

**Electric Vehicle Car-Sharing and Secondhand Market Development in
Frontline Communities in California and Europe**

A Perspective through the Lens of Long-term Land Use Planning

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Project Background and Mandate

Urban planning graduate student Morgan Rose developed this project in collaboration with Coast to Coast Initiative Director Dr. Peter Van Deventer in the summer of 2022. Morgan was placed as a graduate student researcher at the Coast to Coast Initiative at the California Governor’s Office of Planning and Research (OPR), the state’s comprehensive planning agency. OPR focuses on research and land use planning needs, developing collaboration and guidance for partners and local communities throughout the state. OPR signed a memorandum of understanding (MoU) with EIT Climate-KIC—the EU’s largest public-private innovation partnership focused on climate change mitigation, adaptation, and innovation—at COP26 in Glasgow in November 2021. OPR and Climate-KIC, through the Coast to Coast Initiative, have since developed a shared “Synergy Agenda,” with the goal of informing policies that support sustainable, equitable long-term land use planning decisions. This Synergy Agenda outlines areas of collaboration between the state of California and the EU that will result in opportunities for learning and knowledge exchange. The project that follows (an evaluation of electric vehicle car-sharing and secondhand market development in frontline communities) represents one component of that Synergy Agenda.

Executive Summary

This white paper explores electric vehicle (EV) car-sharing and secondary EV market development in frontline communities in California and Europe through the lens of land use planning. It sets the stage by arguing that land use policies can reduce dependency on privately-owned passenger vehicles in the long-term, but that these vehicles still play a significant role in the short-term, particularly in communities underserved by other forms of transportation for whom vehicle access can mean access to opportunity, employment, medical appointments, and other critical services. All vehicles in question will be required to be electric in coming decades—a transition that will require emphasis on those with the greatest barriers toward attaining EV use, lease, or ownership. This white paper focuses on two routes for a just EV transition: car-sharing programs, and programs that facilitate car lease/ownership in frontline communities. Frontline communities are defined here as communities that “experience continuing injustice—including people of color, immigrants, people with lower incomes, those in rural areas, and Indigenous people—due to a legacy of systemic, largely racialized, inequity that influences their living and working places, the quality of their air and water, and their economic opportunities” (Climate Justice Working Group, 2017).

This paper first describes seven key barriers and recommendations for EV car-sharing programs in frontline communities. (1) EV car-share models differ and should be distinguished accordingly; there remains an open question as to what the best EV car-share model in frontline communities might be (and the answer might end up differing in different regions and target communities). (2) That said, many EV car-share programs show great success in reaching socioeconomic and environmental goals. However, these programs have inherent profitability barriers: EV car-share programs in general face high operational costs and thin profit margins, and these barriers are compounded when programs intentionally serve communities who are more likely to be low-income. In this context, programs require dedicated layers of supplementary capital, whether public, private, or philanthropic. It is unreasonable to expect financial self-sufficiency for these programs within several years of operation, and possibly in general. (4) Furthermore, EV car-share vendors are limited, and those that do exist often merge, fold, or can otherwise prove unreliable. Cities and regions must prioritize vendor partnership stability and longevity, and potentially eventual municipal ownership over EV car-sharing fleets as part of the greater mass transit infrastructure. (5) Community-based-organizations (CBOs) and EV car-share ambassadors provide critical on-the-ground exposure, support, and feedback for these programs, and must be compensated accordingly. (6) Evaluation and iteration of EV car-sharing programs in frontline communities will take time, given decades of historical disinvestment in these communities. (7) And finally, notions of frontline community EV car-share success can be reoriented to include successfully-filled transportation needs and increased accessibility/opportunity (meaning, not just decreased VMT or reduced personal vehicle ownership, which this white paper argues can be reductive in this context).

The white paper next explores six key results and recommendations regarding programs that facilitate secondary market EV lease/ownership in frontline communities. (1) EV lease and ownership still plays a significant role in the mobility ecosystem, particularly for frontline communities; however, there is a noted lack of sufficient data on used EV market penetration. (2) Policies can be developed to ensure frontline community EV car-sharing vehicles are eventually

leased/purchased by drivers or CBOs in these communities, assuming strong minimum operational standards when fleet vehicles are retired. (3) Broadscale increases in EV production can stimulate eventual secondary market development. These increases can be bolstered by incentives that attract auto manufacturers to produce EVs in key markets. Regulations can further support faster EV turnover to the secondary market. (4) However, EV lease/purchase programs that intentionally target frontline communities have shown particular success in reaching socioeconomic and environmental goals, and can be funded accordingly. Importantly, these programs can only be scaled to the extent that used EV inventory is available. (5) In complement, general EV lease/purchase programs can be modified through increased rebates for low-income households and expanded programs that include used EVs. (6) Finally, transportation programs for frontline communities can be required to coordinate their outreach and application processes for ease of use.

This white paper next describes how EV trust, exposure, and relatability plays a key role in EV uptake for frontline communities. It emphasizes in particular the critical role childhood education can play for fostering perceptions of trust and reliability in EVs. It recommends that primary/secondary school opportunities and curriculum are explored as part of EV outreach in frontline communities. It also describes collaborations between this research and (a) the Global Institute for Futures Learning (GiFT) and (b) the Twin Rivers Unified School District in McClellan, California as two examples.

Finally, this white paper summarizes three key results and recommendations regarding the EV landscape for frontline communities generally. (1) Long-term relationships with community-trusted CBOs play a vital role throughout both program types and should be compensated and valued for their essential work and contributions. (2) Frontline community EV programs can benefit from both direct program funding *and* increased funding for grant application and administration assistance. (3) While not a primary focus of this white paper, equitable charging infrastructure should be considered in parallel with topics outlined, particularly when applied to the used EV market. In this context, anti-displacement strategies should be pursued when charging is built out in frontline communities to avoid negative impacts of green gentrification.

