enhancing industry stakeholder forums to better tack industry issues, commissioning a comprehensive study of E-trucks and buses, funding demonstration projects focused on advanced technologies (e.g., on-site electricity generation, range extenders, energy storage, and smart charging), creating dedicated program manager positions to support fleets, and continuing to support the electrification of trucks and buses through tax credits, grants, and incentives (Gallo, 2016; Blynn, 2018; Kahlert, 2019).

Additionally, policies can be further informed through the development of mandates, learning from the outcomes of other environmentally-focused initiatives, drawing from strategies in other countries (e.g., Norway, China, and Canada), and working closely with EJCs to overcome TE barriers (Tilley, 2019). This can also be accomplished by benchmarking progress on TE projects through comprehensive planning efforts and established baselines, making data publicly available community participation in mobility needs assessments, and establishing a clear policy direction that encourages both public and private investments (Howard et al., 2021). Transit agencies pursuing fleet electrification can become “good grid citizen[s]” by setting clear fleet electrification goals for ZEV technology deployments based on available resources, priorities, and constraints (Maddrey et al., 2020). They can also perform technology assessments by evaluating current vehicle and infrastructure options, holding exploratory meetings with electric utilities and other stakeholders, and identifying funding sources and rate optimization options to realize their fleet electrification goals.

Disproportionate environmental burdens related to the buildout of warehousing facilities can be mitigated by improving the standards and regulations by which these facilities are built, enhancing the accuracy and transparency of environmental impact reporting in planned projects, developing schemes that internalize externalities of these facilities and compensate affected EJCs, and empowering residents in local EJCs so they can more effectively influence land development decisions (Yuan, 2018).

The monitoring of air pollutant levels can be performed more effectively through the combined use of mobile pollution monitors, dynamic exposure analysis, and EJC identification.

The insights provided by these measures would allow EJCs to share more informed findings and opinions when discussing road expansions or development that could potentially leave them susceptible to heightened levels of near-road mobile source pollution and put sensitive populations at risk. These adjustments would span the entire relationship between housing policy, transportation planning, and land use planning to create fair and equitable solutions (McAllister, 2018).

Likewise, there are a number of actions at the federal level that can improve the implementation of TE projects. The legislature can plan for optimal charging locations and infrastructure on state and federal highways and workplaces by cooperating with auto manufacturers and state and local governments. Doing so would improve vehicle efficiency standards and allow them to provide technology-forcing incentives that benefit stakeholders from various sectors. The legislature can also provide funding for EVSE installation and EV subsidization through budgetary measures and competitive grant programs that provide benefits at or near the time of sale. This calls for clear incentives for both car sellers and buyers. Funding can also be provided for land use planning and mass transit that reduces vehicle miles traveled (VMT) through EJCs and increases their climate resilience (Fischman, 2020).

The literature also provides principles of equitable clean energy program design that should be upheld and are meant to guide local government staff and their associates in the creation of equity-oriented clean energy programs. The first guiding principle is being attuned and responsive to the needs of EJCs. This principle upholds the importance of incorporating strategies that address and provide solutions for the expressed concerns of EJCs and requires transparency - about the resources available to them - and strengthened community engagement to adequately define program goals. Similarly, partnering with trusted community organizations helps to build their capacity and allows them to exercise their autonomy (Curti et al., 2018).

Another principle, recognizing structural racism and its associated barriers, incorporates recognition-based justice - a tenet of energy justice (Jenkins et al., 2016) - by encouraging racial analysis that includes baseline data and racial analysis to facilitate an inclusive program design process. The next three principles (i.e., providing access to energy efficiency benefits, reducing financial burdens, and increasing access to co-benefits) work together to set the intended purpose of equitable clean energy programs and the desired takeaways for program participants. Not only should participants reap these benefits, but their participation should be made as easy as possible regardless of socio-economic status (Curti et al., 2018).

Beyond access to clean energy technologies, the next principle states that programs should also be aligned to service other needs that both protects and educates consumers and workers to avoid negative externalities. Additionally, the needs of EJCs should be centered in program delivery and design. This should be trackable and can be accomplished by establishing and assessing programs against baseline equity data - both qualitative and quantitative - to track progress and establish metrics. Lastly, a long-term commitment to EJCs should be maintained by facilitating provisions that allow programs to be structured in a way that supports technology service, repair, and upkeep (Curti et al., 2018).

III. CASE STUDY: "IMPROVING OUR UNDERSTANDING OF TRANSPORT ELECTRIFICATION BENEFITS FOR DISADVANTAGED COMMUNITIES"

The research conducted and detailed throughout this section was made possible in part by the support of the National Center for Sustainable Transportation (NCST) and sponsorship by the California Department of Transportation (Caltrans) through the "Improving Our Understanding of Transport Electrification Benefits for Disadvantaged Communities" research project. This project was also motivated by the assessment of PG&E's FleetReady Program, their assessment of the resulting EJC benefits, and their consideration of affordability and targeting.

Background

As mentioned previously in the "Background" portion of Section I, the CPUC has directed utilities to pursue TE projects fitting of the utility core competencies in accordance with the goals of SB 350. These goals must also align with regional, local, and state policies to leverage non-utility funding, promote the safety of drivers and workers, and promote widespread adoption through regulatory mechanisms (NCST, 2020). While strategies that focus on EJCs are well-intentioned, there are several pitfalls that can be identified. Because the goals for these programs are usually framed in a broader context, they lack the support of detailed analysis needed to differentiate the needs of the communities they serve.

For example, PG&E's Fleet Ready Program provides financial support for make-ready infrastructure (i.e., the wiring, conduit, distribution lines, and transformers needed to connect the charger to the grid) in support of MD/HD fleets. This program also provides utility-owned make-ready infrastructure at 700 sites for up to 8,800 charging points, customer education and outreach on EV benefits, and operation and maintenance of installed infrastructure (CPUC, 2018). Phases of PG&E's Fleet Ready Program were scrutinized by advocacy groups as provisions made for

EJCs did not clearly point towards tangible benefits for community members aside from lower levels of pollution. PG&E recommended that a 75% rebate on EVSEs for buses, trucks, and forklifts be given to EJCs (which account for 25% of the utility's customer base). However, this rebate was not fully thought out, as the utility could not pinpoint the number of EJC customers that actually owned and/or operated forklifts, as well as the availability of replaceable equipment.

This emphasizes the need for more accurate ways of linking technological incentives to EJC benefits. This also suggests that low-income consumers often find themselves left out of discussions that are pertinent to policy implementation. With the increase of transportation electrification, equitable access to the various technologies in place must be distributed to EJCs and low-income communities. These include residential charging, fast charging infrastructure, and MD/HD fleet infrastructure.

A second example that illustrates challenges presented by failing to ensure tangible benefits to EJCs is PG&E's DC Fast Charging Make-Ready Program. The program's commitment to incorporate 25% of make-ready infrastructure investments in support of fast charging availability in EJCs faced similar critique. When the utility proposed implementing a $25,000 incentive aimed at potential site hosts, methods of selecting/identifying these site hosts were lacking. This uncertainty is exacerbated by the fact that it hasn't been made clear that EV purchasing in EJCs will increase with the input of fast charging stations, nor is it certain that infrastructure investments will be offset by potential co-benefits (i.e. benefits of public charging in frequented locales) even with the inclusion of subsidies.

Examining the Growth of Heavy-Duty Focused Initiatives

Heavy-duty buses are useful for both urban and rural transit agencies but are more prevalent in urban agencies. However, the electrification of fleets in local, county, and state governments, as well as school districts and freight coverage areas (i.e., shipping and delivery) will support the growth of the medium- and heavy-duty sector of EVs in rural areas (Maddrey et al., 2020). With initiatives such as the California Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP), the state has begun to have a pointed focus on medium- and heavy-duty EVs and delivery companies such as Amazon, FedEx, the United Parcel Service (UPS), DHL, and General Motors (GM) are adjusting their fleets to contribute to emissions reduction goals (Domonoske, 2021). Although they have a greater premium cost than transit buses, school buses will experience significant electrification as there are more of them and they have a greater impact on school children and residential areas. For example, concentrations of particulate matter (PM) and air toxins within school buses have been estimated to be 4-12 times higher than ambient concentrations (Blynn, 2018). Similarly, transit buses have seen an increase in cost competitive model offerings by manufacturers. This is especially useful in areas where there is more dependence on public transit (Blynn, 2018). This is also supported by falling battery costs and improvements to upfront costs and economies of scale which benefit all end uses of EVs.

Electrification of medium- and heavy-duty vehicles alone has the potential to prevent 17.6 million metric tons of CO_2 emissions and decrease NO emissions by 60,000 tons. TE in this sector could also save fleet operations $7-$12 billion, create much needed jobs, and reduce costs of health damages related to pollution by $507 million per year by 2025 (Tilley, 2019). Heavy-duty TE could also allow for 22-43% GHG emissions reductions by 2050 (Howard et al., 2021).

As warehouses and distribution centers are often touted as ideal charging locations for medium- and heavy-duty electric vehicles, they can provide significant support to the buildout of EVSE as TE is pursued throughout the entirety of the sector. For instance, in 2018 SCE was given approval from the CPUC for investments of over $300 million to their "Charge Ready Transport" program from 2019 to 2024 with 25% of its budget dedicated to vehicles operating out of the ports and warehouses of Los Angeles and Long Beach (Bradley et al., 2019). 40% of all U.S. imports enter through these two ports alone (Yuan, 2017). Although EVSE installation and truck electrification in the warehouse and distribution industry is a much needed step, the disproportionate siting of these facilities in EJCs can lead to various disparities and externalities. In the Inland Empire alone, almost 150 million square feet of warehouse space has been built over the course of a decade despite protests from various advocacy groups (Knoblauch, 2021). This has left residents susceptible to toxic diesel fumes from trains and semi-trucks passing through the area.

Environmental risks related to warehousing can have detrimental effects on the relationship between these facilities and local communities. For example, studies in traffic engineering and public health show that truck-related emissions (e.g., PM and nitrous oxides (NOx)) pose significantly higher environmental risks than passenger vehicles (Yuan, 2017; Kozawa et al., 2009). Additionally, warehouse buildings can potentially reduce the livability of neighboring communities and their households by contributing to urban heat island effects and the threats of stormwater runoff (Yuan, 2018). These impacts to quality of life, local environment, and property values occur despite the well-intended promotion of clean trucks as the operation, maintenance, and movement of freight vehicles are still primarily responsible for pollution in the transportation sector. Furthermore, the siting of warehouses is normally dependent on labor costs, transportation accessibility, regional connectivity, land affordability, and a sociopolitical environment that benefits the developers rather than impacted residents who may not have autonomy to influence the decision-making process.

Both MDVs and HDVs have particular infrastructure needs, accommodations, planning, and coordination, the cost of which has been underestimated in the past. To facilitate the growth of the electric truck and bus market, changes to CPUC policies and the adjustment of utility rates for innovative arrangements are required. These include market transformations that reduce costs to both operate and charge and minimize demand charge impacts, and the maximization of load factors (i.e., the amount of kWh used per each kW of demand) in order to "[strike] the right balance between incentivizing further vehicle adoption, staying technology neutral, and respecting utility rate design principles" (Gallo, 2016). Among heavy-duty BEVs (i.e., drayage trucks, long-haul tractor-trailers, and delivery vehicles), the infrastructure needed for long-haul tractor-trailers is most costly, followed by delivery vehicles and drayage trucks. However, Direct Current Fast Chargers (DCFCs) or ultra-fast chargers require a disproportionate allocation of capital costs for charging infrastructure. These costs can be minimized through careful planning of routes, applications, and duty cycles as well as with the decrease of costs as the volume of trucks increases and technology becomes more efficient (Hall et al., 2019).

