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Understanding Demand, Revenues, and Costs of Electric Carsharing in Underserved Rural and Suburban Areas

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California Resilient and Innovative Mobility Initiative

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16. Abstract

Transportation access is a significant issue in low-income, rural, and otherwise underserved communities in the US, with few affordable and reliable alternatives to car ownership. Carsharing is one promising alternative to improve access among marginalized communities. Grant programs in California have funded pilot electric carshare services. But little is known about the long-term financial sustainability of these services and how their costs and revenues compare those of transit. In this study, a financial model was used to estimate the *net operating income* (fare revenue minus costs) for Míocar, an electric carsharing service in marginalized suburban and rural communities. The estimated net operating income per month was −$1561, under current operating conditions, and ranged from −$1255 to −$1623 depending on simulated changes to fleet size, pricing, and usage rates. These negative net operating incomes correspond to a shortfall (or need for subsidies) of 68% to 92% of operational costs. Míocar could achieve a higher ratio of fare revenues to operational costs (13%) than existing transit (3 to 8%). To minimize required subsidies, electric carshare operators and prospective carshare communities should carefully consider hub locations (which can affect usage rates), the number of vehicles per hub, and the expected demand over time.

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The California Resilient and Innovative Mobility Initiative (RIMI) serves as a living laboratory – bringing together university experts from across the four UC ITS campuses, policymakers, public agencies, industry stakeholders, and community leaders – to inform the state transportation system's immediate COVID-19 response and recovery needs, while establishing a long-term vision and pathway for directing innovative mobility to develop sustainable and resilient transportation in California. RIMI is organized around three core research pillars: Carbon Neutral Transportation, Emerging Transportation Technology, and Public Transit and Shared Mobility. Equity and high-road jobs serve as cross-cutting themes that are integrated across the three pillars.

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Executive Summary

Executive Summary

Transportation access is a significant issue in the U.S., with few affordable and reliable alternatives available to car ownership (Kawabata & Shen). Carsharing is one promising alternative to improve access among involuntarily carless households (Pan et al. 2022; Shaheen et al. 2019). In recent years, California has developed multiple grant programs that fund shared mobility start-ups in underserved communities. Funding for evaluation of California's implemented programs has been limited. However, recent research indicates that low-cost electric carsharing services located in low-income rural communities of color in the southern San Joaquin Valley can significantly address members' unmet travel needs, especially for employment, education, and related health destinations, while reducing greenhouse gas (GHG) emissions.

Several electric carshare pilots have received funding to launch and operate for limited terms of 1-3 years, such as those funded through the California Climate Investments cap-and-trade program. However, insights into the long-term financial sustainability of these services and cost comparisons to transit have been limited. In this study, we use data provided by a non-profit electric carsharing service called Míocar, which exclusively serves marginalized suburban and rural communities with high rates of carless households and low-quality transit service. We analyze utilization rates, costs, and potential revenues to provide insight into key factors to consider for electric carshare expansion, long-term sustainability of operations, and the need for external subsidies. We also provide a comparison to the local transit service costs. The results begin to shed light on the potential magnitude of costs and the magnitude of subsidies required to provide ongoing support to electric carsharing services in marginalized communities.

Method

We developed a model to assess cost and revenue scenarios for Míocar for different fleet sizes, user counts, vehicle utilization, and operational cost targets. The model incorporated Míocar's revenue structure to output the monthly net operating income, calculated as monthly fare revenue minus total monthly variable and fixed costs (including electricity). Calculating the net operating income for each scenario allowed us to test the sensitivity of net operating income to factors including increases or reductions in daily vehicle utilization or fleet size.

For the purpose of this analysis, monthly operational cost per vehicle refers to long-term operational costs exclusive of start-up costs, such as acquisitions costs for vehicles and electric vehicle supply equipment (EVSE), which for Míocar have historically been covered by initial grant funds. Míocar staff noted that initial start-up costs vary widely depending on location and existing infrastructure, and do not reflect the long-term costs associated with sustaining the service.

Míocar provided service utilization data for October 2023 to March 2024 including hours and miles driven, number of trips and users, and activity per hub and regional Míocar location. We coordinated with Míocar to obtain and review data related to Míocar service costs and categorized each itemized cost as either a variable cost, which is expected to vary depending on the size of the Míocar fleet, or a fixed cost, which would remain constant regardless of fleet size. We incorporated estimates of electricity charging costs into the model based on utility cost and fuel efficiency assumptions. To account for changes in service demand due to increased or decreased fare rates, we incorporated an elasticity factor into the model based on records of Míocar usage during a period of modified pricing. We applied a series of assumptions related to service usage and fare structure based on historic Míocar data.

Using the cost and utilization data provided, the model outputs monthly net operating income as monthly fare revenue minus total monthly fixed and variable operational costs (including electricity). Additionally, the percentage of costs covered by revenue is calculated by dividing monthly fare revenue by total monthly operational cost. The percentage of costs not covered by fare revenue are costs that would need to be offset by subsidies or other revenue sources to allow for sustained long-term electric carshare service.

We used the financial model to construct five cost and revenue scenarios:

- Scenario 1, Base case: Based on Míocar utilization and revenue data from October 2023 to March 2024
- Scenario 2, Increased demand: Increasing user base to 200% of base case
- Scenario 3, Increased fare rate: Applying 50% increase to base case fare rate
- Scenario 4, Increased demand and increased fare rate: Increasing user base to 200% of base case, and removing the daily rate from the fare structure in favor of the higher hourly rate
- Scenario 5, Reduced user demand: Decreasing the user base to 50% of base case

We conducted a comparison of Míocar revenues and costs with those of nearby public transit by obtaining data from the 2022 NTD for Kern Regional Transit, Tulare County Area Transit, San Joaquin RTD, and Alameda-Contra Costa Transit District.

Results

Under the scenarios examined, revenues amount to between 4% and 18% of costs for a smaller 20-vehicle fleet, between 6% and 31% for the current 41-vehicle fleet, and between 10% and 48% for an expanded 80-vehicle fleet. Overall, net operating income and percent of costs covered by revenue in these scenarios is less sensitive to price changes than changes in the size of the user base, and the most significant factor is the size of the carsharing fleet.

