Title
The Central Valley Initiative

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Executive Summary

The Central Valley Initiative focuses on new shared mobility strategies to address the challenge of providing affordable alternatives to personal vehicle travel in the rural areas of the Valley. In rural areas, cost-effective transit service is challenging to deliver due to greater travel distances, lower population densities, and longer travel times than in cities. As a result, the people who rely on public transit contend with infrequent and slow service. Access to a personal car is often essential to the quality of life for most residents, enabling them to readily access work, health care, education, healthy food, and other essential services. However, keeping two (or sometimes even one) cars in reliable working order can consume an estimated 22% to 56% of the household budget for low-income families in California. Rural residents often have lower incomes than their urban counterparts, and the most fuel-efficient vehicles, particularly electric vehicles (EVs), are outside their financial reach.

UC Davis researchers partnered with Caltrans and eight San Joaquin Valley (SJV) Metropolitan Planning Organizations to identify shared-use alternatives in rural disadvantaged communities that might reduce transit costs, increase access, and reduce GHGs. The research team worked closely with key community stakeholders who had a positive rapport with residents. These leaders helped facilitate several community forums with residents to understand the unique mobility needs and whether shared mobility services could benefit their community. Through these dialogues, residents of Kern and Tulare identified carshare as a possible solution to provide connectivity to key life opportunities. Researchers implemented surveys and focus groups exploring the need and interest for pilot services and undertook extensive stakeholder outreach to understand study-related concerns, goals, and analyses.

These efforts resulted in the identification, development, and launch of an electric vehicle carsharing service, known as Míocar, which is located in affordable housing complexes in eight rural communities in Tulare and Kern counties. The implementation of this pilot ultimately required the development of a non-profit organization (doing business under the name of Míocar). Initially, the project was unable to secure a commercial carsharing service that met the requirements of community stakeholders (i.e., retention of vehicles after the pilot period). As a result, the project was launched through a partnership with CalVans, a transit authority that provides farmworker vanpools. However, the cost of renewing carsharing insurance through CalVans insurance in March of 2020 was prohibitive because the carsharing fleet has to be insured under the vanpool entity with a Symbol 1 requirement, which requires their entire fleet be considered. As a non-profit carsharing organization, Míocar was able to secure insurance at 25% of the price quoted to CalVans by several carriers. CalVans then transferred ownership of the vehicles to Míocar, and the pilot resumed toward the end of the summer of 2020. Currently, the program includes 28 electric vehicles. Míocar has been funded to expand service at 50 new sites with 95 additional electric vehicles in the cities of Richmond and Stockton and the counties of Kern and Kings.

Community engagement was critical to developing a program that addressed a transportation problem in the community and thus built support for continuing and expanding the program at the end of the initial funding period. In addition, Míocar was implemented in association with Self-Help Enterprises, which is the largest affordable housing developer in the Valley and has an expensive community outreach program. Self-Help provided both site locations, community support, guidance for implementation, and in-depth community engagement necessary to introduce the project to the community and build membership. Without their participation, this project would not have been possible.

In addition, UC Davis researchers worked closely with the on-the-ground team to collect information about user demographics and trip behavior. Users of the carsharing service were administered a survey during the enrollment process (i.e., Before-Survey) and after they completed a reservation (i.e., Post-Reservation Survey). Surveys were offered in English and Spanish to accommodate the participating population. Users that completed either the Before-Survey or the Post-Reservation Survey were awarded driving credit for their next reservation.

Despite challenges due to COVID-19 and the GM Bolt recall, the Míocar pilot now serves 374 members in the Counties of Kern, Tulare, Fresno, and Kings. Almost 30% of members live more than five miles from their closest Míocar hub, suggesting the need to expand the service to more communities. Currently, subsidies for electric vehicle infrastructure favor many charging stations at one site. However, in low-density rural areas, electric carsharing requires fewer chargers at more sites. Subsidies should focus on quality rather than quantity.

The results of the usage and survey data over two years indicate the following:

- Most members belong to large low-income households with few older vehicles: 62% of respondents have four or more household members; respondents fell into the following Federal Housing and Urban Development categories: 35% extremely low income, 15% very low income, 18% low income, 9% moderate-income, 15% high income, and 9% prefer not to answer; 42% have one or fewer vehicles available to their households, and the average and the median age of household vehicles is 12 years.
- Seventy percent of reservations included two or more passengers.
- Respondents indicated that 68% of all reservation travel could not have been made without access to Míocar.
- Of the 16% of reservations, respondents indicated would have been possible without Míocar, all travel would have been made by a conventional vehicle and only 1% by bus.
- Overall, the usage and survey data from the pilot show a 24% reduction in GHG emissions through the substitution of electric vehicle travel for conventional vehicle travel and a 54% increase in electric vehicle access to reservation destinations.
- Moreover, income was positively correlated with GHG reductions and negatively correlated with increased electric vehicle access.

In sum, electric vehicle carsharing is a promising policy and infrastructure option to reduce vehicle travel and GHGs and improve equity of access. These services act as incentives for changing behavior, which is necessary where few alternatives to personal vehicles are available. Subsidized electric carsharing programs may provide an affordable option to high-quality transit that is costly to provide in rural and suburban areas. Pricing policies are very effective at inducing behavioral change. Still, they are likely to face extreme pushback from constituents who must travel long distances to access affordable housing and employment in suburban and rural areas. Electric carsharing may increase exposure to electric vehicles in rural areas, translating to acceptance and increasing the likelihood of electric vehicle purchases, at least among those who can afford to do so.

On the other hand, researchers know little about what these electric carsharing projects will cost at scale and their actual benefits. It is critical to conduct peer-reviewed evaluations of these programs to verify and quantify the magnitude of benefits. Many of these programs use different business models and are located in different geographic contexts. Lessons learned from these programs should be documented over time as projects grow, evolve, and mature. Experiences from the current pilot suggest that non-profit community programs should reserve at least a share of project costs for research evaluation at this emergent stage. Evaluations need to understand and document changes in travel behavior, GHG emissions, and access to opportunities for marginalized populations. The current study has started this process, but more work is needed. Currently, ongoing funding mechanisms for these electric carsharing programs are uncertain. Peer-reviewed evaluations are necessary to justify the development of a funding mechanism to support these programs. Notably, the California Air Resources Board has increased its funding for evaluation, but more support is needed.

Introduction

In this study, UC Davis researchers draw lessons learned for development, operations, and outcomes of new operational models of electric vehicle carsharing in marginalized communities to reduce greenhouse gas (GHGs) emissions and increase equity of access. These lessons learned are drawn from the following sources: (1) a review of the literature the evaluated implemented carsharing in the US; (2) a discussion of the history of carsharing in the US, especially non-profit carsharing and the new wave of public funding for electric carsharing in the US; (3) a detailed recounting of the institutional issues that arose during the implementation of the Míocar electric vehicle carsharing pilot in marginalized rural areas in the San Joaquin Valley (CS); and (5) final summary of the evaluation of the pilot, including travel, GHG emission, and equity of access results.

Literature Review

Funding for electric carsharing is growing. Carsharing is eligible for $13.2 billion in congestion relief and air quality improvement funds from President Biden's Infrastructure Investment and Jobs Act. The latest version of the Build Back Better Bill supports $1 billion for an electric vehicle infrastructure in underserved communities. New York State recently dedicated $200 million electric vehicle infrastructure and $85 million for electric carsharing and ridesharing in marginalized communities. California is poised to spend an additional $18 million over this next year in similar programs.

The objective of the literature review is to help inform the design and improve the value of investments in future electric carsharing programs by (1) reviewing the academic literature that evaluates the travel, GHGs, and equity effects of implemented carsharing programs U.S. and (2) analyzing the evolution of carsharing in the U.S., including non-profit, for-profit, and recent government-funded carsharing, to glean insights and unanswered questions about government electric carsharing investments.

Travel, Emissions, and Equity

In this section, we, first, examine the peer-reviewed literature on changes in passenger travel, including transit use, vehicle miles travel (VMT), and greenhouse gas (GHGs) from round-trip and one-way carsharing services. Next, we explore issues related to equity of access to carsharing services and the degree to which carsharing has increased access to opportunities in underserved communities. The objective of this literature review is to understand the available peer-reviewed evidence for positive changes in travel behavior, GHGs, and equity. Table 1 documents key results study attributes and results with respect to travel, emissions, and equity. Table 2 summarized the socio-demographic attributes of participants in the studies listed in Table 1 when available.

One of the first evaluations of a large-scale carsharing service is the Cervero and Tsai (2004) study of the San Francisco carsharing service, City CarShare. The non-profit corporation operated a round-trip carsharing service with conventional vehicles. Over two years, they implemented a series of surveys that collected information about individuals, households, car ownership, and travel demand. They collected detailed travel diary information from City Carshare members and non-members, who served as a statistical control group. Survey response rates were 26% (462) for members and 34% (54) for non-members. Surveys asking members about their service use received responses from 351 members who tended to be frequent City CarShare users.

Cervero and Tsai (2004) found that early adopters of City CarShare were young (43.2% between the ages of 25 and 34), majority female (57.1%), and white (81.2%). Most members came from zero-car households (56.7%) and one-car households (33.7%). During the first two years of operation, more City Carshare members reported reducing their car ownership compared to nonmembers (29.1% versus 8%) by a statistically significant amount. Additionally, a larger share of members reported foregoing the purchase of an additional vehicle compared to non-members (67.5% versus 39.2%). While the results of foregone vehicle purchases were interesting, they were not statistically significant at the 0.05 level. Average VMT fell slightly for members and increased for non-members. After adjusting VMT for confounding factors such as mode and engine size, researchers found an even larger decline in VMT among members; however, this result was not statistically significant. Cervero and Tsai suggest that reduced car ownership, selective vehicle use, and higher than average vehicle occupancy rates accounted for the reductions in VMT among City CarShare members. Additionally, the researchers estimated that average carbon dioxide (CO_2) emissions fell by 0.75 pounds for members and increased by 0.25 pounds for nonmembers during the two-year period. Based on a best-fitting regression model, which controlled for factors such as travel day and respondents' socio-economic status, the researchers found statistically significant results that City CarShare membership typically lowered members' daily gasoline consumption by nearly 0.25 gallons.

Another study describes the Philadelphia-based carsharing service's evaluation, PhillyCarShare (Lane 2005). This non-profit operated a round-trip program with a combination of conventional and hybrid electric vehicles (HEV). Lane administered a survey online and by mail to 502 members and received 262 responses, constituting a response rate of 52%. To estimate VMT impacts, he used vehicle usage data from PhillyCarShare, and a personal vehicle travel self-assessment completed by members on their PhillyCarShare application. In addition, PhillyCarShare located vehicles in Philadelphia's most densely populated areas, and most members lived or worked nearby.

Similar to the second-year findings of Cervero and Tsai (2004), Lane (2005) found that early adopters of PhillyCarShare were young (55% between the ages of 25 and 39), white (89%), and owned zero vehicles (61%). Additionally, members were highly educated (99.6% attended college), lived alone or with a significant other (93%), and frequently used transit (91%). During PhillyCarShare's first year of operation, 24.5% of members reported reducing owned vehicles, and 29.1% avoided purchasing an additional vehicle. Members who reduced car ownership reported driving less and increasing their use of other forms of transportation, such as walking, biking, transit, and taxis. The majority of members who did not previously own a car reported no significant change in their transit use after starting PhillyCarShare. Members who did not have access to a vehicle before joining PhillyCarShare increased their VMT at most by an average of 29.9 miles each month. However, Lane estimated that members who gave up a car after using PhillyCarShare saw a monthly VMT decrease.

Martin and Shaheen (2011) evaluated the impact of round-trip carsharing services in North America on GHG emissions. The study included AutoShare in Toronto (CAN); City CarShare in San Francisco (CA); CityWheels in Cleveland (OH); Community Car Share in Bellingham (WA); CommunAuto in Montreal (CAN); Community Car in Madison (WI); Co-operative Auto Network/The Company Car in Vancouver (CAN); IGo in Chicago (IL); PhillyCarShare in Philadelphia (PA) and Wilmington (DE); VrtuCar in Ottawa (CAN); and Zipcar (US and CAN). The authors surveyed participants about their travel behavior before and after starting carsharing. Most participating carsharing services sent out survey invitations to their entire member base. However, due to Zipcar's services' size and geographic spread, Zipcar only allowed

30,000 survey invitations. Therefore, the researchers estimated that 100,000 carsharing members received the survey. Participants completed 9,635 surveys with a 10% response rate. The final analysis included 6,281 responses. The survey included questions on automotive usage, type of household vehicle(s), and demographic information.

Martin and Shaheen (2011) found that nearly half of respondents reported a 2007 household income higher than $60,000. Additionally, most respondents held at least a bachelor's degree (80%), and a large portion had completed an advanced graduate degree (40%). The average respondent household size was 1.9 persons, which was smaller than the national average at the time of the study. Most respondents identified as female (57%) compared to male (43%). Respondents primarily belonged to zero-vehicle households (62%) and one-vehicle households (31%).

Before using the carshare services, Martin and Shaheen (2011) reported respondents collectively owned 2,968 vehicles, and after carsharing, respondents owned 1,507, a decrease of nearly 50%. Out of the 6,281 households in the sample, households shed 1,461 vehicles, constituting a statistically significant reduction in the average number of vehicles per household. They calculated GHG impacts from the change in annual overall automotive use (before and after using carsharing services). More carsharing members increased emissions after joining a carsharing service; however, the impact for those who decreased emissions was more significant. Overall, the sample saw a reduction in GHG emissions. The average change in emissions across all households included in the study was -0.58 ton GHG per household for the observed impact and -0.84 ton GHG per household for the full impact, which included the unobserved impact, such as avoided vehicle purchases. The results of both the observed impact and the full impact were statistically significant. Respondents who decreased their emissions exhibited changes on a larger magnitude with greater variance. Most respondents reported utilizing a carsharing vehicle for short travel distances.

Martin and Shaheen (2016) analyzed Car2go's impact on vehicle ownership, mode shift, vehicle miles traveled, and GHGs in five North American Cities. The Car2go cities included in the study were Calgary, San Diego, Seattle, Vancouver, and Washington, D.C. All cities operated a conventional vehicle fleet except for San Diego, which included all battery electric vehicles (BEV). In addition, car2go operated a one-way free-floating carsharing fleet. The authors used a combination of survey and vehicle usage data. Survey questions assessed Car2go's impact on private vehicle ownership and forgone vehicle purchases and mode shifts. Additionally, researchers used vehicle activity data to determine the total miles driven by each city's Car2go fleet and frequency of use. They distributed an online survey to Car2go members in the five cities of interest between 2014 and 2015, and 9,497 members completed the survey. They used a total of 9,497 samples to assess mode shift; however, a smaller sample (6,167 due to data cleaning) to calculate vehicle usage, VMT, and GHG impacts.

Martin and Shaheen (2016) found that most respondents had not changed their travel mode after becoming a Car2go member. This result was consistent across almost every city and travel mode. However, in each city, respondents both increased and decreased public transit use. More respondents reported a decrease in their public transit use, rather than an increase, due to the presence of Car2go, except for Seattle, where more respondents reported an increase in their public transit use. One-way carsharing may lower travel time and monetary costs than public transit. Increased transit use is less likely for round-trip carsharing because of the additional cost incurred while the vehicle is not in use and the time cost of returning a vehicle to a location that is not the user's final destination.