The lack of available charging infrastructure is more pronounced in EJCs. In California, there are approximately 0.93 Level 2 (L2) chargers and 0.61 DCFCs per 1,000 households in EJCs compared to 1.08 L2 chargers and 0.13 DCFCs per 1,000 households in non-EJCs. This trend is mostly due to EJCs primarily being located in more urban areas (Tilley, 2019). Both DCFCs and L2 chargers serve particular needs as DCFCs are useful for use on interstate highways and L2 chargers are commonly found in homes and public retail locations (Howard et al., 2021).

According to forecasts by the Energy Information Agency (EIA), freight transport will surpass that of passenger vehicles in emissions and energy consumption by 2050 globally. In the U.S., the share of energy use by freight transport will increase from 25% to 31% in 2050 . Technology development in this sector will likely be focused on vehicles with shorter range duty cycles that return to the same location for recharging and operate in slow-speed, urban environments where residents experience the greatest exposure to pollution (Blynn, 2018; Guiliano, 2021).

Motivation

This case study serves as a guide for the evaluation of MDV and HDV TE investments and their ability to provide tangible, quantifiable, and equitable benefits for EJCs. It also provides additional insight that may improve the implementation and evaluation of SB 350's TE programs. The case study focuses on the PG&E FleetReady Program and programs targeting the larger California Central Valley and begins with an assessment of the potential benefits of TE in the PG&E territory. This assessment was used to establish the base conditions for the potential benefits by: (a) utilizing CARB's EMFAC data to estimate the number of vehicles and equipment - by vehicle type - in each air basin and the emissions produced through a statewide forecast scaled to PG&E's service territory, and (b) conducting an inventory of existing stations in this service territory through spatial modeling (i.e., ArcGIS). A detailed technology review of potential MDV/HDV technologies and their diffusion timescales was also conducted (Lozano et al., 2020).

Following the technology assessment, a working framework for identifying the benefits of implementing technologies in EJCs was developed. This framework identifies pathways to EJC benefits and recognizes the uncertainties associated with them. The framework was then applied to one of the SB 350 "Priority Review" pilot projects as a case study - the final results of which can be found in this report (Bush et al., 2021).

Insights from Data and Technology Inventories

Estimates for TE and the adoption of ZEVs and their associated technologies was informed in part by a statewide forecast according to PG&E's service territory. To establish a baseline for potential benefits for new technologies and their use in EJCs, CARB's EMFAC2017 Web Database was used as it contains estimates for the number of equipment and/or vehicles as well as the emissions produced by vehicle type, fuel type, and air basin.

A geographic information system (GIS) (i.e., ArcGIS) was used to provide a spatial representation of the availability of existing charging stations (see Figure 2 below). The base of this data layer was created by implementing a shape file of the various census tracts according to specifications of CalEnviroScreen3.0. This was then layered with a shape file of the PG&E service area in order to display the EJCs housed within the service area.

To build upon the emissions data sourced from EMFAC2017 and to support the build-out of knowledge on charging infrastructure required for different truck technologies, PlugShare data detailing the types of chargers developed within California was collected (PlugShare, 2021). The data, supplied by another researcher at UC Davis[2], included information pertaining to the location of each charger by address as well as by latitude and longitude. It also identified the charging network (e.g., EVgo, DC Fast, Supercharger, etc.) and outlet ID of each charger. This

2. PlugShare data and support to incorporate this data into ArcGIS was provided by Bingzheng Xu from the University of California, Davis and the Institute of Transportation Studies (ITS-Davis).

spreadsheet was implemented as an ArcGIS layer to display the locations of each charger across the state of California. As the focus of this project is MDVs and HDVs, the data layer was adjusted to focus solely on PlugShare chargers useful to these vehicle types. These included Quick Charge (CCS/SAE Combo and CHAdeMO), J-1772, and Tesla Supercharger. To gain additional insight into MD-/HD- charging currently being supported, a spreadsheet containing various models of MDVs and HDVs eligible for the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) was provided by a representative at CARB. A column was added to this spreadsheet to provide information on the chargers required for each of the vehicles listed. This spreadsheet also serves as the justification for the filtering done in the ArcGIS file which was mentioned previously.

This work could be coupled with road networks to ascertain the impacts of charger location relevant to traffic corridors. By including a shape file of the state highway system, this will allow for inferences to be made regarding population density of chargers. Use of the freight analysis framework may be useful for this task as it displays roads accessible by HDVs.

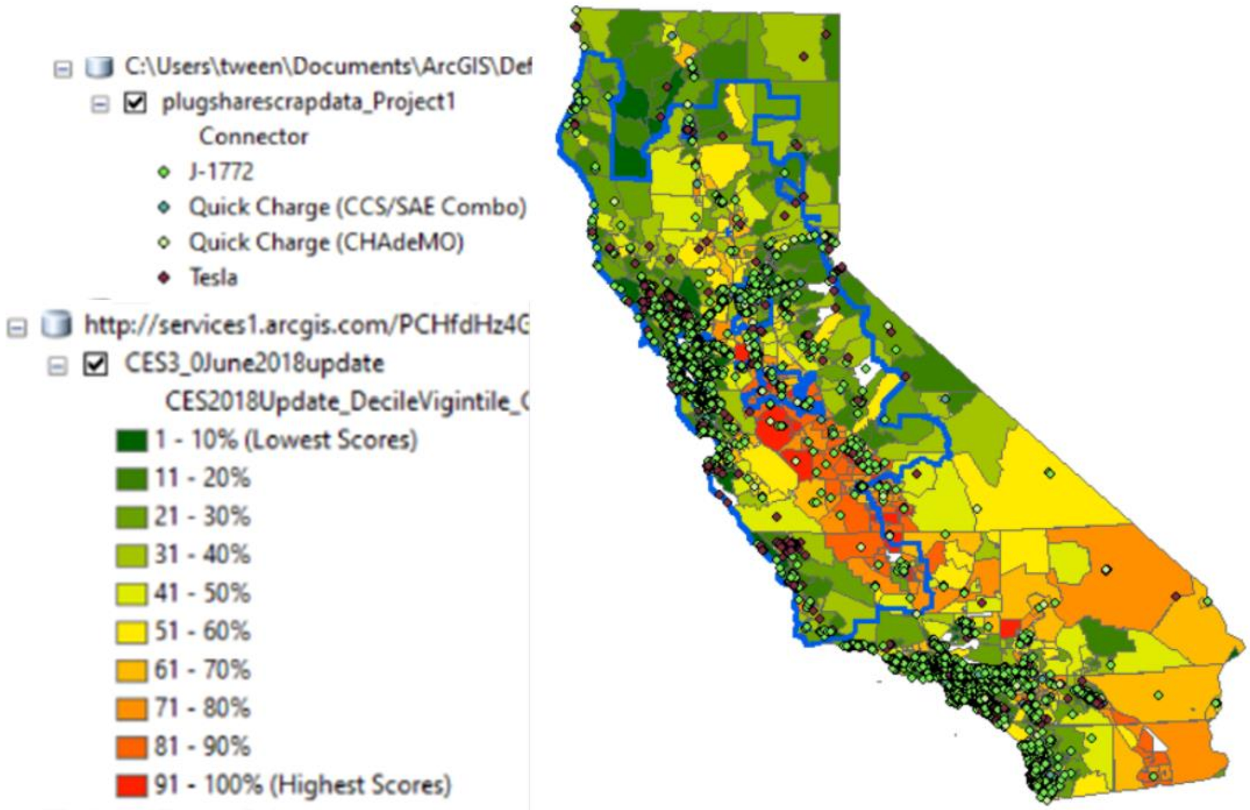

Figure 2: Heavy-Duty EV Charger Map (ArcGIS)

Framework for the Development of Metrics to be Used in the Implementation of Heavy-Duty Transportation Electrification Programs

As the current criteria used for program selection and implementation often lacks adequate considerations of equity and EJC impacts, a set of questions was created to guide the development of metrics to be used in a survey. The survey asked various stakeholders to rank and provide their expert opinion on the relative importance of community engagement, health impacts, safety, technological improvements, and economic considerations and their appropriate influence on TE projects located in EJCs. Stakeholders were selected based on their inclusion in the CPUC Service List associated with the SB 350 proceeding (i.e., Proceeding A1701020 - SDG&E). These questions were motivated by criteria and metrics contained in CARB's California Climate Investments Co-benefit Assessment Methodologies (CA.gov, 2020). These documents were organized into different categories based on the California Energy Commission's (CEC) "Scoring Criteria for Projects that Benefit Disadvantaged and Low-Income Communities (Criteria #9) (CA.gov, 2019). This was also informed by additional guidance found in the literature (Sovacool et al., 2015) and other frameworks such as those found within the NCST's "Framework for Life Cycle Assessment of Complete Streets Projects" report (Harvey et al., 2018). The questions were divided into five categories: Community Engagement, Health Costs and Benefits, Safety, Technological Advancement, and Economic Costs and Benefits. A summary of each of the categories as well as the full list of guiding questions has been included in the Appendix.

Survey Metrics

The survey metrics (i.e., the metrics used to create the final framework) were also divided into five categories: Community Engagement, Health and Safety Costs and Benefits, Effects of Infrastructure, Economic Costs and Benefits, and Technological Resilience (see Tables 1-5). While these categories are similar to those used for the set of guiding questions that was created, adjustments were made for conciseness within the survey.

All feedback was provided anonymously and was not attributed as any form of representation of anyone's respective agency, company, or organization. However, data on which sector stakeholders were from was collected. These metrics were again divided into five categories which are similar to those mentioned previously but were adjusted to better reflect the chosen metrics and for conciseness. Stakeholders were also asked to rank the five categories by their importance towards the end of the survey (see Figure 4 under Overall Weighting of Metric by Sector and Order of Importance and Table 8 under the Discussion section):

Table 1: Community Engagement Metrics

Community Engagement

Description	Metrics
It is important to explore how communities engage with the projects. Further, how do these projects relate to the priorities of the community, and have these priorities been adequately assessed in the project development? These metrics are meant to bring attention to the role the communities have and will play in the rollout of the projects.	Transparent and collaborative community engagement throughout all phases (e.g., design, implementation, education, end-of-debriefing, renewal)
	Addressing a specified community need
	Delivering on priorities expressed by the community with respect to co-benefits of any new projects
	Addressing social and/or linguistic barriers
	Effects of indigenous peoples and their lands
	Effects on native flora and fauna

Table 2: Health and Safety Costs and Benefits Metrics

Health and Safety Costs and Benefits	
Description	Metrics
This set of metrics aims to determine to what extent the strategy or jurisdiction has considered the impacts of implementation on the health of the community, both positive and negative. This includes physical health, such as air pollution or infrastructure to promote exercise, as well as mental health. It also explores how the costs and benefits are distributed across communities.	Changes to noise pollution through electrified vehicle-miles-traveled (VMT)
	Changes to local air pollution through electrified vehicle-miles-traveled (VMT)
	Potential for accident zones (i.e., crash risks due to increased truck traffic)

Table 3: Effects of Infrastructure Metrics

Effects of Infrastructure	
Description	Metrics
These metrics deal with consequences that are beyond individual health and examine city-wide or regional safety.	Effects on the use of green space and/or recreational space
	Upstream impacts (i.e., through raw materials

	acquisition or construction phases)
	End-of-life impacts (i.e., recycling, disposal, or reuse of chargers, vehicle batteries, etc.)
	Effects of additional charging infrastructure and/or related equipment on traffic and congestion

Table 4: Economic Costs and Benefits Metrics

Economic Costs and Benefits	
Description	Metrics
There are almost always financial costs associated with implementing green infrastructure or strategies. These metrics probe the types of economic costs and benefits that are expected, as well as how these trade-offs affect communities. It is important to note that not just the distribution of costs and benefits, but there may also be barriers to accessing benefits that are not immediately obvious. These metrics try to capture the full range of considerations.	Expected tangible benefits for local community members
	Expected tangible benefits for local medium- and heavy-duty vehicle operators
	Potential barriers to benefits along with forecasted business closures
	Job creation
	Maintaining rate payer interests
	Economic burden on DACs due to increased electricity demand

Table 5: Technological Resilience Metrics

Technological Resilience	
Description	Metrics
These metrics examine barriers to accessing technology and associated benefits. While this theme was explored under "Economic Costs and Benefits," here, we focus on the non-financial barriers.	Improves or enhances grid stability and resilience
	Improves or enhances access to additional sustainable technologies
	Supports distributed generation and the development of micro-grids in electrification plans

Each of the metrics in the five categories were weighted with the condition that each of the metric scores add up to 100. The survey was created using Qualtrics and allowed participants to weight metrics through the use of a sliding scale (see Figure 3 below).

