

Mobility Justice in Rural California: Examining Transportation Barriers and Adaptations in Carless Households

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A Research Report from the National Center for Sustainable Transportation

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16. Abstract This report describes the scope and scale of car access in rural areas, identifies barriers that rural zero-car and car-deficit households face in their mobility and access, and proposes personal and policy-level adaptations that would help these households achieve their mobility and access needs using descriptive analysis from US census microdata and interviews with 22 residents of California's Central Valley. Results indicate that 5% of rural residents are fully carless and 18% live in a car-deficit household with less than one vehicle per adult. Both zero-car and car-deficit households tend to be in the Central Valley. Zero-car and car-deficit households in rural areas tend to be more socioeconomically disadvantaged than in nonrural areas. Both groups earn lower household incomes, are more likely to be Black, Latino, or Asian, have lower educational attainment, have more disabilities, have higher housing-cost burdens, and are more likely to be unemployed than their counterparts in nonrural areas. Almost half of workers in rural zero-car households drive alone to work compared to about a quarter in nonrural zero-car households, while mode shares are similar for car-deficit and car fully equipped households. Rural zero-car households are more likely to carpool and far less likely to take public transit. Three major themes emerged from the interviews. First, a commonality uniting the interview participants was the practice of relying on their social networks to get rides or obtain vehicle access. Second, the cost of car ownership and operation was high, placing vehicles out of reach for many. Third, alternatives to car access included public transit, medical transportation services, and car sharing, but poor availability often caused individuals to forgo trips. Interview participants shared a variety of options they saw as solutions to overcoming their barriers to lack of car access. While obtaining a vehicle was not absent from their preferred solutions, most preferred better personal access to transportation without the burden of private car ownership. The findings from demonstrate some of the complexities to consider when addressing transportation barriers in rural areas, where carlessness is less prevalent but solutions may be harder to implement than in urban areas.			
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EXECUTIVE SUMMARY

Rural households face significant challenges to accessibility and mobility because of distant destinations and more dangerous roadways relative to their urban counterparts. These challenges are exacerbated when households lack regular access to a car as public transit is rare, on-demand transportation can be expensive, and pedestrian and cycling conditions are poor. To understand the challenges to improving mobility options in rural areas for those without a car, this report addresses three main questions: (1) What is the scope and scale of rural car access in California? (2) What burdens do carless rural households face with respect to mobility and accessibility? (3) How do rural households adapt to the lack of a household vehicle to meet their transportation needs? The report shares findings from US Census microdata to describe socioeconomic and mobility characteristics of carless households and residents in rural California relative to other households and reveals evidence on rural-nonrural disparities in transportation barriers and adaptations among carless households and residents in California. Building upon the evidence from the descriptive analysis, we also report findings from interviews with 22 individuals from zero-car and car-deficient households in California's San Joaquin Valley to understand their current and preferred travel, transportation burdens, and travel adaptations.

The study results reveal a deeper understanding of rural transportation needs for the communities and populations with a large degree of disadvantage in a less-studied land use context. In rural California, 5 percent of people live in zero-car households, and 18.0 percent of the households are in a car-deficit status, having fewer cars than adults. Rural zero-car and car-deficit households and residents tend to be socioeconomically disadvantaged to a larger degree relative to their nonrural counterparts. Rural zero-car households earn about 40 percent less (\$33,808 vs. \$46,493), and rural car-deficit households earn about 30 percent less (\$73,224 vs. \$94,983) than their nonrural counterparts. People who identified as Black or African American, Hispanic or Latino, and Asian make up 45 percent of rural zero-car residents, and 61 percent of rural car-deficit households, while this number drops to 38 percent of their car-fully equipped peers in rural California. People with a high school degree or less make up 81 percent of rural carless residents, compared to 79 percent of their nonrural carless peers, although they only account for 49 percent of the general population statewide.

Rural residents also face greater mobility barriers and challenges compared to their nonrural counterparts. Compared to their nonrural residents, rural zero-car residents are much less likely to use sustainable modes. For example, rural residents in zero-car households use the bus 6 times less often, subways/rail 26 times less often, and bicycling 1.3 times less often than nonrural residents. Rural car-deficit residents are less likely to ride buses (3.5 times less), subways or rail (13.5 times less), and taxicabs (4 times less) than their nonrural peers.

Interview participants lived in Visalia, Biola, Farmersville, Fresno, Le Grand, Merced, and Woodlake, and identified primarily as Latina/o, Hispanic, or Mexican. About a quarter did not own a vehicle. In the previous week, most had gotten a ride somewhere rather than drive themselves and indicated they would have significant challenges in dealing with unexpected transportation costs. Three significant themes emerged from the interviews. First, those without ready access to cars relied on family and friends to get rides or to borrow a car. The sense of community was evident in the sharing of resources, but there were often stressful negotiations in obtaining vehicle access—especially in a time of high gas prices as was the case during the interview process. Second, travel expenses were one of the most significant factors in why those without cars did not have one. Initial vehicle purchase costs, maintenance, the cost of gas, and costs of private transportation options like taxis and rental cars were all significant barriers in getting around. Third, multiple other barriers were common to getting around. Other barriers to getting around included inadequate public transit and limitations in using medical transportation services or paratransit, resulting in many missed or forgone trips.

Interview participants offered several solutions to overcoming transportation barriers. Overall, the sentiment was not for more or easier car ownership, but for transportation alternatives that would provide them access on their own terms without requiring a privately owned vehicle. Community-oriented solutions like van services to popular shopping locations and more flexible medical transportation were commonly sought. Employer-organized transportation for farmworkers was also seen as an important solution. Alternatives to private car ownership like better bus service, on-demand ridehailing and delivery, and car sharing would also fill access gaps. Electric vehicles were seen as a way to minimize maintenance and gas costs, though high prices remained as a barrier to purchase. Finally, interviewees called for better engagement from political leaders where they would experience the challenges that low-income travelers face daily.

The findings from demonstrate some of the complexities to consider when addressing transportation barriers in rural areas, where carlessness is less prevalent but solutions may be harder to implement than in urban areas where density and population size can afford investment in traditional mobility options that work better at scale, like public transit, paratransit, and active transportation infrastructure. The effort to reduce GHG emissions while providing access will have to come from transformation in the transportation system. Policy should focus on increasing community power in needs assessment and decision making around what transportation options should receive investment, additional investment in alternatives to private vehicle ownership, robust support of specialized transportation services, innovations in transit service and operations, and continued funding for electric vehicle purchases and the development of charging infrastructure in disadvantaged communities.

Introduction

A transition to a more sustainable transportation system that supports multi-modal and clean transportation options in rural and urban fringe areas is fraught with difficulty. Public transit is rare or non-existent and distances to essential destinations are large, making car use practically a necessity. Nearly all rural households have cars, and rural residents make fewer trips but for longer distances by car compared to residents of other neighborhood types, reflecting lower access to destinations (1, 2). However, people in zero-car rural households make fewer trips over shorter distances than people in rural households with at least one car, but make more and longer trips than urban zero-car households. These differences may reveal a higher degree of disadvantage for households without ready vehicle access, corroborated by research in Australia showing that rural residents were more likely to report not being able to do activities because of transportation challenges—even for households with cars (3). Moreover, rural areas may be left behind by a clean vehicle transition: residents of disadvantaged communities are much less likely to purchase electric vehicles, for example (4).

The car-centric nature of rural areas also has significant safety implications for drivers and non-motorists alike: In 2018, 45% of all traffic fatalities occurred in rural areas despite housing only 19% of the population and accounting for 30% of vehicle miles traveled (5). Rural areas have the highest death rates per capita from motor vehicle incidents when compared to urban and suburban areas (6). Rural counties are also the least likely to implement pedestrian and bicycle projects (7). In California, more than a quarter of rural census tracts have CalEnviroScreen scores in the 50th percentile or greater, the vast majority of which are in California's San Joaquin Valley. Poor air quality places cyclists at greater risk than drivers (8), creating another hurdle to a transition away from driving.

The risks are borne disproportionately by people who do not have access to a household vehicle. Although the vast majority of rural households in California own vehicles, 3.4%—over half a million—do not. An additional 6.3% of households in urban clusters of less than 50,000 residents are also carless.¹ These snapshots from the US Census reflect only a glimpse of the true picture of vehicle access. Longitudinal studies show that the nature of car ownership is not static; low-income families, people of color, and immigrants transition into and out of carlessness frequently and are less likely than others to have a car in any single year (9). According to Census public use microdata, rural households without cars are on average poorer than urban carless households,² and those who are unable to own a car have much more limited mobility than those who choose to be carless (10). However, certain households without vehicles have adapted to carlessness, achieving mobility without resorting to the purchase of vehicles. Mexican immigrants, for example, rely on social networks to get rides and to borrow and share vehicles (11, 12). Similarly, in car-deficient households, defined as those households with fewer than one car per driver, there may be significant negotiation among

¹ Authors' calculations from 2015-2019 American Community Survey (ACS) Public Use Microdata Sample (PUMS) data.

² Authors' calculations from 2015-2019 ACS PUMS data.

household members to ensure adequate mobility for daily needs. While previous research has evaluated barriers to transportation access in rural areas, much of this work focuses on access to healthcare or on broad conditions and policy approaches related to travel challenges. Yet little is known, in rural settings, about who does not own a household car and whether and how rural carless households manage to meet their daily essential travel needs.

This study asks the following research questions:

1. What is the scope and scale of car access in rural California?
2. What are the barriers that zero-car or car deficient households face in rural California?
3. What adaptations do zero-car and car deficient rural households make to meet their travel needs?

The study begins with a quantitative characterization of the rural zero-car population in California, followed by a qualitative evaluation of the travel burdens faced by households without cars in the rural San Joaquin Valley of California. The qualitative analysis examines the barriers that individuals face and the adaptations they adopt to achieve mobility and access needs. Qualitative research in transportation can interrogate the ways that identity intersects with structural conditions to create barriers in which the transportation system is central, but for which the usual methods of transportation provision and policy may not be the best solution to help overcome those barriers (13–15). Thus, this mixed-methods study not only reveals evidence on rural-nonrural disparities in car access and equitable services, but also sheds new light on barriers and adaptations of rural residents who have limited or no car access. The study results identify the targeted rural communities and population groups for and recommends future policy and funding interventions to advance rural transportation systems and services, improve sustainability in rural California, and address rural mobility inequity concerns.