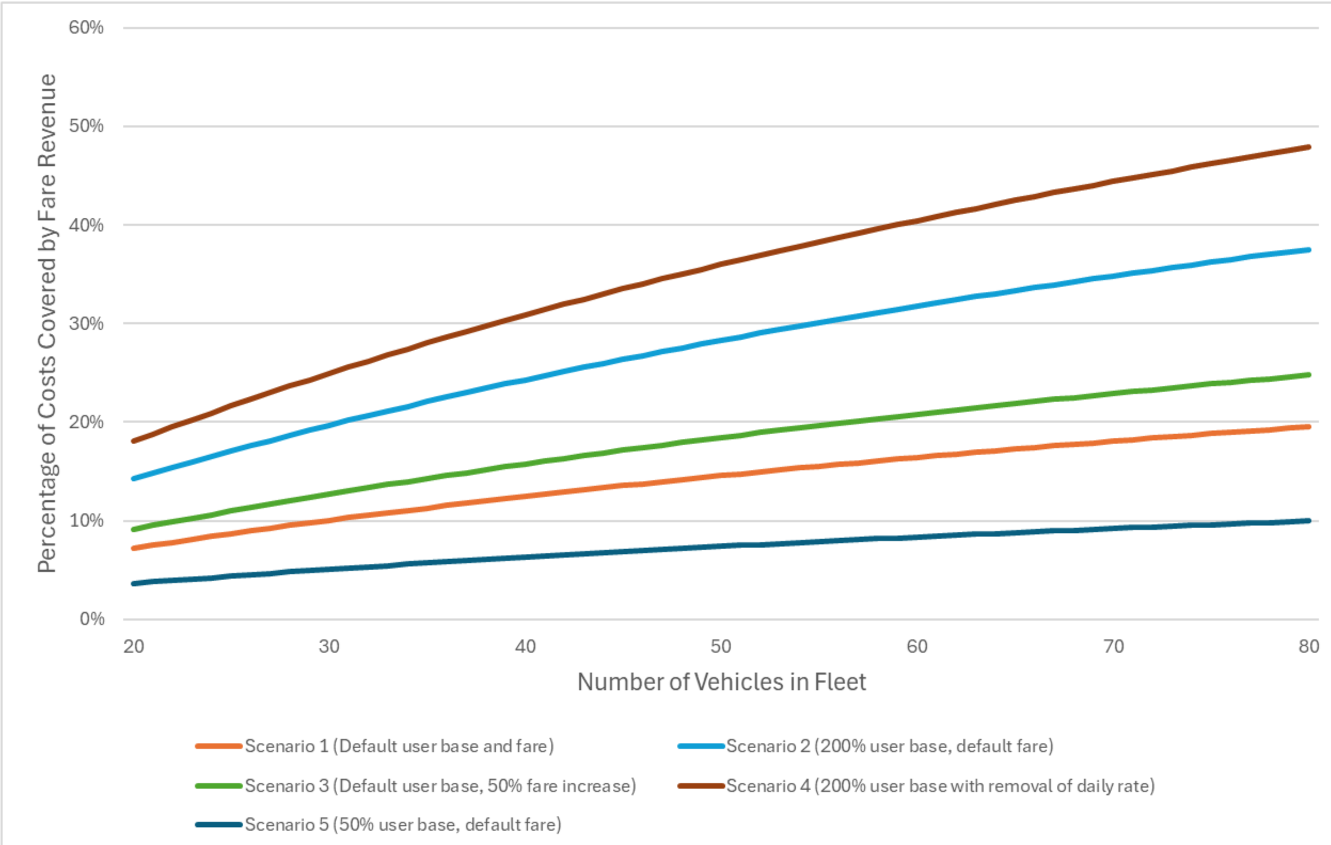

Figure ES 1. Percentage of Costs Covered by Revenue, Scenarios 1-5

The extent to which these scenarios can be implemented, or whether variations or amplifications of factors in a particular scenario may be feasible, depends largely on organizational, regional, and market conditions that likely vary from program to program. Additionally, the model uses static data for operational costs, and changes in fixed or variable costs could significantly affect these results.

The results of the transit comparison show lower The operating expenses per vehicle revenue mile are lower for Míocar than for four transit agencies sampled in this analysis. Míocar shows greater fare revenues per vehicle revenue mile than Kern Regional Transit and Tulare County Area Transit, and lower fare revenues per mile than AC Transit and San Joaquin RTD. In terms of percentage of costs covered by fare revenues, Míocar shows the highest percentage at 13%. This comparison indicates that operating costs and revenues per vehicle revenue mile are similar for Míocar as for some transit agencies, but that its fare revenues offset a considerably higher portion of costs as compared to existing transit in the region. This suggests that while Míocar may require external subsidies to fully offset its operational costs, these subsidies are likely lower than what is required to operate conventional transit service in terms of portion of total costs.

Conclusion

While it appears that operational adjustments can result in fare revenue offsetting a substantial portion of electric carshare operational costs, the cost scenarios suggest that fare revenues from users are likely insufficient to sustain the long-term operations of electric carshare services implemented in underserved and low-income communities. The optimal cost scenario presented in this study suggests that subsidies or other external revenue would need to be at least 52% of operational costs to sustain business operations. We estimate that electric carshare subsidies may range from 60% to 90% depending on fleet size, fare models, organizational structure, and service location.

It is not surprising that the program cannot sustain itself with fare revenues alone given that this type of service is designed as a transportation equity and EV access service rather than a for-profit offering. Electric carshare services that are designed as affordable transportation options in low-income communities are unlikely to be profitable, which may be why the presence of private shared mobility providers is limited in these areas.

Relative to existing transit, electric carshare can achieve a higher ratio of fare revenues to operational costs. This comparison may inform policy considerations such as potential short- or long-term electric carshare subsidies similar to current policies for existing public transit. It may be possible to further offset electric carshare operational costs using alternative revenue models that do not rely on user fares per reservation, but instead involve financial arrangements between the electric carshare operator and affordable housing communities or cities. Our results suggest that to minimize required long-term subsidies, electric carshare operators and prospective carshare communities should carefully consider hub locations, the number of available vehicles per hub, and the expected relationship of carshare demand to these factors over time.

Future studies evaluating the sensitivity of service demand to vehicle availability and hub location in both rural and urban communities may provide valuable data for electric carshare operator and public agency transportation planning and implementation. Future research should also continue to follow the performance of publicly funded EV carsharing, and compare performance, cost-effectiveness, equity outcomes, and climate benefits to other modes that allow for intercity travel. Studying electric carshare operations in different types of communities such as urban, suburban, small town, and rural areas and comparing them to local transportation alternatives to understand where the service is most effective would yield valuable results for policymakers and planners in understanding how to align service structure and features with the specific population density and land use of the operating area.

Contents

Introduction

Transportation access is a significant issue in the US, with few affordable and reliable alternatives to car ownership available (Kawabata & Shen). Simply put, cars are necessary to satisfy basic needs and access opportunities (Blumenberg & Ong 2001; Klein 2020) except for a limited number of cities (e.g., New York City). Mitra and Saphores (2017) found that involuntarily carless households are lower-income, on average, and live in areas with significantly worse transit and walking access. Over the past 50 years, carless households' incomes have significantly decreased, both in absolute terms and relative to households with cars (King et al. 2022).

Carsharing is one promising alternative to improve access among involuntarily carless households (Pan et al. 2022; Shaheen et al. 2019). Among low-income households that suffer from vehicle insufficiency, affordable carsharing is not likely to reduce vehicle miles traveled (VMT) and associated greenhouse gas (GHG) emissions due to latent travel demand. However, affordable electric carsharing may reduce GHGs by replacing conventional VMT with electric VMT, reducing auto ownership levels, and encouraging electric vehicle ownership through carsharing exposure (Rodier et al., 2022c). Historically, commercial carsharing services have concentrated in affluent communities in neighborhoods with high density and transit access (Rodier et al. 2022a). The unsubsidized market costs of commercial carsharing services are cost-prohibitive to many low-income residents of marginalized communities. Recent research on carsharing services finds significant disparities based on race/ethnicity and income (Dill & McNeil 2020; Pan et al. 2022).

California has developed multiple grant programs that fund shared mobility start-ups in underserved communities. The federal government is now beginning to fund similar programs through the Inflation Reduction Act. Evaluation funding for California's implemented programs is limited; however, recent research indicates that low-cost electric carsharing services in low-income rural communities of color can address unmet travel needs, especially for employment, education, and related health destinations, while reducing greenhouse gas emissions (GHGs) through reduced gas consumption (-24%) and auto ownership (-10%) (Rodier et al., 2022b and 2022c).

While several electric carshare pilots in marginalized communities have been funded in recent years, insights into the long-term financial sustainability of these services and cost comparisons to transit are limited. In this study, we use data from a non-profit electric carsharing service that exclusively serves marginalized suburban and rural communities with high rates of carless households and low-quality transit service. The service has operated for approximately five years and is largely funded through climate change investment funds from the California Air Resources Board. In this study, we analyze utilization rates, costs, and potential revenues to provide insights into post-pilot sustainability of the electric vehicle carsharing in marginalized communities. The results shed light on the potential magnitude of costs and the magnitude of subsidies required to provide ongoing support for electric carsharing services in marginalized communities.

Background: The Electric Vehicle Carsharing Service

Míocar is a nonprofit round-trip electric carsharing service that has been operating in California since mid-2019. The service is primarily funded by low-carbon transportation grants through the California Climate Investments portfolio of Greenhouse Gas Reduction Fund programs. Míocar is designed to provide an affordable transportation option in disadvantaged, low-income communities underserved by public transit. Míocar's pricing is standardized across all its locations at $4 per hour or $35 per day, plus an initial one-time $20 application processing fee. Míocar users must be 21 years of age or older, have a valid driver's license, and have a valid debit, credit, or prepaid card. Costs such as insurance and vehicle maintenance are covered by Míocar.