Introduction

Transportation planners and government officials around the world are investing in land use policies that reduce dependency on privately-owned passenger vehicles. Instead, planners are prioritizing a transportation ecosystem in which travelers can match different types of trips with alternating modes of transit (IZEVA, 2022). Regions can provide residents a safe, accessible, reliable “suite” of transportation options—ranging from public transportation and walking to biking and other forms of micromobility (e.g., scooters, skateboards)—all of which can play an important role, depending on the traveler and their trip needs.

In these transportation models, cars continue to occupy one segment of the ecosystem. Certain trips benefit from cars as a transit mode, such as medical appointments, trips that require multiple stops, and trips that require increased carrying capacity for groceries, family, or work equipment. Cars play a particularly significant role for communities that are underserved by other forms of transit and for whom public transportation, walking, and micromobility are not reliable, accessible, or safe. Such is the case for many low-income, rural, and tribal communities. For these travelers, car access can mean access to beneficial opportunities like employment, health services, and other basic necessities, which strengthens the socioeconomic fabric of a place and community. In this context, transportation planners must supplement fixed route services and other mobility modes with cars (IZEVA, 2022).

It is important that the individual vehicles in question are electric. Harmful greenhouse gas emissions emitted by internal combustion engine (ICE) vehicles disproportionately impact low-income communities and communities of color (InterActions, 2022). In other words, these communities have the most to benefit from a transition to zero emission vehicles. Planners and government officials must ensure that electric vehicle (EV) transition programs are structured around equity considerations (Elkind et al., 2022). There are several routes for an EV transition focused on equity: car-sharing programs and programs that facilitate car leasing/ownership in frontline communities.

Some programs help households in frontline communities lease or purchase new or used EVs. This solution is imperfect. Private car ownership provides socioeconomic and logistical benefits described previously; however, it also perpetuates car-dependence and high transportation expenditure burdens that impact low-income communities significantly. Transportation that is oriented around privately-owned passenger vehicles can contribute to sprawl, congestion, fractured public space, health concerns, and car crashes (InterActions, 2022). Importantly, many programs that subsidize private car ownership disproportionately benefit white, wealthy, highly-educated users; these patterns appear all over the world, from California to Germany and the UK (Greenlining Institute, 2021; IZEVA, 2022; Green Alliance, 2021).

Another solution focuses on programs that implement EV car-sharing in frontline communities. Car-sharing has many benefits, including: reduced individual vehicle costs, reduced dependency on privately-owned passenger vehicles; and individual vehicle benefits relative to other modes (e.g., shorter travel times, ease of making multiple trips, more predictable arrival times, increased carrying capacity for passengers/cargo) (InterActions, 2022). Car-sharing can provide particular benefits to frontline communities. Rates of privately-owned vehicles are lower in low-income

and nonwhite populations; car-sharing can meet unmet needs in these communities through trips that benefit from a personal vehicle (California Air Resources Board, 2018). Car-sharing can also provide beneficial economic opportunities for frontline communities, including access to better employment, services, and housing (InterActions, 2022). Car-sharing can further augment transportation gaps in rural communities where destinations are spread out and less walkable/bikeable (InterActions, 2022). As such, car-sharing programs targeted toward frontline communities can have a significant role to play in a just, clean transportation transition.

White Paper Overview

This white paper is structured as follows. First, it will focus on key barriers and recommendations for EV car-sharing programs in frontline communities. Second, it will discuss the still-significant role private EV lease/ownership can play in frontline communities (particularly for communities that lack reliable public transportation) and focus on programs and policies designed specifically to reach drivers in these communities. It will argue that frontline community EV car-sharing programs provide a unique opportunity for retiring fleet vehicles into ownership by individuals in those same communities.

Third, the paper will discuss in particular how a lack of exposure, awareness, and trust in EVs poses a large barrier to EV uptake in frontline communities. The literature and select programs reflect the integral role outreach and community-based organizations (CBOs) play in fostering EV awareness and trust. However, as with much of urban planning praxis, a great deal of literature and analysis disregards the role that primary/secondary school education and children can play in a just EV transition. This paper will highlight this opportunity and propose recommendations using a small-scale example of this kind of education: a collaboration between the Coast to Coast Initiative at the Governor’s Office of Planning and Research and the Global Institute for Futures Learning (GiFT) in California, carried out in conjunction with this white paper. Targeted education for children may prove particularly beneficial in frontline communities where on-the-ground EV exposure is less expansive.

The white paper draws from literature, interviews, and case studies in the state of California and select European countries. Throughout, it will note key areas of synergy and instructive difference when considering these topics across the two regions. On the one hand, while California is the largest EV market in the U.S., it lags behind much of Europe in terms of EV rollout and uptake, reflected in both EV car-sharing programs and private EV lease/ownership. Europe also benefits from relatively far-reaching, complementary public transportation infrastructure that U.S. markets generally lack. On the other hand, European regions could learn from California’s early successes and learnings in implementing EV programs that intentionally serve frontline communities. It would serve both regions to learn from these synergies and make decisions accordingly, given the necessity of rapid GHG reduction in the coming decades.

The end of this paper features an appendix section with opportunities for future research. These topics were not a primary focus in this report’s ultimate writeup, but are important, integral, and warrant future consideration.

Research Methodology and Limitations

In order to assemble this white paper, the following research approach was taken: first, a review of literature was conducted, compiling key articles and best practices from academic journals, industry, and community-based organizations. Second, interviews and listening sessions were conducted. At the time of writing, 23 organizations have been directly consulted and interviewed regarding EV car-sharing and the used EV market in frontline communities (see Appendix II for a complete list). Third, key case studies of frontline community EV programs were evaluated; these evaluations were primarily in California, which features clearer examples of these equity-oriented EV mobility programs. Finally, analysis was performed and key themes and takeaways were assembled.

It is worth noting several limitations to this work. First, the above research methodology was carried out over approximately seven weeks, which is a relatively short time span given the breadth and complexity of this topic. Second, this field continues to develop and is in relatively nascent stages; many equity-oriented EV mobility programs are in relatively early stages and have not yet been fully evaluated or iterated, which limits the paper's ability to make far-reaching, definitive claims. Third, researchers continued to discuss this project and key recommendations beyond the time of writing; all perspectives are thus not comprehensively integrated here. That said, this work makes its best recommendations given these limitations.