The remainder of the research report is organized into the following five sections. We start with a review of the literature on socioeconomic and mobility disparities by varying degrees of car access and rural-nonrural disparities in mobility. We then introduce the data and methods adopted. In the results section, we present and interpret mobility inequity and injustice concerns as a consequence of household car access statewide, report the scope and scale of rural car access in California, reveal rural-nonrural disparities in socioeconomic and mobility characteristics among carless households, and summarize the interview results with rural carless participants which further provide evidence on transportation barriers and challenges that rural carless households face in meeting their daily essential travel needs. We also apply data visualization to present the identified patterns of rural-nonrural disparities and highlight rural California communities in great need of policy and funding interventions. We then in the policy implications and conclusions sections, discuss policy suggestions for improving rural car access, accessibility, and equity.

Literature Review

Car Access: Definition, Scope, and Scale

Sprawling development patterns in the US make private vehicles practically a necessity. US households on average own just under 2 vehicles per household, and US residents make 78 percent of their daily miles traveled and more than 80 percent of trips by cars (16). Although 91 percent of US households own a private vehicle, about 9 percent, or more than 10 million US households, do not (16). And yet car access is still an important component of daily mobility for this group of households, as they still make about one-fourth of their trips by car. These patterns signal that car access is not a binary characteristic but is a matter of degrees. Scholars have created a typology that groups households into zero-car, car-deficit, and car-fully equipped households, defining zero-car households as those owning no cars, car-deficient households as those owning fewer than one household car per driver, and car-fully equipped households as those owning at least one car per driver (17, 18).

Despite owning no cars, car trips still make about one-fourth of the total trips made in zero-car households (10). This difference between car ownership and access to car trips among those without ready cars may signal the limitations of using car ownership to quantify the scope and scale of car access. As a matter of fact, these car trips made by zero-car households do not usually represent car ownership, but are outcomes of car-sharing, pooling, borrowing, and getting rides instead (11). In the US, more than 12 percent of US residents who do not own a car, use ride-hailing services, while less than 10 percent of the general population do so (16). In California, zero-car households make 90 percent of their trips are by carpooling; and zero-car residents are 4 times more likely to hold a car-sharing membership than the general population (18). In addition, findings through interviews and surveys further reveal, that zero-car residents frequently get rides and borrow cars from family, coworkers, and friends for car trips (11).

Who Does Not Have a Household Car?

Income and Financial Constraints

Income and financial status appear to be the primary predictor of household car availability and degrees of car access. In the US, about 40 percent of those households earning \$5,000 or less do not own a car, while this number drops to less than 2 percent as incomes reach to \$50,000 and above (19). In California, more than 75 percent of those without an available car earn \$35,000 or less, relative to less than 30 percent of the general population; moreover, although about 25 percent of the households earn an income of \$100,000 or above, less than 3 percent of zero-car households do so (17). Moreover, challenges and barriers of owning a household car facing low-income households, are further exacerbated by disproportionately high automobile insurance rates as a consequence of discriminatory practices or redlining factors (20).

Household car access also tends to fluctuate as incomes rise and fall, at a particularly high rate among low-income households. A longitudinal study using the data between 1999 to 2011 shows that nearly 50 percent of families in poverty transitioned into and out of carlessness at

least once, compared to 23 percent of all families (9). Moreover, as incomes increase, low-income households are more likely to transfer out of carelessness and purchase a vehicle than their middle-income counterparts (9, 19). Findings from the interviews with 30 residents in Maryland and Virginia suggest that subsidizing car ownership for low-income residents not only improves their mobility but also offers an affordable alternative in getting around (15). In addition, the confluence of vehicle access and financial status appears to be significant. Using data between 1969 and 2013, the study suggests that families with at least one car earned 13 percent more (\$54,992 vs. \$62,187), while those families without ready cars earned 35 percent less in the study period (\$26,492 vs. \$17,237) (21).

Race, Ethnicity, and Nationality

Car access constraints also disproportionately arise among those who face other types of disadvantages, including those associated with individual identities like race, ethnicity, and nationality. Black and African American and Asian populations are less likely to own a private vehicle, even after controlling for incomes (19). In California, relative to the general household, those headed by Black or African American (2.8 times) and Hispanic populations (1.7 times) are more likely to be carless, while the households headed by their White peers are 1.4 times less likely to be carless (17). Similarly, the households headed by Asian populations are 1.3 times more likely to remain in a car-deficit status the general household in California (17). Moreover, Black families are more than twice as likely as white families to transition into and out of carelessness, and similar patterns exist among immigrants (9). Existing disparities in car access by race, ethnicity, and nationality are not only driven by individual-based characteristics but also consequences of race-based discriminations in car loan programs and automobile insurance rates (20).

Other Associations

Car ownership is also influenced by many other factors, such as gender, age, disability status, and living arrangements. In general, prior findings reveal that the presence of children and homeownership are positively associated with one's status of owning a household, while population density and urban status are negatively associated with household car availability, after holding other factors constant (17, 19). In California, compared to the general household, those with a disabled member, are 2.2 times more likely to be carless, while households living in rural settings are 2.6 times less likely to be carless (17). Moreover, obtaining or shedding car access is also driven by life events (14). Coupling, graduating from college, or presence of a child, are often associated with increased car access, while moving to a densely populated and/or transit-rich neighborhood leads to decreased car access (14).

How Do People without a Car Get Around?

Existing literature on how carless individuals meet their daily travel needs centers around the potential of new mobility services such as carpooling and carsharing in advancing mobility, the role of alternative modes plays in promoting sustainability, or the mobility barriers and challenges that zero-car and car-deficit households face when alternatives are not available or are financially or physically unavailable.

Zero-car households, by definition, do not own a car. And yet, car access remains an important component of their daily mobility. Zero-car households make about 25 percent of their total trips by car (10). However, such a relatively large share of car trips made by zero-car households does not represent their access to a household car, but increased access to shared mobility through car-pooling or car-sharing services provided by commercial operators, such as Zipcar and Car2Go, through ride-hailing services, such as Uber and Lyft, or through informal sharing options. The 2017 NHTS summary report reveals that 12 percent of zero-car residents use ride-hailing services. In California, zero-car households make 90 percent of their trips by car-pooling; 4 percent of zero-car residents hold a car-sharing membership compared to 1 percent of the statewide average (18). Moreover, ride-hailing usage in car-deficit households tends to be higher than that in car-fully equipped ones (22), suggesting the role of ride-hailing services eases negotiations among household members in who do not have sufficient household vehicles.

Although shared mobility brings notable benefits in addressing travel barriers, high costs of using those services also pose additional financial burdens to zero-car households, yielding more multimodal behavior. Zero-car residents tend to use a wide range of transport modes and rely more heavily on alternative modes than their peers. Not owning a car, almost 80 percent of zero-car households in California, use transit, walk, or bike to meet their travel needs, compared to nearly 10 percent of their counterparts who have a car (10). Even for trips longer than 15 miles, about 50 percent of zero-car households take public transit, while less than 4 percent of their peers do so (10).

However, not all zero-car households are same. Zero-car households are heterogenous not only in their motivations for continuing to not own a car, whether forced by external constraints or for car-free lifestyles (18), but also in their living environments, such as the availability, affordability, and quality of alternative services. Consequently, zero-car households take fewer than half as many trips and take trips that are less than half as far as households with at least one car, and they spend about 40 percent more time traveling than their peers with car access (10). Similarly, car-deficit residents travel half as far each day compared to their car-fully equipped peers (23). However, car-deficit households in California generated about 10 percent more person-miles traveled than their car-fully equipped peers (63.4 vs. 57.0 miles), suggesting significant car-sharing, car-pooling, and coordinated use among household members navigating insufficient and shared household vehicles (24).

Rural–Nonrural Disparities in Mobility

The confluence of place and individual characteristics, such as living in a rural area without a car, poses additional constraints on the ability to travel how, when, and where a person wants to. Intuitively, rural residents face significant challenges to accessibility and mobility because their destinations are usually distant compared to their urban peers. Those challenges are exacerbated when one lacks car access as alternative services is rare and transportation infrastructure is poor, as is more likely to be the case in rural areas.

Rural-nonrural disparities not only exist in car access but also in socioeconomic characteristics of those not owning a household car and transportation adaptations to being carless. Although 9 percent of US households do not own a car, only 7 percent of rural households are carless (2017 NHTS Summary Report). Moreover, compared to their nonrural counterparts, rural zero-car households experience significant travel burdens and barriers exaggerated by longer travel distances and fewer transportation options in dispersed living environments. In rural settings, public transit is rare or non-existent, making it difficult or impossible for rural carless households to rely on such services (13, 15, 24, 25). Long distances between homes and destinations also make using such services challenging (26). Limited alternative modes leave rural zero-car and car-deficit residents even more vulnerable in meeting their essential daily travel needs (10, 26).

Consequences of rural-nonrural disparities in mobility can be significant. Extensive car usage and long travel distance in rural areas is associated with disproportionately high traffic fatalities compared to urban area. About 45 percent of nationwide traffic fatalities occurred in rural areas despite housing less than 20 percent of the population and accounting for 30 percent of vehicle miles traveled; the fatality rate in rural areas was twice as high as in urban areas (5). At the same time, the low level of mobility and accessibility that rural residents face leads to decreased out-of-home activities, reduced job opportunities, and delayed or reduced medical care (including missed appointments) (3, 27–30). Moreover, relative to their urban peers, rural residents travel two-to-three times farther to meet their medical specialists, and rural children with special healthcare needs are less likely to meet their appointments due to travel difficulties (31, 32). Yet rural mobility burdens and barriers are often not evenly distributed among residents. Disadvantaged populations, including people of color and immigrants, elderly populations with declining health status, and people not owing a household car are disproportionately impacted (27–30).

Thus, policy interventions on improving mobility, sustainability, and equity, should not only build on the individual-based and place-based characteristics associated with car access, but also be driven by evidence on the extent to which the confluence of socioeconomic factors and living environments contributes to mobility challenges and barriers facing disadvantaged populations and communities. In other words, because the scope and scale of car access vary by urban status and population density, efforts to improve sustainable transportation options could lead to disproportionately adverse effects to those who remain underserved by current transportation systems if they do not account for these built form characteristics. Future research efforts on the topic are much needed, and identifying and quantifying rural-nonrural disparities in car access and modal shares are one step in doing so.