Overall, the researchers found that Car2go members reduced VMT, particularly when considering foregone vehicle purchases. To measure the change in VMT, they calculated the net difference between the miles generated by Car2go vehicles and the miles not traveled by sold vehicles and foregone purchases. Next, they calculated the associated GHG emission impacts by estimating the amount of fuel by type consumed by the sold and foregone vehicles. Researchers estimated VMT decreased by 6% to 16% per household, with an associated decrease in GHG emissions by 4% to 18% per household for the five cities. It is important to note that Martin and Shaheen (2016) did not include any analysis to determine the statistical significance of the included results.

Randall (2011) conducts a two-year study of the Buffalo CarShare service. Member surveys ask retrospective questions about the impacts of the service on members' behavior. The response rate was 33% (N=134). Member respondents indicated that they shed vehicles (4%), delayed purchase of a vehicle (27%), and decided to purchase a vehicle (20%). In addition, survey responses indicated that members increased their transit use after joining the service and used transit to access the vehicles. Overall, the analysis indicated a reduction in VMT and vehicle fuel due to participation in the carsharing program.

Clewlow (2016) used the California Household Travel Survey (2010-2012) data to analyze travel behavior among carsharing members in the San Francisco Bay Area. From a total statewide sample of 63,082 responses (4.9% response rate) and a subsample of Bay Area residents, she selected households in census tracts with access to carsharing (79.3% of the Bay Area subsample). This final sample included 1,280 household responses and 2,719 individual responses. Carsharing members accounted for 19.8% of household responses and 13.9% of individual responses, while the remaining responses of non-members served as the control group for comparison. Clewlow defined a "carsharing household" as a household with at least one carsharing member. The control group included households and individuals in the subsample who did not carshare and lived in a census tract with access to carsharing.

Consistent with the findings of Cervero and Tsai (2004) and Lane (2005), Clewlow found that a higher percentage of carsharing members had at least a bachelor's degree (83.5%) compared to non-carsharing members (69.5%). Additionally, Clewow found that a larger percentage of carsharing households have an annual income of $100,000 or higher compared (59%) than non-member households (37.2%). The study found that carsharing members owned significantly fewer vehicles than non-members in urban areas (0.58 cars versus 0.96 cars). In the suburban areas of the study, researchers did not observe a statistical difference between the vehicle ownership of members and non-members. Moreover, based on the Bay Area sample, nearly one-third of carsharing members came from zero-vehicle households (30%), while the non-carsharing control group had significantly fewer zero-car households (8%). Among all car-owning households in the subsample, she found a greater share of owned alternative vehicles, including HEV, plug-in hybrid electric (PHEV), and BEV in the carsharing group. The data showed that carsharing members reported lower daily average VMT than non-members. However, this result was only significant for households in the lower-density areas of the study. A slightly higher percentage of carsharing members used public transit compared to non-members.

Shaheen, Martin, and Totte (2020) studied how exposure to BEVs and PHEVs through a U.S. carsharing fleet affected sentiment toward electric-powered vehicles. They drew a sample of carsharing members from four carsharing operators and across seven cities in the U.S.: Car2go located in San Diego, Portland, and Austin; DriveNow/ReachNow in San Francisco; Zipcar in Boston and New York City; and eGo

Carshare in Boulder. Car2go and DriveNow/ReachNow operated as one-way carsharing, while Zipcar and eGo CarShare were round-trip carsharing services. In addition, the Car2go fleet in San Diego and the DriveNow/ReachNow fleet in San Francisco included only BEVs, while the other fleets contained a mix of BEVs and conventional vehicles.

Shaheen, Martin, and Totte (2020) study included a sample of carsharing members divided into experimental and control groups. The experimental group included carsharing members exposed to a carsharing BEV. The control group included carsharing users not exposed to a BEV through carsharing. There were two sources of data: vehicle activity data provided by the carsharing operator and surveys (one experimental survey and one control survey). The experimental survey received 1,920 responses (74% completion rate) from the experimental population, and the control survey received 1,742 responses (77% completion rate) from the control population. The sample population was well educated (83% of experimental and 85% of the control group were working towards or had completed a bachelor's degree), majority Caucasian (77%), and majority middle income or higher.

The majority of the experimental group (78%) confirmed exposure to BEVs through carsharing, one-fourth (25%) reported exposure to PHEVs through carsharing, and another on-fourth reported that carsharing was their only exposure to electric vehicles (Shaheen et al. 2020). There were low rates of electric vehicle ownership in both the experimental group (4% owned BEVs and 2% owned PHEV) and the control group (2% owned BEVs and 2% owned PHEVs). However, the experimental and control group comparison showed that a more significant percentage of respondents exposed to PHEVs/BEVs expected their next vehicle purchase to be an electric vehicle (17%) relative to the control group (12%). When asked about purchasing an electric vehicle before using carsharing, these proportions differed: 5% of the experimental group versus 7% of the control group reported interest in purchasing an electric vehicle before carsharing. Moreover, carsharing members with BEV and PHEV exposure were more likely to recommend these vehicles to others. Eighty percent of the experimental group versus 59% of the control group agreed or strongly agreed to recommend that others try driving electric vehicles. Fifty-six percent of the experimental group versus 47% of the control group would recommend that others purchase an electric vehicle. A small percentage of respondents would not recommend electric vehicles, and this response was similar across the experimental and control groups. In addition, researchers found a positive correlation between electric vehicle use and positive sentiments toward electric vehicles in the experimental group. Members who used electric vehicles through carsharing more than once a month had greater positive feelings toward using and purchasing electric vehicles than members who used electric vehicles through carsharing once a month or less.

Martin et al. (2021) studied the effects of a New York City pilot program that increased dedicated on- and off-street parking spaces for ZipCar and Enterprise CarShare vehicles in areas with traditionally low carsharing rates. At the time, both ZipCar and Enterprise CarShare operated round-trip services. The pilot initially included the one-way carsharing operator, ReachNow, but operations in the area ended before the pilot began. As a result, ReachNow member data were included in the analysis of the first retrospective survey only (see discussion below), administered before the program's start—the pilot program allocated up to 300 on-street parking spaces and 300 off-street parking spaces to carsharing vehicles. Upon the pilot's launch, the New York City Department of Transportation distributed 230 on-street parking spaces and 55 off-street parking spaces to ZipCar and Enterprise CarShare across 14 geographically and economically diverse neighborhoods in Manhattan, Brooklyn, Queens, and the Bronx.

Study data included responses from three surveys administered to different user populations and vehicle activity provided by ZipCar and Enterprise CarShare. All three surveys asked questions about user households, vehicle ownership, travel patterns, and demographics. The first survey, which included retrospective questions about members' use of the carsharing service, received 2,700 responses from New York City residents who were carsharing members before the pilot program's launch (Martin et al., 2021). The retrospective survey gathered information on travel behavior trends and car ownership among carsharing members. Respondents to the retrospective survey were majority male (59.9%) and white (57.3%), high income (25% with income $200,000 or more), and highly educated (44.7% with bachelor's and 44.7% with post-graduate degree). The second survey, the "before survey," received 1,051 responses and was administered to new members of ZipCar and Enterprise CarShare after the pilot program's start. The third survey, the "after survey," received 841 responses and concentrated on behavioral changes due to the pilot program.

The results indicated a modest reduction in personal vehicle ownership, VMT, and GHGs. A small percentage of respondents reported avoiding purchasing an additional car (7%), and an even smaller percentage reported getting rid of an owned vehicle due to carsharing (0.61%). The researchers estimated a 7% reduction in VMT and a 6% reduction in GHGs across the membership base. Carsharing in New York City appeared to substitute for other forms of conventional vehicle travel, such as car rentals and personal vehicle use, and gain additional mobility compared to being the primary mode of transportation used. However, some members reported reducing their transit use after carsharing. Members who reduced their use of public transit said doing so because transit routes did not serve the area well enough (30%), carsharing was faster (26%), and carsharing allowed better transport of packages and groceries (15%). Additionally, Martin et al. (2021) note no significant difference in carsharing use between the proximity of the added parking locations to respondents' homes or work.

In sum, the studies reviewed above face challenges related to low response rates, limiting our confidence that responses truly represent the sampled population and rely on stated retrospective surveys rather than observed data. Given this, the above literature review that evaluates U.S. round trip carsharing programs from 2004 to 2021 shows reductions in vehicle miles traveled and associated GHG emissions, decreased vehicle ownership, and a neutral effect on transit.

Table 1. Summary of Studies Evaluating the Effects of Carsharing on VMT and Greenhouse Gas Emissions

Source	Study Location	Sample	Methods	Carsharing Type	Vehicle Type	Vehicle Ownership	Transit Use	Vehicle Emissions
Cervero and Tsai (2004)	San Francisco	n=462 members, n=54 nonmembers (RR 25.5% and 34%)	Before and after surveys with control group.	Round-trip	Conventional	29.1% members vs. 8% non-members shed cars, 67.5% of members vs. 39.2% of non-members forego purchase	NA	Member VMT decreases vs non-member increases; CO_2 falls by 0.75 lb for members and 0.25 lb for non-members
Lane (2005)	Philadelphia	n=262 responses (52% RR)	Member survey and usage data	Round-trip	HEV and conventional	average of 23 private vehicles replaced per Carshare vehicle due to shed vehicle and foregone purchases	Increase in transit use for shed vehicle households, but no change for zero-car households	VMT increased by 29.9 mi for members gaining car access; VMT decreased for members who shed vehicles
Martin and Shaheen (2011)	North America	n=6,281 (10% RR)	Retrospective before and after survey	Round-trip	Mixed	50% decrease in car ownership	NA	-0.58 t GHG to -0.84 per household
Randall (2011)	Buffalo	n=134 (33% RR)	Retrospective member survey	Round-trip	Conventional	4% shed car; 27% delayed purchase; 20% decided not to purchase	Used transit more and used transit to access hub	Reduced gas and VMT

Source	Study Location	Sample	Methods	Carsharing Type	Vehicle Type	Vehicle Ownership	Transit Use	Vehicle Emissions
Martin and Shaheen (2016)	Calgary, San Diego, Seattle, Vancouver, and Washington, D.C.	n=9,497 mode shift; n=6,167 vehicle travel and GHGs	Retrospective before and after survey, and vehicle usage data	One-way free floating	Conventional and BEV in San Diego	2%-5% shed vehicle, 7%-10% forgo purchase	Most reported no significant change	Average household VMT reduced by 6% to 16%; GHGs reduced by 4% to 18%
Clewlow (2016)	San Francisco Bay Area	n=1280 households; n=2719 individuals	2010-2012 California Household Travel Survey	Mixed	NA	1.10 average household vehicles for members vs. 1.37 for non-members	Members made 14.5% of trips by transit vs. 10.3% of non-members	Carsharing members had a daily average VMT less than non-members
Shaheen, Martin, & Totte (2020)	San Diego, Portland, Austin, San Francisco Bay Area, Boston, New York City, Boulder	n=1,920 experimental (74% completion rate), n=1,742 control (77% completion rate)	Survey to experimental group of EV carsharers and control group of non-EV carsharers	One-way	Mixed	PHEVs/BEVs exposure increased interest EV purchases	NA	NA

Table 2. Carsharing Socio-Demographic Attributes

Source	Age	Race/Ethnicity Carsharing	Race/Ethnicity General Population Comparison	Education Level	Annual Income	Average Household Size
Cervero and Tsai (2004)	Median age 36	White (81.2%)	White (49.6%)	NA	Median personal income was $57,000	1.9 persons
Lane (2005)	Mean age 38.5 years	White (89%)	NA	Attended college (99.6%)	Household income between $25,000 and $75,000 (57%)	Lived alone or with a significant other (93%)
Martin and Shaheen (2011)	Mean 36.6 years	NA	NA	Bachelor's degree (80%), graduate degree (40%)	Median household income between $50,000 and $60,000	1.9 persons
Clewlow (2016)	16-20 (1.5%), 21-30 (12.9%), 31-40 (24.6%), 41-50 (25.7), 51-60 (22.0%), 61-70 (9.7%), 71 and older (3.5%)	NA	NA	At least bachelor's degree (83.5% of carshare vs. 69.5% of control)	Middle to high income	NA
Shaheen, Martin, & Totte (2020)	NA	White (77%), Asian (8%), Hispanic/Latino (7%), African American (2%)	White (62%), Asian (5%), Hispanic/Latino (17%), African American (12%)	Completed or working towards a bachelor's degree (84%)	Less than $25,000 (12%), $25,000-$49,999 (23%), $50,000-$74,999 (17%), $75,000-$99,999 (12%-15%), $100,000 or more (24%-28%)	NA

Source	Age	Race/Ethnicity Carsharing	Race/Ethnicity General Population Comparison	Education Level	Annual Income	Average Household Size
Martin et al. (2021): Retro-spective survey	18-24 (3.4%), 25-34 (28.6%), 35-44 (30.4%), 45-54 (18.4%), 55-64 (11.9%), 65-74 (6.0%), 75 and older (1.4%)	White (57.3%), Asian (9.0%), Hispanic or Latino (8.2%), Black or African American (8.5%)	White (31.9%), Asian (14.1%), Hispanic or Latino (29.2%), Black or African American (21.7%)	Bachelor's degree (44.7%), graduate degree (39.3%)	Middle to high income	NA
Martin et al. (2021): Before survey	18-24 (7.6%), 25-34 (38.6%), 35-44 (30.3%), 45-54 (12.9%), 55-64 (5.0%), 65-74 (4.6%), 75 and older (1.0%)	White (49.4%), Asian (10.5%), Hispanic or Latino (16.9%), Black or African American (12.7%)	White (31.9%), Asian (14.1%), Hispanic or Latino (29.2%), Black or African American (21.7%)	Bachelor's degree (39.4%), graduate degree (32.1%)	Middle to high income	NA
Martin et al. (2021): After survey	18-24 (5.0%), 25-34 (35.9%), 35-44 (29.3%), 45-54 (16.3%), 55-64 (8.1%), 65-74 (4.2%), 75 and older (1.3%)	White (51.1%), Asian (9.9%), Hispanic or Latino (16.8%), Black or African American (12.9%)	White (31.9%), Asian (14.1%), Hispanic or Latino (29.2%), Black or African American (21.7%)	Bachelor's degree (40.0%), graduate degree (37.0%)	Middle to high income	NA

Equity

This section reviews the literature that evaluates equity of carsharing service coverage by for-profit carsharing services and examines the effects of carsharing programs with specific equity objectives. The review describes the available evidence about whether for-profit carsharing services a diverse range of populations and the impacts of programs that focus on equity of access for marginalized communities.

Lack of Carsharing in Low-Income Communities of Color

Kim (2015) explored whether carsharing could meet the mobility needs for low-income neighborhoods in New York City (NYC). Kim's study used Zipcar's application programming interface (API) to collect vehicle utilization and location data across NYC neighborhoods. The study queried the API 30 minutes before the beginning of Zipcar's three-hour rental periods to capture an accurate representation of usage patterns. Vehicle rental prices and utilization vary, and thus researchers collected data over eight weekdays, four weeknights, and seven weekends to assess differences. In total, researchers identified 358 parking lots and 1,993 Zipcar vehicles in NYC as using Zipcar's API. The location of most Zipcar vehicles was in Manhattan (59.2%) and Brooklyn (26.7%), followed by Queens (7.9%), and lastly, Bronx (2.7%). The sample of Zipcar vehicles in NYC appears to represent the population, as there were a little over 2,000 vehicles operating in the boroughs in total. The study also used socio-demographic data from the 2007-11 American Community Survey (ASC) and the 2011 Longitudinal Employer-Household Dynamics. Regarding typical usage patterns in NYC, Kim found that members used Zipcar more frequently in densely populated areas and public transportation-rich areas, like Manhattan. Additionally, during weekdays, Zipcar was highly utilized in business districts like lower Manhattan and on weeknights in residential areas, such as the outer boroughs and Hoboken/Jersey City.