Míocar began in 2019 with eight vehicle hubs hosting 27 electric vehicles an located at rural, affordable housing communities in Tulare and Kern counties in California's Central Valley. Operations in the Tulare and Kern area suffered setbacks due to COVID-19, and pilot funds were exhausted in mid-2022. As a result, nearly all Tulare and Kern electric carsharing vehicles were removed from service.

Another Míocar pilot launched in Stockton as part of the Sustainable Transportation Equity Project (STEP) Stockton Mobility Collective grant, with hubs and vehicle beta-testing beginning in late 2022 and the formal public launch in April 2023. The service expanded to Richmond, California in 2023–2024 with funding from the California Energy Commission and California Climate Investments Clean Mobility Options program, and added a hub in Tracy, California with funds from Clean Mobility Options.

As of March 2024, Míocar had 41 vehicles in its fleet across 9 hubs in Stockton, Richmond, and Visalia, and is continuing to expand in the Stockton and Richmond areas. Míocar is planning to use the funds from Clean Mobility Options and the California Energy Commission to expand its fleet to 81 vehicles in 2025-2026. This will include redeploying 10 vehicles in Tulare and Kern counties, increasing the Richmond fleet from 3 to 14 vehicles, and expanding into Watsonville, California with 8 vehicles. As a service operating in rural and underserved areas, Míocar tends to have a smaller user base than commercial companies in larger and more densely populated locations. However, with individuals in these areas having a lower rate of vehicle ownership and limited access to high quality transit, many Míocar members become frequent users, and some rely on the service as their primary form of transportation. In March 2024, there were 61 active users across the fleet, and each user reserved vehicles 75 hours per month on average.

We have conducted research to evaluate the design and outcomes of Míocar pilots since the initial launch in 2019. Through post-reservation surveys, we found that 63% of the miles traveled by Míocar survey respondents would not have been traveled in the absence of the service. Approximately 20% of the miles traveled by survey respondents would have been traveled with a conventional internal combustion engine (ICE) vehicle in the absence of the service. These results showed that Míocar was significantly improving the mobility of its users, many of whom live in transit-disadvantaged rural areas (Rodier et al., 2022c). In post-reservation and in-depth retrospective surveys, Míocar users also reported that they rarely used the service as a substitute for transit trips and that public transit is not a viable way to make necessary trips. The demand for electric carsharing in rural and disadvantaged areas of California has sparked interest in the scalability and use cases of this type of service, including the optimal size and location of carsharing hubs and the costs and revenues for different operational scenarios.

Methods

Financial Model

We developed a model to assess cost and revenue scenarios for Míocar for different fleet sizes, user counts, vehicle utilization, and per-vehicle operational costs. The model incorporates Míocar's revenue structure to estimate the monthly net operating income for each scenario. This allows us to test the sensitivity of net operating income to increases or reductions in daily vehicle utilization, the size of the user population, and fleet size. Míocar provided the data to support development of the financial model, as described below.

For this analysis, monthly operational cost per vehicle refers to long-term operational costs exclusive of start-up costs, including planning, site acquisition, and acquisition of vehicles and electric vehicle supply equipment (EVSE). Start-up or initial grant funds typically cover these costs. Míocar staff noted that initial start-up costs vary widely depending on location and existing infrastructure and do not reflect the long-term costs of sustained service. The model inputs and outputs are shown in Table 1.

Table 1. List of Inputs and Outputs for Financial Model

Inputs	Outputs
Fleet vehicle count	Demand (hours reserved per month)
Average monthly user count	Monthly fare revenue
Hourly fare rate	Adjusted hourly rate weight (% of usage paying hourly)
Daily fare rate	Adjusted daily rate weight (% of usage paying daily)
Monthly cost per vehicle	Total monthly cost (including electricity)

Monthly net operating income is calculated as monthly fare revenue minus total monthly variable and fixed costs (including electricity). Additionally, the percentage of costs covered by revenue is calculated by dividing monthly fare revenue by total monthly operational cost. The percentage of costs not covered by fare revenue are costs that would need to be offset by subsidies or other revenue sources to allow for sustained long-term electric carshare service.

Data

Data for the financial model includes electric carshare utilization data and service cost data. Both were provided by Míocar. While shared mobility operators are generally protective of the data they provide to external parties, partially due to potential misuse or misinterpretation, we worked closely with Míocar over several years of service operation and evaluation to understand the context of the data and to ensure that the data would be treated securely and appropriately, while protecting the proprietary interests of the organization. The data shared by Míocar provide a rare opportunity to understand at a high level of detail the financial and operational characteristics of a non-profit electric carshare service that serves marginalized communities.

Utilization

As a pilot program, Míocar experienced a ramp-up period in each of its service regions with higher operational costs and lower utilization rates than would be typical for the service in the long term. This includes initial one-time costs associated with vehicle and charging station procurement; costs associated with operations planning, promotional events, and training for new staff; and initially lower utilization rates due to service awareness. Because we sought to understand the relationship between long-term expected service costs, utilization, and revenues, we worked with Míocar to identify an analysis period and dataset most representative of expected future costs and usage. We selected the period from October 2023 through March 2024 as the best service utilization and revenue dataset for this purpose because the Stockton and Richmond sites had achieved steady state operations as of fall 2023, after initial implementation and ramp-up of the services. Míocar provided service utilization data for this period including hours and miles driven, number of trips and users, and activity per hub and regional Míocar location. During this period, 33 unique vehicles actively operated in Stockton, 12 in Richmond, and 2 in Visalia. Due to Míocar's fleet management and vehicle maintenance, these vehicles were not all active at the same time. Stockton had an average of 15 active vehicles per month and a maximum of 18, Richmond had an average of 4 active vehicles per month and a maximum of 5, and Visalia had one vehicle operating at a time.

Table 2 provides a summary of Míocar utilization across the entire fleet of vehicles from October 2023 through March 2024, including reservation hours, miles driven, and revenue rounded to the nearest $100. Vehicles driven refers to the number of unique Míocar vehicles with at least one reservation during the period. This does not include vehicles in the Míocar fleet that were unavailable for reservations due to maintenance or other operational considerations. As of March 2024, the entire Míocar fleet consisted of 41 vehicles.

Table 2. Utilization Summary for Active Míocar Vehicles Across All Locations, October 2023 to March 2024

Month	Reservations	Miles Driven (Rounded)	Reservation Hours (Rounded)	Vehicles Driven	Active Users	Reservation Revenue (Rounded)
October 2023	262	19,300	3,700	13	50	$6,500
November 2023	268	19,600	3,900	17	57	$7,100
December 2023	281	20,300	4,200	18	55	$7,700
January 2024	228	16,800	3,500	20	45	$3,100
February 2024	285	23,000	4,100	19	57	$7,400
March 2024	342	28,200	4,700	24	61	$9,600

Costs

We coordinated with Míocar to obtain and review data related to service costs, including staffing, insurance, software and hardware, marketing, maintenance, and other related costs. Míocar provided us with forecasts of itemized, ongoing annual costs based on past expenses and expected long-term operational needs for its current fleet size of 41 vehicles. We categorized each itemized cost as either a variable cost that is expected to vary by fleet size, or a fixed cost that would remain constant regardless of fleet size.

Table 3 displays the variable versus fixed categorization for each of the cost types provided by Míocar. While certain costs may be partially fixed or partially variable or may not have a linear correlation to fleet size, these classifications are intended to allow for a general estimate of how costs can change based on the scale of the service. Míocar reviewed this approach to ensure that it represents the most detailed separation of cost categories from the available data.

Table 3. Cost Categorization for Míocar Expenses

Fixed Costs	Staff: executive staff, fleet managers and associates, customer support, administrative support
	Overhead: administrative supplies and equipment, marketing and outreach, business licenses and permits, office rent, miscellaneous overhead expenses
Variable Costs (depending on fleet size)	Staff: fleet associate contractors
	Overhead: membership processing, insurance, incidental travel and staff costs
	Operations: fleet-related transportation, maintenance and repairs, towing and recovery, DMV fees, misc. operating expenses

Using these categorizations, the ongoing fixed costs for the current 41-vehicle fleet are estimated to be approximately $630,000 annually. The ongoing variable costs for this fleet are estimated to be approximately $225,000 annually for a total annual cost of approximately $855,000. Converted to a cost per vehicle, this represents approximately $1,740 per month per vehicle in the fleet, not including electricity.[1]

We scaled these costs to estimate per-vehicle costs for fleet sizes from 20 to 80 vehicles. This approach showed that monthly costs ranged from about $3,100 per vehicle for a 20-vehicle fleet, to about $1,100 per vehicle for an 80-vehicle fleet.