Data and Methods

We designed a mixed-methods approach to answer the three research questions posed in this study. The following sections detail the quantitative methods used to describe the scope and scale of car access in rural California, and the qualitative methods used to describe the barriers and adaptations to car access.

Quantitative Data and Measurement Indicators

We used the 2019 American Community Survey (ACS) 5-year Public Use Microdata Sample (PUMS) and the spatially aggregated 2019 ACS 5-year data to identify rural–nonrural disparities in socioeconomic and mobility characteristics as a function of car access. We obtained the data through US Census Application Programming Interface (API)³. The PUMS sample contains information about individual and household characteristics, including race and ethnicity, nativity, household income, household composition, housing tenure, employment status, disability status, and commute mode to work. We calculated the degree of financial burden a household faces using data on home and utility costs relative to household income. These socioeconomic and mobility indicators from PUMS allowed for detailed cross-tabulations at the individual or household level by car access. The spatially aggregated ACS data at the census tract level was used to define and distinguish rural and nonrural environments.

The measure of car access in this study is derived from previous research that developed such a typology (17, 18). The car access indicator is measured at the household level and is calculated as the number of household cars available⁴ per adult (person aged 18 or older). Households with no cars are referred to as zero-car households. Households with fewer cars than adults are referred to as car-deficit households. Households with at least one car per adult are referred to as car-fully equipped households.

The analysis requires an indicator defining rural areas. PUMS data used in the descriptive analysis is available at the Public Use Microdata Area (PUMA) scale—large areas of geography consisting of at least 100,000 people. PUMAs thus cover a broad range of land use types, sometimes mixing rural and nonrural areas within the same geographic region. Thus, a rural–nonrural indicator is not available in the PUMS data. To overcome this limitation, we calculated the degree of rurality for each PUMA from census-tract ACS population estimates to derive a rural–nonrural classification. We used the 2019 ACS 5-year data at the census tract level to collect the variables of the rural population, the urban population, and total population. We then conducted a spatial join and merged geographies by assigning a census tract to a PUMA if the centroid of the census tract fell within the boundaries of its corresponding PUMA. We then aggregated the rural population and the total population from the census tract level to the PUMA level. Lastly, we calculated the percentage of the rural population living in each PUMA as an indicator of rurality. We classified PUMAs as rural if at least 10 percent of the residents lived

³ US Census Available APIs: <https://www.census.gov/data/developers/data-sets.html>

⁴ The American Community Survey asks the following question about car access: “How many automobiles, vans, and trucks of one-ton capacity or less are kept at home for use by members of this household?”

in rural census tracts. Using the 10 percent as the threshold distinguishing rural–nonrural disparities is appropriate as it represents the approximate statewide average rural population measured by US Census. In choosing the threshold of defining rural California, we also conducted a sensitivity analysis by comparing a threshold of 10 percent rural residents with a threshold of 50 percent rural residents. The results indicated that a 50 percent threshold captured only about 1.5 percent of the statewide population (507,928 out of 36 million) living in rural areas—a significant underestimate of rural populations in California. Thus, using the 10 percent threshold is more appropriate in carrying out the analysis in this report.

Through the review of the literature, we identified a set of socioeconomic factors associated with the degree of household car access. Key individual characteristics included gender, age, race and ethnicity, language, citizenship, nationality, educational attainment, disability status, employment status, and marital status. Key household characteristics included household income, owner cost, rent cost, home ownership, single-parent household, presence of children, and presence of older adults. We also used journey to work data for the mobility characteristics of household workers. The list of the socioeconomic variables and mobility characteristics evaluated are shown in Table 1.

Table 1. Socioeconomic and mobility characteristics analyzed

Sociodemographic Characteristics	Definitions
Gender	Male or Female
Age	Age
Race and Ethnicity	
Black or African American	Black or African American alone
Hispanic or Latino	Hispanic origin, including Spanish/Hispanic/Latino
Asian	Asian alone
White	White alone
Others	Other races
Limited English Proficiency	Not speak English well or at all, or otherwise
Non-citizen	Not a citizen of the U.S. or otherwise
Foreign-born	Foreign born or otherwise
Educational Attainment	
Bachelor's or above	Bachelor's degree or above
Some College/Equivalent	Some college no degree, Associate's degree
High School/Equivalent	High school diploma, GED, or alternative credential
Less than High School	Grade 12 no diploma or less
No Schooling	No schooling completed
Unemployed	Civilians unemployed in labor force (aged 18+)
Not Married	Not married
Household Income (\$)	Household income in the past 12 months
% Owner Cost	As % of household income during the past 12 months
% Gross Rent	As % of household income during the past 12 months
Single-parent Household	With children (18-) and no spouse/partner present
Owned Unit	Including 1) with mortgage or loan, 2) free and clear
Presence of Children (17-)	With children under 18 years old
Presence of Older Adults (65+)	With household members aged 65 years old or above
Mobility Characteristics	Definitions
Transportation means to Work	
Drive Alone	Drive alone
Carpool	In two-person or more carpool
Public Transit	Bus, subway, or elevated rail
Bike and Walk	Biking or Walking
Others	Taxicab, Motorcycle, Work from home, or Other means

Source: 2015-2019 5-Year American Community Survey (ACS) Original Codebook⁵ (USA IPUMS, 2021).

⁵ 2015-2019 5-Year ACS Original Codebook: <https://usa.ipums.org/usa/volii/codebooks.shtml>

Descriptive Analysis

To understand whether and to what extent sociodemographic and mobility characteristics of rural California carless households differ from their nonrural counterparts and those owing at least one household car, we calculated summary statistics and cross-tabulations, and performed statistical tests to compare individual and household characteristics among rural and nonrural California by household car availability. We first compared sociodemographic and mobility characteristics of California carless households and residents with those that owned at least one household car. We then compared socioeconomic and mobility characteristics of rural California carless households with those of their nonrural counterparts. In doing so, we grouped California households into three categories based on the degree of household car access defined earlier.

We conducted Chi-squared tests of comparison for those contributing factors that are categorical variables, such as gender, race and ethnicity, and educational attainment, and conducted Kruskal-Wallis rank-sum tests to estimate differences in continuous values, such as household income. All differences reported in the text are statistically significant ($p < 0.05$) unless otherwise noted. We then mapped the results to highlight the rural communities that face significant structural disadvantages because of limited vehicle access.

Qualitative Methods

The qualitative methods address the second and third research questions on the burdens of and adaptations to carlessness in rural California. The following sections describe the initial identification of communities in which to recruit interviewees, the recruiting procedures, and the interview methods.

Community identification and recruiting

After completing the quantitative analysis, we defined the set of criteria for communities to include in interview recruiting efforts. We used the following criteria for our target list of communities (Figure 1):

1. Disadvantaged communities as defined by SB 535
2. Rural communities
3. High degrees of limited car access
4. Significant structurally disadvantaged populations not otherwise identified in the SB 535 definitions, including people who experience language barriers, people of color, immigrants, non-citizens, people with disabilities, low-income populations, and older adults
5. Communities with partner organizations that have working relationships with UC Davis researchers and communities where local transportation agencies or community organizations have identified significant challenges to transportation for rural residents.

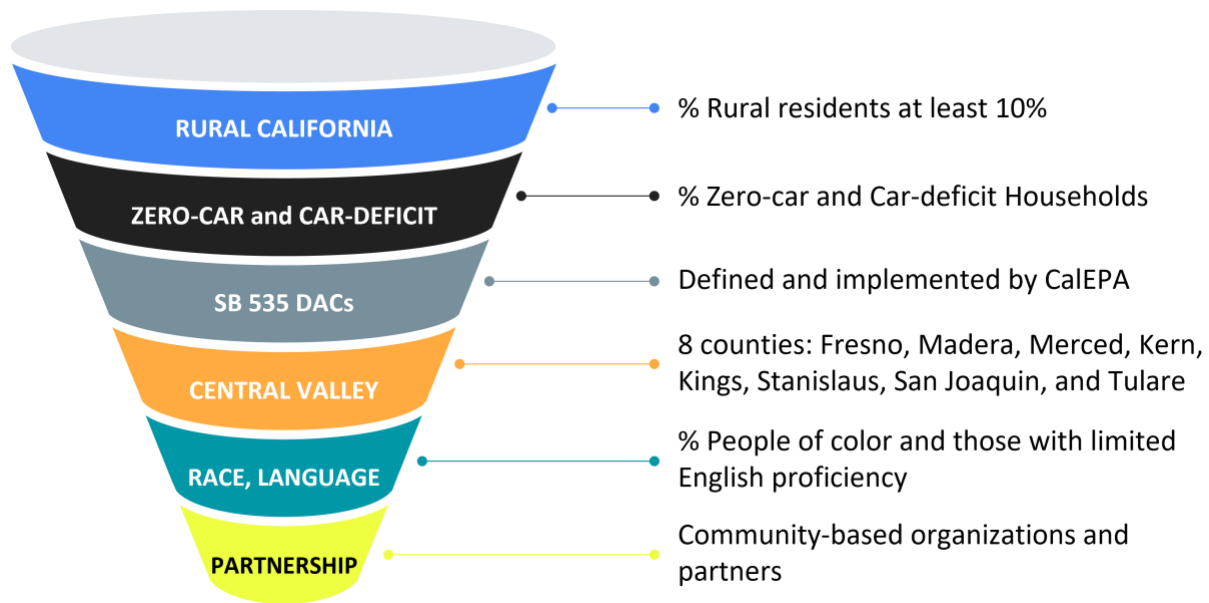


Figure 1. Interview community screening criteria

We partnered with Self-Help Enterprises (SHE), a non-profit community development organization based in Visalia, California, to assist in recruiting interviewees for the project in several of the communities identified earlier. The recruitment goal was 50 adult participants who lived in a rural area and had fewer cars than household drivers (including those with no cars at all). We aimed to conduct half of the interviews with Spanish-speakers or farmworkers. Recruiting efforts were concentrated in the Central Valley communities of Visalia, Farmersville, Le Grand, Merced, and Woodlake. Participants were offered a \$75 gift card as an incentive for participation.