Kim (2015) estimates Multiple Linear Regression models to assess Zipcar use patterns across time periods and neighborhoods. Kim identified low-income neighborhoods of interest, referred to as "Environmental Justice Neighborhoods" (EJN), by comparing NYC Housing Authority's (NYCHA) public housing program income limit for 2012 and ACS estimates of median family income and household size. Researchers labeled tracts as EJN if ACS estimates were lower than NYCHA's limit. Out of the 247 census tracts included in the study, researchers identified 66 tracts (26.7%) as EJNs that included 272 Zipcar vehicles, roughly 13% of cars in the sample. Kim found that members used Zipcar vehicles in EJN more during weeknights when rental prices were lower than weekdays and weekends. Additionally, members used vehicles in EJNs more than in non-EJ neighborhoods during weeknights. For example, members' use of Zipcar is above average in Queens (+9.6%) during weeknights and less than average during weekends (-3%). Weekend usage in the Bronx was also below average. Kim specifically linked this difference in usage to an issue of affordability, as rental prices during weeknights were at their lowest and highest during weekends. Overall, Kim argues that rental prices should remain low or subsidized when expanding services to low-income neighborhoods to meet carsharing demand in EJ neighborhoods.

Tyndall (2017) researched the geographic locations of available Car2go vehicles in ten U.S. cities and compared the locations to census tract demographics. The cities included Austin, Columbus, Denver, Miami, Minneapolis, New York City, Portland, San Diego, Washington D.C., and Seattle. Vehicle location data was collected using Car2go's API, and the final data set contained 44,014,696 observations of available vehicles. Additionally, researchers obtained demographic information from the 2013 American Community Survey 5-year estimates for 1,728 census tracts. Using Ordinary Least Squares regression, Tyndall identified which census tract types were associated with high levels of access to Car2go vehicles. The model accounted for confounding factors such as census tract density, geographic size, and other city-specific characteristics. Researchers found an uneven distribution of Car2go vehicles within their "home zone," the geographic range for returning the carsharing vehicles. Instead, they found vehicles clustered in census tracts disproportionately populated by educated, young, employed, and white residents. On average, home zones accounted for 63% of the primary city's population and 16% of the metropolitan population. Across all ten cities included in the study, the most predictive demographic variable of vehicle availability was the percentage of 20 to 34-year-old residents in the census tract, followed by the rate of college completion. Tyndall found a statistically significant positive relationship between the availability of vehicles and the high school and college completion rates. Tyndall found no significant association between income level and vehicle availability. A potential methodological concern is the carsharing vehicle's cluster in the Central Business District, with particular demographic characteristics. Results show that vehicle availability is higher in census tracts disproportionately populated by young, white, educated, and employed residents.

Impacts of Carsharing Focused on Equity

As discussed above, Martin et al. (2021) studied the effects of a New York City pilot program that increased dedicated on-and off-street parking spaces for ZipCar and Enterprise CarShare vehicles in areas with traditionally low rates of carsharing. As described above, there was almost no improvement in the representation of non-white participants, education, and income after the pilot's implementation.

Randall (2011) describes the results of a retrospective survey of Buffalo CarShare members with a response rate of 33%. Two-thirds of members report household incomes of less than $35,000. Members' racial diversity mirrors the neighborhood location of cars: 68% identified as White/Caucasian, 22% Black/African American, and 8% Hispanic. In addition, members represented a relatively balanced mix of young and older users: 28% of members were 50 or older, and 27% were under 30.

Mitra (2021) used data from the 2012 California Household Travel Survey to model the impact of carsharing on low-income households. The results indicated that low-income households are less likely than high-income households to use carsharing; however, when low-income households use carsharing, there is a significant impact on their mobility, particularly when combined with transit.

In sum, we review studies of traditional carsharing services. These programs locate in densely populated neighborhoods with member bases primarily of young, white, upwardly mobile, affluent, educated individuals and households. The literature cited indicates that it may be possible for shared mobility to meet unique transportation challenges and needs of low-income neighborhoods, particularly if rental prices remain low or subsidized (Kim 2015; Shaheen 2020). While several shared mobility pilot programs aim to cater to traditionally underserved communities, limited research exists on how carsharing has effectively advanced transportation equity.

Short History of Carsharing in the U.S.

This section reviews the history of carsharing in the U.S. from 1998. In addition, this section aims to understand lessons learned that can inform funding and implementation of future publicly funded electric carsharing programs.

Overview

Early carsharing efforts in the U.S. were small and community-based, for example, the Dancing Rabbit Vehicle Cooperative in Rutledge (MO). In 1998, the first large-scale carsharing program in the U.S., CarSharing Portland, launched.

From 1998 to 2009 saw the development of numerous non-profit carsharing services dedicated to addressing barriers to access and environmental sustainability in the communities they serviced. Most served major urban areas, for example, City CarShare (San Francisco, CA), PhillyCarshare, IGO (Chicago, IL), and Hourcar (Twin Cities). Some, however, served smaller cities and rural areas, for example, Carsharing Vermont, Ithaca Carshare (NY), Colorado Carshare (Boulder, CO), and Buffalo Carshare. In addition, capital Carshare launched in Albany (NY) in 2013—a bit later than most non-profits.

In the early 2000s, two for-profit carsharing-focused companies emerged. In 2000, Zipcar launched in Boston and Cambridge. Flexcar initially focused on the West coast, acquired CarSharing Portland in 2001. They were the two largest carsharing companies when they merged in 2007. However, both received venture capital funds (AOL CEO Steve Case's Revolution LLC and Benchmark Capital), and Zipcar had yet to make a profit at the time of the merger (Shaheen et al. 2006).

The rental car company, Enterprise, entered the carsharing market in 2005, U-Haul and Hertz followed in 2007, and Avis in 2011 with its acquisition of Zipcar. In 2011, Enterprise acquired the for-profit Mint carsharing service, PhillyCarShare, and IGO. Meanwhile, Zipcar/Avis acquired Community Carshare (Madison, WI) and Buffalo Carshare in 2015. A review of publicly available location data since the acquisition of these non-profit services by Enterprise and Avis indicates that significant service cutbacks occurred in less profitable low-income communities of color. In contrast, service consolidated in profitable markets typically in dense high-income areas with high-quality transit and on or near college campuses. Published studies by Kim (2015), Tyndall (2017), Mitra (2021), and Kodransky and Lewenstein (2014) confirm these observations.

The peer-to-peer carsharing model launched in 2011 with Getaround has grown rapidly since then. This model allows car owners to rent their vehicles to others. The operator facilitates rentals through mobile phone apps and websites. Today, the two largest peer-to-peer carsharing services are Getaround and Turo (which provides only daylong or multi-day rentals). Since the pandemic, both companies have rebounded and are pursuing listings as public companies as of fall 2021 (Alamalhodaei 2021; Hu 2021).

The emergence of ridesharing and the prospect of driverless cars fueled speculation that new technology could make both car ownership and drivers obsolete. In the 2010s, automakers began experimenting with carsharing led by Daimler's Car2Go, which entered the U.S. market in Austin in 2010. Car2go, once considered the largest carsharing network globally, operates in nine countries and nearly 30 cities (Martin and Shaheen 2016). Four years later, GM's Maven and BMW's ReachNow launched in 2016. Car2Go and ReachNow merged in 2019 as ShareNow. Maven and ShareNow shut down their carsharing services in 2020 before the pandemic due to difficulties operating in the North

American market, such as a lack of infrastructure to support electric vehicles. However, ShareNow continues to operate successfully throughout Europe. Hyundai, the most recent automaker to enter the space, launched a 100-vehicle carsharing service called Mocean in Los Angeles in 2020 that shut down just over one year later at the end of 2021.

More recently, federal, state, and local agencies have begun funding and supporting pilots that address climate change by implementing electric carsharing and EVSE (electric vehicle service equipment) and locating these services in underserved communities at an affordable cost. The latter funding programs address the concern that carsharing and other shared mobility services have largely left low-income communities of color behind, as well as the concern that EV incentives have primarily benefited affluent households. BEV carsharing may increase affordable mobility without increasing GHG emissions and, perhaps, even reduce GHGs by substituting for conventional vehicle travel. Another potential benefit is that exposure to BEV vehicles and the availability of infrastructure may encourage a more rapid uptake of BEVs as personal vehicles.

California uses cap-and-trade Climate Investment funds to develop BEV carsharing in affordable housing communities in Sacramento (Our Community CarShare) and rural areas of Tulare and Kern counties in the Central Valley (Míocar), and one-way carsharing in Los Angeles (BlueLA). New pilots are launching in the Bay Area and Stockton (Míocar expansion). Furthermore, cap-and-trade funds distributed through the 2020 Clean Mobility Options program have also found their way into two indigenous communities (Twenty-Nine Palms Band of Mission Indians and the Cahuilla Band of Indians).

California also permitted Volkswagen (VW) to use a share of settlement funds from the “dieselgate”[1] scandal to support BEV carsharing in Sacramento: $44 million funded BEV point-to-point carsharing in the central city area of Sacramento (GIG carsharing owned by AAA) and BEV carsharing as a housing amenity (Envoy Technologies) in underserved areas[2] of the city. In addition, part of the $44 million also went to fund ten direct-current fast chargers (Electrify America 2018).

New York and Massachusetts have funded programs similar to California’s Clean Mobility programs, albeit at a smaller scale. The Federal Department of Energy has also funded BEV carsharing programs in Portland (Hacienda), rural Oregon (CRuSe), and the Twin Cities’ Evie expansion of HourCar. In addition, the federal government invested CARES Act funds in Colorado to fund BEV carsharing in underserved communities.

The new wave of support for carsharing to reduce GHG emissions and support mobility in underserved communities raises interest in the scale and sustainability of non-profit carsharing in the past and present. Next, we describe the size and years of non-profit carsharing and discuss their plans for expansion with new funding opportunities. Many of these non-profit programs had social and environmental goals.

[1] The VW “dieselgate” began when VW made the decision to use illegal “defeat device” software to bypass emissions control equipment in order to create the appearance that its cars met California and U.S. health-based air quality standards.
[2] As classified by the State of California CalEnviroscreen 3.0

Non-Profit Carsharing

As discussed above, several carsharing organizations began as non-profits. For-profit companies then acquired them. The San Francisco non-profit, City Carshare, one of the first shared mobility options in the Bay Area, launched in 2001. In 2016, City CarShare reached a deal with Getaround, the peer-to-peer car rental platform, to take over the non-profit's parking spaces, fleet, and member base. At the time of acquisition, CityCarshare had approximately 20,000 active members and a 200-vehicle fleet (Creely 2016). Records indicate that City Carshare may have peaked at about 340 vehicles in 2011 (Siu 2016). According to the San Francisco Chronicle, City CarShare faced fundraising challenges and heavy competition from venture-backed rivals, which ultimately led to partnering with Getaround (Said 2016). See Table 3 for a comparison of non-profit carsharing programs in the U.S.

Enterprise acquired several non-profit carsharing services in major urban areas. Enterprise Holdings purchased PhillyCarShare (located in Philadelphia, Pennsylvania, and Wilmington, Delaware) in 2011. PhillyCarShare operated as a non-profit beginning in 2002. The parent company rebranded Enterprise carsharing as Enterprise CarShare in 2013 (Fisher 2013). Before the acquisition, PhillyCarShare had a 400-vehicle fleet at its peak in 2009 (Fernandez 2011). At the acquisition time, Philly CarShare had over 13,000 members (Enterprise Holdings 2011). Reports indicate that the acquisition of Philly CarShare resulted from a debt of $2.7 million in back taxes and penalties (Fernandez 2011). Next, Enterprise CarShare purchased IGO CarSharing in Chicago, Illinois, and AutoShare in Toronto, Canada, in 2014 (CNT; Keenan 2014). In 2013, IGO's had 250 vehicles and 15,000 members (Wernau 2013). At the time, these non-profits indicated that for-profit companies might be better positioned to expand services and increase awareness of carsharing (Said 2016; CNT).

The Buffalo CarShare program operated from 2009 to 2015 in Buffalo, New York (Gottlieb 2015; Drury 2015). During its operation, members completed roughly 35,000 trips using this service. According to a 2015 article, half of its active members were people of color with a household income of less than $25,000 per year. By the end of its operations in 2015, Buffalo CarShare had 900 registered members sharing a fleet of 19 vehicles. Unfortunately, the high cost of insurance coverage in New York ended its non-profit operations, and Avis/Zipcar acquired the non-profit (Randall 2011).

Capital Carshare launched in Albany, NY, in 2014. This carshare program received funding from the Capital District Transportation Committee and a Community Loan Fund. Unfortunately, several accidents resulted in an increase in insurance premiums, which was unsustainable at the scale of an eight-car program and was one factor that led the carsharing service to end all operations at the end of 2020 (Karlin 2020). During the six years of operation, Capital Carshare's fleet fluctuated between 6 to 10 vehicles, including conventional and electric vehicles.

Ultimately, three non-profit carsharing services continue to serve their local communities today. Hourcar, in the Twin Cities, launched in 2005, and Ithaca Carshare and Carsharing Vermont launched in 2008. However, member revenues sustained IGO, City CarShare, and Buffalo CarShare for several years. PhillyCarShare received a significant grant that supported the operations, and thus, it is unclear to what degree revenues sustained their operations.

Since 2005, Hourcar has operated its round-trip service and includes over 50 conventional and HEVs. The program launched in the Twin Cities and expanded to Rochester, Minnesota, in late 2019 (Baker

2019). Currently, the service has 42 locations along Interstate-94 and near Minneapolis and St. Louis (Melo 2021).

Formally known as eGo, Colorado Carshare has roots in the Little Red Car Co-Op, launched in 1997. Co-op members would physically transfer the vehicle keys and share one vehicle in North Boulder, Colorado (Tidd 2013). Federal funding has enabled Colorado Carshare to expand operations. In 2009, Colorado Carshare received a Congestion Mitigation and Air Quality (CMAQ) grant to expand from three to thirty carsharing sites in Denver. Another CMAQ grant allowed Colorado Carshare to expand carsharing sites to nearby B-cycle (bikeshare) sites for first and last-mile transit access in Denver and Boulder (Colorado Carshare 2021). Today Colorado Carshare operates as a non-profit carsharing program in both Denver (30 sites) and Boulder (24 sites) with more than 50 vehicles in their fleet, which includes conventional, BEV, HEV, and all-wheel drive vehicles (Colorado Carshare 2021). It also provides discounted rates for low-income members. According to tax documents comparing revenue in 2017 to 2014, Colorado Carshare's revenue declined in 2017 compared to 2014 levels when revenue peaked. Ride-hailing may have impacted revenues (Bosselman 2019). In 2020, Colorado Carshare used Federal CARES Act funds to expand BEV carsharing in underserved communities in six new sites (DOCA 2021).

In 2006, Ithaca Carshare obtained funding from the New York State Department of Transportation and the New York State Energy Research and Development Authority (NYSERDA). Ithaca Carshare launched later in 2008 with six hatchback vehicles. It operates in downtown Ithaca, Collegetown, Fall Creek, Northside, and the West End. The current fleet includes 29 vehicles, two of which are BEVs, and serves over 6,000 members (Ithaca Carshare Member Handbook 2021). Ithaca Carshare operates under an umbrella organization known as the Center for Community Transportation (CCT). The CCT also includes Bike Walk Thompkins and Backup Ride Home. Bike Walk Thompkins facilitates the Lime Bikeshare program and conducts outreach and education to promote active transportation. The Back-Up Ride Home guarantees anyone who commutes to work by carpool, transit, walking, or biking a convenient way to leave work due to unexpected events.