Defining “Frontline” Communities

Policies and grant programs with equity focuses must explicitly define the target communities they seek to serve. Terms are often used interchangeably, despite actual differences in meaning, as seen through communities variably described as “underserved,” “low-income,” “vulnerable,” “disadvantaged,” “marginalized,” “environmental justice,” or “frontline” (Greenlining Institute, 2021). In addition, many programs deploy specific terminology as defined in statutes and legislation, only further necessitating explicit definitions.

Furthermore, the State of California and various countries in Europe define target communities for environmental justice programs quite differently. Most state programs in California, for example, employ the notion of a “disadvantaged community,” identified by census tracts that rank highly on a combination of metrics that gauge vulnerability and pollution burden as defined by [CalEnviroScreen](#), a screening methodology operated by the California Office of Environmental Health Hazard Assessment. This reflects broader notions in the United States that environmental justice is a necessary response to environmental racism, and that communities most burdened by the impacts of environmental injustices ought to be prioritized in terms of green investments and benefits (IZEVA, 2022). Europe differs in its conception of target communities for environmental justice programs. Stakeholders in the UK and the Netherlands, for example, tie environmental inequality to income more than race, and frame environmental justice as a means to address existing inequalities—economic and otherwise—from an intersectional perspective (IZEVA, 2022). Stakeholders across both regions highlight the necessity of community-driven decision-making, as well as inclusive planning processes, to foster environmental justice (IZEVA, 2022).

This white paper will refer to target communities for equity-oriented EV programs as “frontline” communities. “Frontline” communities are communities that “experience continuing injustice—including people of color, immigrants, people with lower incomes, those in rural areas, and Indigenous people—due to a legacy of systemic, largely racialized, inequity that influences their living and working places, the quality of their air and water, and their economic opportunities” (Climate Justice Working Group, 2017).

EV Car-sharing in Frontline Communities

EV car-sharing provides benefits to both households and cities/regions in frontline communities. It provides households auto access without ownership—allowing drivers to pay only for the automobility they use—and is a cleaner travel mode than privately-owned ICE vehicles (InterActions, 2022). EV car-sharing provides benefits to regions by facilitating a stronger local economy (i.e., workers can better access jobs and wages), increasing clean fuel vehicle travel, and catalyzing electric charging infrastructure in frontline communities (InterActions, 2022).

Large-scale EV car-sharing first emerged in France in the 1990s and proliferated across Europe and the U.S. over subsequent decades. Many early programs failed, but renewed interest has emerged in recent years as EV technology has become more affordable, reliable, and scalable (Nicolas and Bernard, 2021). EV car-sharing for frontline communities in particular remains in relatively nascent stages. Several pilot programs have emerged in the U.S. in the last 5 years, a large proportion of which are in California (InterActions, 2022). While European countries have a longer history of successful EV car-sharing programs in general, Europe lacks robust programs that specifically target frontline communities. In this context, it is helpful to highlight key themes that emerge from analyses of current and recent EV car-sharing programs—both targeted toward frontline communities and not—in California and Europe.

EV Car-share Models

EV car-share models vary widely. Some car-share programs are for-profit, distributed across a region, and available to the general public (e.g., [GIG in Sacramento, California](#) and [GreenMobility in Europe](#)). Programs that specifically target frontline communities can differ. Some frontline EV car-share programs are tied to low-income housing developments and only available to development residents (e.g., [Rancho San Pedro in San Pedro, California](#)). Some frontline EV car-shares are based in low-income housing developments but are available to the public (e.g., [Miocar in California’s San Joaquin Valley](#)). Frontline community EV car-shares can be intentionally stationed in frontline communities only, but available to the general public (e.g., [BlueLA in Los Angeles, California](#)). Car-share schemes can deploy varying pricing models depending on user income thresholds (e.g., BlueLA). EV car-share programs can both site stations in high-need locations for target populations *and* incorporate below-market rate pricing structures for low-income users (which stakeholders note are most effective in terms of effectively reaching priority communities). Car-share schemes can be one-way station-based, round-trip station-based, or free-floating.

When evaluating EV car-share models, it is vital that officials and planners distinguish between these various configurations and goals. Given that EV car-shares, particularly in frontline

communities, are in such early stages, this specificity is important as officials evaluate whether models are successful and make funding decisions accordingly.

Profitability, Financial Sustainability, and Fleet Vendors/Providers

EV car-sharing faces higher operational complexity and increased overall costs compared to ICE vehicle car-sharing, which poses a barrier to profitability (Liao and Correia, 2020). Concerns over EV car-sharing profitability and financial sustainability are shared across California and Europe (CARB, 2022; IZEVA, 2022). These concerns are amplified in the context of frontline community EV car-sharing programs (IZEVA, 2022). Regions generally contract with private vendors to provide car-sharing vehicles and servicing, and when programs target frontline communities with lower-incomes who will intentionally pay less for car-sharing services, questions over profitability emerge and compound. In this context, stakeholders note, frontline community EV car-share programs that require financial self-sufficiency within several years of operation impose unrealistic program expectations.

To achieve financial sustainability, EV car-sharing programs can choose to increase prices for frontline communities, or open services to non-frontline communities and customers—but these solutions mean less vehicle availability and more expense to frontline communities, which goes against equity targets of these programs. Alternatively, EV car-sharing programs can find external funding to fill the gap, which relies on continued availability and consistency of private and/or public sources of funding (Bruns Auri, Inc., 2020). Some stakeholders note the value in public-private partnerships in this context, given that public entities are reluctant to take on financial risks compared to private institutions.