We used several strategies to recruit individuals for interviews. We first created flyers for SHE to post in the housing complexes they manage with the contact information of the research team. Seventeen residents contacted us for initial interest; we completed 3 interviews from this list of individuals. Second, SHE housing managers screened individuals who met the study criteria and developed lists of individuals who agreed to be contacted. Of the 55 individuals on these lists, 10 participated. Third, SHE shared information about the study at an in-person event they held; we did not receive any interest from this recruitment method. Finally, we asked interview participants to share information about our study with their networks. We interviewed 10 individuals through these snowball contacts. In total, we interviewed 22 individuals, including 11 in Spanish.

Interviews

Interviews were conducted remotely via telephone or Zoom by a Spanish–English bilingual interviewer. Before conducting the interview but after obtaining consent, participants filled out a short survey to capturing their car-borrowing, car-sharing, and carpooling habits, their major transportation costs, plans to purchase a vehicle, and basic demographic questions. The

answers to the survey then helped guide some of the questions asked later in the interviews. The pre-interview survey can be found in Appendix B.

After obtaining the survey responses, we conducted the interview. Interviews followed a semi-structured interview guide and lasted approximately 45 minutes. We developed the interview guide in consultation with SHE and with Dr. Dana Rowangould, who is conducting a similar study of rural zero-car households in northern New England on a parallel timeline, to strive for comparability and consistency across our projects. Questions covered current travel, including car borrowing habits, use of shared vehicles, previous car ownership; travel burdens, including daily travel difficulties and specific transportation concerns; adaptations and resources used for transportation in the absence of ready access to a vehicle; and policy and technology solutions that might be relevant to the interviewee's experience. The interview guide can be found in Appendix C.

Interviews were recorded for later transcription and translation, if appropriate, by a third-party service. Immediately after each interview, the interviewer wrote a summary memo that highlighted the main themes and unique aspects of the conversation. The analysis that follows is a summary of themes uncovered in the interviews and the initial observations from the summary memos.

Findings

The study findings are presented as follows. We begin with quantifying the scale and scope of car access statewide and rural California, respectively, and socioeconomic and mobility characteristics by household car availability and particularly rural-nonrural disparities. We then turn to mobility barriers and adaptations that rural zero-car and car-deficit residents experience revealed through qualitative evidence. Finally, we share qualitative findings about day-to-day travel, barriers to travel, and suggestions for solution from the interviews with rural residents in zero-car or car-deficit households.

Household and Individual Characteristics Associated with Statewide Car Access: Quantitative Results

Scope and Scale of Statewide Car Access

Overall, in California, 93 percent of households statewide own at least one car. Slightly less than 1 million households (7%) have no household cars, and nearly 2.9 million households (22%) are car-deficit (Figure 2. Share of California households by car access type. In other words, currently, about one-third of California households experience no or limited access to a private vehicle, posing barriers and challenges to their daily essential travel activities.

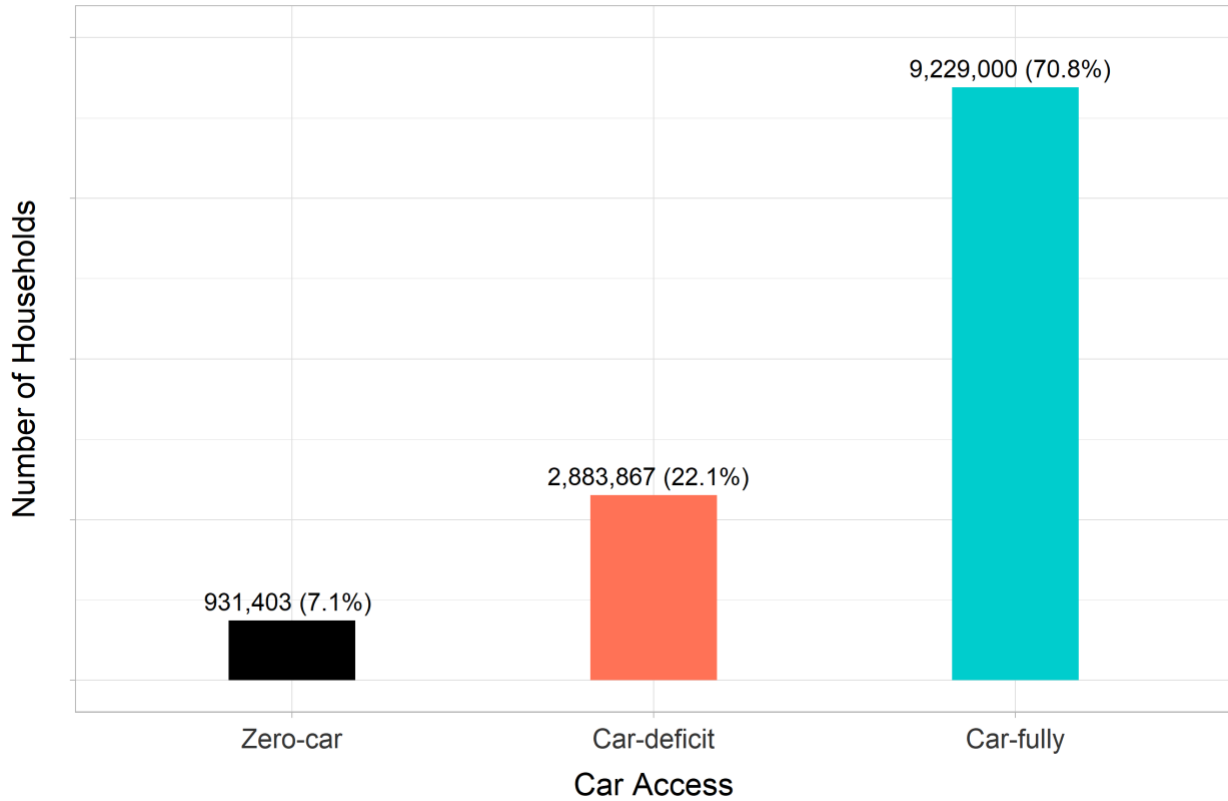


Figure 2. Share of California households by car access type

Socioeconomic Differences by Car Access

Household car access is not evenly distributed among individuals and households. Socioeconomic disparities are notable by household car availability to varying degrees. Zero-car households and residents more likely to belong to disadvantaged population groups, including low-income populations, people of color, immigrants, and those with a high school degree or less than those with at least one car. Car-deficit households and residents experience similar patterns relative to fully equipped households and residents, but to a lesser degree.

Across California, household income is significantly associated with car access. Households without car access earn significantly less than those with at least one car. Zero-car households earn 2.5 times less than their car-fully equipped counterparts and 2.3 times less than the statewide median household income. Similarly, car-deficit households earn nearly \$20,000 less than fully equipped households and about \$10,000 less than the statewide median household income (Figure 3).

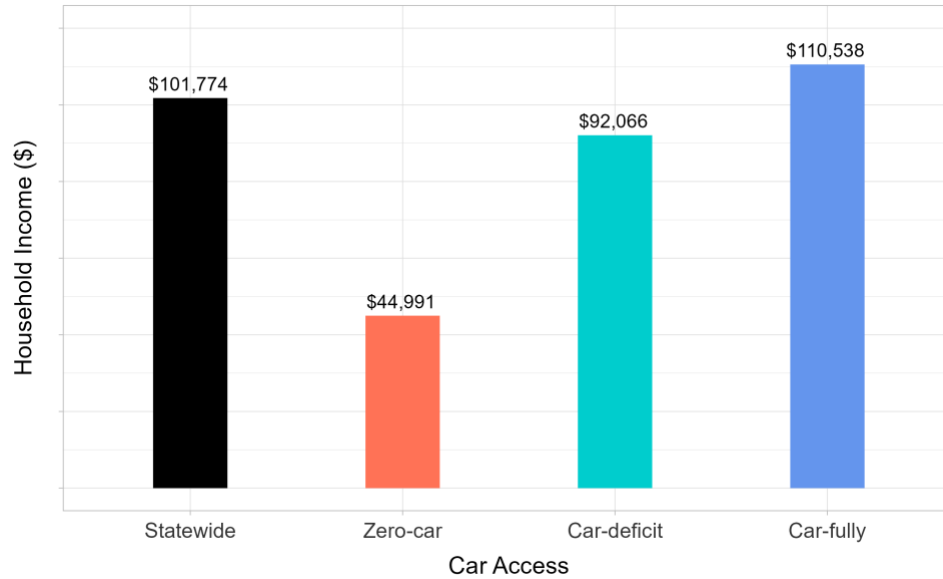


Figure 3. Median household income by car access, statewide

Household car ownership is also associated with race and ethnicity. People of color turn to be overrepresented among zero-car and car-deficit residents. Black or African American people are 2.7 times more likely to live in a zero-car household compared to white residents and 2.4 times more likely live in a zero-car household than the general population. Hispanic or Latino and Asian populations are nearly 2 times more likely live in a zero-car or car-deficit household than the white population (Figure 4).

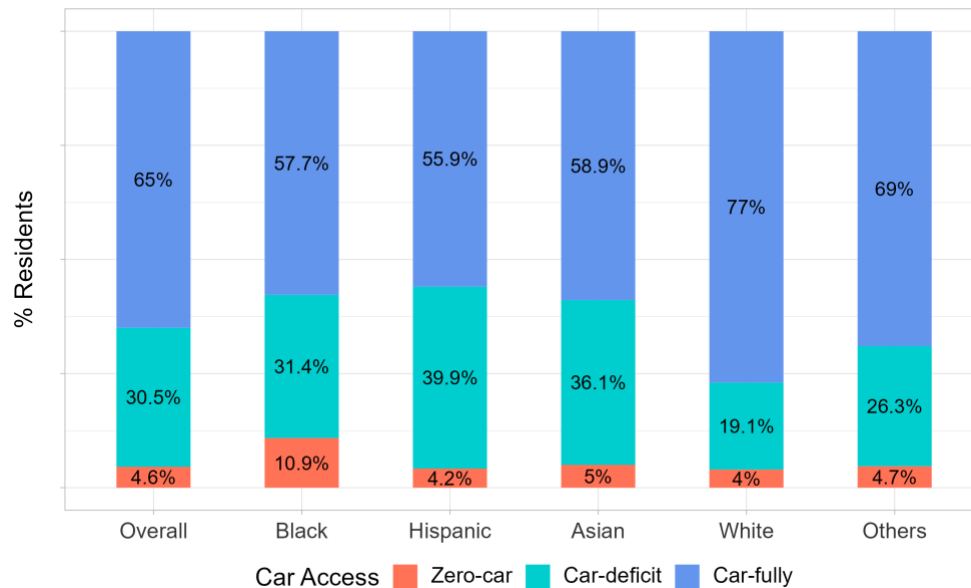


Figure 4. Race/ethnicity by car access, statewide

Educational attainment is also associated with car ownership. People with no more than a high school degree are 1.5 times more likely to lack a car than those with at least a bachelor’s degree. They are also 1.2 times more likely to live in a zero-car or car-deficit household than their others (Figure 5).