Carshare Vermont launched at the end of 2008 with an eight-vehicle fleet in the Burlington, Vermont area (Bourdon 2011). Today the program has a 21-vehicle fleet, including four electric vehicles (CarShare Vermont 2021). In 2020 Carshare Vermont, played an active role in guiding the City of Burlington to eliminate parking minimums (Carshare Vermont 2020). In 2020, Carshare Vermont launched an electric vehicle pilot program (Carshare Vermont 2021). In 2021, Carshare Vermont received a $100,000 grant from the Vermont Agency of Transportation to develop an electric vehicle supply equipment (EVSE) network at affordable housing developments within the City of Burlington (VTrans 2021).

New Wave of Public Funding

UC Davis researchers reviewed 12 projects supported by the new wave of carsharing programs, which included the use of electric vehicles and/or low-cost services in underserved communities. We categorized these programs and described their progress.

Public or Community-Controlled Programs: The first category of projects includes four public programs initiated and supported by cities, counties, or metropolitan regions with the explicit intention of providing an enduring public service. Most of these programs range in scale from large (Los Angeles at 100 current and 300 planned electric vehicles), to moderate (San Joaquin at 27 current and 95 planned electric vehicles and Twin Cities at 150 planned electric vehicles), and to small scale (Sacramento at 22 electric vehicles). All four programs have recently launched and/or are expanding operations. The Los Angeles and Sacramento programs have relationships with vendors that own the electric vehicles and operate the carsharing service. Míocar and Hourcar are non-profits that own electric vehicles and operate their carsharing service in-house. All programs address issues of affordability with below-market-rate pricing. Carsharing services are almost exclusively located in underserved communities and often with affordable house developments. The programs are funded mainly through public investments. The California Air Resources Board (CARB) and the U.S. Department of Energy (DOE) are the two largest investors in these models. As an exception, the BlueLA program in Los Angeles secured significant private funding commitments in both the program's first and second phases.

Public-Private Demonstrations: This includes pilots/demonstrations with public funding. These programs receive funds from a public agency to test specific goals and typically originate from a pre-existing public-private partnership formed before the investment of public funding. Private carsharing companies manage the program's operations with varying degrees of public oversight. As a result, the long-term investment is less in the pilot/demonstration compared to a public partner. Three of the four projects in this category have ended. The Sacramento Envoy project, with GHGs and equity goals, is still ongoing but reduced its BEV feet by two-thirds (from 142 Electric vehicles to 48 electric vehicles). The scale of two of these projects (San Diego Car2GO and BlueIndy) was significant (300 electric vehicles and 282 electric vehicles, respectively). GHG reductions were the goal of both programs. With GHG and transit accessibility goals, the Chattanooga program included 20 electric vehicles and operated for three years before.

Private Ventures and Non-profit Demonstrations: The third category includes privately led public-private partnerships and non-profit demonstrations with a clear end date. Privately administered and sponsored, these projects may receive grant money and/or public space. However, outside of their grants and public space agreements, these programs are independent of public oversight. Two of the four projects included in this category have ceased operations (Portland's Hacienda and Los Angeles' Hyundai Mocean). The other two are currently operational (Sacramento's GIG and CRuSe in Hood River, Oregon). The Oregon programs are small (3-5) pilots to test GHG and equity goals. Mocean included 100 electric vehicles and focused on increased accessibility. GIG operates 260 electric vehicles in a 13 square mile of central Sacramento. Its objectives are GHG reductions and improved accessibility.

Lessons Learned

Lesson Learned #1: Carsharing, especially with electric vehicles, is likely to reduce GHG emissions.

The academic literature review that evaluates U.S. carsharing programs from 2004 to 2021 shows reductions in vehicle miles traveled and associated GHG emissions, especially for round-trip carsharing, based on self-reported pre-and post-carsharing surveys. The evaluations also suggest that carsharing members often decreased vehicle ownership and forwent the purchase of an additional vehicle. Furthermore, the studies indicate that round-trip carsharing does not reduce transit use. In some cases, it increases, often serving to complement trip types and destinations that are more challenging to serve with fixed-route transit. The use of electric carsharing would tend to further increase GHG reduction benefits compared to conventional vehicle carsharing.

Lesson Learned #2: Private carsharing services are likely to limit service to urban areas with high demand where residents can pay the market rate fares.

Our review of the evolution of carsharing services in the U.S, not surprisingly, shows that commercial carsharing services locate their services where they can make a reasonable profit for their efforts. Such locations have high usage rates by members who can afford profit-making fares. Private sector companies, whose sole business was carsharing (such as Mint and the original Zipcar), were acquired by rental car companies. In the U.S. today, non-peer-to-peer carsharing is primarily operated by rental car companies, and carsharing is part of a diversified business model.

Our literature review shows that private sector carsharing tends to be in major metropolitan urban areas with high-quality transit and in neighborhoods where residents are affluent (median to high incomes), highly educated, young, and white. In addition, reviews of the publicly available location data since the Enterprise and Avis acquisitions indicate significant service cutbacks occurred in less profitable low-income communities. In contrast, service consolidated in profitable markets, typically in dense high-income areas with high-quality transit and on or near college campuses. Moreover, published studies by Kim (2015), Tyndall (2017), Mitra (2021), and Kodransky and Lewenstein (2014) confirm that the geographic distribution of services and service costs have been key barriers to accessing carsharing among marginalized populations.

Lesson Learned #3: In the short term, most private sector carsharing will likely continue to use conventional or hybrid vehicles.

There is no example of a commercially successful electric carsharing program to date because of the lack of developed and consistently reliable electric vehicles and infrastructure (e.g., the 2021 Chevy Bolt recall). Three automakers, Daimler, GM, and BMW, launched major carsharing initiatives in the U.S., including some electric vehicle fleets, and, in 2020, each shut down operations nationwide. Where these operators piloted electric carsharing, such as the Car2go (Daimler) program in San Diego, these electric vehicle-dependent markets were some of the first to close due, in part, due to challenges with electric vehicles and infrastructure. Hyundai, the most recent automaker trying to make a go of carsharing services in Los Angeles, announced in fall 2021 that it would end services by the end of the year before even bringing electric vehicles into their fleet mix. The exception is GIG carsharing, funded by AAA, which uses electric vehicles in Sacramento. However, the grant subsidized financed the electric vehicles and infrastructure. Until electric vehicles become competitive with hybrid sedans and charging infrastructure becomes more widespread, subsidies for electric vehicles and charging infrastructure for carsharing services are critical to soften operational risks. As such, cities will be challenged to attract these larger private sector partners to small-scale pilots in disadvantaged communities that lack this infrastructure and are often not proximal to their preferred market. In other words, the combination of EVs with the prioritization of low-income communities presents a barrier to entry for a retrenched private sector in this industry.

Lesson Learned #4: Non-profit carsharing continues to be feasible in the U.S. and maybe one approach to expanding service beyond the service boundaries of private sector carsharing.

This study also suggests that sustainable local non-profit carsharing programs that address environmental and social goals in their community are possible inside and outside of major urban areas. For many years, non-profit carsharing operated at a large-scale in major metropolitan areas (e.g., San Francisco Bay Area, Chicago, and Philadelphia). However, the emergence of ride-hailing companies in 2010 and the dominance of for-profit carsharing services run by rental car companies from 2010 to 2012 preceded the decline in non-profit carsharing. In addition, rental companies also acquired many non-profit carsharing services. Nevertheless, four long-established non-profit carsharing programs continue to provide services in large and small urban areas and are largely self-sustaining. Two of these programs, Ithaca Carshare and Carshare Vermont, were interviewed as part of this study and reported that 1% to 20% of non-profit carsharing revenue typically comes from private or government contracts. In addition, service can expand with an infusion of public funds (e.g., in Colorado and the Twin Cities).

Lesson Learned #5: In recent years, public or community-controlled electric vehicle carsharing projects show progress towards effectively increasing equity of access in marginalized populations, as measured by these programs' ability to sustain operations. More evaluation of costs, benefits, and designs that incorporate lessons learned from evaluations.

Electric vehicle carsharing is a promising policy and infrastructure option to reduce vehicle travel and GHGs and improve equity of access. These services act as incentives for changing behavior, which is necessary where few alternatives to personal vehicles are available. Subsidized electric carsharing programs may provide an affordable option to high-quality transit that is costly to provide in rural and suburban areas. Pricing policies are very effective at inducing behavioral change. Still, they are likely to face extreme pushback from constituents who must travel long distances to access affordable housing and employment in suburban and rural areas. Electric carsharing may increase exposure to electric vehicles in rural areas, translating to acceptance and increasing the likelihood of electric vehicle purchases, at least among those who can afford to do so.

On the other hand, researchers know little about what these new wave projects will cost at scale and their actual benefits. It is critical to conduct peer-reviewed evaluations of these programs to verify and quantify the magnitude of benefits. Many of these programs use different business models and locate in different geographic contexts. Lessons learned from these programs should be documented over time as projects grow, evolve, and mature. Funding programs should reserve at least ten percent of project costs for research evaluation at this emergent stage. Evaluations need to move beyond usage data and integrate surveys (with reasonable response rates) and focus groups. This data is necessary to understand and document changes in travel behavior, GHG emissions, and access to opportunities for marginalized populations. Currently, ongoing funding mechanisms for these electric carsharing programs are uncertain. Peer-reviewed evaluations are necessary to justify the development of a funding mechanism to support these programs. Notably, CARB has increased its funding for evaluation, but more support is needed.

Electric Carsharing Pilot

Introduction

This section discusses the development and implementation of the Míocar electric carsharing service in the Southern San Joaquin Valley. Following this discussion, critical lessons learned from this process are summarized.

Background

The San Joaquin Valley (Valley) is California's most productive agricultural region and one of the most in the U.S. However, the Valley also has some of the worst air quality in the nation and high rates of childhood asthma. California has classified most of the census tracts in the Valley as some of the most economically and environmentally disadvantaged in the State.

In California, legislation (Senate Bill 375) requires metropolitan planning organizations (MPOs) to develop land use and transportation plans (or Sustainable Community Strategies) to reduce GHG emissions from passenger vehicle travel. Initially, the Valley MPOs expressed concern about creating regional community plans with measures typically applied in major urban areas, for example, transit-oriented development and expanded fixed-route transit. In addition, the MPOs were skeptical about the effectiveness of these measures, given the large share of the Valley's population that resides in rural and very low-density areas. As a result, in 2014, the California Department of Transportation funded a study to examine new technology alternatives to transit in rural communities that might better meet mobility gaps and reduce emissions.

In partnership with Caltrans, eight San Joaquin Valley MPOs, and Sigala Inc. (a local planning firm), researchers at UC Davis identified shared-use alternatives in rural disadvantaged communities that might reduce transit costs, increase access, and reduce GHGs. Researchers quantified the quality and price of transit services relative to shared-use options. They worked to gain regional consensus on the most promising shared-use mobility concepts and pilot locations. Researchers implemented surveys and focus groups exploring the need and interest for pilot services and undertook extensive stakeholder outreach to understand study-related concerns, goals, and analyses.

Community Engagement

UC Davis researchers met Self-Help Enterprises early on in the stakeholder outreach process. Self-Help Enterprises is one of the largest affordable housing developers in the San Joaquin Valley and has over 50 years of experience conducting engagement with low-income families to build and sustain healthy communities. Self-Help expressed strong interest in bringing electric carsharing to low-income residents in their multi-family housing complexes. To help determine the viability of such a service, Self-Help Enterprises helped researchers implement surveys to all their residents that explored unmet travel needs and willingness to use new shared mobility options, including carsharing to meet those needs. They also help recruit participants for focus groups at each proposed pilot site area. These participants included some Self-Help residents but also residents from the larger community. The result of these engagement efforts indicated support for the service among residents and community members.

These efforts resulted in the identification, development, and launch of three mobility pilot programs, which would serve the highly disadvantaged San Joaquin Valley areas that contend with low inter-city transit access and low levels of vehicle availability. At the end of the feasibility study, project partners expanded to include Self-Help (site hosts and engagement) and technology advisors (Shared-Use Mobility Center and later Mobility Development), in addition to UC Davis, MPOs, transit agencies, and Sigala Inc. Together, these partners worked together to develop a Clean Mobility Options proposal that would be funded by the California Air Resources Board (CARB). The San Joaquin Valley Air Pollution Control District agreed to serve as lead on the proposal because it included two other shared mobility projects in the northern San Joaquin Valley.

Project partners worked closely with Self-Help Enterprises community development team to work with the community to inform the design of the implemented pilots. This included organizing community advisory boards in both Kern and Tulare Counties and holding focus groups in the communities with the electric carsharing service. These two engagement efforts resulted in the naming of the service “Míocar,” agreement on fare levels, and identifying the need to include larger vehicles in the pilot (we ultimately included three Chrysler Pacificas in the fleet). These also guided Self-Help engagement, education, and training activities during the ramp-up of the pilot. Community participants were compensated for their time to advise partners on this project.

The community education and capacity building by Self-Help during the pilot ramp-up period and before the COVID-19 pandemic were critical to the adoption of Míocar. Electric vehicles are new to most Míocar members. For many community members, Míocar use was their first experience driving an electric vehicle. Self-Help provided training and technical assistance and created a safe space to ask questions and become familiar with new technologies. They presented information that was easy to understand in the appropriate language. Self-Help also developed partnerships with local community-based organizations, which are trusted by the community. These included schools, clinics, cities, and counties. Local partners shared Míocar information with parents, clients, and residents. Partners also became members and used the service.

Start-Up Operations

Project partners had initially planned to secure a private operator through a request for proposal (RFP) process. We offered approximately $20,000 per car in subsidies (plus significant in-kind) for a two-year, 24 electric car program.[3] However, we only received one proposal, and it was not responsive to our RFP. This lack of response suggests that expected profits in rural low-income communities were not sufficient for commercial carsharing operators.

As a result, project partners worked to develop an alternative operational model that focused on long-term sustainability through the inclusion of a trusted local transportation provider and retaining as much vehicle capital as possible after the end of the pilot period. Partners recruited California Vanpool authority (or Calvans) to manage the fleet, including insurance, maintenance, equipping vehicles with carsharing telematics, and cleaning. CalVans owned over 1,000 vans and operated farmworkers and other employment vanpools throughout the SJV and in other California counties. In addition, we recruited our shared mobility advisory, Mobility Development, to run the carsharing operations, which included managing applications, reservations, payments, members, and, in general, responding to operational problems. Mobility Development operated a non-profit carsharing program that served low-income households in Buffalo and Albany, New York (see description of these programs above). However, this process was not easy.

As a small carsharing organization, partners faced challenges securing software, hardware, and insurance because of vendors' focus on more profitable relationships with larger companies and automobile manufacturers. In the end, Mobility Development was able to secure, at a reasonable price, a carsharing platform from Good Travel Software based in Dublin, Ireland, and carsharing telematics from Inverse based in Germany.

CalVans was also able to secure affordable carsharing insurance for ramp-up operations from April 2019 to March 2020. At the end of that period, CalVan shut down Míocar fleet operations because of challenges securing affordable insurance and addressing public health concerns with the service related to COVID-19. Meanwhile, to address the issue of a "long-term home" for Míocar after the end of the pilot period, project partners applied for a 501(c)(3) nonprofit (doing business as Míocar) in early 2020. The cost of renewing carsharing insurance through CalVans insurance in March of 2020 was prohibitive because the carsharing fleet has to be insured under the vanpool entity with a Symbol 1 requirement, which requires their entire fleet to be considered. As a non-profit carsharing organization, Míocar was able to secure insurance at 25% of the price quoted to CalVans by several carriers. CalVans then transferred ownership of the vehicles to Míocar, and the pilot resumed operations at the end of July 2020; however, many vehicles in the fleet needed repairs due to non-use when in storage. In addition, Míocar implemented COVID-19 protocols for the use of the Míocar service by members. Since the service reopened, demand for Míocar service has ebbed and flowed with COVID-19 shutdowns and surges (see more discussion below).