Assumptions and Limitations

The study applies various assumptions to allow for cost and revenue analysis using the data available, and we acknowledge certain limitations with this study.

Because Míocar was launched as a pilot program in each of its service areas (described in *Background* above), past operational data may not be indicative of future demand patterns and operational costs. We coordinated with Míocar to determine the most representative data for the analysis, but the usage and costs for long-term carshare service may differ from the currently available datasets. Additionally, each service area has unique characteristics related to land use, available transit, resident demographics, and other factors that may create different demand, cost, and revenue patterns than those presented in this study. We intend this analysis as an example of the cost and revenue relationship for an electric carshare service, and the model does not account for programmatic or geographical factors other than those belonging to Míocar.

The model also serves as a "snapshot" of monthly and annual net operating income and does not incorporate adjustments for inflation, interest rates, electricity rates, insurance rates, or other changes in costs that may occur in a long-term program.

Míocar Fare Structure

Under the Míocar fare structure, reservations are automatically converted to the daily fare when the total hourly fare reaches the daily fare, effectively setting a maximum fare for the day. For example, on a weekday when the daily rate is $35, an hourly reservation (at $4/hour) will be converted to a daily reservation if it lasts longer than 8.75 hours. With an average daily rate of $38 based on interpolating the $35-weekday rate and $40-weekend rate, the average reservation is converted to the daily rate at 9.5 hours.

Based on Míocar utilization data, the duration of reservations is evenly distributed from 1 to 24 hours in duration, such that approximately 40% of reservations have a duration of less than 9.5 hours (0.40×24 hrs ≈ 9.5 hrs), and 60% have a duration of equal to or greater than 9.5 hours. For our analysis, we assume that reservation durations will continue to be evenly distributed. For example, if pricing were to shift such that the

[1] Electricity costs are estimated based on vehicle utilization as part of the financial model. See the *Assumptions and Limitations* section.

hourly rate remained $4, but the daily rate decreased to $28, it would only take 7 hours for a reservation to be converted to the daily rate and we expect that 29% (i.e., [7 hours/24 hours] × 100) of reservations would be under 7 hours. We incorporated this even distribution of reservation durations into the model to estimate hourly and daily revenue changes resulting from increases or decreases in one or both fare rates.

Electricity Costs

Because the model seeks to estimate costs for different fleet sizes and utilization rates, we considered charging electricity cost as a separate variable that is dependent on the vehicle utilization input. For this variable, we used a conservative estimate of 3 miles per kWh for electric vehicle mileage efficiency, based on the published fuel economies of the Nissan Leaf and Chevrolet Bolt, the two most common vehicles in the fleet (EPA Fuel Economy, 2023). For charging rates, we assumed an average electricity cost of $0.37 per kWh, based on Míocar's electricity charging expenses for the service period of October 2023 through March 2024.

Price Elasticity of Demand

The model is designed to estimate the net operating income of different sizes of electric carshare fleets and allows for inputs of price changes to the daily or hourly rate for the service. To account for changes in service demand due to increased or decreased fare rates, we incorporated an elasticity factor into the model based on records of Míocar usage during a period of modified pricing. Míocar offered a 50% promotional discount for all reservations during January 2024, which corresponded to a 16% increase in reserved carshare hours over the average for the two months before and the two months after the promotional period. We calculated the price elasticity as follows:

$$Price\ Elasticity\ e_{(p)} = \frac{\%\ change\ in\ the\ quantity\ demanded\ (\Delta Q)}{\%\ change\ in\ the\ price\ (\Delta P)}$$

Using a ΔP of −50% to reflect the promotional discount and a ΔQ of 16% to represent the increase in reservation hours during the promotional period, this results in a $Price\ Elasticity\ e_{(p)}$ of −0.32. We used this elasticity value in the model to predict how increases or decreases in carshare pricing could correspond with increases or decreases in service demand and revenue. We acknowledge that the data used to calculate price elasticity represents a small sample of reservations relative to all Míocar usage and expect that the elasticity value may change significantly for extreme price changes for different periods of service but consider this promotional period to be the best indicator of price elasticity of demand available from the dataset.

We do not intend the price elasticity of demand variable to represent the price elasticity of demand for electric carshare in general. We use this estimate as a method of accounting for the likelihood that some level of increase or decrease in demand will occur based on changes in price.

Summary of Model Assumptions

Table 4 summarizes the core assumptions used in the financial model to estimate changes in demand and revenue for the service. We base these assumptions on the published Míocar pricing structure, Míocar fare and usage data from October 2023 through March 2024, and the electricity rate and price elasticity methods described in the above sections.

Table 4. List of Model Assumptions

Assumption	Value
Average miles driven per vehicle reservation hour	5.3
Base hours reserved per month per user	67.4
Base hourly fare rate	$4.00
Base daily fare rate (interpolated weekday-weekend rate)	$38.00
Base hourly rate weight (portion of usage paying hourly)	40%
Base daily rate weight (portion of usage paying daily)	60%
Average miles per kWh	3
Average electricity cost per kWh	$0.30
Price demand elasticity factor	−0.32

Comparison to Existing Transit

We compared Míocar to transit agencies operating in the same regions in terms of operational costs, fare revenue, subsidies and the ratios between these parameters. We used the National Transit Database for operational cost data on Kern Regional Transit, Tulare County Area Transit, San Joaquin Regional Transit District (San Joaquin RTD), and Alameda-Contra Costa Transit District (AC Transit). This data was from 2022, the most recent year available at the time of the study, and the data from Míocar was from October 2023. We examined the following metrics for each service:

- annual operating expenses;
- annual fare revenues;
- annual vehicle revenue miles;
- operating costs per vehicle revenue mile;
- fare revenues per vehicle revenue mile; and
- fare revenues as a percentage of operating costs.

Results

Financial Model

We used the model to construct five cost and revenue scenarios as follows:

- Scenario 1, Base case: based on Míocar utilization and revenue data from October 2023 to March 2024;
- Scenario 2, Increased demand: increasing user base to 200% of base case;
- Scenario 3, Increased fare rate: applying 50% increase to base case fare rate;
- Scenario 4, Increased demand and increased fare rate: increasing user base to 200% of base case, and removing the daily rate from the fare structure in favor of the higher hourly rate;
- Scenario 5, Reduced user demand: Decreasing the user base to 50% of base case.

The following sections describe the inputs and outputs of each scenario, followed by a comparison across all scenarios.

Sensitivity of Revenue and Cost to Fleet Size, Base Case (Scenario 1)

We created a base case scenario based on October 2023–March 2024 operations data for the Míocar fleet (Scenario 1). In this scenario, there are 41 fleet vehicles and an average of 54 active monthly users, and Míocar pricing is the default published rate of $4 per hour and $38 daily average (interpolated weekday and weekend rate), as described in Table 4 above. The Míocar dataset shows that users reserve vehicles for an average of 67.4 hours per month per user, and 40% of these hours are charged by the hourly fare while 60% are charged by the daily fare. Using Míocar cost data, the estimated long-term operational cost per vehicle for a fleet of 41 vehicles is $1,740 per month. The results for Scenario 1 show that fare revenues amount to less than 15% of operational cost per vehicle. The monthly net operating income per vehicle for Scenario 1 is –$1,577. The inputs and resulting outputs for Scenario 1 are shown in Table 5 below.