Other stakeholders believe that long-term sustainability will require that cities or regions operate their own EV car-share fleets as part of its larger transportation system. This type of model can strengthen residents' relationship with the transportation system generally, given occasional reliance on a city-owned car-share vehicle could mean a consistent ridership base for the rest of a city's transportation infrastructure. Stakeholders do note that this jump to city or regional EV car-share fleets is one that requires bandwidth that many governments do not have (InterActions, 2022). Regardless, financial sustainability will play a huge role in broadscale implementation of frontline community EV car-sharing programs, secured either through long-term government funding or company profitability. Overall, the best business model for EV car-sharing remains an unanswered question, and stakeholders note a lack of acknowledgement that for long-term sustainability, these programs will require long-term capital.

It is worth additionally emphasizing the barriers and complexities posed by EV car-sharing vendors. First, it can be challenging to attract private vendors to programs that target frontline communities: Miocar in the San Joaquin Valley, for example, offered significant subsidies for an operator and still received no responsive bids; they ended up developing a nonprofit instead to remove the necessity of vendor profitability (InterActions, 2022). Such nonprofit models might be necessary in areas where private companies are unable to make the profit they need (InterActions, 2022). Second, there is a limited number of EV car-sharing vendors in general, and those that do exist often fold or rapidly change/merge (InterActions, 2022). Examples of this can be seen in Los Angeles (where BlueLA's initial vendor Bollere was replaced by Blink

Mobility after less than two years of operation) and in Paris (where flagship car-sharing program Autolib' was retired and replaced by Moov'in, only to be replaced by Zity two years later). It can be challenging for regions to collaborate with such an inconsistent private sector market (InterActions, 2022).

From a business case perspective, transportation officials will have to foster an transportation environment in which EV car-share providers want to operate their fleets. This will be challenging given the frontline community EV car-sharing environment, in which frontline communities are more likely to be lower-income and limit profitability for the relatively few number of potential vendors in the first place. It is thus likely that different regions will require different EV car-share models and funding structures (e.g., nonprofit models in lower-income areas; for-profit models in higher-income areas) to ultimately attract stable providers and provide effective service.

Transportation stakeholders in California note high developer demand for VMT/GHG credits and the fact that EV car-sharing programs qualify as a mitigation measure ([the California Air Pollution Control Officers Association's GHG handbook](#) describes this in detail). EV car-sharing programs could therefore provide a business incentive for developers throughout the state.

EV Exposure/Awareness

Basic exposure to EVs in frontline communities plays a large role in program uptake. This pattern repeats across frontline community car-shares in California (e.g., [Our Community CarShare in Sacramento](#), BlueLA, GIG). EV exposure can be facilitated through communication and outreach events, advertising, and, unsurprisingly, households simply seeing neighbors using EVs, or seeing a station in their neighborhood (InterActions, 2022; Shared-Use Mobility Center, 2019). This exposure not only drives uptake in frontline community car-share programs, but may even facilitate EV adoption and purchase outside of the program (Libgober and Song, 2022).

It is possible that Europe's comparatively high volume of EVs and EV car-sharing programs serves to drive this exposure more organically; however, EV uptake remains inequitably distributed in Europe, particularly in rural areas (e.g. in Germany, Wappelhorst et al., 2022; e.g., in the Netherlands and the UK, Colle et al., 2022). It is worth reiterating that Europe hosts more extensive, reliable public transportation infrastructure, which likely reduces the need for privately-owned vehicles, with particular benefits for lower-income households in particular. However, stakeholders in both California and Europe have emphasized strong cultural values in support of private car ownership, particularly in rural and some immigrant communities. These cultural barriers, in combination with exposure barriers, serve to further limit car-sharing uptake in frontline communities.

Outreach, Community-based Organizations, and Car-share Ambassadors

Outreach through trusted community members and community-based organizations (CBOs) is vital to frontline community EV car-sharing success. This ensures that target audiences are reached contextually and effectively. Ample budget and staff resources must be set aside for

outreach in frontline communities to achieve these goals, as well as regular communication with and feedback from CBO leaders (Shared-Use Mobility Center, 2019; Bruns Auri, Inc., 2020).

In-person, face-to-face outreach and support provides significant value. This can be achieved through in-person enrollment events and test drives to bolster EV familiarity and trust (InterActions, 2022). This can also be achieved through dedicated car-sharing “ambassadors” (also known as “community representatives,” “coaches,” and “coordinators”) who assist with real-time education, outreach, operations, and relay valuable program feedback to administrators. These ambassadors can be offered carshare program benefits or other forms of direct compensation in exchange for their service. Ultimately, frontline community car-share users benefit greatly from in-person support over impersonal customer service via phone (InterActions, 2022). Examples of car-sharing ambassadors exist in programs across California (e.g., BlueLA in Los Angeles) and Europe (e.g., [MyWheels in the Netherlands](#)).

Reporting, Metrics, and Evaluation Timeline

How to best measure success for frontline community EV car-sharing programs remains an open question. These programs are not designed to generate revenue, for example, but rather augment transportation gaps and increase accessibility in target communities—all while reducing GHG emissions, substituting ICE vehicles with EVs, and reducing individual auto ownership (InterActions, 2022). Some of these metrics are less straightforwardly measurable than financial measurements (CARB, 2022). It is also worth noting that numbers in this context can be somewhat reductive. Households in frontline communities simply having car access (and therefore access to opportunity) that was previously unavailable is a success worth celebrating, irrespective of numerical analysis (InterActions, 2022). This VMT can be considered “good” VMT: access to otherwise unattainable mobility and opportunity (InterActions, 2022).

Finally, program adoption takes time and effort. Frontline communities require long-term investment, given that they have often been disinvested in for decades. Furthermore, frontline community EV car-sharing programs are also relatively new in the state of California, for example, and much evaluation is still in-progress. In this context, it is important that government officials not assume the success or failure of such programs without ample time for implementation and evaluation.

Uptake and Effectiveness

Frontline community EV car-sharing programs in California showcase early successes in terms of both environmental and equity goals. Low-income BlueLA members represent 60% of the utilization base; BlueLA has also been associated with an increase in EV adoption more broadly in membership communities (InterActions, 2022; Libgober and Song, 2022). 69% of Miocar members fall into low-income categories; Miocar members also report a 20% reduction in overall vehicle ownership (InterActions, 2022). Our Community CarShare reports that the biggest demand among members is for project expansion (Brunns Auri, Inc., 2020). Given early successes in terms of reaching target communities, reducing personal vehicle ownership, increasing EV adoption, and fostering interest in program expansion, frontline community EV car-sharing poses an exciting opportunity for the evolving clean transportation landscape.