Most of the vehicles purchased for Míocar were used and driver for less than 30,000 miles to save money on the capital cost of the service. However, we found that if the vehicles came in from out of

[3] At this time the project scope included 24 cars, the California Air Resources Board allowed us to include three more Chrysler Pacificas after input from community partners as described above.

state, registration and delivery times were long. As Míocar expands in the near future they plan to buy new vehicles in bulk to obtain a lower cost.

In July 2021, 17 of the 27 Míocar vehicles were impacted by the Chevy Bolt recall. Chevy struggled to address the problems of the recalled vehicles, and thus Míocar could only offer limited access to the fleet through December 2021. However, Míocar anticipates that their fleet will be fully operational by the end of March of 2022.

Electric Vehicle Infrastructure

This section describes the particular experience of installation of electric vehicle supply equipment (EVSE) for the Míocar pilot. At the time of installation in the summer and fall of 2019 and though winter of 2020, project partners realized the involvement of the area utility involvement would push our EVSE installation time out by about 9 to 12 months. As a result, we needed sites that did not involve the utility for make-ready installations. Self-Help had many complexes in the pilot areas, many were new and ready for EVSE. This flexibility to move locations was essential to avoid EVSE delays and to meet our grantee's timelines. In general, however, this means that it is cheaper and faster to install EVSE in locations that are new and usually farther from the city center and thus less accessible and visible to the larger community.

At the time of EVSE installation for the pilot, the utility that services the pilot areas offers generous subsidies. However, its minimum for funding applications is 10 consecutive dedicated parking spaces per site. The number of required parking spaces per site effectively eliminates the smaller affordable housing developments (40-60 units) that are most common in rural areas. This policy also undermines the success of carsharing services scaled to accommodate fewer vehicles placed at multiple strategic locations to reduce barriers to access.

Loans secured for affordable housing built before EVSE building codes typically require separate meters to account for carsharing vs. community electricity use. Separate meters can more than double installation costs. Submetering technology available for such accounting at a much lower cost. During the period of EVSE pilot installation, the California Public Utilities Commission (CPUC) was still testing the accuracy of submetering and did not allow is use for utility billing purposes.

Lessons Learned

Lesson Learned #6: Community engagement is essential to developing an electric vehicle carsharing program that is wanted and needed by a community and to shape the program to meet the needs of the community. Community engagement should be conducted early and often throughout the development, implementation, and roll-out of a carsharing pilot.

Lesson Learned #7: Government agencies should consider reducing the barriers and costs for electric carsharing services in marginalized communities that may need to develop their own service through partnerships or as a non-profit, like Míocar. Government agencies should consider reducing the barriers and costs for these programs.

First, securing high-quality software for small carsharing operators is challenging. The public sector should consider the development of an open-source software platform, perhaps in collaboration with the University of California, that could be used by community carsharing providers across the U.S.

Second, the public sector should consider developing bulk vehicle and telematics purchasing agreements for multiple grantees or small operators to secure lower prices secured by commercial operators.

Third, affordable carsharing insurance is available for non-profit carsharing services in California. However, state and federal agencies may want to consider developing a self-insurance mechanism for carsharing to ensure stable and affordable insurance products.

Lesson Learned #8: Electric carsharing can be a valuable anchor client in areas where there are few electric vehicles. EVSE incentives, however, need to focus on the quality (i.e., well-distributed rather than clustered in one community location) rather than the number of stations in order to attract sufficient carsharing members that use the charging stations. This may increase short-term costs but could reduce long-term costs and promote great use of electric vehicles.

Lessons Learned #9: The CPUC may want to consider partnering with affordable housing developers who are installing EVSE for carsharing as part of public grants to test submetering technology and fast-track these technologies used for billing purposes. The result could be significantly reduced cost due to avoided separate meter installations.

Evaluation of Míocar

In this section, we describe the evaluation methods and results for Míocar.

Methods of Data Collection and Analysis

Evaluation of the Míocar pilot involved collecting a wide range of data from multiple sources that researchers categorize as Member Data, Utilization Data, and Survey Data. This section defines these data sources, describes the format and frequency of data collection and summarizes the metrics associated with each source for program evaluation.

Members provide member data to the service operator(s) as part of the application or enrollment process. Míocar collected member data continually as each member enrolled in the service and provided an export of member data to UC Davis every month. The member dataset provided to UC Davis for research evaluation purposes included metrics such as:

- Member ID
- Date of birth
- Gender
- Address census block
- Member status (e.g., active, inactive)
- Contact information (e.g., telephone/email address)

Míocar converted addresses to census blocks before analysis, allowing for the calculation of metrics such as members by census block, distance to the closest Míocar hub, and distance to other hubs and major cities.

Utilization Data (Application/Platform Data)

Míocar collects Utilization Data about individual EV reservations and trips and continually collects utilization data as members reserve and use carsharing vehicles. Míocar equips its vehicles with telematics software that allows for GPS tracking and on-board recording of vehicle usage (or "Utilization Data"). Thus, the program collects time and distance data for each Míocar vehicle, reservation, and member. Míocar provided an export of utilization data to UC Davis monthly. The information recorded and stored during each Míocar reservation includes:

- Member ID,
- Date and time of reservation start and end,
- Date and time of vehicle pick-up and drop-off,
- Duration of reservation (hours),
- Duration of travel (hours during which vehicle was moving), and
- Total miles traveled during the reservation.

The data also contain information about each vehicle, including year, make, model, and hub.

Survey Data

Survey data is self-reported data collected by surveying users before, during, and after participating in the service. UC Davis researchers administered a survey to members after they joined Míocar (i.e., a "Before Survey") to ask about their planned service use and demographic attributes. Míocar sent out survey invitations to the program members, who completed surveys online through Qualtrics. As an incentive to complete the survey, responding members received five hours of Míocar driving credits for their next reservation. Before surveys collected the following information:

- Member ID,
- Information about member's vehicle(s) (i.e., number of vehicles available to their household and each vehicle's year, make, model, and estimated annual miles driven),
- Composition of member's household (i.e., population, number of adults, and relationship to other household members),
- Member's reason for joining the service,
- Member's expected use of the service (i.e., whether it will allow them to make more trips, expected types of trips, and what mode they will use to access the Míocar hubs),
- How the member first heard about the program,
- Member's level of education, and
- Household income.

Míocar asked members to complete these surveys after enrollment and before using the service. However, many members who did not initially respond later completed the Before survey after using the Míocar service.

To capture information related to individual Míocar reservations, UC Davis developed a survey to be completed after a reservation (i.e., a "Post-Reservation Survey"). Míocar sent invitations for these surveys by email to members who had completed a reservation within the previous week. As an incentive to complete the survey, Míocar rewarded responding members with one hour of Míocar driving credit for their next reservation. Members completed post-reservation surveys online through Qualtrics and collected the following information:

- Member ID,
- Purpose of reservation,
- Number of passengers in Míocar vehicle,
- Mode of travel to pick up Míocar vehicle,
- Counterfactual travel options (i.e., would travel have occurred without the Míocar service, and if so, with what mode), and
- Vehicle cleanliness rating and comments about the service.

Though the post-reservation survey does not ask members to indicate which Míocar reservation they are referencing for their responses, the survey instructs respondents to provide information about their *most recent* reservation when they complete the survey. As a result, each post-reservation survey completed by an individual member should refer to a separate Míocar reservation, which can be determined by reviewing the Míocar utilization data associated with that member.

All survey respondents were active members who had used the carsharing service and therefore had vehicle usage data associated with the Míocar. An anonymous identifier linked all users and survey data to the vehicle usage data, allowing for analysis that integrates all data sets at the individual member level. In addition, UC Davis researchers offered surveys in both English and Spanish to accommodate the participant population.

Researchers linked Survey Data, Member Data, and Utilization Data to assess the overall performance of Míocar and develop key findings for the study period.

Before Survey

The member survey response rate, calculated as the ratio of people who completed Before Surveys to the total number of members in the program, was 26% (101/394). User members completed 78 Before Surveys. There were 149 user members of Míocar during the study period, so the response rate in terms of user members was 52% (78/149). Researchers conducted 2-sample t-tests to test whether the group of user members who filled out the Before Survey (N1) differed significantly group of user members who did not fill out the Before Survey (N2) with data available for all users. This data included driving distance from the home to the nearest Míocar and the nearest major city and median, frequency of Míocar use, and median reserved hours, actual duration, and distance for reservations. As shown in Table 3, there are no significant differences between the two groups for these measures.

Table 3. T-Tests Results for Users who Did (N1) and Did Not (N2) Complete the Before Survey

Variable	N1	N2	t-statistic	p-value
Driving Distance to Nearest Míocar (miles)	75	67	-1.038	0.303
Driving Distance to Nearest Major City (miles)	75	67	-0.991	0.325
Frequency of Use for Reserved Hours/Membership Duration[4]	78	71	0.243	0.808
Frequency of Use for Reserved Hours/Active Days[5]	78	71	-1.686	0.095
Median Reserved Hours	78	71	-1.035	0.303
Median Trip Hours	78	71	-0.919	0.36
Median Distance	78	71	0.463	0.644

Post-Reservation Survey

UC Davis researchers administered the post-reservation survey from August 2019 through November 2021. In total, researchers collected 881 responses to this survey from 72 unique Míocar users. The total number of Míocar reservations during the study period is 1,971, made by 149 individual users. Therefore, the response rate for all trips is 44.7% (881/1971), and the proportion of users who responded to the reservation survey is 48.3% (72/149).

Using the time of survey completion and information provided by respondents about their trips, UC Davis researchers linked responses to the Post-Reservation Survey with Míocar utilization data to match survey responses to individual Míocar reservations. In some cases, researchers could not confidently match a survey response to a specific Míocar trip due to users taking multiple trips in a short period or completing multiple Post-Reservation Surveys at once. However, researchers could link 744 of the 881 Post-Reservation Survey responses to an individual Míocar reservation.

Researchers conducted t-tests to identify significant differences between observed reservation attributes linked to a Post-Reservation Survey and reservations not linked to a Post-Reservation Survey for all users and for all users who filled out the Post-Reservation Survey. The observed reservation attributes included reserved hours, actual hours, and VMT, as shown in Table 2. Reserved hours refer to the number of hours that members had vehicles reserved. In contrast, trip hours refer to the time between members entering a vehicle and returning a vehicle at the end of their reservation. The t-test

[4] Membership duration = Number of days from joined date to April 30, 2021

[5] Active days = Last reservation date – First reservation date + 1

assessed these metrics and evaluated their distribution for linked and non-linked reservations. The results show that for all user members, there are no significant differences (at the 0.05 level) between reservations linked to a Post-Reservation Survey and reservations not linked to a post reservation survey. Similarly,

Tables 4 and 5 show that for all users who filled out the Post-Reservation survey, there are no significant differences (at the 0.05 level) between reservations linked to a Post-Reservation Survey and reservations not linked to a post reservation survey.

Table 4. T-Tests Results for Reservations Linked (N1) and Not Linked (N2) to Post-Reservation Survey Responses for *All Users*

VARIABLE	N1 (RESERVATIONS LINKED TO SURVEYS)	N2 (RESERVATIONS NOT LINKED TO SURVEYS)	T-STATISTIC	P-VALUE
RESERVED HOURS	744	1227	-1.568	0.117
ACTUAL HOURS	744	1227	-1.490	0.136
VMT	724	1145	0.165	0.869

Table 5. T-Tests Results for Reservations Linked (N1) and Not Linked (N2) to the Post-Reservation Survey for *Responding Users*

VARIABLE	N1 (RESERVATIONS LINKED TO SURVEYS)	N2 (RESERVATIONS NOT LINKED TO SURVEYS)	T-STATISTIC	P-VALUE
RESERVED HOURS	744	956	-0.843	0.400
ACTUAL HOURS	744	956	-0.930	0.352
VMT	724	904	1.124	0.261

Finally, researchers compared the sample of user members who responded to one or more Post-Reservation Surveys and user members who did not respond to Post-Reservation Surveys. As shown in Table 6, researchers conducted t-tests comparing attributes available for all members (i.e., reported home census block and observed usage data) between user members who did (N1) and did not (N2) complete Post-Reservation Surveys. The results show no significant differences (at the 0.05 level) between these two groups for driving distance to the nearest Míocar or major city, median reserved hours, median actual hours, or median VMT. In addition, the results show a p-value of less than 0.05 for frequency of use in terms of reserved hours per number of active days. Researchers found that the median number of active days for user members who did not respond to Post-Reservation Surveys is minimal, meaning that most of these non-respondents used Míocar very infrequently (Table 7). Additionally, comparing the two groups using a frequency of use metric of reserved hours throughout the duration of Míocar membership shows no significant difference between the two groups.

Table 6. Descriptive Statistics for Users who Did (N1) and Did Not (N2) Respond to the Post-Reservation Survey

Variable	N1 (Users with reservation survey)	N2 (Users without reservation survey)	t-statistic	p-value
Driving Distance to Nearest Míocar (miles)	70	72	0.932	0.355
Driving Distance to Nearest Major City (miles)	70	72	1.017	0.313
Frequency of Use for Reserved Hours/Membership Duration	72	77	0.739	0.462
Frequency of Use for Reserved Hours/Active Days	72	77	-2.777	0.007**
Median Reserved Hours	72	77	-1.763	0.081
Median Actual Hours	72	77	1.759	0.081
Median VMT	72	72	0.317	0.752

Table 7. Descriptive Statistics for Active Days of Use for Users with Reservation Surveys and Users Without Reservation Surveys

	All Users	Users with Reservation Survey	Users without Reservation Survey
count	149.000000	72.000000	77.000000
mean	216.436242	339.458333	101.402597
std	257.711428	262.559929	192.841240
min	1.000000	1.000000	1.000000
25%	1.000000	71.000000	1.000000
50%	71.000000	315.500000	6.000000
75%	462.000000	571.000000	71.000000
max	847.000000	847.000000	653.000000

Counterfactual Travel

Researchers developed a counterfactual travel score for each Míocar trip associated with a survey response using the survey responses. Researchers categorized the associated reservation for each post-reservation survey response as Increased Mobility Travel, Avoided ICE Travel, Avoided Non-ICE Travel, or Unknown Travel. These categories are defined as follows:

- Increased Mobility Travel: A trip that would not have occurred at all in the absence of Míocar.
- Avoided ICE Travel: A trip that would have occurred using an ICE vehicle in the absence of Míocar.
- Avoided Non-ICE Travel: A trip that would have occurred using a mode other than an ICE vehicle in the absence of Míocar.
- Unknown Travel: A trip that may or may not have occurred in the absence of Míocar; a determination cannot be made due to lack of data.

Researchers base this assignment on users' responses to the following questions:

- Q3: If Míocar was not available, would you have been able to travel to the primary destination of your last reservation?
- Q5: What mode of travel would you have used?

Where,

- A response of "No" to Q3 categorizes the reservation as "Increased Mobility Travel" (i.e., the trip would not have occurred in the absence of Míocar);
- A response of "Yes" to Q3, AND a response of "Driven a private vehicle," "Rented a car," "Taken a taxi, Uber, or Lyft," "Borrowed someone else's car" OR "Gotten a ride from someone" to Q5 categorizes the reservation as "Avoided ICE Travel" (i.e., the user would have taken the trip using an ICE vehicle in the absence of Míocar);

- A response of "Yes" to Q3, AND a response of "Walked," "Biked," "Taken a bus," "Taken a train," or "Other" to Q5 categorizes the reservation as an "Avoided Non-ICE Travel" (i.e., the user would have taken the trip using a mode other than an ICE vehicle in the absence of Míocar); and
- A response of "Unsure" to Q3, OR a response of "Yes" to Q3 and "Null" to Q5 categorizes the reservation as "Unknown Travel".