Table 5. Financial Model Results, Scenario 1 (Míocar Fleet October 2023 – March 2024)

Inputs		Outputs	
Fleet vehicle count	41	Demand (hours reserved per month)	3,640
Average number of users per month	54	Monthly fare revenue	$9,260
Hourly fare rate	$4	Hourly rate weight (% of usage paying hourly)	40%
Daily fare rate	$38	Daily rate weight (% of usage paying daily)	60%
Monthly cost per vehicle	$1,740	Total monthly cost (including electricity)	$73,269
		Net operating income per vehicle	-$1,561
		Percentage of costs covered by fare revenue	13%
		Subsidy percentage needed	87%

To understand the sensitivity of revenue and cost to fleet size, we calculated costs and revenues per reservation mile using the Scenario 1 default pricing and utilization structure for fleet sizes ranging from 20 to 80 vehicles. This analysis assumes that the user base would continue to grow at a linear rate with fleet size such that the utilization per vehicle would remain constant at approximately 2.9 hours reserved per vehicle per day.

Figure 1 displays the total monthly cost and revenue under Scenario 1 for fleet sizes between 20 to 80 vehicles. With 20 vehicles, fare revenues account for about 7% of costs. With 80 vehicles, fare revenues account for about 20% of monthly costs, suggesting that about 80% of costs would need to be covered by continued subsidies or alternative revenue sources.

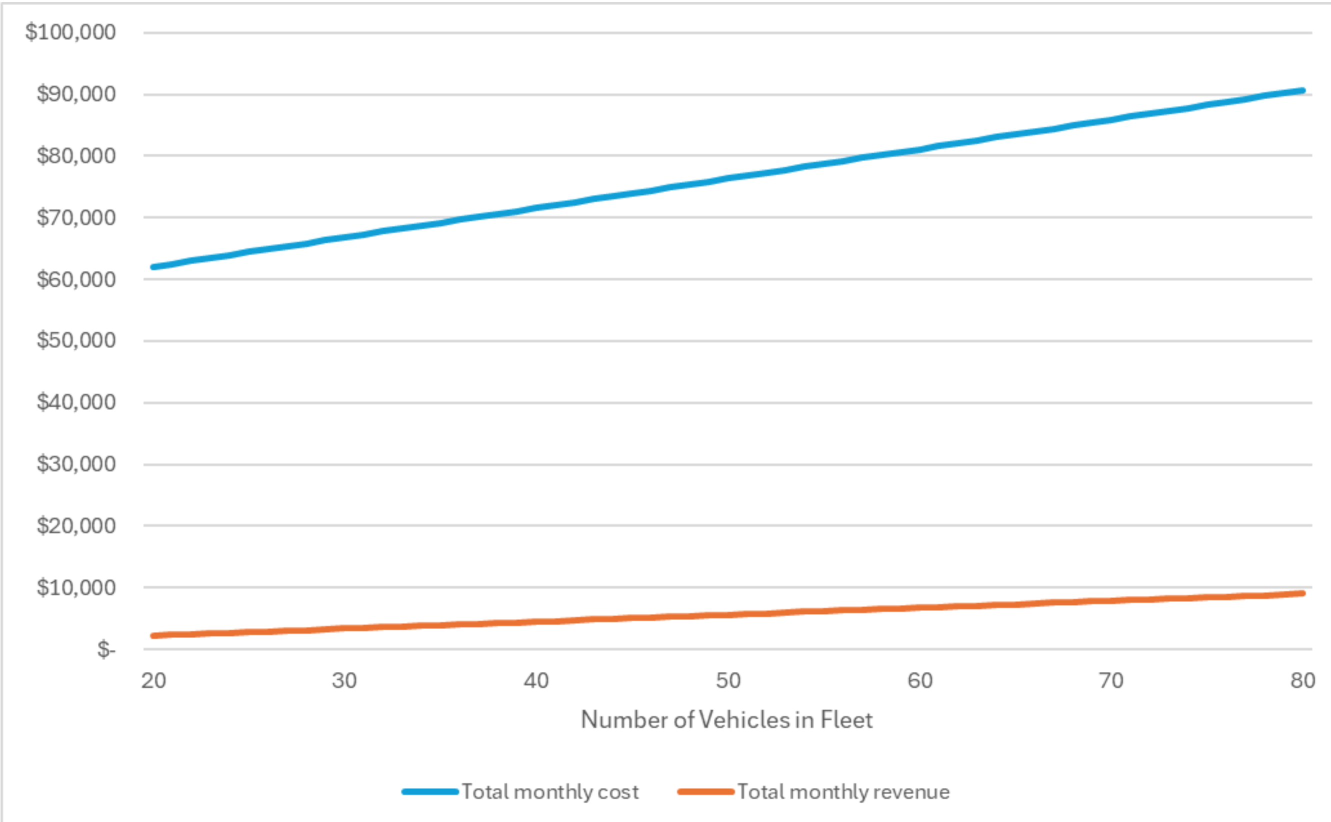

Figure 1. Total Monthly Cost and Revenue for Varying Fleet Sizes, Scenario 1 (Default Pricing and Utilization)

Figure 2 displays the cost per reservation mile and revenue per reservation mile under Scenario 1 for the same range of fleet sizes. Revenue per reservation mile is constant at $0.48. Cost per reservation mile ranges from $6.63 for a 20-vehicle fleet to $2.45 for an 80-vehicle fleet.

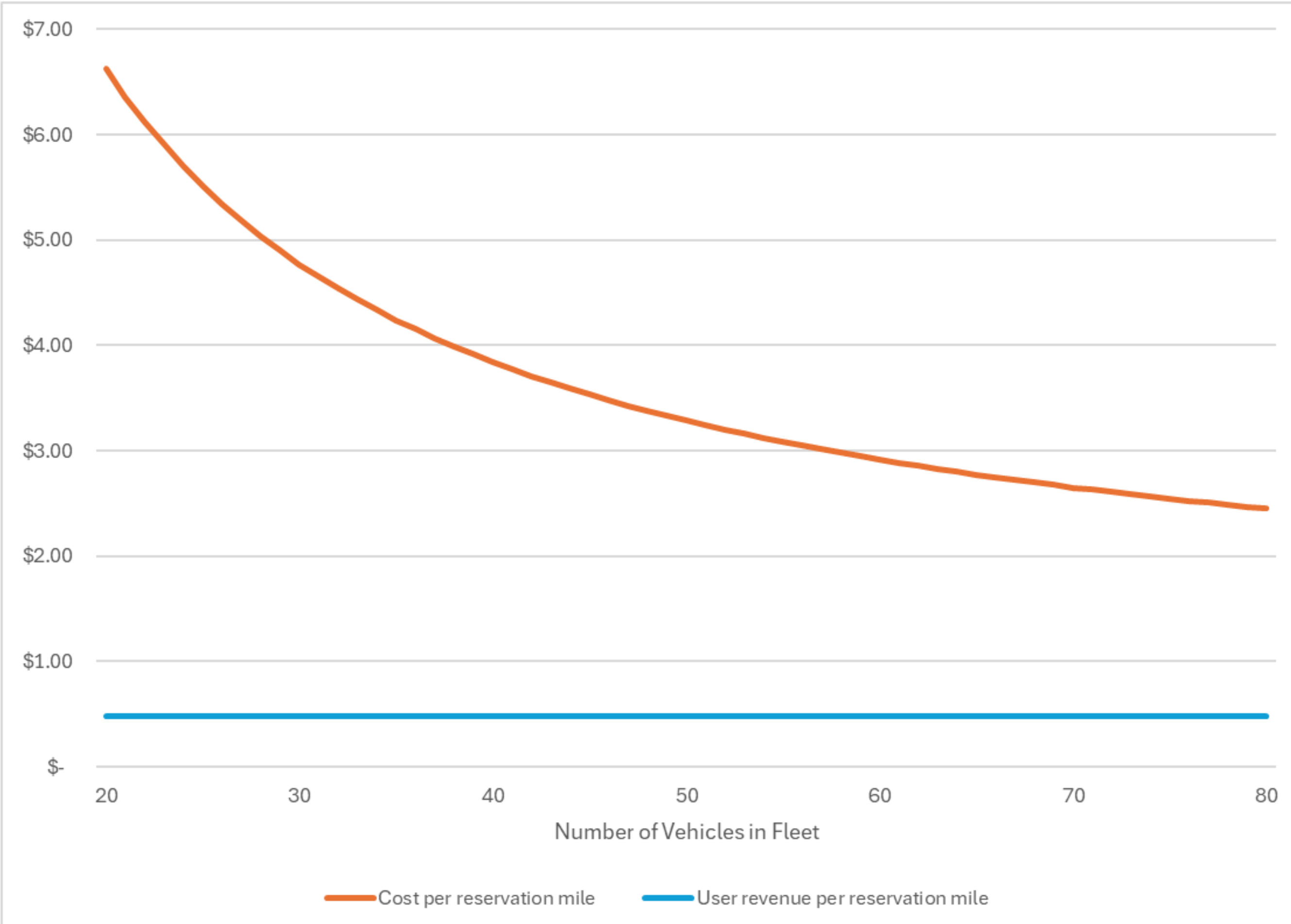

Figure 2. Cost and Revenue Per Reservation Mile for Varying Fleet Size, Scenario 1 (Default Pricing and Utilization)

Sensitivity of Revenue and Cost to Fleet Size, Adjusted Utilization and Fare Rates (Scenarios 2-5)

To understand the sensitivity of net operating income to utilization and pricing factors, we constructed several additional hypothetical scenarios.