Summary of Key Results and Recommendations:

1. EV car-share models differ and should be distinguished accordingly.
2. EV car-sharing programs have shown success in reaching socioeconomic and environmental goals. Given their inherent profitability barriers, they require funding support. The level and type of support will likely vary, depending on the car-share program model and goals.
3. EV car-share vendors are limited and can prove somewhat unreliable. To the extent possible, partnerships should prioritize vendor stability and longevity. Cities can also explore eventual municipal ownership over car-sharing fleets as part of mass transit infrastructure.
4. CBOs and ambassadors provide critical on-the-ground events/exposure, support, and feedback, and should be compensated accordingly.
5. Evaluation and iteration of these programs will take time, given decades of historical disinvestment in frontline communities.
6. Notions of program “success” can be reoriented to include successfully-filled transportation needs and increased accessibility/opportunity (i.e., not just reduced VMT or reduced personal vehicle ownership; “good” VMT).

Secondary Market EV Lease/Purchase in Frontline Communities

As discussed in the Introduction, certain types of trips (e.g., trips that require increased cargo capacity, multi-stop trips, medical appointments) still benefit from individual car use. Cars can provide access to employment and other resources that foster economic stability. This access is particularly salient in frontline communities where other forms of transit (e.g., public transportation, walking, biking) are more likely to be unreliable and limited.

Car ownership rates in general tend to be lower in low-income communities and communities of color (IZEVA, 2022). This is largely due to the fact that cars are expensive and unaffordable, both in terms of upfront cost and ongoing costs for insurance and maintenance. This unaffordability is compounded in the case of electric vehicles, which have higher upfront costs than ICE vehicles. Despite the fact that electric vehicles ultimately cost less than ICE vehicles over time, higher upfront costs pose a huge barrier for many would-be low-income purchasers (in addition to other, non-financial barriers like inadequate charging infrastructure and a lack of trust, as described at other points in this paper). These high upfront costs are compounded by other types of financial barriers, like a lack of banking opportunities and inaccessible credit in frontline communities (CARB, 2018).

Used EVs—which are presumed to be less expensive than new EVs—can play a role in offsetting this dynamic. This argument is supplemented by the fact that two-thirds of households in the U.S., for example, only purchase used vehicles (Hardman et al., 2021). However, it is worth noting that there lacks comprehensive data on used EV market penetration in California, for example (Tal et al., 2021). Future used EV market penetration research will be critical to understanding the spatial distribution of used EVs, including impacts on frontline communities, infrastructure requirements, and anticipated energy demand (Tal et al., 2021).

While the state of California pursues a longer-term goal of enhanced public transportation infrastructure, frontline communities in particular throughout the state will continue to rely on privately-owned vehicles to access critical opportunities and services. While Europe's public transportation system is more reliable and accessible than that in the state of California, low-income and rural communities still face transportation barriers and have the potential to benefit from affordable EVs (IZEVA, 2022).

Pipeline Opportunity: Retire Secondary Market EV Car-share Fleet Vehicles to Frontline Communities

Fleet vehicles are typically sold after three years of use, and sometimes sooner (Green Alliance, 2021). Car-share fleet vehicles deployed in frontline community programs therefore pose a unique opportunity: when vehicles are retired after several years of car-sharing use, these vehicles can be channeled into lease/ownership by drivers or organizations in those same frontline communities. This concept is proposed with the caveat that vehicles retired in this context must uphold strong operational standards: retired vehicles must be retired for minor aesthetic or other non-mechanical reasons to ensure that programs do not impose vehicles that pose a liability or additional burdens for secondhand owners.

That said, the state of California has several proposed mechanisms in place for such a pipeline. California's Department of General Services (DGS), for example, is developing policies to encourage EVs retired from the state fleet to benefit communities most in need by, in part, contributing these surplus state vehicles to preexisting used vehicle programs (California Department of General Services, 2022). The California Air Resources Board (CARB) has proposed recent regulations that would provide automakers additional incentives if they offer used EVs to low-income residents first (2022). Overall, it is critical that policies focus on the flow of EVs to the secondary market in order to help frontline communities increase EV adoption rates and supplement used EV market growth in the future (Tal et al., 2021).

Stakeholders in California note the potential to retire fleet vehicles specifically to CBOs in frontline communities. Retiring fleet vehicles to individual consumers requires a great deal of logistical effort (e.g., complex title transfers and registration fees). Individual customers also benefit from a choice of vehicles that retired fleets do not provide, as well as capital-intensive outreach efforts. CBOs, on the other hand, have greater bandwidth to manage complex transfer logistics and are less likely to have qualms with receiving similar retired EV types. CBOs are also excluded from other equity EV programs; stakeholders note there is a great need for a used EV pipeline that serves these organizations in particular.

Notions of used EV pipelines and equity are echoed in Europe. UK-based think tank Green Alliance, for example, encourages increased EV purchasing by fleet buyers to foster a more robust secondhand market in subsequent years (Green Alliance, 2021). Europe also contends with a broader question of whether and how EVs subsidized in higher-income countries should travel across borders to European countries underserved by EVs and EV infrastructure. In these ways, the extent to which used EVs can best foster in-country and cross-country equity will grow increasingly significant in coming years.

Incentivizing Faster EV Turnover to the Secondary Market

Ramped up EV production in general plays a decisive role in stimulating EV accessibility. As more EVs are sold new, more EVs will arrive on the secondary market down the line. From a business case perspective, it is critical that governments pursue actions that attract automakers to produce EVs to be sold in their region. Stakeholders attribute Norway's highly successful EV rollout to their policies that made it highly attractive for auto manufacturers to produce and sell vehicles there. The U.S. faces particular challenges in this context, where there exists both a perception and a reality that U.S. markets seek larger passenger vehicles that are far less common in current EV production. From an equity perspective, many drivers in frontline communities require larger passenger vehicles to transport heavy cargo such as construction equipment. These cultural and logistical barriers will play a large role in how governments can best incentivize auto manufacturers to produce a greater volume of EVs, for eventual ownership in the secondary market.