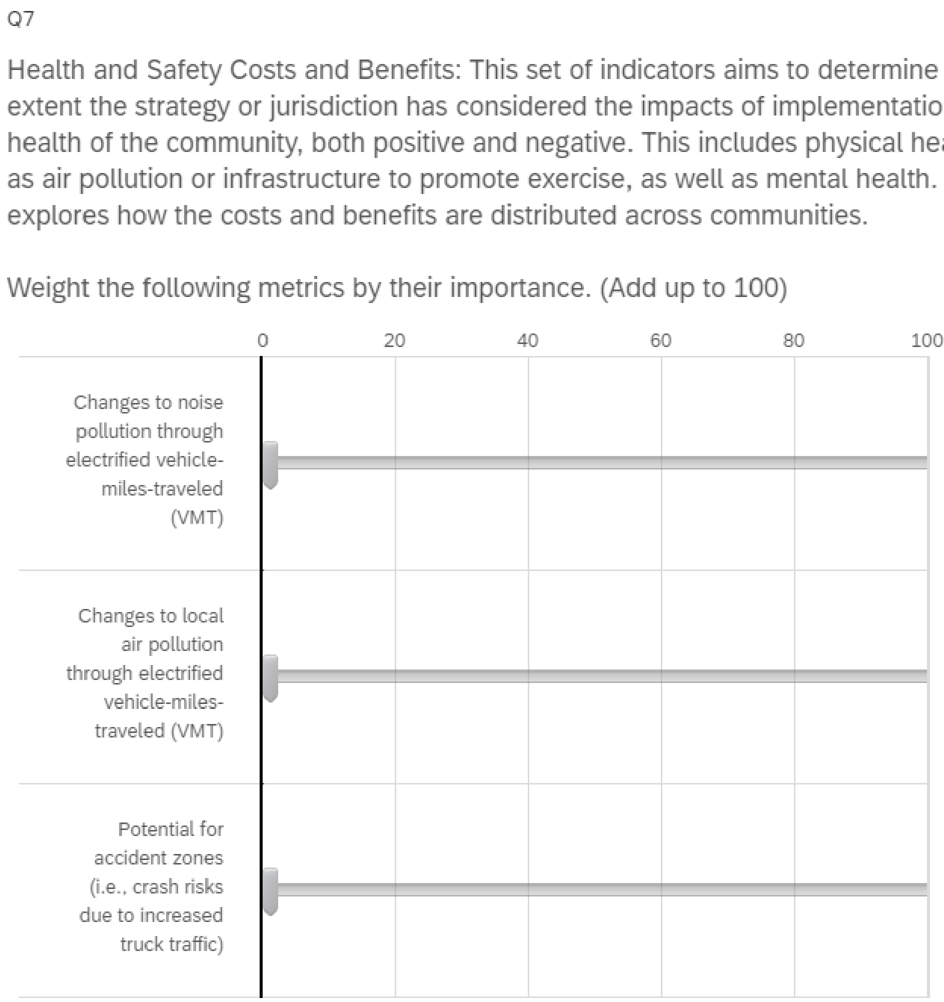

Figure 3: Sliding Scale for the Scoring of Metrics (Health and Safety Costs and Benefits)

Survey Results

Overall Findings

The survey was sent to a total of 181 stakeholders and responses were collected over a two-week period. A total of 51 responses were collected with 24 of them being under 100% completion. The remaining 27 survey responses were fully completed with four of the respondents declining to proceed with the survey for a response rate of approximately 15%. The small sample size of survey participants was a limitation in this study. Respondents were allowed to describe their affiliation as belonging to government, utility, the private sector, community organization, advocacy group, environmental non-governmental organization (NGO), legal representation, or other. Of the completed survey responses, five of the respondents worked in government, four worked in the private sector, three worked in advocacy groups, two worked in environmental NGOs, five worked in legal representation, and four belonged to other affiliations. There were no respondents who worked for utilities or community organizations. One respondent from an investor-owned utility declined participation in the survey due to the open regulatory items (i.e., SB 350) that were cited in the survey.

On average, the respondents felt that Economic Costs and Benefits were of most importance followed by Health and Safety Costs and Benefits, Community Engagement, Effects of Infrastructure, and Technological Resilience (see Figure 4 under Overall Weighting of Metric by Sector and Order of Importance and Table 8 under the Discussion section). The mean weights for the survey categories as well as the individual metrics have been included in the Appendix (see Tables A1-A42).

Overall Weighting of Metrics by Category and Order of Importance

Economic Costs and Benefits: Overall, expected tangible benefits for local community members was weighted as the most important metric followed by expected tangible benefits for local medium- and heavy-duty vehicle operators, maintaining rate payer interests, job creation, economic burden on DACs due to increased electricity demand, and potential barriers to benefits along with forecasted business closures (see Figure 5 under Overall Weighting of Metric by Sector and Order of Importance).

Health and Safety Costs and Benefits: Overall, changes to local air pollution through electrified VMT was weighted as the most important metric followed by potential for accident zones, and changes to noise pollution through electrified VMT (see Figure 6 under Overall Weighting of Metric by Sector and Order of Importance).

Community Engagement: Overall, both transparent and collaborative community engagement throughout all phases and addressing a specified community need were closely weighted as the most important metrics followed by delivering on priorities expressed by the community with respect to co-benefits of any new projects, addressing social and/or linguistic barriers, effects on indigenous peoples and their lands, and effects on native flora and fauna (see Figure 7 under Overall Weighting of Metric by Sector and Order of Importance).

Effects of Infrastructure: Overall, end-of-life impacts was weighted as the most important metric followed by effects of additional charging infrastructure and/or related equipment on traffic and congestion, effects on the use of green space and/or recreational space, and upstream impacts (see Figure 8 under Overall Weighting of Metric by Sector and Order of Importance).

Technological Resilience: Overall, improvements or enhancements of access to additional sustainable technologies was weighted as the most important metric followed by improvements or enhancements to grid stability and resilience, and the support of distributed generation and the development of micro-grids in electrification plans (see Figure 9 under Overall Weighting of Metric by Sector and Order of Importance).

Overall Weighting of Metrics by Sector and Order of Importance

Respondents from the Government Sector

On average, the respondents felt that both Economic Costs and Benefits and Health and Safety Costs and Benefits were of equal importance followed by Community Engagement, Effects of Infrastructure, and Technological Resilience.

Economic Costs and Benefits: Overall, expected tangible benefits for local community members was weighted as the most important metric followed by expected tangible benefits for local medium- and heavy-duty vehicle operators, maintaining rate payer interests, economic burden on DACs due to increased electricity demand, potential barriers to benefits along with forecasted business closures, and job creation.

Health and Safety Costs and Benefits: Overall, changes to local air pollution through electrified VMT was weighted as the most important metric followed by changes to noise pollution through electrified VMT, and potential for accident zones.

Community Engagement: Overall, delivering on priorities expressed by the community with respect to co-benefits of any new projects was weighted as the most important metric followed by addressing a specified community need, transparent and collaborative community engagement throughout all phases, effects on indigenous peoples and their lands, addressing social and/or linguistic barriers, and effects on native flora and fauna.

Effects of Infrastructure: Overall, end-of-life impacts was weighted as the most important metric followed by effects of additional charging infrastructure and/or related equipment on traffic and congestion, upstream impacts, and effects on the use of green space and/or recreational space.

Technological Resilience: Overall, improvements or enhancements of access to additional sustainable technologies was weighted as the most important metric followed by improvements or enhancements to grid stability and resilience, and the support of distributed generation and the development of micro-grids in electrification plans.

Respondents from the Private Sector

On average, the respondents felt that Economic Costs and Benefits were of most importance followed by Health and Safety Costs and Benefits, Technological Resilience, Community Engagement, and Effects of Infrastructure.

<u>Economic Costs and Benefits:</u> Overall, expected tangible benefits for local medium- and heavy-duty vehicle operators was weighted as the most important metric followed by maintaining rate payer interests, expected tangible benefits for local community members, job creation, economic burden on DACs due to increased electricity demand, and potential barriers to benefits along with forecasted business closures.

<u>Health and Safety Costs and Benefits:</u> Overall, changes to local air pollution through electrified VMT was weighted as the most important metric followed by changes to noise pollution through electrified VMT, and potential for accident zones.

<u>Technological Resilience:</u> Overall, improvements or enhancements to grid stability and resilience was weighted as the most important metric followed by the support of distributed generation and the development of micro-grids in electrification plans, and improvements or enhancements of access to additional sustainable technologies.

<u>Community Engagement:</u> Overall, addressing a specified community need was weighted as the most important metric followed by transparent and collaborative community engagement throughout all phases, delivering on priorities expressed by the community with respect to co-benefits of any new projects, addressing social and/or linguistic barriers, effects on indigenous peoples and their lands, and effects on native flora and fauna.

<u>Effects of Infrastructure:</u> Overall, effects of additional charging infrastructure and/or related equipment on traffic and congestion was weighted as the most important metric followed by

effects on the use of green space and/or recreational space, end-of-life impacts, and upstream impacts.

Respondents from Advocacy Groups

On average, the respondents felt that Economic Costs and Benefits were of most importance followed by Health and Safety Costs and Benefits, Community Engagement and Effects of Infrastructure which were tied for relative importance, and Technological Resilience.

<u>Economic Costs and Benefits:</u> Overall, maintaining rate payer interests was weighted as the most important metric followed by expected tangible benefits for local community members, expected tangible benefits for local medium- and heavy-duty vehicle operators, and job creation, economic burden on DACs due to increased electricity demand, and potential barriers to benefits along with forecasted business closures all three of which were tied for the least important metric.

<u>Health and Safety Costs and Benefits:</u> Overall, changes to local air pollution through electrified VMT was weighted as the most important metric followed by changes to noise pollution through electrified VMT, and potential for accident zones.

<u>Community Engagement:</u> Overall, transparent and collaborative community engagement throughout all phases was weighted as the most important metric followed by addressing a specified community need, delivering on priorities expressed by the community with respect to co-benefits of any new projects, addressing social and/or linguistic barriers and effects on indigenous peoples and their lands which were tied for relative importance, and effects on native flora and fauna.

Effects of Infrastructure: Overall, end-of-life impacts was weighted as the most important metric followed by effects on the use of green space and/or recreational space, upstream impacts, and effects of additional charging infrastructure and/or related equipment on traffic and congestion.

Technological Resilience: Overall, improvements or enhancements to grid stability and resilience was weighted as the most important metric followed by improvements or enhancements of access to additional sustainable technologies, and the support of distributed generation and the development of micro-grids in electrification plans.

Environmental NGO

On average, the respondents felt that Health and Safety Costs and Benefits were of most importance followed by Economic Costs and Benefits, Effects of Infrastructure, Community Engagement, and Technological Resilience.

Health and Safety Costs and Benefits: Overall, changes to local air pollution through electrified VMT was weighted as the most important metric followed by changes to noise pollution through electrified VMT, and potential for accident zones.

Economic Costs and Benefits: Overall, job creation was weighted as the most important metric followed by expected tangible benefits for local community members, expected tangible benefits for local medium- and heavy-duty vehicle operators, maintaining rate payer interests, economic burden on DACs due to increased electricity demand, and potential barriers to benefits along with forecasted business closures.