Scenario 2: Increased Demand

Scenario 2 modifies Scenario 1 to understand the cost and revenue relationship with an increased user base that could result in greater vehicle utilization. Scenario 2 uses the same fleet size, pricing structure, and per-user demand as Scenario 1, but doubles the user base from 54 average monthly users to 108 average monthly users. As shown in Table 6, fare revenues under these conditions account for about one-quarter of total costs.

Under the structure of the model, the size of the user base has a linear relationship to monthly revenues such that a large enough user base would ostensibly allow revenues to fully offset costs. However, there are real-world limitations that must be considered such as the size of the potential user market, fleet logistics, and potential demand changes resulting from limited vehicle availability.

Table 6. Financial Model Results, Scenario 2 (200% User Base)

Inputs		Outputs	
Fleet vehicle count	41	Demand (hours reserved per month)	7,279
Average number of users per month	108	Monthly fare revenue	$18,478
Hourly fare rate	$4	Hourly rate weight (% of usage paying hourly)	40%
Daily fare rate	$38	Daily rate weight (% of usage paying daily)	60%
Monthly cost per vehicle	$1,740	Total monthly cost (including electricity)	$75,198
		Net operating income per vehicle	–$1,383
		Percentage of costs covered by fare revenue	24%
		Subsidy percentage needed	76%

Scenario 3: Increased Fare Rate

As an alternative to increasing the user base, Scenario 3 below tests the sensitivity of revenue to the Míocar rate structure by increasing the hourly rate by 50% to $6 per hour and increasing the daily rate by 50% to $57 (Table 7). Using the price elasticity of demand assumption of –0.32, this results in a 16% decrease in demand but an increase in revenue from $9,260 in Scenario 1 to $11,652 in Scenario 3. In this scenario, fare revenues account for 16% of costs (an increase from 13% from Scenario 1). This 50% price increase results in fare revenue of $0.72 per reservation mile. If the fleet size is increased to 80 vehicles, the cost per reservation mile is $2.80 with revenues amounting to 26% of costs.

Under Scenario 3, users would pay an average of $3.81 per reservation hour. In effect, Scenario 3 is similar to estimating the demand and revenue that would result from removing the daily rate option from the service and requiring all users to pay $4 per hour regardless of the reservation length.

Table 7. Financial Model Results, Scenario 3 (50% price increase)

Inputs		Outputs	
Fleet vehicle count	41	Demand (hours reserved per month)	3,058
Average number of users per month	54	Monthly fare revenue	$11,652
Hourly fare rate	$6	Hourly rate weight (% of usage paying hourly)	40%
Daily fare rate	$57	Daily rate weight (% of usage paying daily)	60%
Monthly cost per vehicle	$1,740	Total monthly cost (including electricity)	$73,269
		Net operating income per vehicle	–$1,503
		Percentage of costs covered by fare revenue	16%
		Subsidy percentage needed	84%

Scenario 4: Increased User Base and Fare Rate

Scenario 4 considers components of both Scenario 2 and 3 by modifying both the user base and the fare structure (Table 8). In this scenario, the user count is doubled to 108 users and the hourly fare rate is set to the default of $4.00 per hour, but the daily fare rate is removed. In effect, this sets the fare to $4.00 per hour for all reservations, an increase from the $2.54 average hourly fare associated with the default pricing structure. As with Scenario 3, Scenario 4 results in a 16% decrease in reservation hour demand.

Scenario 4 shows a large increase in monthly revenue, which amounts to about one-third (32%) of monthly costs. In this scenario, vehicles are used for an average of 5.8 hours per day and there are about 1.6 users per vehicle, which may be manageable from a fleet logistics perspective. However, there may be challenges associated with successfully recruiting a larger user base for a set number of vehicles. Additionally, as the service is designed to be an affordable option in underserved areas, price increases may be viewed particularly unfavorably and may work against the transportation equity goals of this type of program.

Table 8. Financial model results, Scenario 4 (200% user base and removal of daily rate option)

Inputs		Outputs	
Fleet vehicle count	41	Demand (hours reserved per month)	3,058
Average number of users per month	108	Monthly fare revenue	$23,760
Hourly fare rate	$4	Hourly rate weight (% of usage paying hourly)	100%
Daily fare rate	N/A	Daily rate weight (% of usage paying daily)	0%
Monthly cost per vehicle	$1,740	Total monthly cost (including electricity)	$75,198
		Net operating income per vehicle	–$1,255
		Percentage of costs covered by fare revenue	32%
		Subsidy percentage needed	68%

Figure 3 uses the inputs from Scenario 4 to estimate costs and revenues for fleet sizes ranging from 20 to 80 vehicles. With 80 vehicles, monthly costs are about $95,000 and monthly revenues are about $46,000, meaning that revenues account for 48% of costs. With 20 vehicles in this scenario, revenues account for just 18% of costs.