At this stage of market development in California, research also shows that used EVs are not trickling down at a high rate (Tal et al., 2021). Stakeholders note how EV production inventory has decreased greatly in recent years, which has been compounded by the COVID-19 pandemic and supply chain shortage. This is particularly the case for base model, mass-produced EVs that retain their value and do well on the secondary market in frontline communities. These shortages will likely have ripple effects for years as production ramps back up; incentive programs, therefore, need to realistically project used EV inventory before they scale used EV programs for frontline communities.

That said, government entities can implement policies that incentivize faster turnover of new vehicles to the secondary market and target frontline communities specifically in the process (Elkind et al., 2022). In California, the California Air Resources Board has proposed new regulations for faster rollover of new vehicles to the secondary market, including EV sales credits to automakers and incentives for owners who retire their EVs quickly for low-income residents (CARB, 2022). Government agencies can also implement regulations that require greater levels of vehicle durability and thereby support the longevity of a used EV market. CARB's new regulations, for example, include minimum warranty and durability requirements, proposals to increase serviceability, and proposals to facilitate charging infrastructure specifically for used EVs in frontline communities (CARB, 2022). In these ways, government entities can support the used EV market by establishing minimum standards that bolster the lifetime and reliability of an EV. These strategies supplement necessary increases in the volume of EVs produced.

Equity Limitations of EV Subsidies and Rebates

Many programs devoted to the EV transition provide rebates that subsidize an EV purchase or lease. These programs have existed across California and Europe over the last 10 years, with the goal of supporting increased EV uptake generally among drivers. However, these programs have faced equity challenges. In California, for example, many studies have shown how the [Clean Vehicle Rebate Project](#) (CVRP) has disproportionately benefited middle and higher-income

white purchasers (Greenlining Institute, 2021). These patterns are replicated in Europe: subsidies in Germany to offset the cost of a new EV have mostly been taken up by the wealthy (Martin, 2019); in the UK, the top 20% of earners own over half of EVs sold (Green Alliance, 2021); in Norway, 37% of new electric cars in 2019 were registered by the 10% richest households (Wappelhorst et al., 2022). Rebate programs that do not explicitly focus on equity consistently face challenges reaching frontline communities.

Regional governments can implement programs that explicitly target communities facing the largest barriers to EV adoption. Stakeholders in California and Europe call for these types of changes (e.g., Martin, 2019; Greenlining Institute, 2021). There exists several models of successful used EV programs that focus specifically on frontline communities. France, for example, provides a conversion bonus to drivers who purchase a new or used EV, with higher amounts for low-income households (Wappelhorst et al., 2022). California's CVRP, for example, offers increased rebates to low-income households and has recently introduced rebate income caps, which have substantially decreased the number of high-income households receiving rebates. Policymakers and stakeholders across California and Europe recommend further fostering equity in these programs by increasing rebates for low-income households by significant amounts and expanding programs to include used EVs (Elkind et al., 2022; Wappelhorst et al., 2022).

For the sake of scope, this paper will now consider EV lease/purchase programs that specifically and exclusively target frontline communities: for example, California's [Clean Cars 4 All](#) (CC4A) and [Clean Vehicle Assistance Program](#) (CVAP) programs. CC4A helps low-income Californians replace old, polluting cars with cleaner vehicles like EVs. CVAP provides grants and affordable financing to help income-qualified Californians purchase or lease a new or used hybrid or EV. Both programs have been shown to be successful in terms of reaching frontline communities, as described below.

Uptake, Effectiveness, and Funding

CC4A is positively associated with recipients from frontline communities (Pierce et al., 2021). 74% of CVAP funding has gone to applicants who reside in low-income or disadvantaged communities (Greenlining Institute, 2021). CC4A has placed over 11,000 vehicles with eligible households (Pierce et al., 2021). Importantly, recipients provide consistent, positive feedback about these programs (Pierce et al., 2021). These dynamics precipitate the recommendation that programs specifically focused on connecting frontline communities with new and used EVs receive more funding.

In the state of California, Programs like CC4A and CVAP are underfunded compared to programs like CVRP (Greenlining Institute, 2021). In addition, there is extremely high demand for CC4A and CVAP, and funding constraints have resulted in lengthy waiting lists, which pose even greater negative impacts to low-income households (Pierce et al., 2021). In response, governments can immediately increase funding for such programs (Greenlining Institute, 2021). However, it is vital to note that programs can only be scaled to the extent that used EV inventory is available. This inventory has undergone a tremendous recent dip in California, which will

cause ripple effects for years before the market stabilizes and these programs can be reasonably scaled.

Coordinating Applications and Tools

Equity-focused mobility programs like CC4A and CVAP are, at the moment, administered separately. These programs coexist with several other state and federal programs to support an EV transition; these programs overlap with and vary from one another. In response, many stakeholders recommend a mechanism for streamlining these various programs, applications, and tools. Transportation equity incentive programs, for example, can be formally required by the state to coordinate their outreach and application processes with other programs through a centralized platform or tool (Greenlining Institute, 2021). Doing so can alleviate the inefficiencies and confusion created by the lack of coordination.

It is also important to note that some households are less equipped to use shared mobility services that require internet access or smart phone technology (Barriers Study, 2018). Any tools that centralize these programs, as well as their applications and services, must also be made available to these communities through other means and in partnership with trusted CBOs.