Effects of Infrastructure: Overall, effects on the use of green space and/or recreational space was weighted as the most important metric followed by end-of-life impacts, effects of additional charging infrastructure and/or related equipment on traffic and congestion, and upstream impacts.

Community Engagement: Overall, transparent and collaborative community engagement throughout all phases was weighted as the most important metric followed by addressing a specified community need, delivering on priorities expressed by the community with respect to co-benefits of any new projects, addressing social and/or linguistic barriers, effects on indigenous peoples and their lands which were tied for relative importance, and effects on native flora and fauna.

Technological Resilience: Overall, improvements or enhancements of access to additional sustainable technologies was weighted as the most important metric followed by improvements or enhancements to grid stability and resilience and the support of distributed generation and the development of micro-grids in electrification plans - both of which were tied for least importance.

Respondents from the Legal Sector

On average, the respondents felt that Economic Costs and Benefits were of most importance followed by Technological Resilience, Health and Safety Costs and Benefits, Effects of Infrastructure, and Community Engagement.

Economic Costs and Benefits: Overall, expected tangible benefits for local community members was weighted as the most important metric followed by maintaining rate payer interests, expected tangible benefits for local medium- and heavy-duty vehicle operators, job creation, economic burden on DACs due to increased electricity demand, and potential barriers to benefits along with forecasted business closures.

Technological Resilience: Overall, the support of distributed generation and the development of micro-grids in electrification plans was weighted as the most important metric followed by improvements or enhancements to grid stability and resilience, and improvements or enhancements of access to additional sustainable technologies.

Health and Safety Costs and Benefits: Overall, changes to local air pollution through electrified VMT was weighted as the most important metric followed by changes to noise pollution through electrified VMT, and potential for accident zones.

Effects of Infrastructure: Overall, effects of additional charging infrastructure and/or related equipment on traffic and congestion was weighted as the most important metric followed by end-of-life impacts, upstream impacts, and effects on the use of green space and/or recreational space.

Community Engagement: Overall, transparent and collaborative community engagement throughout all phases was weighted as the most important metric followed by delivering on priorities expressed by the community with respect to co-benefits of any new projects, addressing a specified community need, effects on native flora and fauna, addressing social and/or linguistic barriers, and effects on indigenous peoples and their lands.

Respondents from Other Sectors

On average, the respondents felt that Economic Costs and Benefits were of most importance followed by Health and Safety Costs and Benefits, Community Engagement, Effects of Infrastructure, and Technological Resilience.

Economic Costs and Benefits: Overall, expected tangible benefits for local medium- and heavy-duty vehicle operators was weighted as the most important metric followed by expected tangible benefits for local community members, maintaining rate payer interests, job creation, potential barriers to benefits along with forecasted business closures, and economic burden on DACs due to increased electricity demand.

Health and Safety Costs and Benefits: Overall, changes to local air pollution through electrified VMT was weighted as the most important metric followed by changes to noise pollution through electrified VMT, and potential for accident zones.

Community Engagement: Overall, addressing a specified community need was weighted as the most important metric followed by delivering on priorities expressed by the community with respect to co-benefits of any new projects, transparent and collaborative community engagement throughout all phases, addressing social and/or linguistic barriers and effects on indigenous peoples and their lands which were tied for relative importance, and effects on native flora and fauna.

Effects of Infrastructure: Overall, end-of-life impacts was weighted as the most important metric followed by effects on the use of green space and/or recreational space, upstream impacts, and effects of additional charging infrastructure and/or related equipment on traffic and congestion.

Technological Resilience: Overall, improvements or enhancements of access to additional sustainable technologies was weighted as the most important metric followed by improvements or enhancements to grid stability and resilience, and the support of distributed generation and the development of micro-grids in electrification plans.

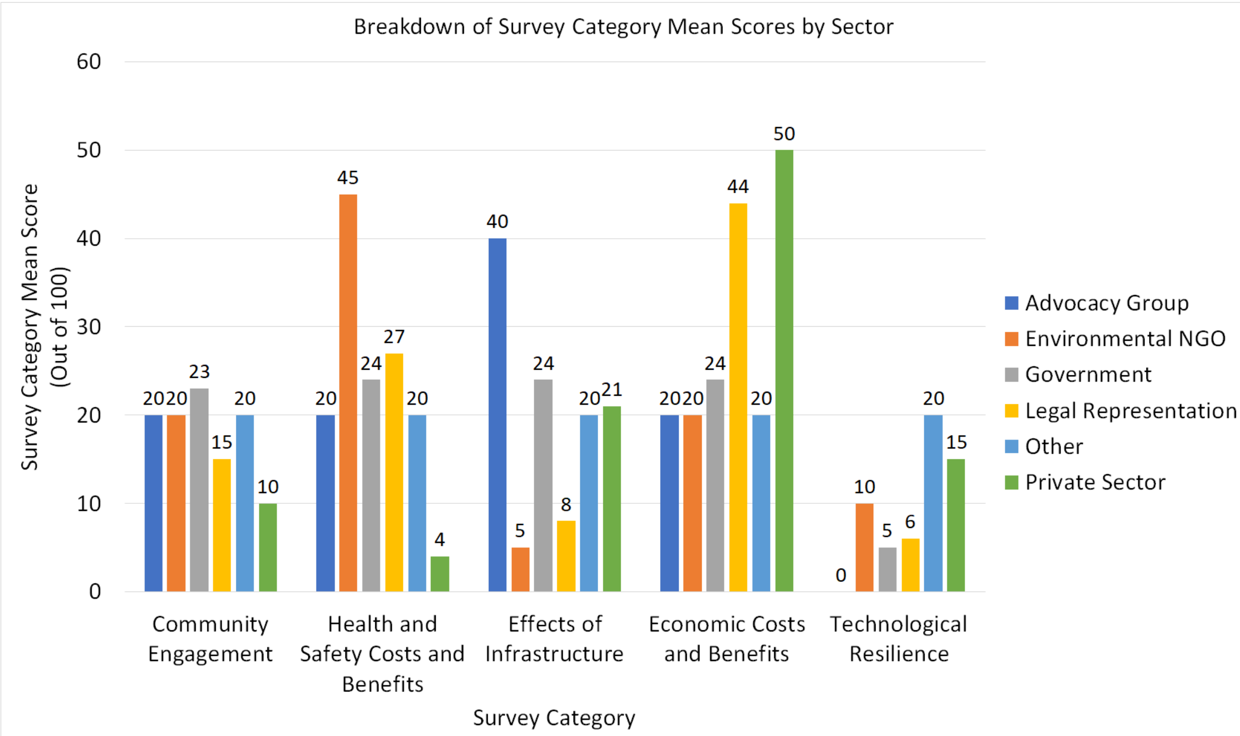

Figure 4: Mean Scores of Survey Categories Weighted by Overall Importance

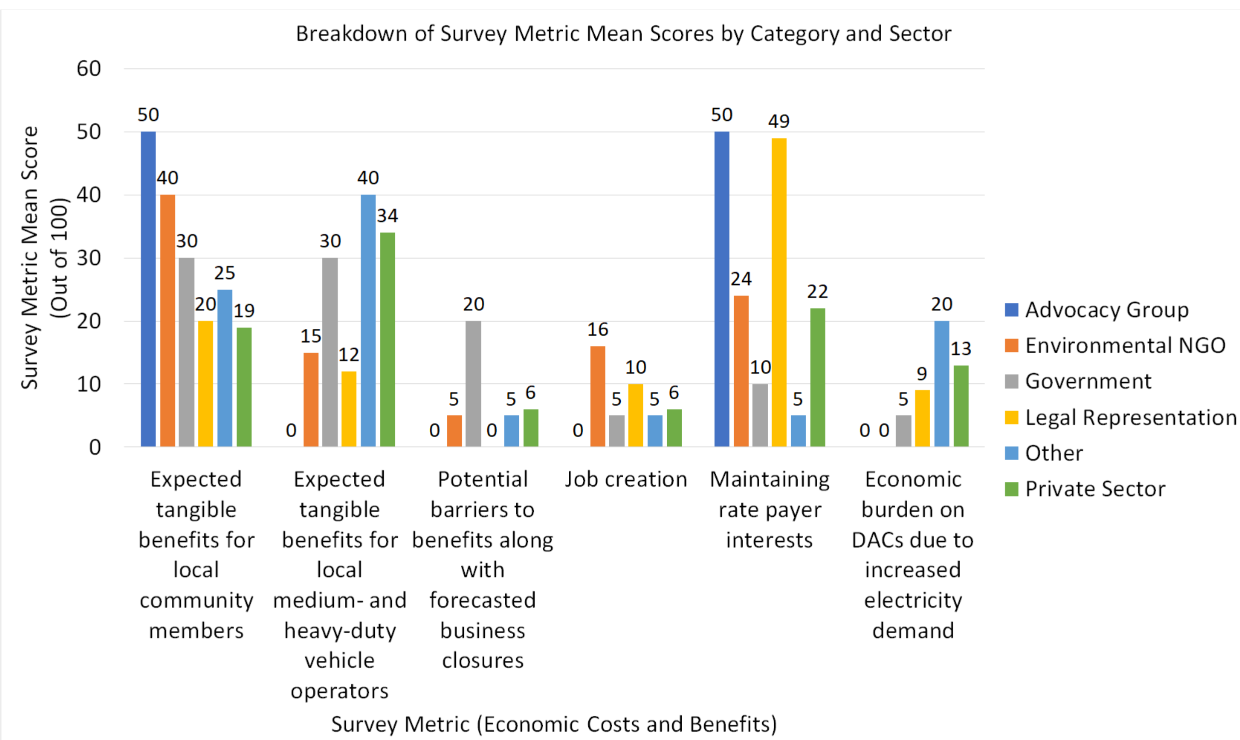

Figure 5: Economic Costs and Benefits - Mean Scores of Survey Metrics Weighted by Overall Importance

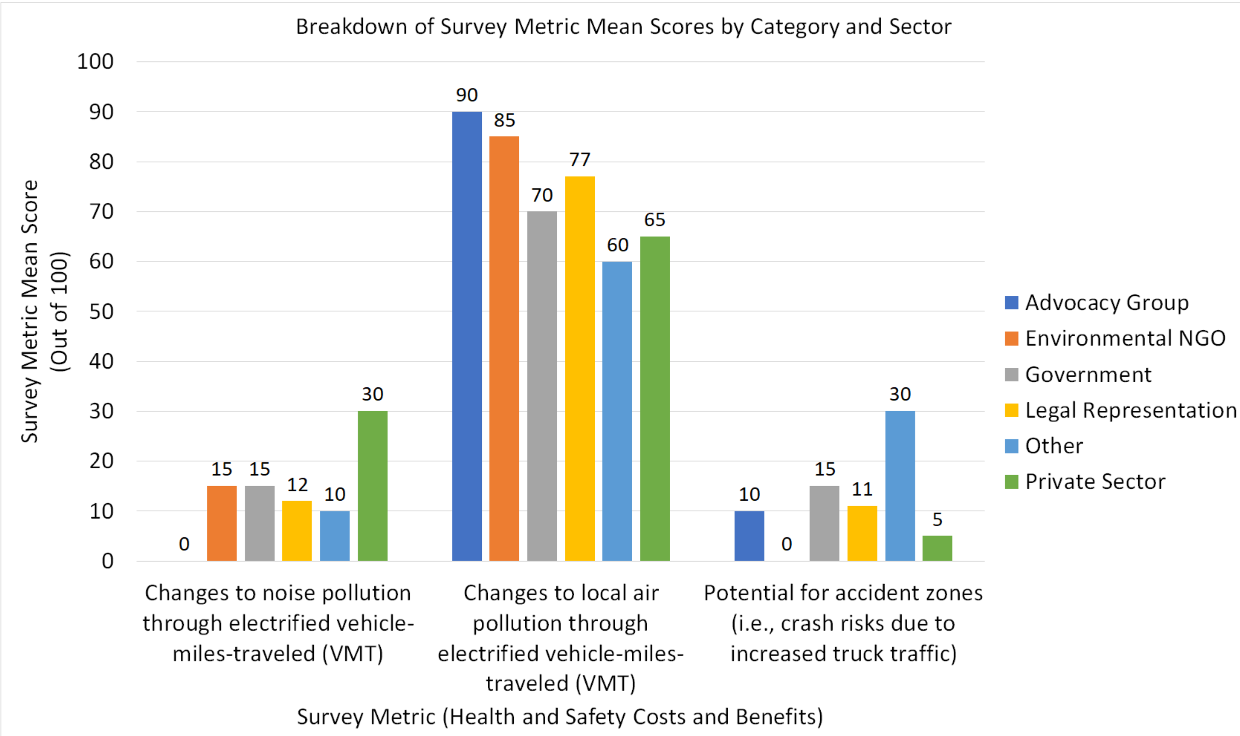

Figure 6: Health and Safety Costs and Benefits - Mean Scores of Survey Metrics Weighted by Overall Importance