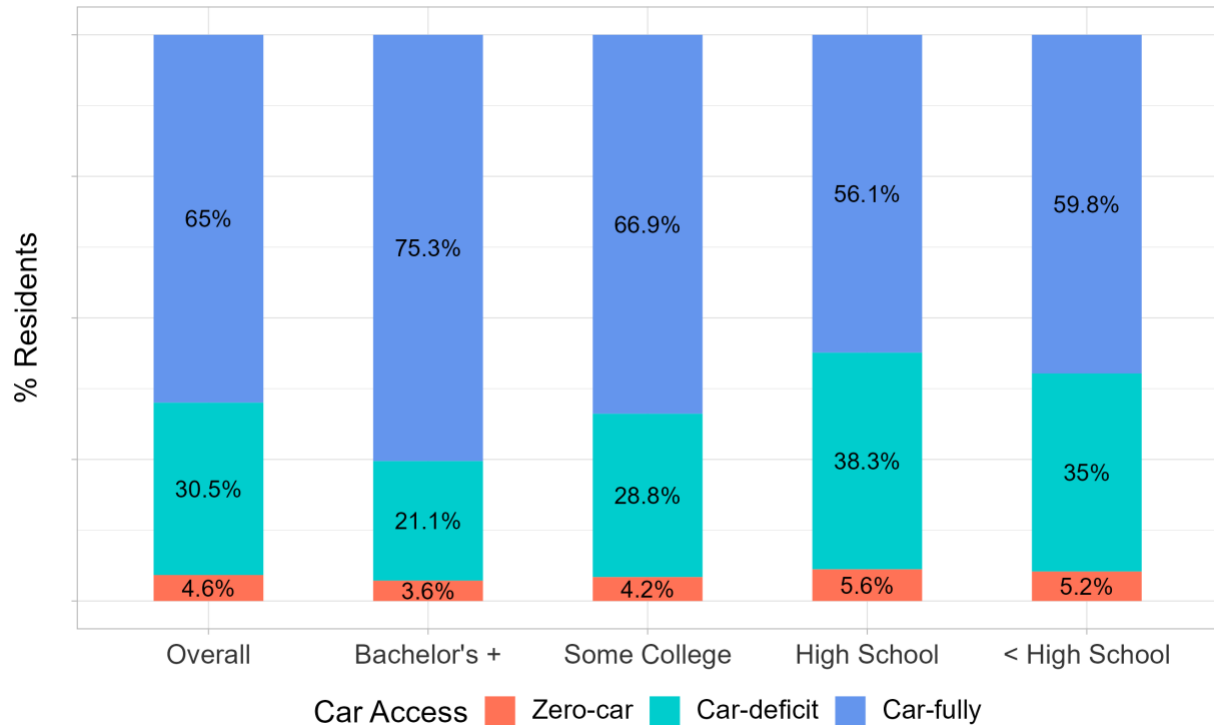


Figure 5. Educational attainment by car access, statewide

Other factors associated with car access include disability status, English-language proficiency, citizenship, and the presence of older adults in households. Compared to the general population, people with disabilities are 2.8 times less likely to have access to a car, and those with limited English proficiency are about 2 times more likely to have no household cars or live in a car-deficit household. Households with at least one member aged 65 years old or above are 15 times more likely to lack a car than the general household. Non-citizens, those who are foreign-born, and those who are unemployed are each about 1.5 times more likely to lack a car or living in a car-deficit household relative to the general population. Single adults are 1.3 times less likely to live in a zero-car household. Conversely, households in an owned unit or with children and single-parent households appear to be significantly underrepresented among zero-car households. Compared to the general household, single-parent households are 4.2 times less likely and those in owned units are 2.7 times less likely to be zero-car. Households with children are 2.3 times less likely to in a zero-car status than the general household (Appendix A, Table A1).

Zero-car and car-deficit households experience relative lower homeowner cost burdens than the general household and their car-fully equipped counterparts⁶. Zero-car households spend less than 7 percent of their incomes on owning a home, while this percentage increases to 17 for their car-fully equipped counterparts and 15 percent for the general household. However, this appears not to be a sign of low costs or high earnings, but a lower chance of being a homeowner. Supporting evidence shows that although zero-car households make up more than 7 percent of all households, they only account for 3 percent of homeowners. Their rental costs are substantially higher, however. Zero-car households pay nearly 40 percent of their incomes on rentals, compared to less than 18 percent for the general household and less than 15 percent among car-fully equipped households. These disparities in homeownership and rental cost burdens by household car availability signal the severe housing and living burdens that zero-car households face (Figure 6).

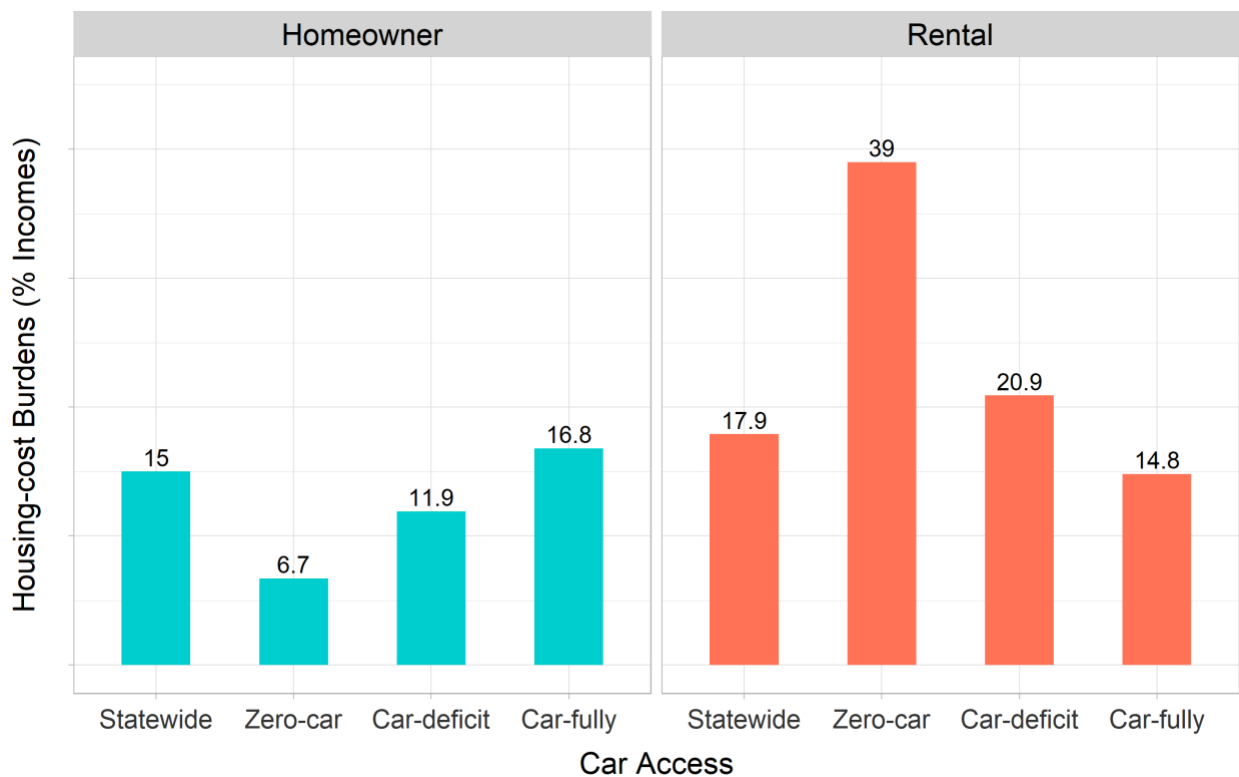


Figure 6. Housing-cost burden by car access, statewide

Mobility Differences by Car Access

Predictably, car access is significantly associated with mode choice. There are wide differences in transportation mode to work by household car availability. Overall, zero-car residents drive much less and heavily rely on a wide range of alternative transportation modes compared to

⁶ Homeowner or rental cost burdens are defined as the percentage of household incomes that are used to maintain homeownership or pay rentals.

their peers with at least one household car. Although 74 percent of the population statewide drives alone for work trips, only 27 percent of zero-car residents do so. In overcoming the limitations of household car access, one-third of zero-car residents rely on buses, subways, or rail and 18 percent of bike or walk between homes and workplaces. Compared to their car-fully equipped peers, zero-car household residents drive alone to work 2.9 times less often. Conversely, for work trips, zero-car residents are 6.8 times more likely to ride public transit and 5.5 times more likely to bike or walk than the general population, and they are more than 10 times more likely to use sustainable modes than their car-fully equipped peers (Figure 7).

Similar patterns exist among car-deficit residents but to a lesser degree. Car-deficit household residents are 1.2 times less likely to drive alone for work trips but are about 3 times more likely to use public transit, bike, or walk, compared to their car-fully equipped peers. Car-deficit household residents appear to be 2 times and 1.5 times more likely to carpool than their car-fully equipped and zero-car household peers, respectively (Figure 7). These disparities in adopting carpooling may indicate significant negotiations of using insufficient household cars among household members that may occur in car-deficit households, and reveal evidence on potential benefits of carpooling and carsharing services in easing travel challenges for car-deficit residents.