Summary of Key Results and Recommendations:

1. EV lease/ownership still plays a significant role in the mobility ecosystem, particularly for frontline communities.
 - a. There lacks sufficient data on used EV market penetration.
2. Policies can be developed to ensure frontline community EV car-sharing vehicles are eventually leased/purchased by drivers or CBOs in these communities, assuming strong minimum operational standards.
3. Broadscale increases in EV production can stimulate eventual secondary market development. Incentives can further attract auto manufacturers to produce EVs in key markets. Regulations can incentivize faster EV turnover to the secondary market.
4. EV lease/purchase programs for frontline communities have shown success in reaching socioeconomic and environmental goals, and should be funded accordingly.
 - a. Programs can only be scaled to the extent that used EV inventory is available.
5. General EV lease/purchase programs can be modified by increasing rebates for low-income households and expanding programs to include used EVs.
6. Transportation programs for frontline communities can be required to coordinate their outreach and application processes for ease of use.

Awareness/Education & School Collaborations

EV Trust, Exposure, and Relatability Barriers

Many frontline communities do not view EVs as an option. This can be because of higher upfront costs of EVs over ICE vehicles, as previously noted. This can also be due to a lack of convenient vehicle charging infrastructure, EV range anxiety, and smaller carrying capacities in EV models (Barriers Study, 2018). Other types of barriers also persist: frontline communities can

be reluctant to adopt new technology and have high levels of distrust in government programs within their community (CARB, 2018; Pierce et al., 2021). These types of patterns echo across California and Europe: in California, frontline communities sometimes consider EVs a luxury they can't afford; in Germany, for example, surveyed low-income drivers living in rural areas felt detached from the EV era due to affordability and infrastructure concerns (Pierce et al., 2021; Martin, 2019).

These barriers can, in part, be overcome by targeted investments in EV recognition and trust in frontline communities. Strategies like test drives, in-person workshops, experiential testimonials, translation services, and youth education play a huge role in fostering community knowledge to overcome perceptions about EVs and whether they would align with a household's budget or lifestyle (Pierce and Connolly, 2019; Elkind et al., 2022). This paper will focus briefly on youth education in particular, and specifically that in schools.

Education and School Curriculum Opportunities

Research shows that early childhood encounters with various transportation modes (e.g., cars, trains, buses) are critical to the development of a child's eventual mobility expectations and values as an adult (Sovacool, et al., 2019). Cross-curricular efforts led by schools can be sufficient in affecting everyday behavior and influencing parents regarding sustainable transportation (Kopnina, 2011). In order to foster a just and effective EV transition, childhood education can integrate curriculum specific to the subject. However, it is worth noting that the vast majority of articles consulted through this research fail to mention the role of children or primary/secondary school curriculum in fostering a just EV transition. This aligns with much of planning and land use praxis in the United States, for example, which often fails to include children in planning and policy.

That said, CARB's 2018 Barriers Study does recommend the provision of educational curricula for kindergarten through 12th grade students in frontline communities about clean vehicles, biking and walking benefits, and transportation safety. The state of California is implementing several programs to foster childhood education on EVs in particular: CARB's [Clean Mobility in Schools Project](#) is piloting grants in three school districts in frontline communities to focus on EV infrastructure and exposure. As part of Pacific Gas & Electric's [EV Charge Schools](#) program, 22 schools across California will receive not only charging infrastructure but EV curriculum and educational outreach in the next several years (40% of sites in this program must be designated as "disadvantaged" per CalEnviroScreen). Smaller-scale, regional programs also exist throughout California, including the Electric Vehicle Learning Center in San Marcos and The Switch Lab in Sebastopol. One such program aligned with this research in particular is [Mission Z](#), a [Global Institute for Fused Learning](#) (GiFT) program produced in collaboration with Electrify America and Ecology Action that asks high school students to creatively imagine and design a world filled with EVs.

Coast to Coast / GiFT Collaboration

Researchers involved in this white paper collaborated with GiFT on online learning materials for high school students in frontline communities in California. They participated in a career

pathways panel where they discussed EVs and workforce development. They also recorded experiential videos of utilizing EVs and clean transportation technology in various countries in Europe, to be hosted on the GiFT platform and eventually embedded in the GiFT curriculum. Given that exposure via educational curriculum is so vital, such programs can play an essential role in the EV transition.

Coast to Coast / Twin Rivers Unified School District Collaboration

Researchers in this work also collaborated with the Twin Rivers Unified School District in McClellan Park, California. They conducted interviews with school teachers wherein they discussed barriers to EV adoption for children families in their school district. These barriers included a lack of tangible connection or relatability to EV use, as well as the need to make EVs seem attractive and exciting to young people. To better understand these barriers, researchers developed a survey in collaboration with a teacher from the Twin Rivers Unified School District, to be distributed among students and families once the 2022-2023 school year began. Results of this survey are forthcoming and beyond the time scope of this report.

Summary of Key Results and Recommendations:

1. EV trust, exposure, and relatability plays a key role in EV uptake for frontline communities.
 - a. Childhood education in particular can be significant for this trust and reliability.
2. Primary/secondary school educational opportunities and curriculum can be explored as part of EV outreach in frontline communities, (e.g., this paper's collaboration with GiFT, with the Twin Rivers Unified School District).

Final Considerations

Community-based Organizations and Outreach

A prevailing theme throughout this white paper has been the vital role played by community-based organizations (CBOs) and outreach efforts. EV programs in frontline communities benefit greatly from building off of existing, community-trusted programs that already have support and buy-in (Greenlining Institute, 2021). Research repeatedly shows the benefits of prioritizing local stakeholders and CBOs in program design and implementation; of pursuing local, hands-on education and outreach in partnership with CBOs; of developing messaging that is customizable and targeted to a region or community; of the value of in-person events and word of mouth (Elkind et al., 2022; Barriers Study, 2018; Pierce and Connolly, 2019). This value is echoed in Europe, though perhaps practiced less: stakeholders from the Netherlands and Germany report the need to engage with low-income communities in the EV transition, but a lack of concrete strategy or nuance in terms of implementation (IZEVA, 2022). Europe could turn to successful models of participatory planning and CBO partnership in California for learnings.

It is worth noting that CBOs in frontline communities must be fairly compensated for their work (CARB, 2020). This is especially the case when CBOs apply for funding streams via grant

solicitations, which require significant bandwidth and effort (Barriers Study, 2018). This recommendation to fund grant application assistance is described further below.