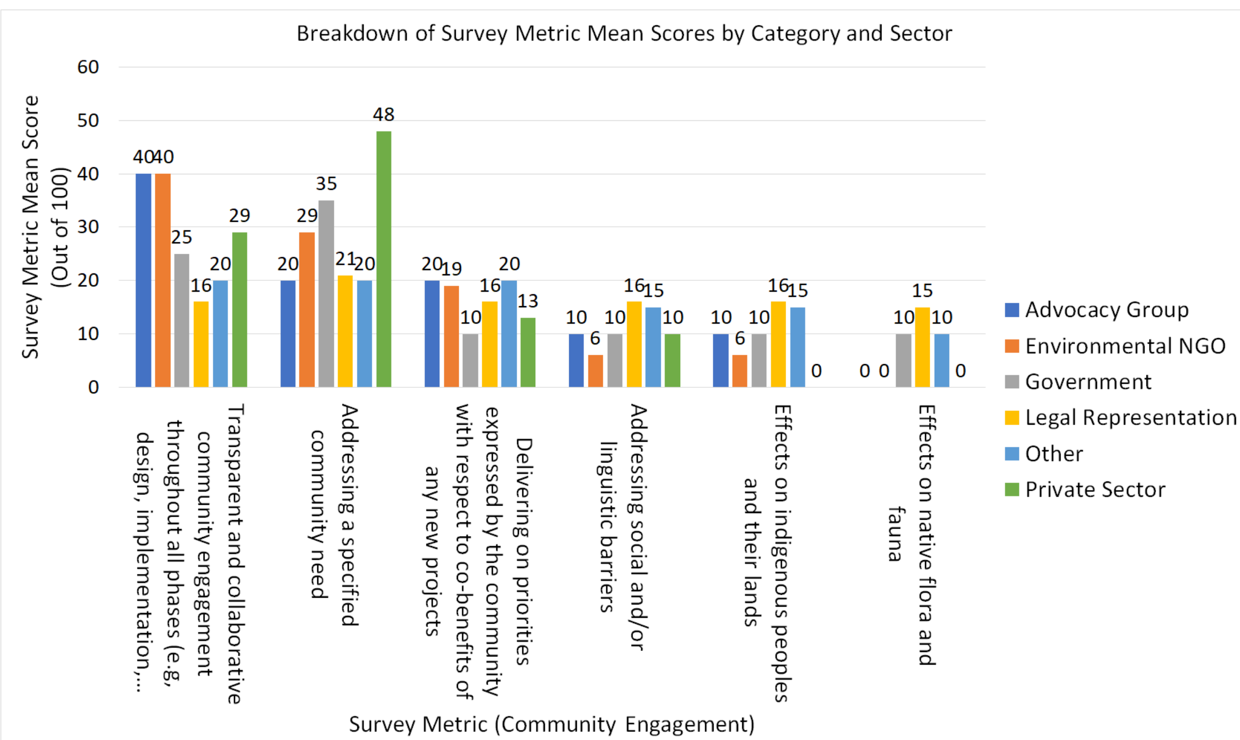

Figure 7: Community Engagement - Mean Scores of Survey Metrics Weighted by Overall Importance

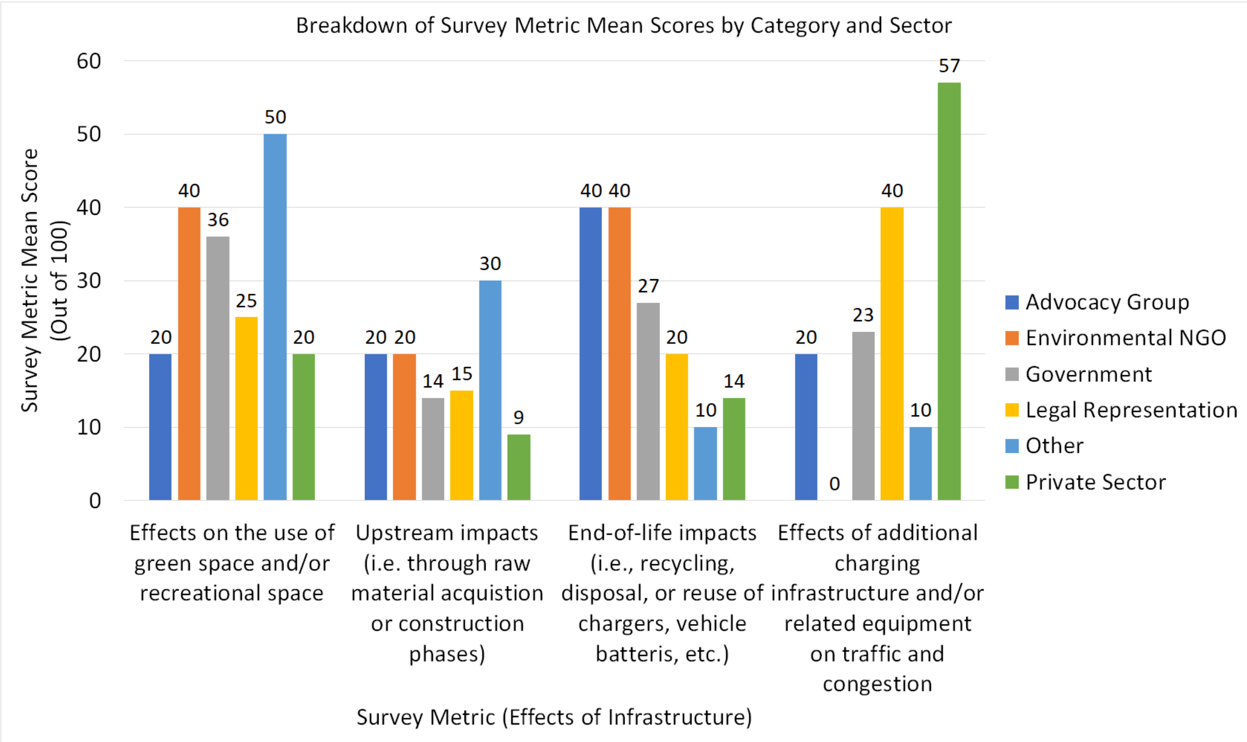

Figure 8: Effects of Infrastructure - Mean Scores of Survey Metrics Weighted by Overall Importance

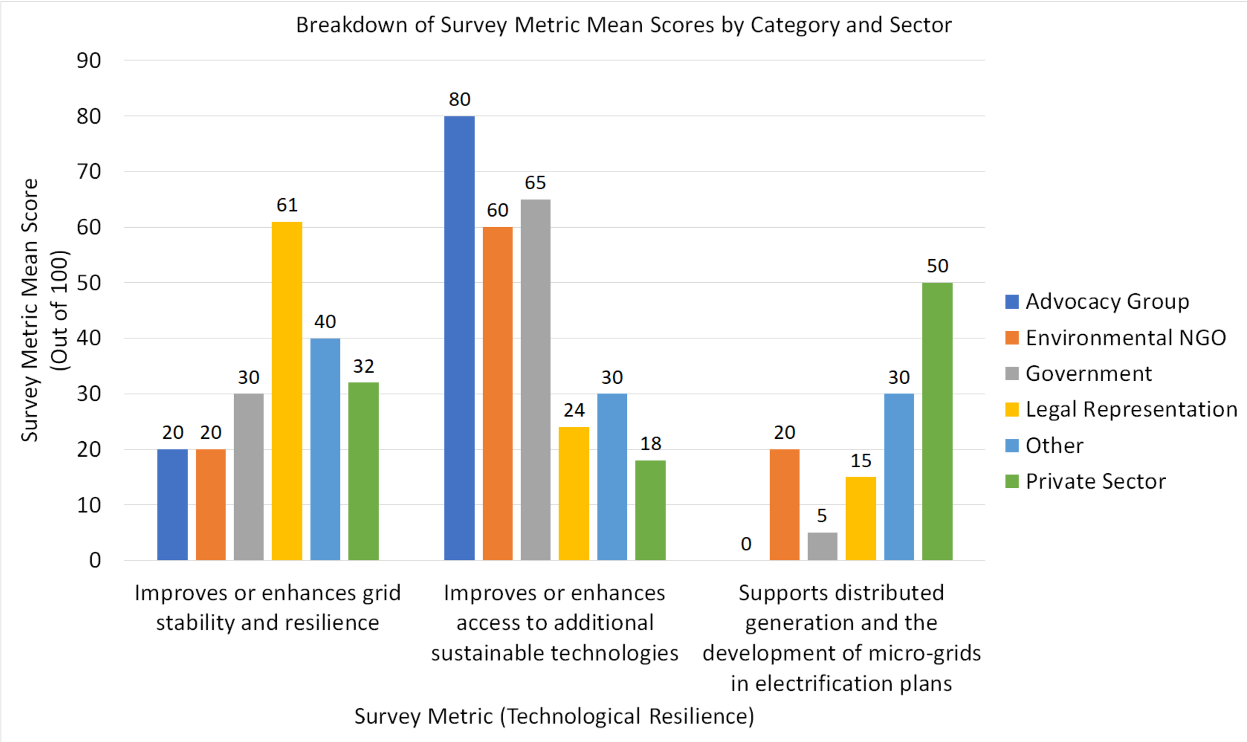

Figure 9: Technological Resilience - Mean Scores of Survey Metrics Weighted by Overall Importance

Discussion

When taking all of the selected affiliations into account (i.e., Government, Private Sector, Advocacy Group, Legal Representation, and Other), the most important metrics across all categories (i.e., Economic Costs and Benefits, Health and Safety Costs and Benefits, Community Engagement, Effects of Infrastructure, and Technological Resilience) were (see Table 6 below):

Table 6: Metrics of Most Importance (Overall)

Metrics of Most Importance (Overall)	
Metric	Category
Expected tangible benefits for local community members	Community Engagement
Changes to local air pollution through electrified VMT	Health and Safety Costs and Benefits
Transparent and collaborative community engagement throughout all phases (e.g., design, implementation, education, end-of-project debriefing, renewal)	Community Engagement
End-of-life impacts (i.e., recycling, disposal, or reuse of chargers, vehicle batteries, etc.)	Effects of Infrastructure
Improves or enhances access to additional sustainable technologies	Technological Resilience

The least important metrics across all categories were (see Table 7 below):

Table 7: Metrics of Least Importance (Overall)

Metrics of Least Importance (Overall)	
Metric	Category
Potential barriers to benefits along with forecasted business closures	Economic Costs and Benefits
Potential for accident zones	Health and Safety Costs and Benefits

Effects of native flora and fauna	Community Engagement
Upstream impacts (i.e., through raw material acquisition or construction phases)	Effects of Infrastructure
Supports distributed generation and the development of micro-grids in electrification plans	Technological Resilience

Based on the insights of industry experts that were collected through the survey, TE projects focused on HDVs should primarily consider the economic advancement of EJCs and the tangible benefits associated with this advancement. These benefits should not only lead to improvements to local air pollution through a decrease in emissions (i.e., electrified VMT), but should also allow for the autonomy of EJCs to be fully realized and strengthened through comprehensive community engagement. This community engagement should be transparent and should take place through all phases of project implementation and should prioritize the views and opinions of trusted EJC leaders and community organizers who can adequately speak to the needs of those who will directly be affected by the project.