Table 8 displays the travel categories assigned to the 744 survey responses that researchers linked to specific reservations based on counterfactual survey responses. According to members, most Míocar trips (63%) are Increased Mobility Travel and would not have occurred in the absence of Míocar. UC Davis researchers also found that only one trip met the criteria for Avoided Non-ICE Travel as the user stated that they would have used a mode other than an ICE vehicle to complete the trip in the absence of Míocar. Avoided ICE Travel accounts for 20% of all surveys linked to a specific reservation.

Table 8. How Availability of Míocar Affected Travel (Based on Counterfactual Survey Responses)

Based on counterfactual responses	Avoided ICE Travel	Avoided Non-ICE Travel	Increased Mobility Travel	Unknown Travel*	Total
Responses	151	1	472	120	744
Percentage of Responses	20.3%	0.1%	63.4%	16.1%	100%

*Insufficient survey data to make a determination for these trips.

Results

UC Davis researchers used the collected Member Data, Utilization Data, and Survey Data to analyze the participation and impacts of Míocar. The analyses included developing member and usage summaries, distilling survey results, linking survey data to utilization data to analyze service usage by key member characteristics, and comparing participant characteristics to regional census data. This section presents the evaluation results for the Míocar pilot study period of May 2019 through November 2021.

Member Use

In this report, Míocar "Members" include three types of participants: (1) active members who are still able to use the service; (2) inactive members who used the service at least once but the current Míocar status is inactive; and (3) canceled members who used the service at least once but are no longer members now.

In total, 1121 individuals began an application for the Míocar service, and 374 became members. Of the 374 members, 149 members used the service ("active users"), and 225 members did not use the service during the study period ("inactive members"). Inactive members may not have used the service because of the limited geographic locations of the hubs, failure to meet membership qualifications, and joined the service as a backup in case their car broke down. During the study period, researchers noted substantial increases in applications after the service made news on TV and radio and in the papers, first during the local launch events in August and September 2019 and again during the regional launch in November 2019.

Figure 1 shows the cumulative number of members and users, vehicles in service and vehicles used per month, and monthly reservation counts and VMT. Vehicle use peaked in March 2020, just before the onset of the COVID-19 pandemic. To fully address COVID-19 safety concerns and insurance issues, project partners shut the service down until July 2020. Thus the figures below do not include data from April through June 2020. Vehicle availability gradually increased after the reopening to address vehicle battery issues that resulted from non-use during the shutdown. However, in July 2021, 17 of the 27 Míocar vehicles were impacted by the Chevy Bolt recall. Chevy struggled to address the problems in the recalled vehicles, and thus Míocar could only offer limited access to the fleet through December 2021.

Comparing the reservations and VMT below shows that monthly VMT for the Míocar fleet dropped more substantially than the monthly reservation count following the July 2021 vehicle recall. This trend is due to members taking more short trips on average during this period. Possible explanations for this trend may be that more members took shorter trips as they became familiar with the service during this period or that the vehicles affected by the recall were more likely to be used for long-term trips than the remaining vehicles.

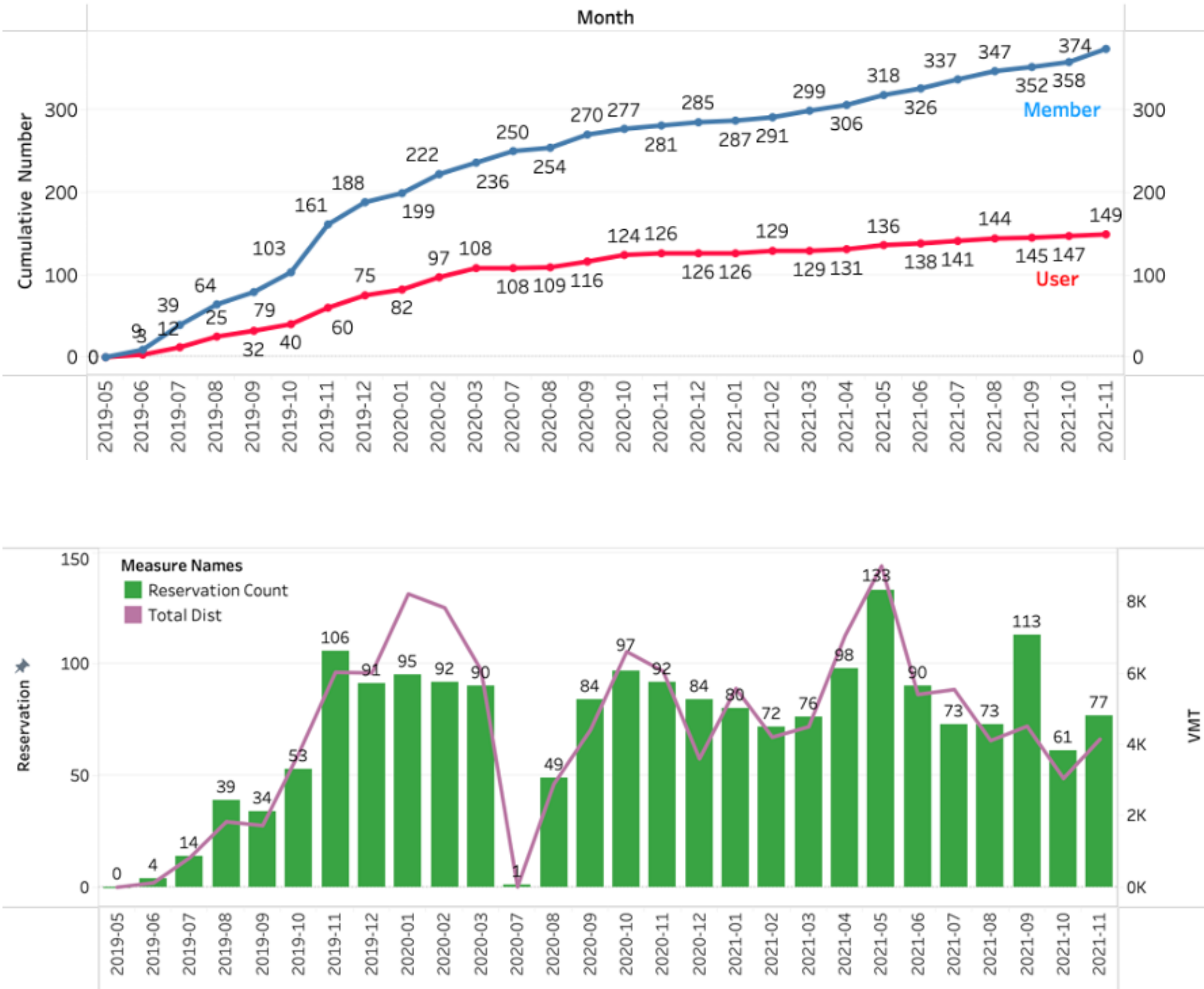


Figure 1. Changes over month: (top) Numbers of Registered Members and Members who Used the Service ("Users"); (middle) Total Number of Fleet Vehicles in Service and Vehicles Used; (bottom) Number of Reservations (green bars) and VMT (purple line).

Table 9 presents the summary statistics for user members, including monthly reservations, VMT, and hours of service use. Values vary because many members do not use the service every month, and some members use the service very frequently. However, on average per month, user members made 0.89 reservations and traveled 58.50 miles over 12.67 hours during the study period. The study period's median value (50th percentile) is 0.21 reservations per month, 14.31 miles per month, and 2.26 hours per month.

Table 9. Monthly Use Statistics for User Members (N=149)

	Reservations/Month	*VMT/Month*	*Hours of Use/Month*
COUNT	149	149	149
MEAN	0.89	58.50	12.67
STD	2.85	143.86	37.27
MINIMUM	0.03	0.00	0.03
25TH PERCENTILE	0.07	4.36	0.61
50TH PERCENTILE	0.21	14.31	2.26
75TH PERCENTILE	0.62	45.24	8.36
MAXIMUM	28.12	1364.00	381.69

Table 10 presents the summary statistics for each reservation. The median reservation distance was 37 miles during the study period, and the duration was 3.5 hours. The maximum values are high because users reserve Míocar for as long as a week and make many trips during their reservations.

Table 10. Summary Statistics for Reservations

	VMT	*Hours*
COUNT	1869	1971
MEAN	65.93	12.12
STD	97.04	26.42
MINIMUM	0.00	1.00
25TH PERCENTILE	16.00	1.50
50TH PERCENTILE	37.00	3.50
75TH PERCENTILE	84.00	15.50
MAXIMUM	1389.00	336.00

Member Attributes

Members who responded to the Before Survey provided information about their household composition and other demographic variables. To better understand the differences and similarities between Míocar users and the county population, researchers also compared the summary statistics of demographic variables between users and the county population. Researchers developed a single weighted average of county-level results for the Míocar service areas of Kern County, Fresno County, Tulare County, and Kings County using the population of each county. Researchers based the weights on the frequency of members living in those counties. Table 9 displays the member attributes and weighted county population results.

Regarding household income, Míocar members reported lower average household incomes than the county averages. Most respondents (68%) have a household income of less than $50,000, compared to the county data where most households (55%) have a household income of more than $50,000.

Table 11 also shows the income categories associated with Míocar survey respondents, based on 2021 State Income Limits and as prescribed by the Department of Housing and Urban Development (HUD). See Appendix A for more information about income categories and respondent assignments to those categories. Míocar members reported larger household sizes on average than the county population, with most respondents (62%) stating that their household has at least four residents, while 34% of households have four or more residents for the weighted county population sample. In terms of adults, most respondents indicated that they are either the only adult in the household or one other adult living in the home.

Míocar members are required to be 21 years of age or older. Members tend to be somewhat younger on average than the weighted county population, with less than 10% of Míocar members being 60 years old or older, as compared to 25% of the greater population.

Table 11. Míocar Member Demographic Attributes

Demographic Attribute	Míocar Users	Population	Demographic Attribute	Míocar Users	Population
Household Size	**N = 77**	**N = 777732**	**Age**	**N = 148**	**N = 1688279**
1-person	10.4%	21.5%	21 to 29 years	25.0%	20.5%
2-person	13.0%	27.3%	30 to 39 years	36.5%	21.3%
3-person	14.3%	16.8%	40 to 49 years	22.3%	17.2%
4-person	32.5%	16.2%	50 to 59 years	9.5%	15.9%
5-person	18.2%	9.5%	60 to 69 years	3.4%	13.3%
6-or-more person	11.7%	8.6%	70 to 79 years	3.4%	7.8%
Total	100.0%	100.0%	80 years and over	0.0%	3.9%
Household Income	**N = 69**	**N = 77732**	Total	100.0%	100.0%
Less than $10,000	8.7%	6.4%	**Education Level**	**N = 74**	**N = 1545936**
$10,000 to $24,999	26.1%	15.7%	Above Master's degree	1.4%	1.9%
$25,000 to $49,999	33.3%	22.9%	Master's degree	2.7%	4.1%
$50,000 to $99,999	17.4%	29.6%	Bachelor's degree in college (4-year)	17.6%	12.5%
$100,000 to $199,999	14.5%	25.3%	Associate degree in college (2-year)	17.6%	9.1%
Total	100.0%	100.0%	Some college but no degree	31.1%	23.3%
Income Category	**N = 70**		Trade or vocational	5.4%	0.0%
Extremely Low	31.4%		High school graduate (including GED)	21.6%	24.8%
Very Low Income	18.6%		Less than high school	1.4%	20.4%
Low Income	18.6%		No schooling completed	1.4%	3.8%
Median Income	4.3%		Total	100.0%	100.0%
Moderate Income	11.4%				
High Income	15.7%				
Total	100.0%				

The survey asked users about the number of personal vehicles available to their households (Table 12). This number is similar to the weighted county averages, with most members (72%) reporting that they have one or two vehicles available (compared to 67% at the county level). Researchers also cross-tabulated the number of vehicles per household with the household size, which shows a similar distribution of vehicles per person in the household for Míocar members compared to the larger population.

Table 12. Míocar Member Vehicle Availability

Demographic Attribute	Míocar Users	Population
Vehicles Available	**N = 77**	**N = 461758**
No vehicle available	10.4%	6.8%
1 vehicle available	32.5%	30.9%
2 vehicles available	39.0%	36.2%
3 vehicles available	13.0%	16.2%
4 or more vehicles available	5.2%	9.9%
Total	100.0%	100%
Household Size By Vehicles	**N = 78**	**N = 777732**
1-person household:	10.3%	8.9%
No vehicle available	2.6%	2.0%
1 vehicle available	3.8%	4.0%
2 vehicles available	2.6%	2.0%
3 vehicles available	1.3%	1.0%
4 or more vehicles available	0.0%	0.0%
2-person household:	12.8%	17.8%
No vehicle available	0.0%	1.0%
1 vehicle available	2.6%	4.0%
2 vehicles available	9.0%	11.9%
3 vehicles available	0.0%	0.0%
4 or more vehicles available	1.3%	1.0%
3-person household:	15.4%	14.9%
No vehicle available	3.8%	3.0%
1 vehicle available	3.8%	5.0%
2 vehicles available	6.4%	5.9%
3 vehicles available	1.3%	1.0%
4 or more vehicles available	0.0%	0.0%
4-or-more-person household:	61.5%	58.4%
No vehicle available	5.1%	5.0%
1 vehicle available	21.8%	17.8%
2 vehicles available	20.5%	21.8%
3 vehicles available	10.3%	10.9%
4 or more vehicles available	3.8%	3.0%
Total	100.0%	100.0%

The Before Survey also asked members about the model year of each vehicle available to their households. Researchers then calculated the average vehicle age for all user members. If the number of reported personal vehicles was six or more, researchers used a vehicle quantity of six to calculate the average age. Table 13 summarizes the average vehicle age for vehicles reported by the user members who have at least one available vehicle. The median value of users' average vehicle age is 11.5 years, and 75% of users have an average vehicle age over 8.5 years.

Table 3. Summary Statistics for Average Age of Vehicles Owned by Users in Years (N=89)

	AVERAGE AGE OF VEHICLES
COUNT	89
AVERAGE	12.4
MEDIAN	11.5
STD	5.6
MINIMUM	3.0
25^{TH} PERCENTILE	8.5
75^{TH} PERCENTILE	16
MAXIMUM	33

Accessing Míocar

Figure 2 shows the Míocar hubs and the percentage of users in different towns in the San Joaquin Valley, based on member home zip code. Many Míocar members live in communities without Míocar hubs.