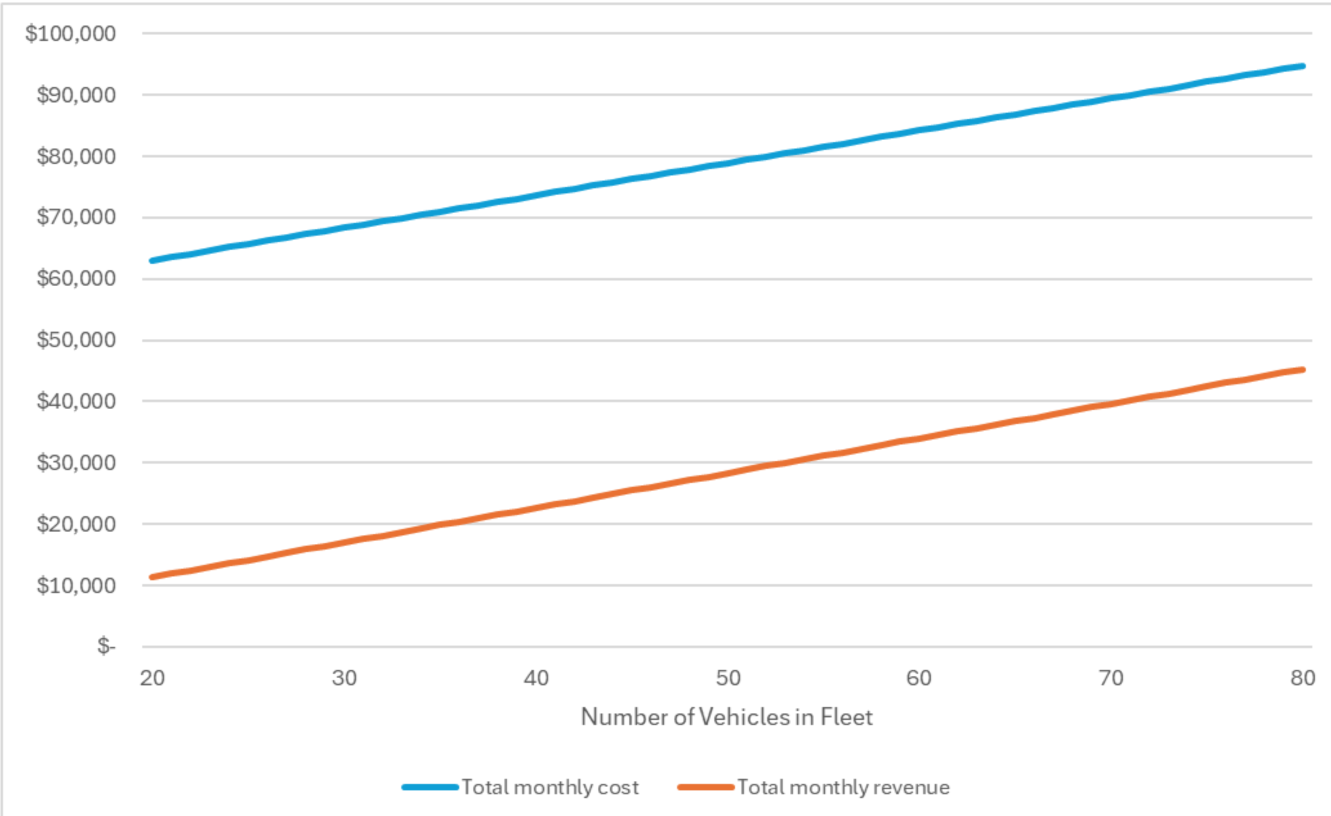

Figure 3. Total monthly cost and revenue for varying fleet sizes, Scenario 4 (Adjusted Pricing and User Base)

Figure 4 displays the cost per reservation mile and revenue per reservation mile under Scenario 4 for varying fleet sizes. Revenue per reservation mile is $0.75, and cost per reservation mile ranges from $3.99 for a 20-vehicle fleet, to $1.50 for an 80-vehicle fleet.

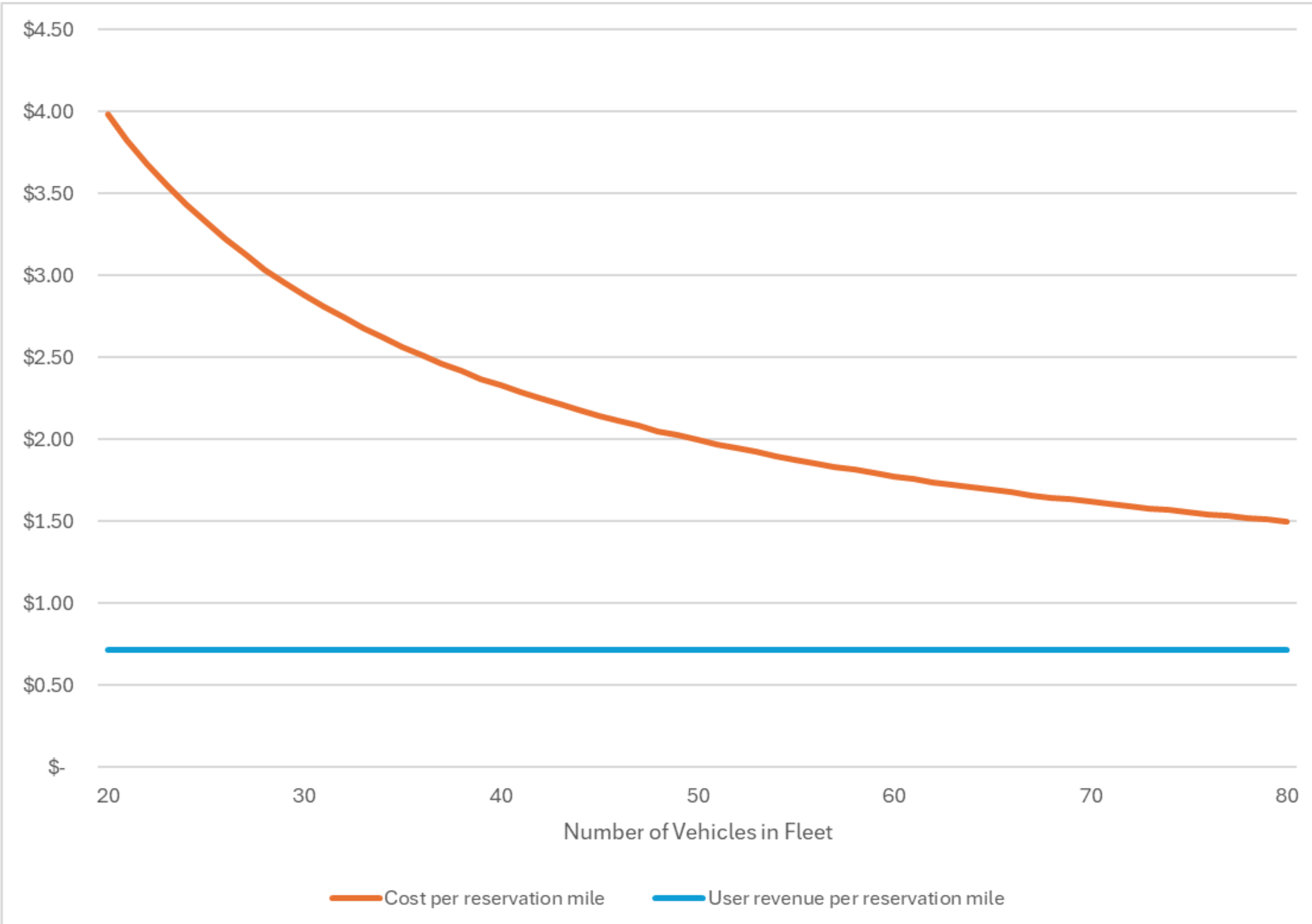

Figure 4. Cost and revenue per reservation mile for varying fleet sizes, Scenario 4 (Adjusted Pricing and User Base)

Scenario 5: Decreased User Base (Underutilization)

To address the possible risks of underutilization for an implemented fleet, Scenario 5 uses default fares but reduces the user base by 50%. As expected, revenues drop significantly in this scenario and account for just 8% of total costs (Table 9). Expanding this analysis to varying fleet sizes shows that with an 80-vehicle fleet, revenues would cover just 10% of total costs in the underutilization scenario. This emphasizes the importance of matching fleet size to the user base and achieving sufficient utilization of the vehicles.

Table 9. Financial model results, Scenario 5 (50% user base)

Inputs		Outputs	
Fleet vehicle count	41	Demand (hours reserved per month)	1,752
Average number of users per month	26	Monthly fare revenue	$5,719
Hourly fare rate	$4	Hourly rate weight (% of usage paying hourly)	40%
Daily fare rate	$38	Daily rate weight (% of usage paying daily)	60%
Monthly cost per vehicle	$1,740	Total monthly cost (including electricity)	$72,269
		Net operating income per vehicle	–$1,623
		Percentage of costs covered by fare revenue	8%
		Subsidy percentage needed	92%

Scenario Comparison: Percentage of Costs Covered by Fare Revenue for Varying Fleet Sizes

Figure 5 displays all of the analyzed scenarios in terms of percentage of costs covered by revenue for fleet sizes ranging from 20 to 80 vehicles. Under the scenarios examined, revenues account for 4% to 18% of costs for a 20-vehicle fleet, 6% to 31% for the current 41-vehicle fleet, and 10% to 48% for an 80-vehicle fleet. Overall, net operating income and percent of costs covered by revenue in these scenarios is less sensitive to price changes than changes in the size of the user base, and the most significant factor is the size of the fleet.