Additionally, while TE projects should improve or enhance access to sustainable technologies, the end-of-life impacts of these technologies and the infrastructure needed to support this technology must be considered to avoid any negative impacts to EJCs and the local environment. However, the discrepancies between the metrics and categories of most and least importance may allude to shortcomings in program implementation and the supporting legislation. Although TE projects do allow for positive impacts to EJCs and the local environment, more needs to be done to ensure that the potential for negative externalities has been thoroughly considered.

For instance, across all sectors the metric of most importance (i.e., expected tangible benefits for local community members) belonged to the Community Engagement category -

which was weighted most favorably by the government sector and least favorably by the Private Sector. However, of all the categories Economic Costs and Benefits - which was weighted most favorably by the private sector and least favorably by members of advocacy groups, environmental NGOs, and those of other sectors - was weighted overall as the most important while Community Engagement was weighted as the third most important after Health and Safety Costs and Benefits. Conversely, the metric of least importance overall (i.e., supports distributed generation and the development of micro-grids in electrification plans) belonged to the Technological Resilience category - which was weighted as the least important category most consistently.

Though these findings are on a limited scale, they are illustrative of the inconsistencies that are driving TE implementation in EJCs - the strategies of which are meant to fully reflect both the tenets of energy justice (i.e., distributional, recognition-based, and procedural justice) (Jenkins et al., 2016; Lee et al., 2019) as well as the associated equity concepts (i.e., procedural, distributive, and intergenerational equity) (Brown et al., 2020). The main energy justice concept of concern that is lacking - based on the findings - is procedural justice, which encompasses the democratic and equitable involvement of all stakeholders in the decision-making process. Naturally, stakeholders from various sectors will have varying preferences and areas of interest that each of them will want to be reflected. However, equitable involvement - when paired with targeted universalism (Curti et al., 2018) - calls for strategies that not only involve all stakeholders but establish universal desired outcomes that can be achieved to tangibly benefit communities with the highest need (i.e., distributive equity). Additionally, neither the desired outcomes nor the strategies themselves should be based on broad assumptions that prioritize equal treatment over equitable treatment (Mullen et al., 2016) of what is in the best interest of

EJCs - which in the case of the survey findings is represented most by the favoring of Economic Costs and Benefits over other categories by most sectors. Whenever possible, governance and political power should have little influence on the actual needs of EJCs for the sake of mobility justice (Henderson, 2020).

Table 8: Categories of Most and Least Importance by Sector

Categories of Most and Least Importance by Sector		
Sector	Category/Categories of Most Importance	Category of Least Importance
Government	Health and Safety Costs and Benefits Effects of Infrastructure Economic Costs and Benefits	Technological Resilience
Private	Economic Costs and Benefits	Health and Safety Costs and Benefits
Advocacy Groups	Effects of Infrastructure	Technological Resilience
Environmental NGOs	Health and Safety Costs and Benefits	Effects of Infrastructure
Legal	Economic Costs and Benefits	Technological Resilience
Other	Community Engagement Health Safety Costs and Benefits Effects of Infrastructure Economic Costs and Benefits Technological Resilience	---

A section of the survey allowed respondents to offer additional comments and feedback regarding the contents of the survey and their suggestions for additional metrics that could be considered. From the government sector, one respondent suggested adding more detail to the job creation metric and separating out medium- and heavy-duty impacts on localized air pollution and respiratory problems in EJCs to reflect their unique challenges. Another suggested including a metric that considers driving technology advancement, helping to meet state goals (e.g., petroleum reduction, GHG reductions, and infrastructure deployment), and facilitating compliance with other state regulations. A respondent from an advocacy group suggested including a metric that addressed the "regressive impact on low- and middle-income customers funding these projects through utility bills." A respondent from an environmental NGO suggested including a metric that addressed the "cluster effects of the entire goods movement system on air quality and public health for residents." Another respondent offering a consultant's perspective suggested including "redundancy and space availability for infrastructure" as a metric. A different respondent suggested including "compliance costs for maintaining a gas fleet and gas infrastructure" as a metric noting it as a significant avoided cost. From the private sector, a suggested metric was "economic benefit to all ratepayers of increased throughput of electricity through existing fixed cost electric grid."

A respondent from the government sector offered feedback on the SB 350 legislation itself. This comment highlights the unintended consequences that can occur as a result of poorly targeted TE projects that serve as a detriment to both mobility justice and transportation justice:

> "Current SB350 incentives encourage the development of heavy industrial infrastructure in DAC's, without regards to job creation, while giving no incentives to provide actual clean transportation service to the residents of DACs-unless that service is confined to the DAC. Projects allowing people in DACs to travel to where the jobs and opportunities are located outside the SB350 areas aren't incentivized. A massive fleet vehicle charging station with heavy duty vehicle traffic all night long gets subsidized, electric bus service from poor neighborhoods (e.g., San Jose) to restaurant and entertainment districts (e.g., Los Gatos and Mountain View downtowns) does not. Also, consumer friendly infrastructure subsidized with SB 350 funding, such as the last three BART stations, created massive, rapid gentrification in the immediate neighborhoods, driving out the original DAC residents."

Another respondent offered the following, highlighting the challenges of developing equitable rate structures for affected customers:

> "DACs need to go beyond and include small commercial business customers. The technology and load associate[d] [with] EVs creates a rate design barrier related to demand fees and/or subscription fees. All small commercial customer sites will be impacted in rate design.

Small commercial customers do not have the same amount of [VMT] to increase their kilowatt hour energy use as it relates to demand fees [therefore] these customers will be most impacted by the low load factor issue. This does not create equity for small commercial customers. Incentives and infrastructure for small commercial customers should be the same as [those created for DACs]. Only DACs and small commercial customers should get the funding."

The same respondent also offered this statement, again acknowledging the unique needs of MDVs and HDVs and their impact on surrounding areas within legislation:

"Understanding public charging versus medium-/heavy-duty fleet charging is critical. Fleets and the medium-/heavy-duty sector will require higher voltage equipment which is more expensive but provides the solution that EVs require to increase capacity for every charger installed and allow the charging speed needed to keep the vehicles on the road daily (i.e., opportunity charging). In addition, understanding and creating a definition for a small commercial fleet, a medium commercial fleet, and/or a large commercial fleet is important. A small, a medium, or a large fleet, each will have a different footprint at a different amount of kilowatt hours and energy consumed and thereby just as in electric rate design for residential versus commercial there needs to be a creation of a definition for rates that support these different sectors uniquely. In addition in California there is the Low Carbon Fuel Standards program. There needs to be more equity and education as it relates to the revenue created from these communities when using the technology. This revenue should not be going to the utilities. Lastly, I will add that the decision makers after CPUC and/or advocating parties have room for education and improvement as it relates to the medium-/heavy-duty sector which is very different compared to public charging and residential charging. The commission needs to understand that public charging is currently not passing on any rate design benefits to the drivers and [therefore] is not in the interest of [ratepayers] as there really is no behavior signal to support charging at off-peak versus peak time when charging at a public charging station."

One respondent from the legal profession shared that:

"A major issue is the cost shifting in current rate structures, particularly where volumetric rates are used to collect non-variable costs. There's a significant tension in the transition to low/zero carbon and maintenance of supply reliability during periods where extreme weather variability is increasing due to climate change."

IV. CONCLUSIONS

The allocation of funds spent through SB 350 provides significant support to the buildout of MD-/HD- charging infrastructure located in EJCs. However, these approved investments rely primarily on geographic location as a determining factor. As a result, the investments made through this legislation stop short of useful considerations of energy justice, transportation justice, equity, and their associated barriers. Additionally, the perceptions and priorities of stakeholders as gauged through the study are inconsistent with much of the justice concepts detailed in the literature review. As they disproportionately value the economic costs and benefits of TE projects - as opposed to the equitable involvement and equitable treatment needed to realize the unique needs of EJCs - these perceptions result in TE implementation that sacrifices procedural justice in favor of broad assumptions of what is needed.

While the study was performed at a limited scale, this method is replicable and can offer additional insights if used with a larger sample size. This would also allow for contributions from other sectors that were not represented. This method would be useful for use by the CPUC, CARB, and other state agencies and entities in the energy sector who wish to layer additional evaluations of equity considerations onto the implementation and oversight of TE projects specific to MD-/HD- charging infrastructure. Based on the findings gathered from both the literature review as well as the study, a need for enhanced inter-agency cooperation exists. This cooperation should value the views and opinions of all stakeholders equally and should not prioritize the interests of any individual sector or organization disproportionately. It should also be iterative in nature to not only keep everyone informed, but to develop trackable progress indicators that can be improved and built upon. The narrative of any TE project's desired outcomes should be thoroughly informed by the tangible benefits EJCs wish to receive, their unique needs, as well as the political, economic, social, and health challenges they face. By both understanding the present challenges of EJCs and developing strategies to bring about palpable and significant solutions, the implementation of TE projects will do a better job of addressing long-standing inequities and burdens.

As California continues to work towards its GHG goals, TE will be an important contributing factor in ensuring adequate progress. Although the ambition of the state's transportation-related climate goals includes commendable considerations towards EJCs, these potential benefits must be measured by their ability to address the existing inequalities and inequities faced by those who not only stand to benefit the most from these initiatives but who have a heightened inability to access them. The interests of those who are responsible for TE implementation are insufficient if these programs do not result in tangible benefits for EJCs that can be accessed in real-time. Furthermore, the expertise and affiliation of professionals that are involved in TE implementation and related programs largely informs which aspects are emphasized and prioritized. These priorities vary greatly and can often contradict one another. This in turn can lead to discrepancies which confuse TE goals and fail to address the needs of EJCs that are targeted within these programs.

The success of TE implementation is contingent on the success of community engagement and communication across all disciplines and professions that not only sufficiently acknowledges the needs of all stakeholders, but also holds itself accountable through implementation strategies that can be tracked and measured. In this way, the distribution of benefits will be more equitable and socially responsible. Strategies that increase the autonomy of EJCs will be of great benefit to policymakers as this will allow for more nuanced TE implementation that covers all areas of interest that address the most prominent needs of EJCs.

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VI. APPENDIX

Guiding Questions and Categories

Community Engagement: While it is important to note the health, safety, and economic implications of projects on communities, it is equally important to explore how the community has engaged with the projects. Further, how does these projects relate to the priorities of the community, and have these priorities even been explored? These questions are meant to bring attention to the role the communities have and will play in the rollout of the projects.

- Across which phases of this project was/will the community be engaged (e.g. design, implementation, education, end of project debriefing, renewal)?
- Has the community expressed its priorities with respect to co-benefits of any new projects? How do the co-benefits of installing additional chargers compare to these expressed priorities/needs?
- Were social and/or linguistic barriers addressed in promoting the project? How?
- Has the project considered its effects on indigenous peoples and their lands?
- Does this project affect native flora and fauna?
- What is the horizontal/vertical distribution of energy efficiency capacity?
- Does an electrification plan include support for distributed generation and development of micro-grids?
- Does the project address a specified community need? How will community engagement continue after the completion of the project?

<u>Health Costs and Benefits:</u> This set of questions aims to determine to what extent the strategy or jurisdiction has considered the impacts of implementation on the health of the communities, both positive and negative. This includes physical health, such as air pollution or infrastructure to promote exercise, as well as mental health. It also explores how the costs and benefits are distributed across communities, and considers the current state of affected communities to assess equity implications.

- What are the effects of the additional charging infrastructure on traffic and congestion?
- How much of the change in VMT affects residents of DACs? What percentage of DAC residents will use the electrified transportation?