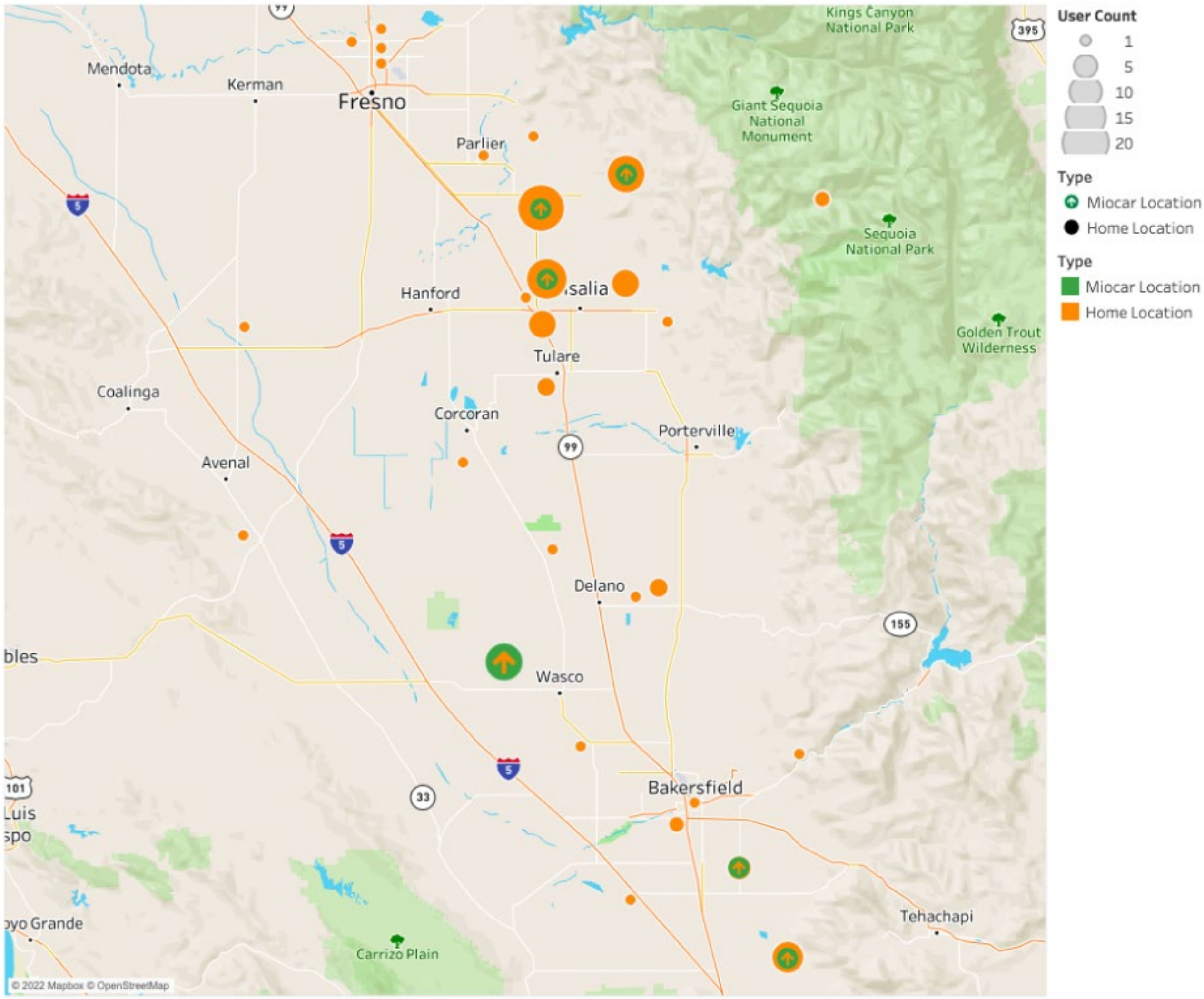
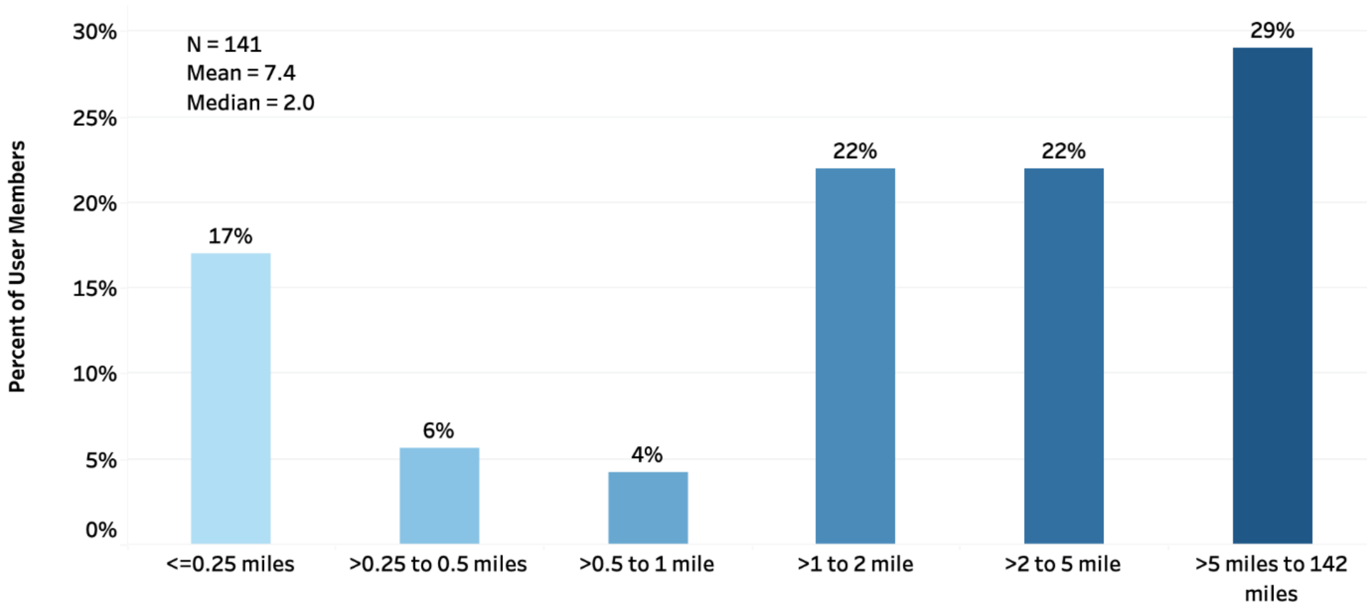


Figure 2. User Members by Home Locations (Zip Codes)

Figure 3 shows the percentages of user members according to their travel distance from a Míocar hub. Of user members, 29% were willing to travel more than five miles from their home to access Míocar hubs. The average distance is 7.4 miles, and the median is two miles. The minimum distance is close to zero for members who live directly next to a Míocar hub, and the maximum distance is 142 miles. These results show that most user members do not have a hub within walking distance of their residence.

While these individuals can travel long distances to Míocar hubs using private vehicles or other modes, other individuals in their communities who do not have these transportation options may not be able to access Míocar. These results suggest an opportunity to explore the expansion of Míocar into additional communities, both to reduce reliance on personal vehicles for EV access and to meet the needs of current non-members and non-users.



*There are seven incomplete addresses that can not be geocoded and one address outside of California, which are excluded in this figure.

Figure 3. Driving Distance from User Member's Local Home Location to Nearest Míocar Hub (N=141)

The Post-Reservation Survey asked how users traveled to the Míocar hub to pick up the vehicle they had reserved. As shown in Table 14, members walked to the vehicle for most reservations (67%). Still, more members reported using a private vehicle to travel to the Míocar hub (71% of members) than any other transportation mode. Together, these results suggest that users who live within walking distance of Míocar hubs used the service more frequently than others.

Table 14. Mode of Travel to Míocar Hub for Most Recent Reservation

How did you travel to pick up the Míocar?	Percentage of Responses (N = 874)	Percentage of Respondents (N = 69)
Walk	67%	43%
Private Vehicle (car or truck)	23%	71%
Public Transit Bus	7%	12%
Taxi, Uber, or Lyft	3%	10%
Bicycle, Scooter or skateboard	2%	11%
Motorcycle	<1%	1%
Other	1%	13%

*Respondents were able to select more than one response. Thus, the total percent of respondents is greater than 100%.

Travel Purposes

The Post-Reservation Survey asked users to indicate the primary purpose of their last Míocar reservation. As shown in Figure 4, respondents most commonly stated that the primary purpose of their reservation was to conduct family or personal errands (51% of all respondents and 35% of all reservations). Work-related activities were the second most commonly cited reservation purpose.

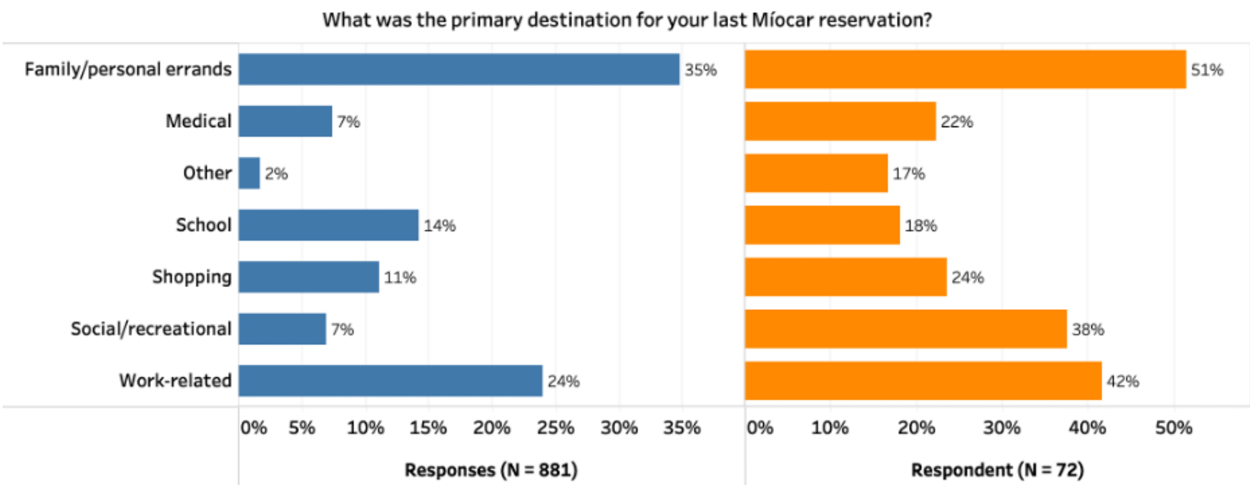


Figure 4. Primary Purpose of the Most Recent Reservation

Carpooling

When asked to report how many passengers, including themselves, were in the Míocar vehicle during the reservation, members most often reported that two or fewer people were in the vehicle (Figure 5). As indicated by the average and median values, Míocar vehicle reservations typically consisted of the driver and one other passenger.

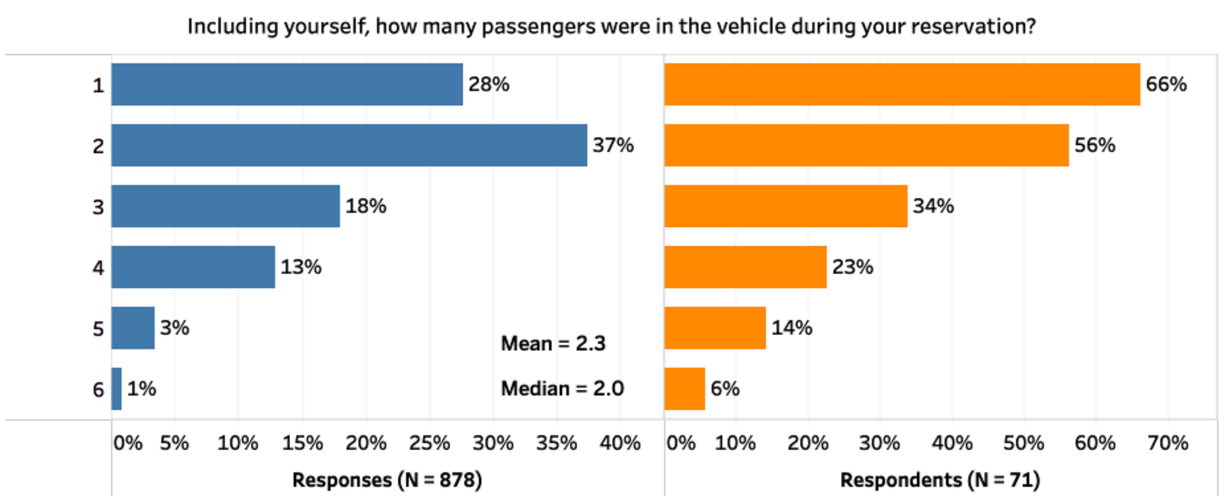


Figure 5. Number of People in Vehicle for Most Recent Reservation

Counterfactual Travel

The Post-Reservation Survey asked several questions to gain insight into members' possible counterfactual decisions about travel in the absence of Míocar. These questions related to alternative transportation options.

The primary question used to determine the likely counterfactual travel scenario asked respondents if they would have made the particular trip in question had Míocar not been available. Respondents most commonly stated that the trip would not have occurred in the absence of Míocar, suggesting that the availability of Míocar induced 68% of trips (Figure 6).

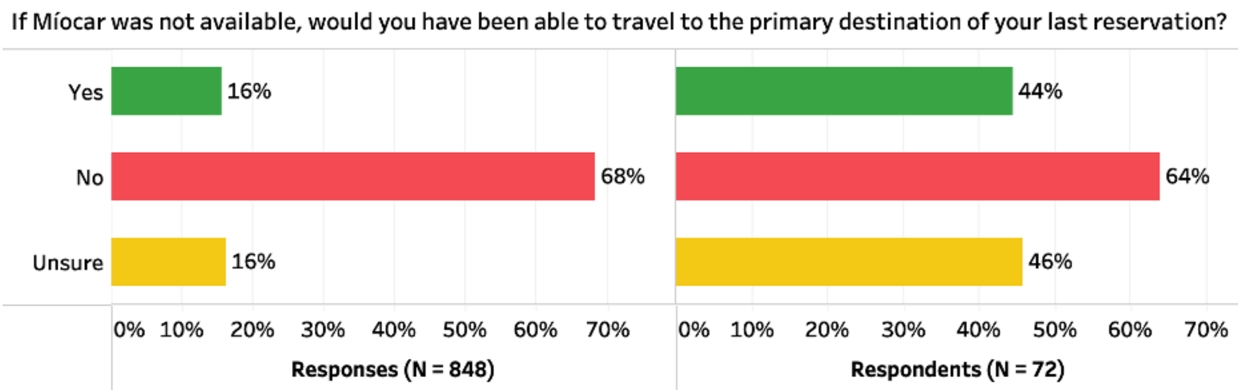


Figure 6. Counterfactual Trip Decision in the Absence of Míocar

The Before Survey included questions related to new members' expected service use. First, the survey asked users whether they thought Míocar would increase the number of trips their household would make. As displayed in Figure 7, 45% of respondents expected that the service would increase their number of trips, while 34% of respondents were not sure.

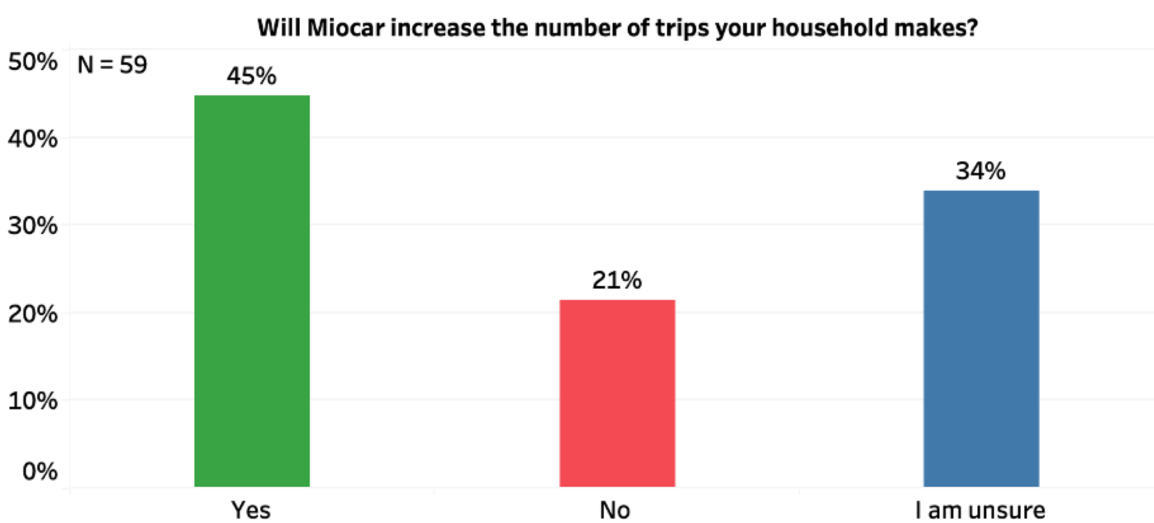


Figure 7. Expected Change in Trip Making due to Míocar

For the responses stating that the trip would have been possible in the absence of Míocar, the Post-Reservation Survey asked members how they would have made these trips under this counterfactual scenario. All members in this subset indicated that they would have used a different mode of travel to make the trip at least once (Table 15).