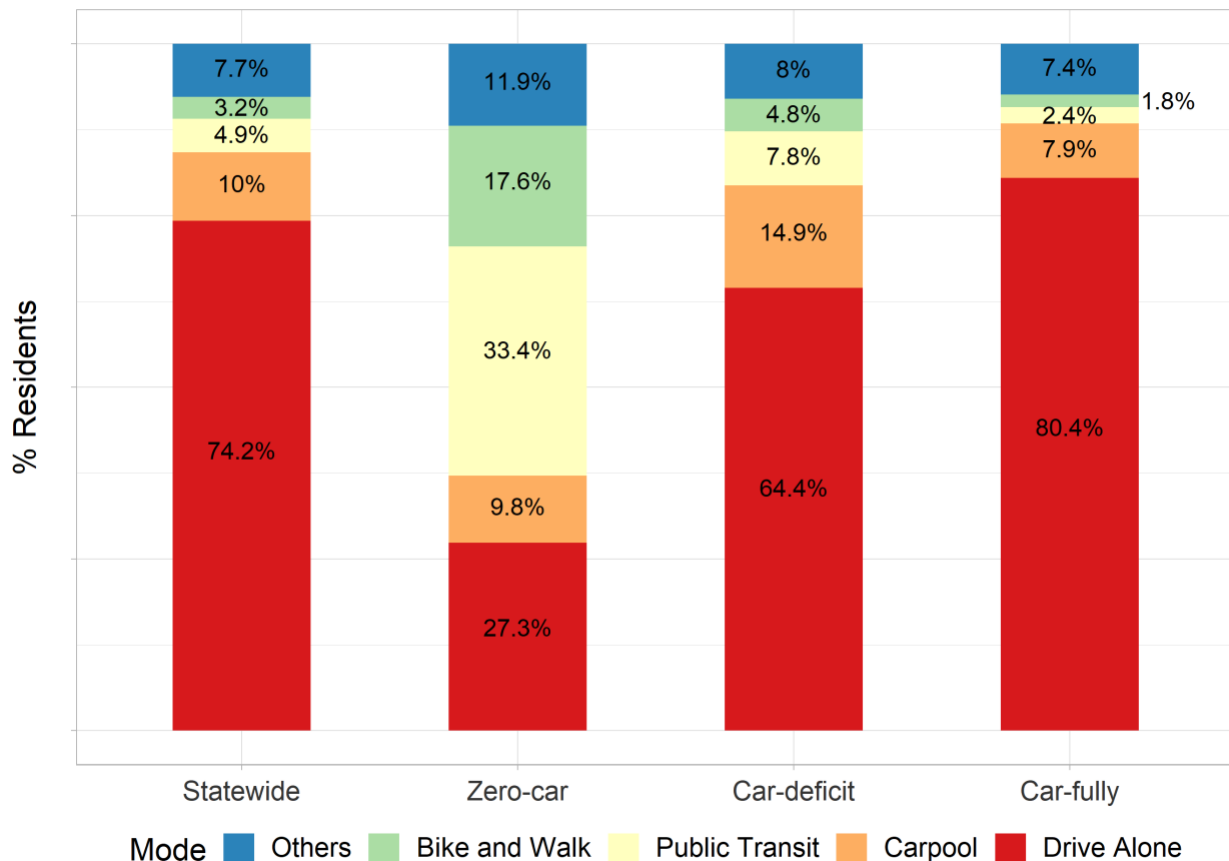


Figure 7. Travel mode to work by car access, statewide

Scope and Scale of Rural Car Access in California

This section focuses on rural–nonrural differences in car access in California. With the definition of rural area used in the methods section above, we captured 16 percent of the statewide households (2.1 million) living in rural California, and the remaining households (10.9 million) are those living in nonrural California. Figure 8 depicts the areas where rural and nonrural communities are concentrated across the state.

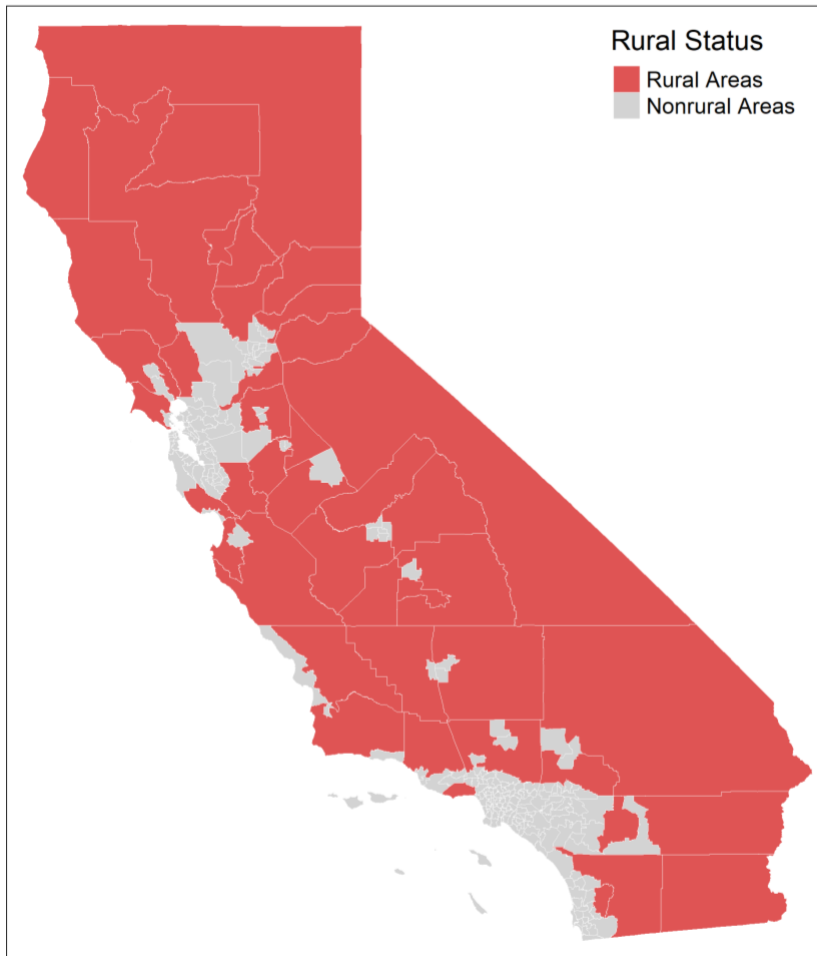


Figure 8. Rural PUMAs

Applying this binary classification of rural areas by PUMA, the data indicate that household car access is unevenly distributed between rural and nonrural areas (Figure 9). Compared to their nonrural counterparts, a slightly larger proportion of rural households and residents own at least one car (94.9% vs. 92.5%). Despite long-distance travel needs, 5.1 percent of rural households (110,294 households) are carless, and 18 percent of the households (386,596 households) are in a car-deficit status.

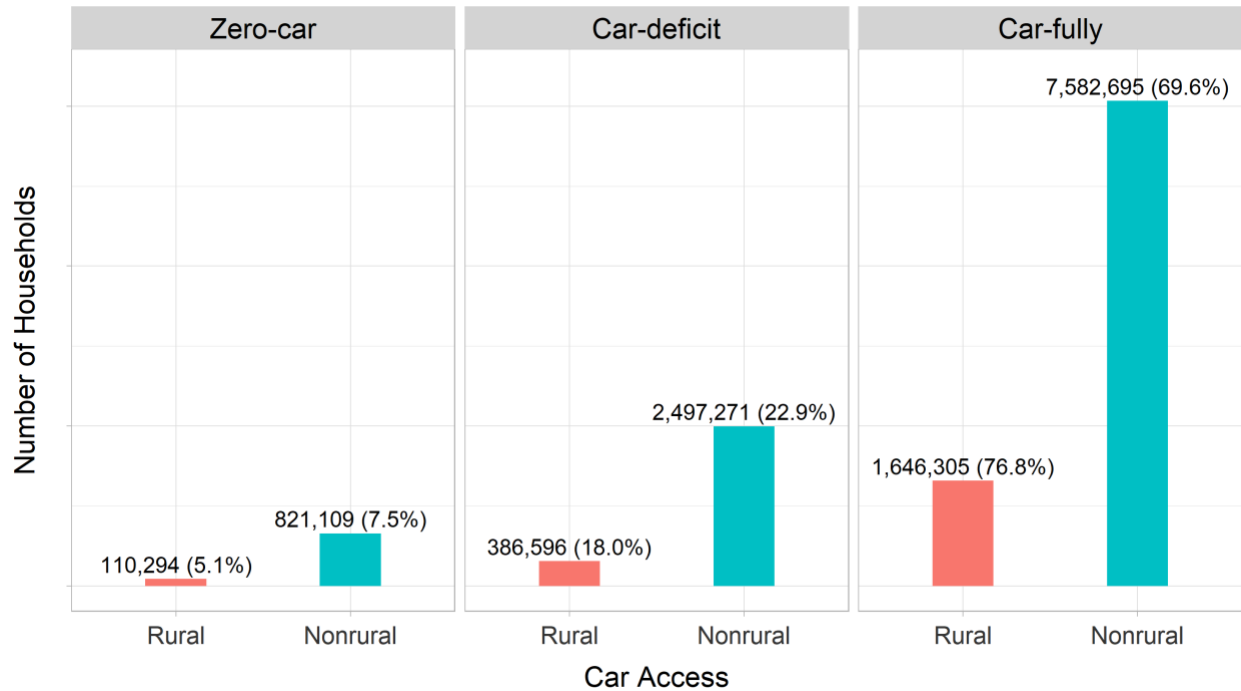


Figure 9. Household car access in rural and non-rural areas

The highest shares of rural zero-car households are concentrated in the Imperial Valley, San Bernardino County, and Fresno County, where at least 8% of households do not have regular access to a vehicle (Figure 10). Far northern California also has significant populations of carless households, likely because of the populations of the smaller cities within the rural counties (e.g., Ukiah, Eureka, Crescent City, Yreka, and Redding) are included those PUMAs. The geography of car-deficit households is substantially different. The highest shares of households with fewer cars than drivers are almost entirely located in the Central Valley (Figure 11). The Imperial Valley also has a significant population of car-deficit households, while relatively fewer car-deficit households are located in far northern California.