- How many additional truck VMT are expected near the site? How many VMT are electrified (additional or original)?
- Does this project increase or decrease local air pollution and where (i.e., % air pollutant reduction)? Who sees these costs and/or benefits?
- Does this project affect green space and/or recreational space?
- Are there upstream impacts (i.e., through raw material acquisition or the construction phases) that can be tracked and located? How are DACs affected?
- What are the end-of-life impacts of this project? What happens to the chargers, vehicle batteries, etc.?

<u>Safety:</u> This section includes consequences that are beyond individual health and regards matters of city-wide or regional safety.

- How does increased electricity demand affect grid stability and resilience?
- Do potential accident zones disproportionately affect low-income communities? Will increased truck VMT exacerbate existing accident zones?
- Does additional infrastructure affect safety in other ways?

<u>Technological Advancement and Accessibility:</u> These questions examine barriers to accessing technology and associated benefits. While this theme was explored under "Economic Costs and Benefits," these barriers may not only be financial.

- Does a technological solution intended to improve reliability reach the end user regardless of her income level?
- If there is an increase in sustainable technologies, who can access them?

<u>Economic Costs and Benefits:</u> There are almost always financial costs associated with implementing green infrastructure or strategies. These questions probe the types of economic

costs and benefits that are expected, as well as how these affect communities. That is, it is important to note not just the distribution of costs and benefits, but also whether there are barriers to accessing benefits that may not be immediately obvious.

- Will local MDV and HDV operators within the community benefit? Will local businesses benefit?
- Does this project create short- and/or long-term jobs? How is this verified?
- Do the costs of this program reach customers? How are the costs distributed? Does the increased electricity demand increase the economic burden on DACs?
- How transparent is the allocation of energy revenues?

Table A1: Overall Statistics of Weighted Categories

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Economic Costs and Benefits	8	50	30.4	11.2	126	23
2	Health and Safety Costs and Benefits	4	45	24.7	8.9	79.8	23
3	Community Engagement	0	25	15.8	6.9	47.5	23
4	Effects of Infrastructure	0	40	14.9	10.7	115.4	23
5	Technological Resilience	0	41	14.1	10.3	106.7	23

Table A2: Economic Costs and Benefits - Statistics of Weighted Metrics

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count

1	Expected tangible benefits for local community members	9	51	27.1	11.9	142.0	23
2	Expected tangible benefits for local medium- and heavy-duty vehicle operators	0	60	22.6	16.2	260.9	23
3	Maintaining rate payer interests	0	72	21.4	17.2	294.8	23
4	Job creation	0	50	12.2	11	120.3	23
5	Economic burden on DACs due to increased electricity demand	0	25	9.6	8.5	71.7	23
6	Potential barriers to benefits along with forecasted business closures	0	20	7.1	7.9	61.8	23

Table A3: Health and Safety Costs and Benefits - Statistics of Weighted Metrics

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Changes to local air pollution through electrified vehicle-miles-traveled (VMT)	15	90	65.5	18.8	351.6	23

2	Changes to noise pollution through electrified vehicle-miles-traveled (VMT)	0	44	20.9	11.4	128.8	23
3	Potential for accident zones (i.e., crash risks due to increased truck traffic)	0	45	13.7	12.7	162.1	23

Table A4: Community Engagement - Statistics of Weighted Metrics

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Varianc e (%)	Count
1	Transparent and collaborative community engagement throughout all phases (e.g, design, implementation, education, end-of-project debriefing, renewal)	0	55	26.9	11.1	123.3	23
2	Addressing a specified community need	9	50	26.6	11.8	138.8	23

3	Delivering on priorities expressed by the community with respect to co-benefits of any new projects	10	50	22.9	9.9	97.0	23
4	Addressing social and/or linguistic barriers	0	17	9.3	5.3	28.0	23
5	Effects on indigenous peoples and their lands	0	20	8.4	6.5	42.1	23
6	Effects on native flora and fauna	0	15	5.9	5.0	25.2	23

Table A5: Effects of Infrastructure - Statistics of Weighted Metrics

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	End-of-life impacts (i.e., recycling, disposal, or reuse of chargers, vehicle batteries, etc.)	10	88	30.2	17.3	300.5	23
2	Effects of additional charging infrastructure and/or related equipment on traffic and congestion	0	65	28.6	17.5	305.0	23

3	Effects on the use of green space and/or recreational space	0	60	22.6	15.3	235.4	23
4	Upstream impacts (i.e. through raw material acquisition or construction phases)	0	40	18.6	8.6	74.4	23

Table A6: Technological Resilience - Statistics of Weighted Metrics

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Varianc e (%)	Count
1	Improves or enhances access to additional sustainable technologies	10	80	37.0	19.7	387	23
2	Improves or enhances grid stability and resilience	9	70	35.4	16.0	256.4	23
3	Supports distributed generation and the development of micro-grids in electrification plans	0	60	27.5	15.2	231.9	23

Table A7: Overall Statistics of Weighted Categories (Government)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Economic Costs and Benefits	24	32	26.2	2.9	8.6	5
2	Health and Safety Costs and Benefits	20	31	26	4.1	16.4	5
3	Community Engagement	0	25	17.2	8.9	79.8	5
4	Effects of Infrastructure	5	24	15.4	6.3	39.4	5
5	Technological Resilience	5	20	15.2	5.3	28.6	5

Table A8: Economic Costs and Benefits - Statistics of Weighted Metrics (Government)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Varianc e (%)	Count
1	Expected tangible benefits for local community members	12	40	26.4	9.6	91.8	5
2	Expected tangible benefits for local medium- and heavy-duty vehicle operators	5	60	24.4	19.6	383.4	5

3	Maintaining rate payer interests	0	29	17.2	10.9	118.2	5
4	Economic burden on DACs due to increased electricity demand	0	25	14.8	10.3	106.2	5
5	Potential barriers to benefits along with forecasted business closures	0	20	11.2	7.8	60.6	5
6	Job creation	0	15	6	4.9	24	5

Table A9: Health and Safety Costs and Benefits - Statistics of Weighted Metrics (Government)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Changes to local air pollution through electrified vehicle-miles-traveled (VMT)	42	70	58.4	11.1	122.2	5
2	Changes to noise pollution through electrified vehicle-miles-traveled (VMT)	15	40	27	8.1	66	5
3	Potential for accident zones (i.e., crash risks due to increased truck traffic)	0	33	14.6	11.6	134.6	5

Table A10: Community Engagement - Statistics of Weighted Metrics (Government)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Varianc e (%)	Count
1	Transparent and collaborative community engagement throughout all phases (e.g, design, implementation, education, end-of-project debriefing, renewal)	0	29	20.6	10.4	109.0	5
2	Addressing a specified community need	9	50	25.4	15.6	241.8	5
3	Delivering on priorities expressed by the community with respect to co-benefits of any new projects	10	50	25.6	14.8	218.6	5
4	Addressing social and/or linguistic barriers	0	16	10	5.5	30.4	5
5	Effects on indigenous peoples and their lands	0	20	12.2	6.9	47.4	5
6	Effects on native flora and fauna	0	12	6.2	4.3	18.6	5

Table A11: Effects of Infrastructure - Statistics of Weighted Metrics (Government)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	End-of-life impacts (i.e., recycling, disposal, or reuse of chargers, vehicle batteries, etc.)	25	45	35.2	7.8	61	5
2	Effects of additional charging infrastructure and/or related equipment on traffic and congestion	10	50	28	13	167.6	5
3	Upstream impacts (i.e. through raw material acquisition or construction phases)	10	40	22.4	10.4	108.2	5
4	Effects on the use of green space and/or recreational space	0	36	14.4	12.7	161.0	5

Table A12: Technological Resilience - Statistics of Weighted Metrics (Government)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Improves or enhances access to additional sustainable technologies	28	65	42.6	14.73	217.04	5

2	Improves or enhances grid stability and resilience	20	44	31.8	7.81	60.96	5
3	Supports distributed generation and the development of micro-grids in electrification plans	5	40	25.6	11.46	131.44	5

Table A13: Overall Statistics of Weighted Categories (Private Sector)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Economic Costs and Benefits	35	50	42.5	7.5	56.25	4
2	Health and Safety Costs and Benefits	4	35	18.5	11.15	124.25	4
3	Technological Resilience	10	20	16.25	4.15	17.19	4
4	Community Engagement	10	20	12.5	4.33	18.75	4
5	Effects of Infrastructure	0	21	10.25	10.26	105.19	4

Table A14: Economic Costs and Benefits - Statistics of Weighted Metrics (Private Sector)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Expected tangible benefits for local medium- and heavy-duty vehicle operators	15	34	26	7.1	50.5	4
2	Maintaining rate payer interests	15	30	23	5.4	29.5	4
3	Expected tangible benefits for local community members	15	30	22.3	5.7	32.7	4
4	Job creation	6	25	15.3	7.6	57.7	4
5	Economic burden on DACs due to increased electricity demand	0	15	7	7.0	49.5	4
6	Potential barriers to benefits along with forecasted business closures	0	20	6.5	8.2	66.8	4

Table A15: Health and Safety Costs and Benefits - Statistics of Weighted Metrics (Private Sector)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count

1	Changes to local air pollution through electrified vehicle-miles-traveled (VMT)	35	80	63.8	17.5	304.7	4
2	Changes to noise pollution through electrified vehicle-miles-traveled (VMT)	5	30	20	9.4	87.5	4
3	Potential for accident zones (i.e., crash risks due to increased truck traffic)	0	40	16.3	15.6	242.2	4

Table A16: Technological Resilience - Statistics of Weighted Metrics (Private Sector)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Improves or enhances grid stability and resilience	30	50	38	7.9	62	4
2	Supports distributed generation and the development of micro-grids in electrification plans	25	50	35	9.4	87.5	4

3	Improves or enhances access to additional sustainable technologies	18	35	27	6.3	39.5	4

Table A17: Community Engagement - Statistics of Weighted Metrics (Private Sector)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Transparent and collaborative community engagement throughout all phases (e.g, design, implementation, education, end-of-project debriefing, renewal)	15	30	23.5	6.3	39.3	4
2	Addressing a specified community need	25	48	34.5	8.6	73.3	4
3	Delivering on priorities expressed by the community with respect to co-benefits of any new projects	13	35	23.3	9.4	89.2	4
4	Addressing social and/or linguistic barriers	5	15	10	3.5	12.5	4

5	Effects on indigenous peoples and their lands	0	15	5	6.1	37.5	4
6	Effects on native flora and fauna	0	10	3.8	4.2	17.2	4

Table A18: Effects of Infrastructure - Statistics of Weighted Metrics (Private Sector)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Varianc e (%)	Count
1	Effects of additional charging infrastructure and/or related equipment on traffic and congestion	23	65	42.5	18.7	350.8	4
2	Effects on the use of green space and/or recreational space	15	31	22.8	5.9	35.2	4
3	End-of-life impacts (i.e., recycling, disposal, or reuse of chargers, vehicle batteries, etc.)	10	25	18	6.2	38.5	4
4	Upstream impacts (i.e. through raw material acquisition or construction phases)	9	25	16.8	7.3	53.2	4

Table A19: Overall Statistics of Weighted Categories (Advocacy Group)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Economic Costs and Benefits	20	45	31.7	10.3	105.6	3
2	Health and Safety Costs and Benefits	20	30	23.3	4.7	22.2	3
3	Community Engagement	20	25	21.7	2.4	5.6	3
4	Effects of Infrastructure	0	40	21.7	16.5	272.2	3
5	Technological Resilience	0	5	1.7	2.4	5.6	3

Table A20: Economic Costs and Benefits - Statistics of Weighted Metrics (Advocacy Group)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Maintaining rate payer interests	5	72	42.3	27.9	777.6	3
2	Expected tangible benefits for local community members	25	50	34.3	11.2	124.2	3