Table 4. Counterfactual Mode in the Absence of Míocar

How would you have made this trip without Míocar?	Percent of Responses (N = 132)	Percent of Respondents (N = 32)
I would have used a different mode of travel (for example, my own car or bus).	97%	100%
I am unsure.	3%	9%
I would have gone to a different location.	2%	6%

*Respondents were able to select more than one response. Thus, the total percentage of respondents is greater than 100%.

When asked what form of transportation they would have used to make their trips in the absence of Míocar, members most often reported that they would have driven their car (Figure 8). Overall, 98% of responses indicated that trips that would have still been taken in the counterfactual scenario would have been completed using a motor vehicle (driving a car, getting a ride from someone, borrowing a car, renting a car, or taking a taxi, Uber, or Lyft).

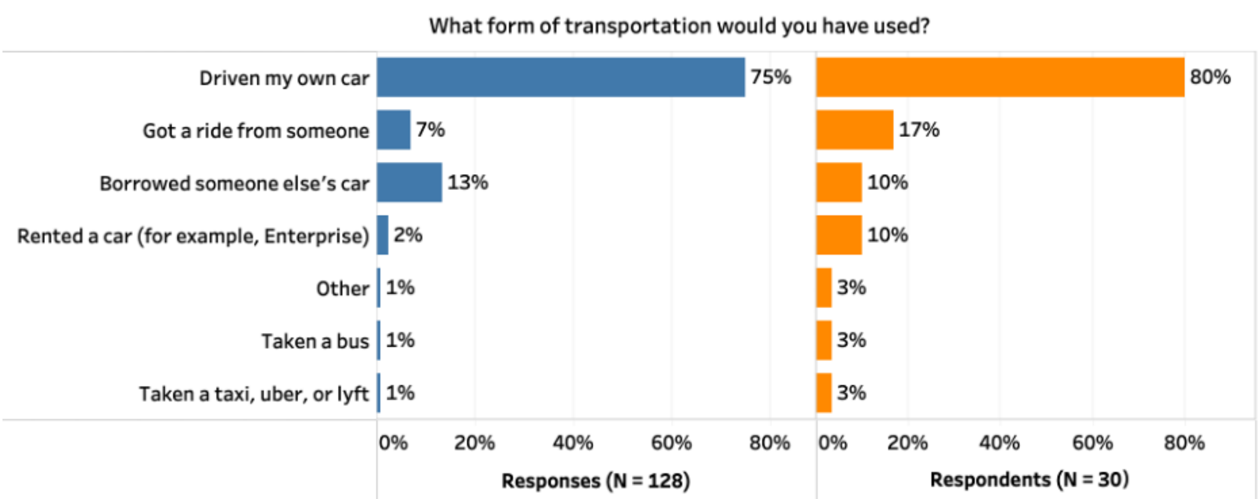


Figure 8. Counterfactual Mode for Trips Taken with Míocar if Service Were Not Available

Change in Travel by Conventional and Electric Vehicles

Table 16 presents the results of applying the counterfactual travel analysis for each user to the total Míocar distance traveled within that member's surveyed reservations. The 744 survey responses confidently linked to a specific reservation account accounted for a total of 47,730 miles traveled. In this table, the column labels refer to the following:

- Increased Mobility Miles: Miles traveled with Míocar that would not have occurred at all in the absence of Míocar.
- Avoided ICE Miles: Miles traveled with Míocar that would have occurred using an ICE vehicle in the absence of Míocar.
- Avoided Non-ICE Miles: Miles traveled with Míocar that would have occurred using a mode other than an ICE vehicle in the absence of Míocar.
- Unknown Miles: Miles traveled with Míocar that may or may not have occurred in the absence of Míocar; a determination cannot be made due to lack of data.

According to members, the majority of miles traveled for these reservations (54% or 25,761 miles) would not have occurred in the absence of the service. Of the total miles traveled, 24% (11,578 miles) would have been traveled using an ICE vehicle in the absence of the service.[6]

Table 5. How Availability of Míocar Affected Miles Traveled (Based on Counterfactual Survey Responses)

Based on counterfactual responses	Avoided ICE Miles	Avoided Non-ICE Miles	Increased Mobility Miles	Unknown Miles*	Total Miles
VMT	11,578	101	25,761	10,292	47,730
Percentage	24.3%	0.2%	54.0%	21.6%	100%

Figure 9 displays the distribution of reservations, users, and the VMT across income categories. A description of the method researchers used to categorize respondents to these income categories can be found in Appendix A. Extremely Low-Income households accounted for most reservations (57%) and the largest group of users (35%). Most miles traveled with Míocar were driven by users from Low-Income, Very Low-Income, or Extremely Low-Income households.

[6] Two of the reservations linked to survey responses had a recorded distance of 0 in the utilization data. UC Davis researchers found that this was due to an error with the telematics software, and therefore removed these 0 values prior to completing this portion of the analysis. Both of these reservations were completed by users who had completed a single survey, so the removal of these distance values does not affect the calculations for any other reservations.

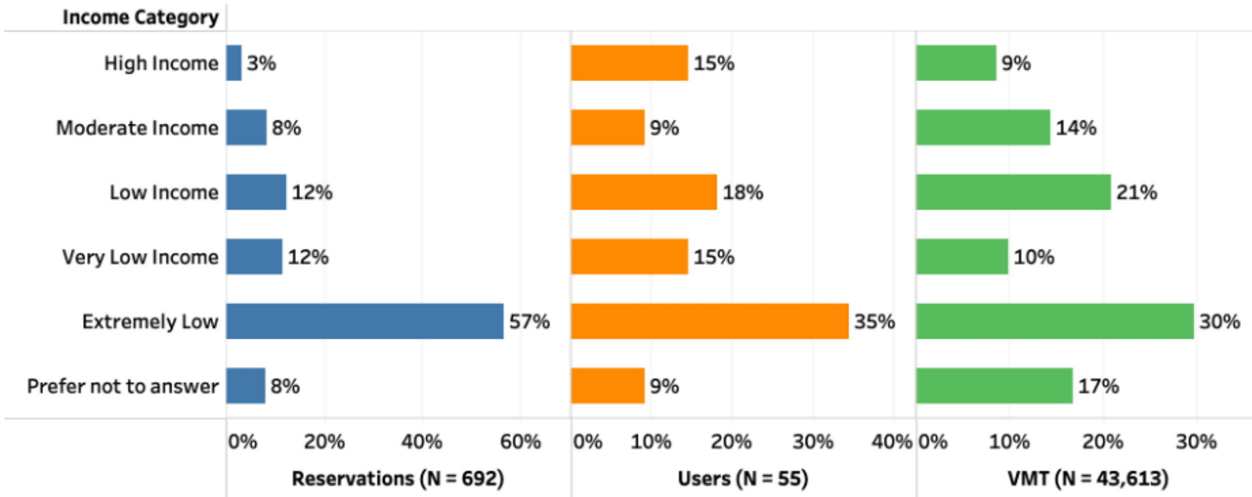


Figure 9. Summary of Reservations by User's Income Category

Figure 10 shows the miles traveled by income category by VMT types. The proportion of trips categorized as Increased Mobility trips is highest for the Extremely Low-Income user population at 42% of all trips. The proportion of trips categorized as Avoided Travel trips is highest for the Moderate-Income and High-Income user populations, at 41% and 24% of all trips, respectively. This analysis shows that members in the lower-income groups account for most of the VMT associated with Increased Mobility Travel. In contrast, members in the higher-income groups account for most of the VMT associated with Avoided Travel.

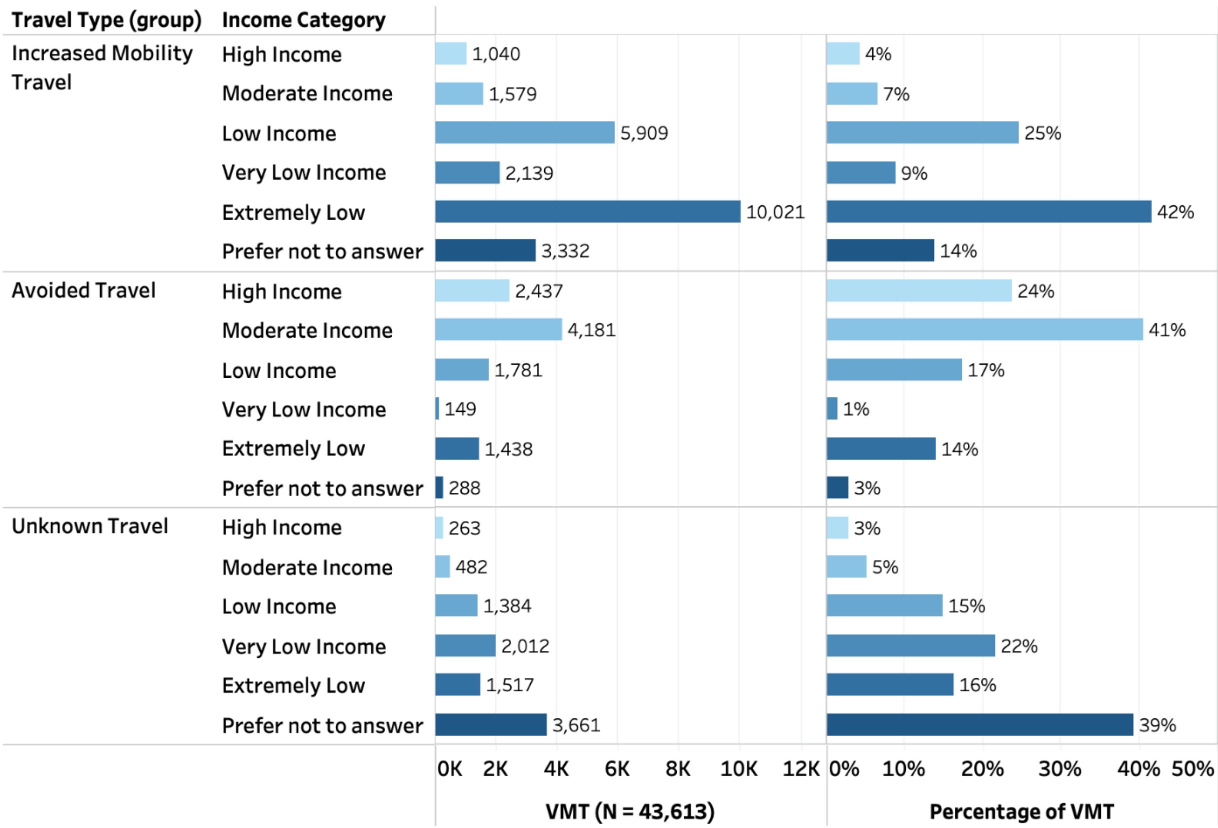


Figure 10. VMT Associated with Míocar Effects on Travel by Income Category

Table 17 summarizes the counterfactual travel analysis by reservation purpose, which involves cross-referencing the counterfactual survey responses with the stated reservation purpose from the Post-Reservation Survey.

The trip purposes with the highest proportion of trips categorized as Increased Mobility Travel were School trips, Family/personal errands, and Medical trips, where user responses indicated that 84%, 75%, and 74% of these trips would not have occurred in the absence of Míocar, respectively. Conversely, the trip purpose with the highest proportion of trips categorized as Avoided Travel was Social/recreational. Users indicated that about half of these trips (49%) would have used a different mode in the absence of Míocar.

Table 6. Counterfactual Trip Summary by Purpose of Reservation

Primary Destination	Avoided Travel (N = 136)	Increased Mobility Travel (N = 448)	Unknown Travel (N = 108)	Total (N = 692)
Family/personal errands	8%	75%	16%	100%
Medical	9%	74%	17%	100%
Other	21%	50%	29%	100%
School	13%	84%	3%	100%
Shopping	22%	62%	16%	100%
Social/recreational	49%	40%	11%	100%
Work-related	34%	43%	22%	100%
Total	20%	65%	16%	100%

The results above suggest that Míocar is predominantly providing access to essential destinations for individuals who do not have sufficient transportation alternatives.

Conclusion

The before and after evaluation of Míocar provided several insights into who is using the service, how they are using it, and how EV carsharing affects transportation behaviors within the membership population.

Míocar membership grew throughout May 2019 through November 2021 study period. However, barriers to growth included the onset of the COVID-19 pandemic in March 2020 and a major vehicle recall in July 2021. On average, user members traveled about 59 miles per month over 13 hours. The median reservation distance was 37 miles with a duration of about 3.5 hours, though members tended to make shorter reservations on average during the last few months of the study period. Fluctuations in vehicle availability likely affected the frequency and type of reservations completed. Further observations of the pilot at full operational capacity would be needed to forecast use estimates under typical conditions.

A total of 149 individuals became members of Míocar and used the service during the study period, and 78 of these individuals completed the Before Survey (52%). Based on this survey, Míocar members tend to have larger household populations and lower household incomes than the average for their surrounding county populations.

While Míocar members have roughly the same number of personal vehicles per household as the overall county averages, many members expected that Míocar would increase the number of trips their households could make (45% of members in the Before Survey). The role of Míocar as a method of improving household mobility is further evidenced by the after data collected in the form of a Post-Reservation Survey. This survey suggests that most Míocar trips (63%) would not have been possible in the absence of the service. For the 20% of Míocar trips that would occur in the absence of the service, respondents indicated that nearly all (98%) would have traveled by personal ICE vehicles or other ICE vehicles.

A cross-tabulation of counterfactual trip scores with member income categories suggests that Avoided ICE VMT is positively correlated with household income. This means that higher-income households would be more likely than lower-income households to complete the same trips, using an ICE vehicle, in the absence of Míocar. Conversely, the results suggest that Increased Mobility VMT is negatively correlated with household income, meaning that lower-income households are less likely to complete trips in the absence of Míocar. Together, these results suggest that Míocar is replacing ICE travel for higher-income households and providing improved mobility to lower-income households with fewer transportation alternatives. Additionally, the long distances traveled during some reservations, and the lack of members citing transit as a counterfactual mode of travel, indicate that members use the service for inter-city and inter-county trips that cannot be accomplished by available transit service.

The Post-Reservation Survey found that members use Míocar for a wide variety of trip types, including family and personal errands, work- and school-related travel, accessing medical appointments, and traveling to social activities. In addition, most respondents who provided information about a medical, school, or work-related trip in the Post-Reservation survey indicated that they would not have been able to make these trips in the absence of the service. Thus Míocar is providing increased access to essential destinations.

The results also suggest that additional carsharing hubs may improve the accessibility and use of Míocar for current members and future members. Of the user members, 29% were willing to travel more than 5 miles from their homes to access Míocar hubs, and 71% of Post-Reservation Survey respondents reported that they drove private vehicles to Míocar hubs to pick up the EVs. However, many members live in communities without Míocar hubs, and 60% of individuals who signed up to use the service did not complete a Míocar reservation during the study period.

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