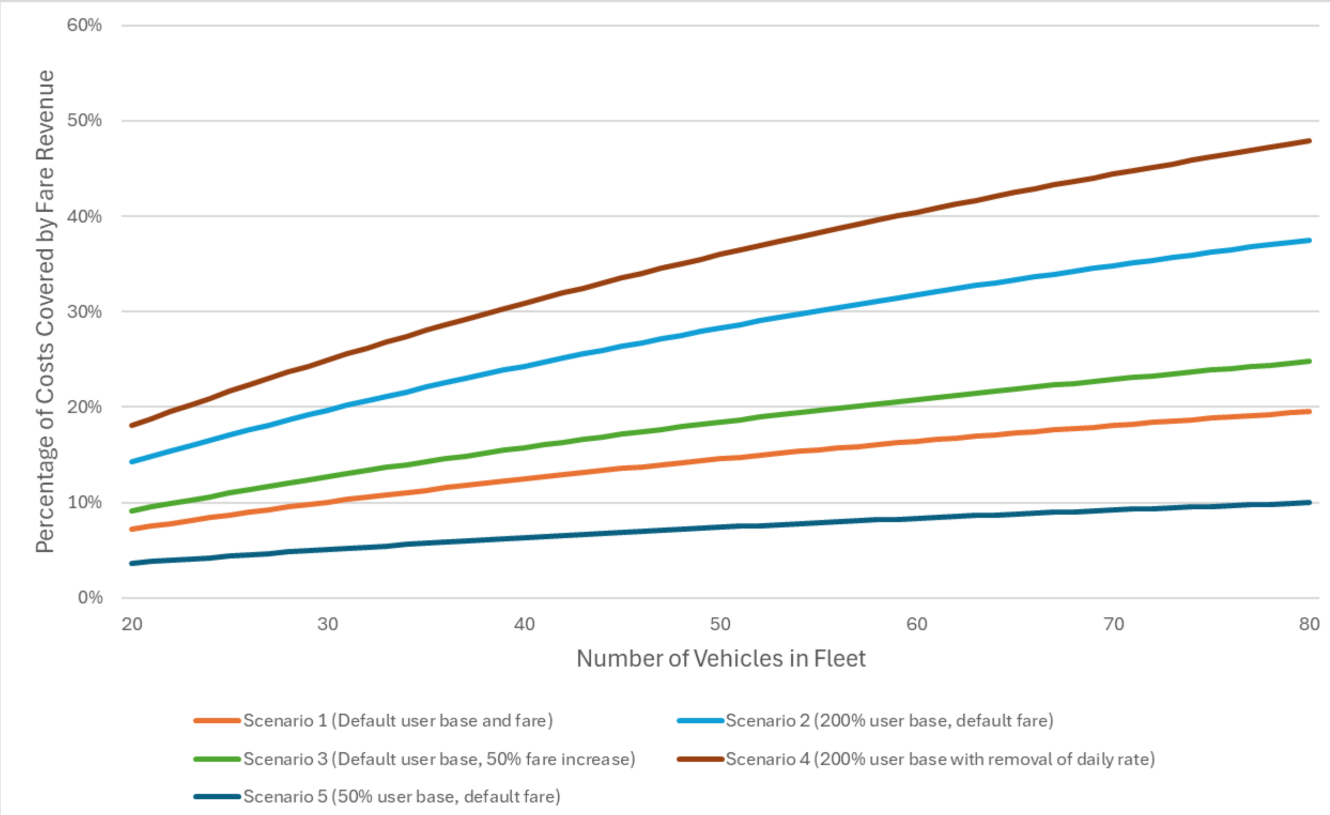

Figure 5. Percentage of costs covered by revenue, Scenarios 1-5

The extent to which these scenarios can be implemented, or whether variations or amplifications of a particular scenario may be possible, depends largely on organizational, regional, and market conditions that likely vary from program to program. Additionally, the model uses static data for operational costs, and changes in fixed or variable costs could significantly affect these results.

Comparison to Regional Transit Costs

We obtained data from the 2022 NTD for Kern Regional Transit, Tulare County Area Transit, San Joaquin RTD, and Alameda-Contra Costa Transit District to understand how the relationship between costs and revenues for transit agencies compare with electric carshare, using Míocar data from October 2023 to March 2024 for comparison.

The results of the transit comparison show lower operating expenses per vehicle revenue mile for Míocar as compared to the four transit agencies sampled for this analysis. Míocar shows greater fare revenues per vehicle revenue mile than Kern Regional Transit and Tulare County Area Transit, and lower fare revenues per mile than AC Transit and San Joaquin RTD. In terms of percentage of costs covered by fare revenues, Míocar shows the highest percentage at 13%. This comparison indicates that Míocar achieves similar operating costs and revenues per vehicle revenue mile to some transit agencies, but that its fare revenues account for a considerably higher portion of costs as compared to existing transit in the region.

This suggests that while Míocar may require external subsidies to fully offset its operational costs, these subsidies are likely lower than what is required to operate conventional transit service in terms of portion of total costs. This comparison uses actual Míocar data and does not incorporate the model scenario changes to variables such as the user base, pricing structure, or fleet size, which if implemented may further increase this difference.

Table 10. Operating expenses and revenues for local transit agencies and Míocar

Agency Name	**Average *Metrics (Transit: 2022 Demand Response and Bus; Míocar: Full fleet, October 2023 – March 2024)***		
	Operating Costs Per Vehicle Revenue Mile	**Fare Revenues per Vehicle Revenue Mile**	**Fare Revenue as a Percentage of Operating Costs**
Kern Regional Transit	$5.62	$0.23	4%
Tulare County Area Transit	$4.56	$0.13	3%
San Joaquin RTD	$15.31	$0.71	5%
Alameda-Contra Costa Transit District	$22.38	$1.76	8%
Míocar (October 2023 – March 2024)	$3.80	$0.48	13%

Conclusion

Several electric carshare pilots have received funding to launch and operate for limited terms of 1-3 years. However, insights into the long-term financial sustainability of these services and cost comparisons to transit have been limited. In this analysis, the net operating income for an electric carshare was most sensitive to the size of the carshare fleet and the corresponding user base. According to our model, operational adjustments can result in fare revenue offsetting a substantial portion of operational costs. However, the cost scenarios suggest that fare revenues from users are likely insufficient to sustain long-term operations of electric carshare services implemented in underserved and low-income communities. The most optimal cost scenario presented in this study suggests that subsidies or other external revenue would need to be at least 52% of operational costs to sustain business operations. We estimate that electric carshare subsidies may range from 60% to 90% depending on fleet size, fare models, organizational structure, and service location.

It is not surprising that the program cannot sustain itself with fare revenues alone given that this is designed as a transportation equity and EV access service rather than as a for-profit offering. Electric carshare services that are designed as affordable transportation options in low-income communities are unlikely to be profitable, which may be why the presence of private shared mobility providers is limited in these areas. Since the introduction of equity-focused programs such as Clean Mobility Options and the Sustainable Transportation Equity Project, shared mobility services in underserved areas have been supported significantly by state grant programs, and Míocar has historically focused on providing low-cost transportation in underserved areas with limited transit service rather than seeking profitability through a more costly user pricing structure.

Relative to existing transit, electric carshare can achieve a higher ratio of fare revenues to operational costs. This comparison may inform policy considerations such as potential short- or long-term electric carshare subsidies similar to current policies for existing public transit. This is particularly applicable to underserved areas, where common low-density development patterns make fixed-route transit and non-zone based microtransit very expensive to provide.

It may be possible to further offset electric carshare operational costs using alternative revenue models that do not rely on user fares per reservation, but instead involve financial arrangements between the electric carshare operator and affordable housing communities, cities, or healthcare providers who may be interested in promoting the service as a means to access medical appointments, for example. For example, a housing developer paying a subscription for electric carshare hubs could allow its residents to use the service at no cost or at a reduced cost, while ensuring revenue for the carshare operator and potentially attracting residents to a new or underutilized housing development.

To minimize required long-term subsidies, the results of this analysis suggest that electric carshare operators and prospective carshare communities should carefully consider hub locations, the number of available vehicles per hub, and the expected relationship of carshare demand to these factors over time. Inefficient fleet deployment and underutilization of vehicles can greatly decrease fare revenue and increase reliance on subsidies and other forms of funding.

Future studies evaluating the sensitivity of service demand to vehicle availability and hub location in both rural and urban communities may provide valuable data for electric carshare operators and public agency transportation planning and implementation. Future research should continue to follow the performance of publicly funded electric carsharing and compare performance, cost-effectiveness, equity outcomes, and climate benefits to other modes that allow for intercity travel. Studying electric carshare operations in different types of communities such as urban, suburban, small town, and rural areas and comparing them to local transportation alternatives to understand where the service is most effective may yield valuable results for policymakers and planners.

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