3	Expected tangible benefits for local medium- and heavy-duty vehicle operators	0	40	13.3	18.9	355.6	3
4	Potential barriers to benefits along with forecasted business closures	0	10	3.3	4.7	22.2	3
5	Job creation	0	10	3.3	4.7	22.2	3
6	Economic burden on DACs due to increased electricity demand	0	10	3.3	4.7	22.2	3

Table A21: Health and Safety Costs and Benefits - Statistics of Weighted Metrics (Advocacy Group)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Changes to local air pollution through electrified vehicle-miles-traveled (VMT)	64	90	78	10.7	114.7	3

2	Changes to noise pollution through electrified vehicle-miles-traveled (VMT)	0	25	13.3	10.3	105.6	3
3	Potential for accident zones (i.e., crash risks due to increased truck traffic)	5	11	8.7	2.6	6.9	3

Table A22: Community Engagement - Statistics of Weighted Metrics (Advocacy Group)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Transparent and collaborative community engagement throughout all phases (e.g, design, implementation, education, end-of-project debriefing, renewal)	25	40	35	7.1	50	3
2	Addressing a specified community need	20	40	26.7	9.4	88.9	3
3	Delivering on priorities expressed by the community with respect to co-benefits of any new projects	20	20	20	0	0	3

4	Addressing social and/or linguistic barriers	0	10	6.7	4.7	22.2	3
5	Effects on indigenous peoples and their lands	0	10	6.7	4.7	22.2	3
6	Effects on native flora and fauna	0	15	5	7.1	50	3

Table A23: Effects of Infrastructure - Statistics of Weighted Metrics (Advocacy Group)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	End-of-life impacts (i.e., recycling, disposal, or reuse of chargers, vehicle batteries, etc.)	15	49	34.7	14.4	206.9	3
2	Effects on the use of green space and/or recreational space	20	31	27	5	24.7	3
3	Upstream impacts (i.e. through raw material acquisition or construction phases)	20	25	21.7	2.4	5.6	3

4	Effects of additional charging infrastructure and/or related equipment on traffic and congestion	0	30	16.7	12.5	155.6	3

Table A24: Technological Resilience - Statistics of Weighted Metrics (Advocacy Groups)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Improves or enhances grid stability and resilience	20	70	47	20.6	424.7	3
2	Improves or enhances access to additional sustainable technologies	24	80	44.7	25.1	630.2	3
3	Supports distributed generation and the development of micro-grids in electrification plans	0	25	8.3	11.8	138.9	3

Table A25: Overall Statistics of Weighted Categories (Environmental NGO)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Health and Safety Costs and Benefits	40	45	42.5	2.5	6.3	2

2	Economic Costs and Benefits	20	20	20	0	0	2
3	Effects of Infrastructure	5	30	17.5	12.5	156.3	2
4	Community Engagement	10	20	15	5	25	2
5	Technological Resilience	0	10	5	5	25	2

Table A26: Health and Safety Costs and Benefits - Statistics of Weighted Metrics (Environmental NGO)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Changes to local air pollution through electrified vehicle-miles-traveled (VMT)	85	90	87.5	2.5	6.3	2
2	Changes to noise pollution through electrified vehicle-miles-traveled (VMT)	5	15	10	5	25	2
3	Potential for accident zones (i.e., crash risks due to increased truck traffic)	0	5	2.5	2.5	6.3	2

Table A27: Economic Costs and Benefits - Statistics of Weighted Metrics (Environmental NGO)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Job creation	16	50	33	17	289	2
2	Expected tangible benefits for local community members	20	40	30	10	100	2
3	Expected tangible benefits for local medium- and heavy-duty vehicle operators	15	20	17.5	2.5	6.3	2
4	Maintaining rate payer interests	0	24	12	12	144	2
5	Economic burden on DACs due to increased electricity demand	0	10	5	5	25	2
6	Potential barriers to benefits along with forecasted business closures	0	5	2.5	2.5	6.3	2

Table A28: Effects of Infrastructure - Statistics of Weighted Metrics (Environmental NGO)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count

1	Effects on the use of green space and/or recreational space	40	40	40	0	0	2
2	End-of-life impacts (i.e., recycling, disposal, or reuse of chargers, vehicle batteries, etc.)	10	40	25	15	225	2
3	Effects of additional charging infrastructure and/or related equipment on traffic and congestion	0	40	20	20	400	2
4	Upstream impacts (i.e. through raw material acquisition or construction phases)	10	20	15	5	25	2

Table A29: Community Engagement - Statistics of Weighted Metrics (Environmental NGO)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Transparent and collaborative community engagement throughout all phases (e.g, design, implementation, education, end-of-project debriefing, renewal)	30	40	35	5	25	2

2	Addressing a specified community need	29	30	29.5	0.5	0.3	2
3	Delivering on priorities expressed by the community with respect to co-benefits of any new projects	19	30	24.5	5.5	30.3	2
4	Addressing social and/or linguistic barriers	6	10	8	2	4	2
5	Effects on indigenous peoples and their lands	0	6	3	3	9	2
6	Effects on native flora and fauna	0	0	0	0	0	2

Table A30: Technological Resilience - Statistics of Weighted Metrics (Environmental NGO)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Varianc e (%)	Count
1	Improves or enhances access to additional sustainable technologies	34	60	47	13	169	2

2	Improves or enhances grid stability and resilience	20	33	26.5	6.5	42.3	2
3	Supports distributed generation and the development of micro-grids in electrification plans	20	33	26.5	6.5	42.3	2

Table A31: Overall Statistics of Weighted Categories (Legal Representation)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Varianc e (%)	Count
1	Economic Costs and Benefits	8	44	27.6	13.1	171.4	5
2	Technological Resilience	6	41	23.6	13.8	190.6	5
3	Health and Safety Costs and Benefits	15	30	21.4	6.0	36.2	5
4	Effects of Infrastructure	0	29	14.6	10.8	117.0	5
5	Community Engagement	8	20	12.8	4.3	18.2	5

Table A32: Economic Costs and Benefits - Statistics of Weighted Metrics (Legal Representation)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Expected tangible benefits for local community members	9	51	26	16.8	280.4	5
2	Maintaining rate payer interests	4	49	22.8	14.6	211.8	5
3	Expected tangible benefits for local medium- and heavy-duty vehicle operators	12	30	19.8	5.9	34.6	5
4	Job creation	10	20	14	4.9	24	5
5	Economic burden on DACs due to increased electricity demand	0	20	11.8	7.6	57	5
6	Potential barriers to benefits along with forecasted business closures	0	20	5.6	7.8	61.4	5

Table A33: Technological Resilience - Statistics of Weighted Metrics (Legal Representation)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Supports distributed generation and the development of micro-grids in electrification plans	15	60	41.4	14.8	217.4	5
2	Improves or enhances grid stability and resilience	9	61	36	19.1	364.4	5
3	Improves or enhances access to additional sustainable technologies	10	45	22.6	12.2	148.6	5

Table A34: Health and Safety Costs and Benefits - Statistics of Weighted Metrics (Legal Representation)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Changes to local air pollution through electrified vehicle-miles-traveled (VMT)	44	89	66	15.5	241.2	5
2	Changes to noise pollution through electrified vehicle-miles-traveled (VMT)	11	44	22	11.9	142	5

3	Potential for accident zones (i.e., crash risks due to increased truck traffic)	0	20	12	6.8	46.8	5

Table A35: Effects of Infrastructure - Statistics of Weighted Metrics (Legal Representation)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Varianc e (%)	Count
1	Effects of additional charging infrastructure and/or related equipment on traffic and congestion	20	55	38.2	11.7	137.8	5
2	End-of-life impacts (i.e., recycling, disposal, or reuse of chargers, vehicle batteries, etc.)	20	40	30	8.6	73.6	5
3	Upstream impacts (i.e. through raw material acquisition or construction phases)	4	25	16.8	7.1	51	5
4	Effects on the use of green space and/or recreational space	3	25	15	7.6	57.2	5

Table A36: Community Engagement - Statistics of Weighted Metrics (Legal Representation)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Varianc e (%)	Count
1	Transparent and collaborative community engagement throughout all phases (e.g, design, implementation, education, end-of-project debriefing, renewal)	16	55	33	13.4	180.4	5
2	Delivering on priorities expressed by the community with respect to co-benefits of any new projects	10	40	22.2	10.4	109	5
3	Addressing a specified community need	9	40	20	11.2	124.4	5
4	Effects on native flora and fauna	2	15	8.8	4.7	22.2	5
5	Addressing social and/or linguistic barriers	3	16	8.2	5	24.6	5
6	Effects on indigenous peoples and their lands	0	16	7.8	6	35.4	5

Table A37: Overall Statistics of Weighted Categories (Other)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Economic Costs and Benefits	20	45	31.3	11.4	129.7	4
2	Health and Safety Costs and Benefits	20	33	25.8	5.9	34.2	4
3	Community Engagement	4	25	17.3	7.9	62.7	4
4	Effects of Infrastructure	10	20	13	4.1	17	4
5	Technological Resilience	6	20	12.8	5.3	27.7	4

Table A38: Economic Costs and Benefits - Statistics of Weighted Metrics (Other)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Variance (%)	Count
1	Expected tangible benefits for local medium- and heavy-duty vehicle operators	0	60	30	22.4	500	4
2	Expected tangible benefits for local community members	20	45	27.5	10.3	106.3	4

3	Maintaining rate payer interests	5	30	12	10.5	109.5	4
4	Job creation	3	25	10.8	8.6	74.2	4
5	Potential barriers to benefits along with forecasted business closures	0	20	10	7.9	62.5	4
6	Economic burden on DACs due to increased electricity demand	2	20	9.8	6.6	43.2	4

Table A39: Health and Safety Costs and Benefits - Statistics of Weighted Metrics (Other)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Varianc e (%)	Count
1	Changes to local air pollution through electrified vehicle-miles-traveled (VMT)	15	85	55	25.3	637.5	4
2	Changes to noise pollution through electrified vehicle-miles-traveled (VMT)	10	40	23.8	11.9	142.2	4

3	Potential for accident zones (i.e., crash risks due to increased truck traffic)	0	45	21.3	17.5	304.7	4

Table A40: Community Engagement - Statistics of Weighted Metrics (Other)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Varianc e (%)	Count
1	Addressing a specified community need	18	40	27	8.8	77	4
2	Delivering on priorities expressed by the community with respect to co-benefits of any new projects	18	30	21.5	5	24.8	4
3	Transparent and collaborative community engagement throughout all phases (e.g, design, implementation, education, end-of-project debriefing, renewal)	15	29	20.5	5.2	27.3	4
4	Addressing social and/or linguistic barriers	0	17	11.8	6.8	46.7	4

5	Effects on indigenous peoples and their lands	5	17	11.8	4.7	21.7	4
6	Effects on native flora and fauna	5	10	7.5	1.8	3.3	4

Table A41: Effects of Infrastructure - Statistics of Weighted Metric (Other)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Varianc e (%)	Count
1	End-of-life impacts (i.e., recycling, disposal, or reuse of chargers, vehicle batteries, etc.)	10	88	35.8	31.9	1014.2	4
2	Effects on the use of green space and/or recreational space	0	60	30	25.5	650	4
3	Upstream impacts (i.e. through raw material acquisition or construction phases)	0	30	17.5	10.9	118.8	4
4	Effects of additional charging infrastructure and/or related equipment on traffic and congestion	10	35	16.8	10.6	111.7	4

Table A42: Technological Resilience - Statistics of Weighted Metrics (Other)

#	Field	Minimum (%)	Maximum (%)	Mean (%)	Std Deviation (%)	Varianc e (%)	Count
1	Improves or enhances access to additional sustainable technologies	20	80	47.5	23.9	568.8	4
2	Improves or enhances grid stability and resilience	10	60	32.5	19.2	368.8	4
3	Supports distributed generation and the development of micro-grids in electrification plans	10	30	20	7.1	50	4