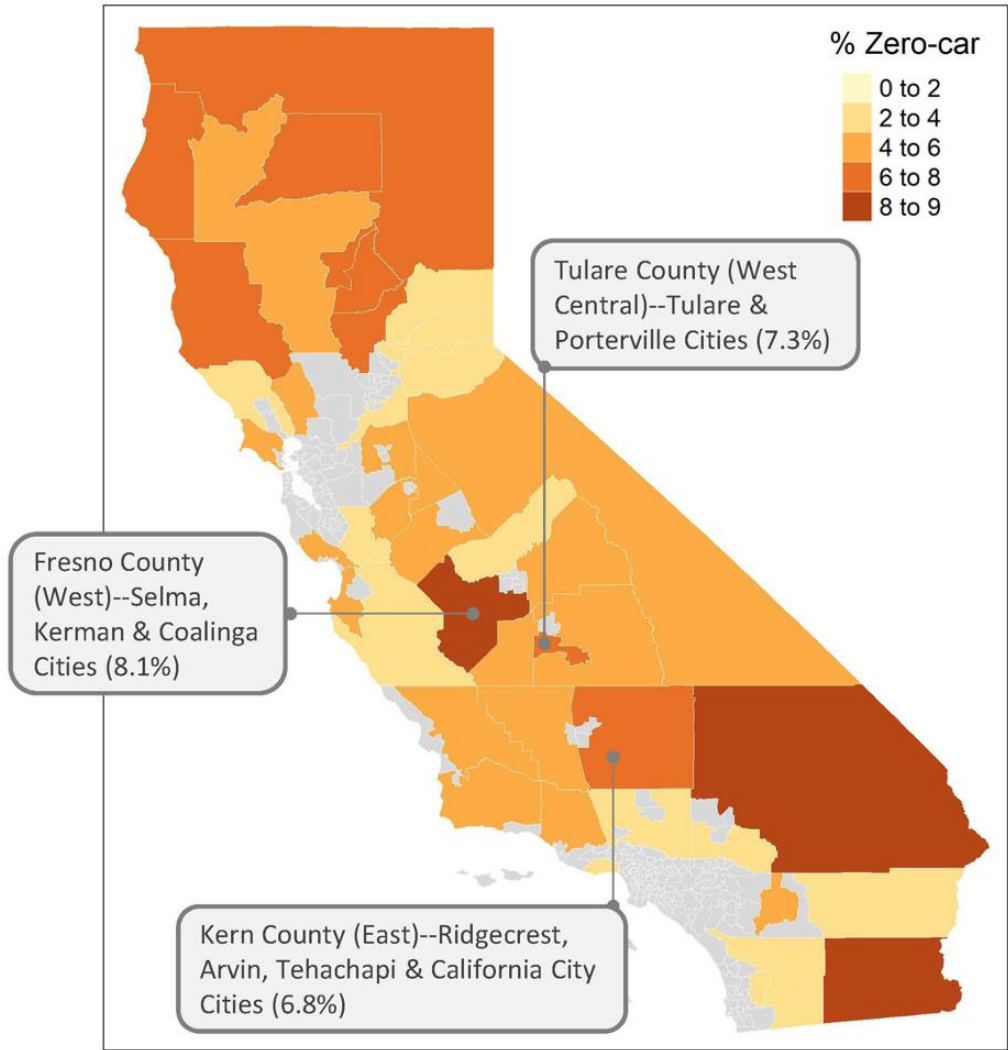


Figure 10. Zero-car households in rural California

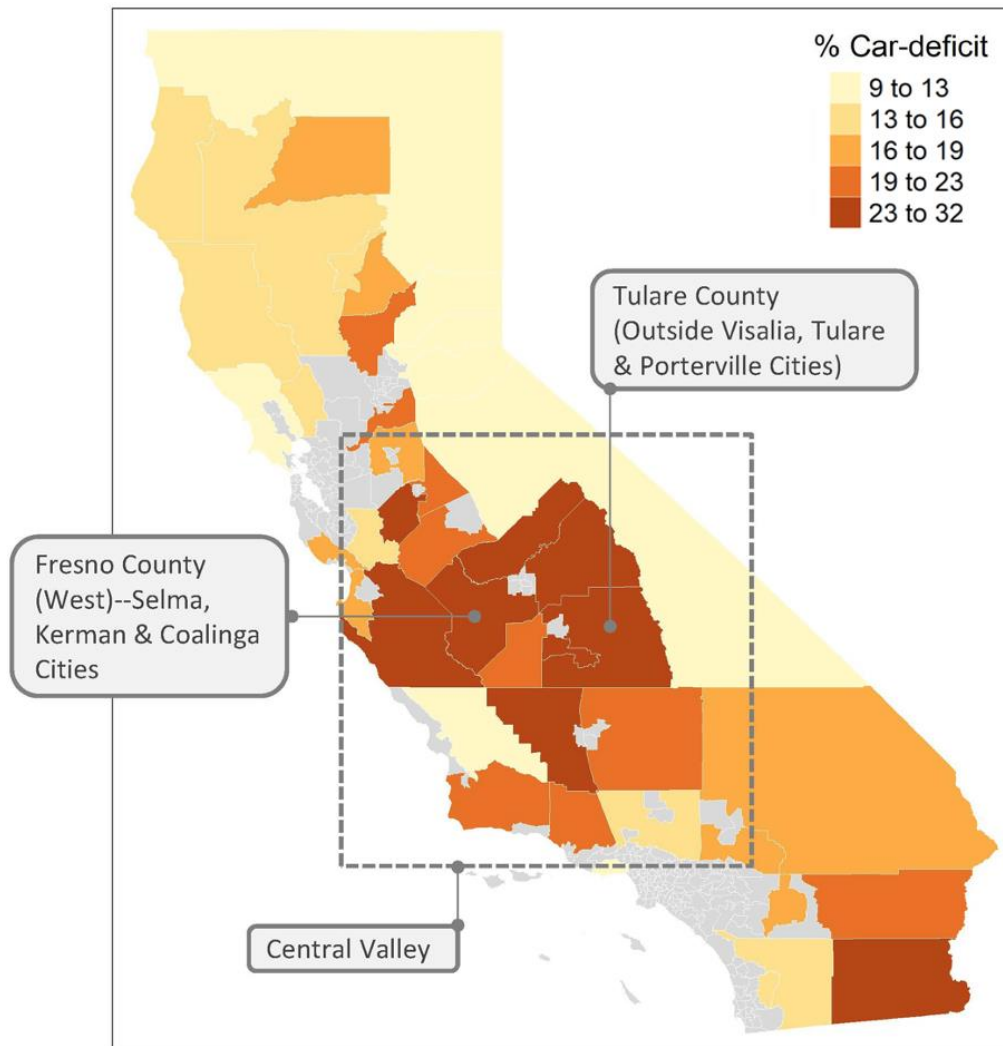


Figure 11. Car-deficit households in rural California

Rural-Nonrural Disparities in Socioeconomic and Mobility Characteristics

Rural-nonrural disparities are evident in household car access as well as who owns a car and how they get around. Overall, the results show that rural zero-car households and residents experience social and physical disadvantages to a larger degree, relative to their nonrural peers. Moreover, even though more than half of zero-car residents rely on sustainable modes for work trips statewide, this appears to be not the case in rural California. The detailed interpretations of the findings on such disparities are as follows.

Socioeconomic Characteristics

Relative to their counterparts in nonrural areas, rural zero-car and car-deficit households and residents are poorer and are represented among other categories of socioeconomic disadvantage to a larger degree. Rural zero-car households earn a median household income 2.5 times less and rural car-deficit households earn 1.2 times less than the rural median.

Moreover, rural zero-car households earn 1.4 times less than their nonrural counterparts. A similar pattern exists among rural car-deficit households (Figure 12).

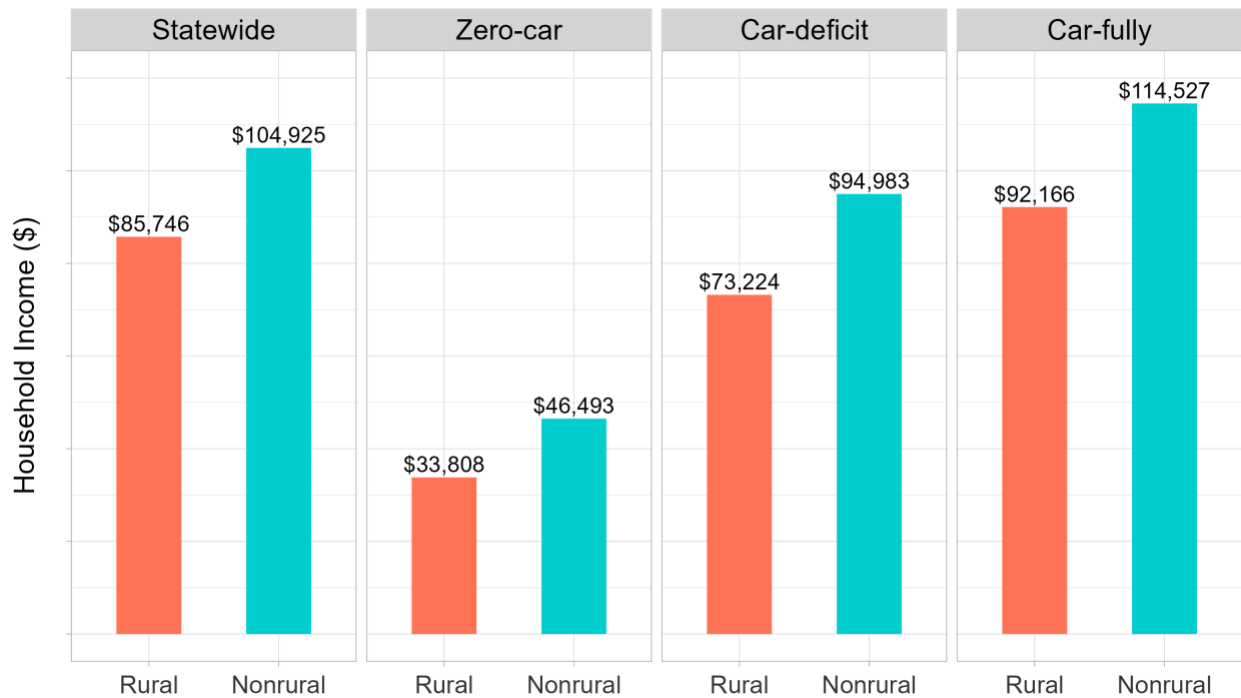


Figure 12. Household income by car access and rural status

People of color are more likely to lack sufficient access to a vehicle in both rural and nonrural areas (Figure 13 and Figure 14). Black or African American people are 2.4 times more likely to be car-less than the general population in rural areas, while this number is 2.3 times in nonrural areas. They have the highest share of carlessness among all racial or ethnic groups in both rural and nonrural areas. Black or African American people are overrepresented among car-deficit residents in rural areas as well, and they are far more likely than white residents to be in a car-deficit status. In addition, rural Hispanic or Latino and Asian populations are about 1.4 times more likely to live in a car-deficit household than the general population in rural areas. Hispanic or Latino and Asian groups have the highest share of car-deficit households in rural areas, with twice the share as white groups.