Funding and Grant Assistance for EV Equity Programs

As noted previously, funding must immediately be expanded to scale frontline community EV programs: compared to other EV transition programs, programs focused on frontline communities in particular are funded insufficiently and are unable to currently meet demand (Greenlining Institute, 2021). EV car-sharing programs in frontline communities, for example, should also not be required to be completely financially self-sustaining, given that they target communities that are likely to be low-income; these programs need to be continually subsidized to ensure frontline community accessibility (Greenlining Institute, 2021). Programs that support used EV purchase in frontline communities like Clean Cars 4 All and the Clean Vehicle Assistance Program, for example, have extremely high demand and not enough financial support; the state ought to provide continuous and reliable funding for these programs, and when applicable expand them statewide (Greenlining Institute, 2021).

This paper notes particularly the lack of bandwidth in frontline communities to track state funding opportunities to participate in these programs. These opportunities require careful tracking, planning, applications, implementation, and evaluation—which is a large, often unfunded task (Greenlining Institute, 2021; InterActions, 2022). The state can help pay for grant application assistance so that CBOs and local planning organizations can help communities track funding opportunities and be successful in their grant applications (InterActions, 2022). It is also worth emphasizing that effective grant assistance is more complex than a budget line item, but requires dedicated, comprehensive support throughout a funding cycle, which can include grant workshops and non-financial assistance that takes staff time and resources beyond capital alone.

Charging Infrastructure and Green Gentrification

Finally, while not in the scope of this white paper, it is important to note the equally important and parallel role that charging infrastructure plays in frontline community EV adoption. There are too few charging stations in the U.S., for example, and those that do exist are disproportionately in high-income areas (Elkind et al., 2022). Without adequate charging infrastructure and technical assistance, EVs will not be practical or accessible for frontline communities (Greenlining Institute, 2021). It is worth further noting profitability barriers charging manufacturers face in frontline communities who are more likely to be low-income. In order to offset these barriers, manufacturers can be incentivized to accept a longer return on investment for charging stations that might not immediately be profitable through, for example, tax credits or rebates. These barriers can be further offset by the provision of mobility wallets and prepaid charging cards for drivers in frontline communities to deploy at EV charging stations, thereby supplementing profitability concerns felt by infrastructure providers

Furthermore, as charging infrastructure is implemented in frontline communities, there are concerns that this infrastructure will raise rents and cause green gentrification (IZEVA, 2022). Unintended consequences of direct investments in frontline communities must be mitigated by

requiring parallel, community-driven anti-displacement strategies to accompany new EV infrastructure (Greenlining Institute, 2021).

Summary of Key Results and Recommendations:

1. Long-term relationships with community-trusted CBOs are vital. CBOs should be compensated for their essential work and contributions.
2. Frontline community EV programs can benefit from both direct program funding and increased funding for grant application and administration assistance.
3. Equitable charging infrastructure should be considered in parallel with topics outlined, particularly when applied to the used EV market.
 - a. Anti-displacement strategies should be pursued when charging is built out in frontline communities.

Appendix I: Opportunities for Future Research

1. Battery vs. hydrogen fuel cell vs. hybrid vehicles
2. Bundling/one-stop-shops
3. Car make/model variety and ADA
4. Community ownership and decision-making
5. Demographics deep dive (e.g., gender, caregiving)
6. Global effects/impacts of EVs (e.g., mining/extraction)
7. Eligibility requirements and verification
8. EV recalls
9. Infrastructure best practices (i.e., interoperability, distributional equity, affordability, housing type)
10. Language barriers
11. Loans, financial assistance/resilience, banking/credit considerations
12. Local leadership
13. Maintenance costs and availability
14. Microbility and other shared fleet types (e.g., bikes, scooters)
15. Mobility wallets/debit cards
16. Multi-issue perspective and analysis (i.e., transportation as it relates to housing, income, employment)
17. Needs assessments
18. Needs-based eligibility models vs. first-come, first-served
19. One-way vs. round trip station-based car-sharing vs. free-floating car-sharing
20. Pandemic/supply chain challenges
21. Parking
22. Ride-hailing services
23. Self-driving cars
24. Site selection, permitting, and testing
25. Travel training
26. Utilities
27. Workforce development/job transition
28. Zoning opportunities

Appendix II: Organizations Consulted

California Air Resources Board (California Environmental Protection Agency)
California Department of Transportation
California Energy Commission
California State Transportation Agency
California Governor's Office of Planning and Research
Center for Neighborhood Technology
The Climate Group
Coast to Coast Initiative
Community Assistance for Climate Equity Program (California Strategic Growth Council)
Community Economic Resilience Fund (California Office of Planning and Research, Labor & Workforce Development Agency, and Office of Business and Economic Development)
DG CLIMA
EIT Climate-KIC
EIT Urban Mobility
Global Institute for Futures Learning
International Zero Emission Vehicle Alliance
The Netherlands Ministry of Infrastructure & Water Management
Province of North Holland
Rebel Group
Swedish Environmental Protection Agency
Twin Rivers Unified School District
UC Davis Institute of Transportation Studies
UCLA Lewis Center for Regional Policy Studies
Valley Clean Air Now (CAN)

Appendix III: Key Programs

EV Car-sharing:

BlueLA (Los Angeles)
Miocar (San Joaquin Valley)
Rancho San Pedro (San Pedro)
Our Community CarShare (Sacramento)
MyWheels (The Netherlands)
Greenmobility (Europe—multi-country)
+others...

Used EVs in Frontline Communities:

Clean Cars 4 All (California)
Valley Clean Air Now (San Joaquin Valley)
Clean Vehicle Assistance Program (California)
Clean Vehicle Rebate Project (California)
+others...

Primary/Secondary School Education and Curriculum:

Clean Mobility in Schools Project (California)
EV Charge Schools (California)
Mission Z / Global Institute for Futures Learning (California)
Twin Rivers Unified School District (California)
+others...

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