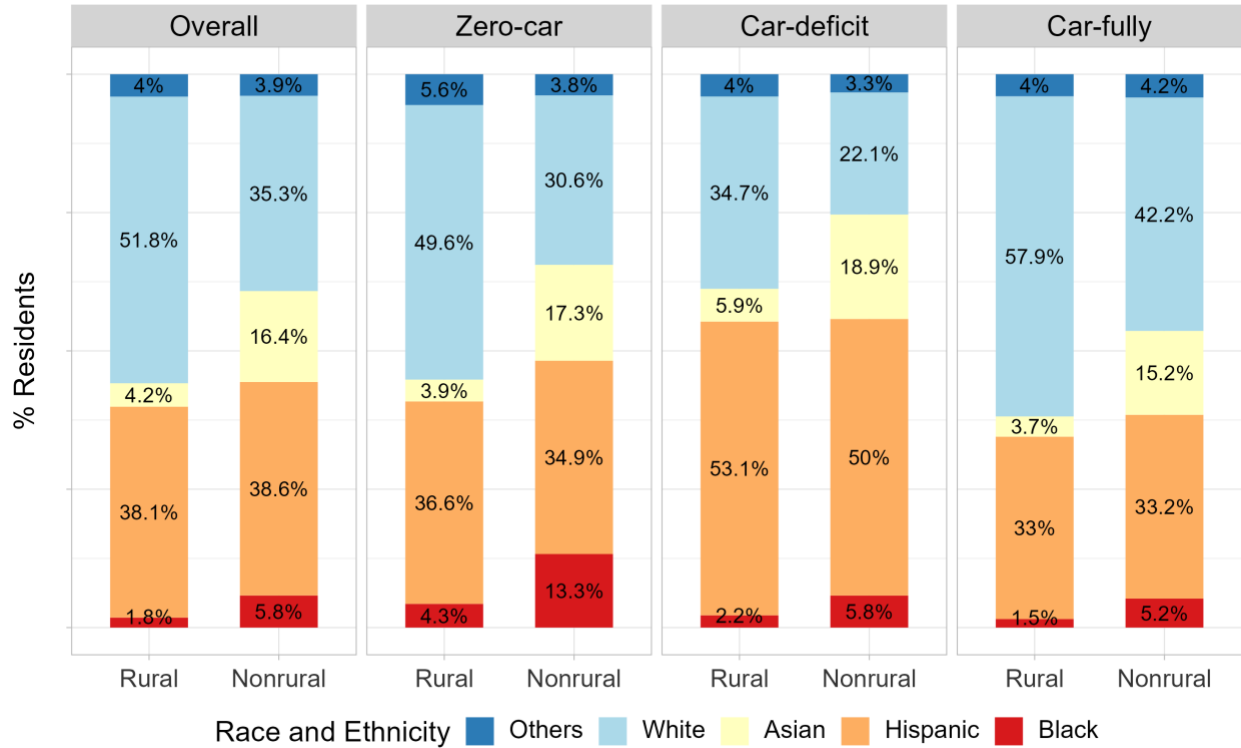


Figure 13. Distribution of race and ethnicity by car access for rural and nonrural areas

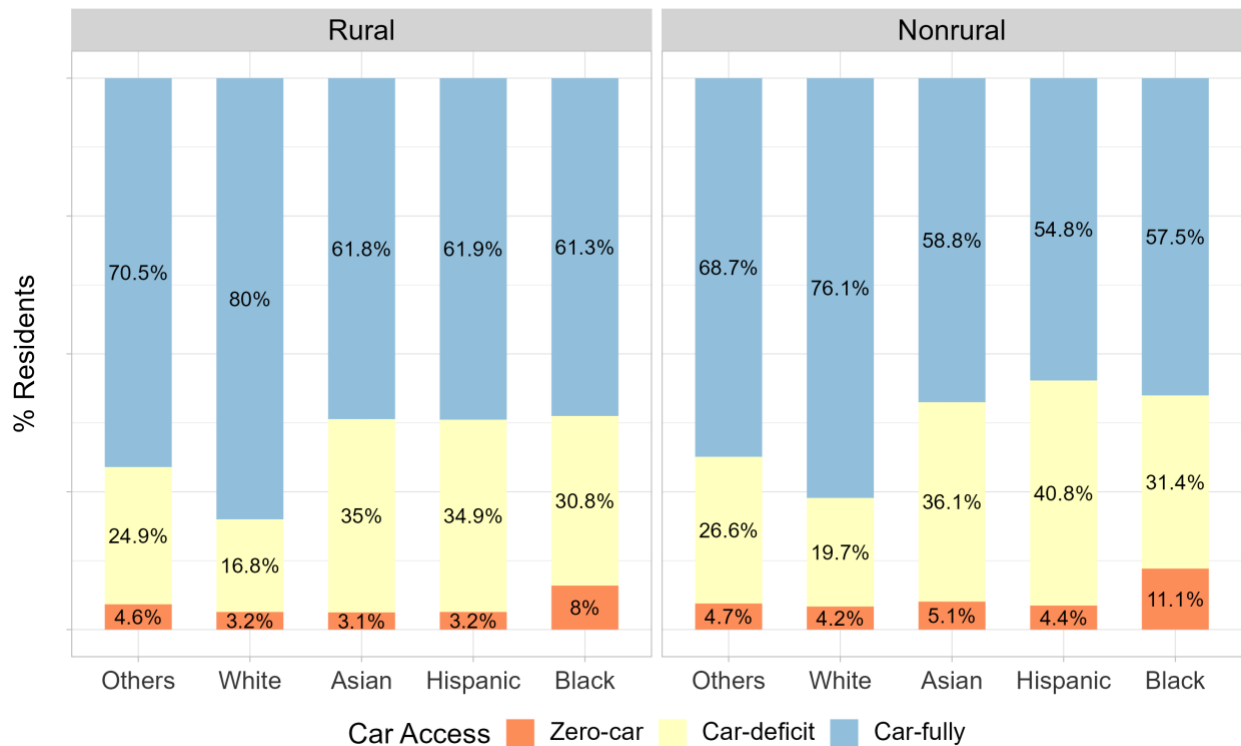


Figure 14. Distribution of rural and nonrural car access by race/ethnicity

Educational attainment is another distinguishing characteristic of car access between rural and nonrural locations. Across the state, 27 percent of nonrural residents have a bachelor’s degree or above, while less than 20 percent of rural residents do so. Overall, rural residents with a high school degree or less are 1.2 times more likely to be car-less or live in a car-deficit household compared to their nonrural peers (Figure 15).

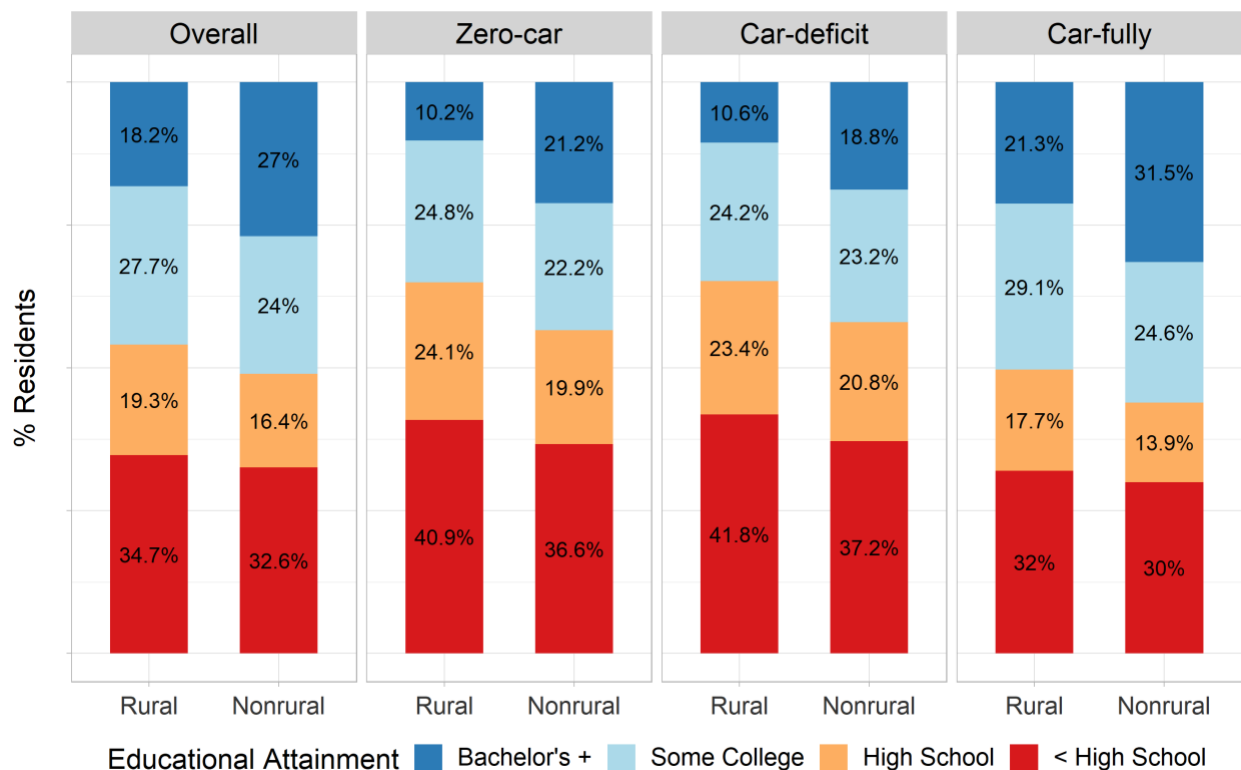


Figure 15. Distribution of educational attainment by car access for rural and nonrural areas

Other factors that are notable in rural-nonrural differences include employment status, disability status, and presence of children or older adults, and homeowner cost burdens. Relative to their nonrural peers, rural residents who are unemployed are 1.7 times more likely to be carless, and those who have disabilities are 1.3 times more likely to be carless. Also, rural households with children or older adults are 1.1 times more likely to be carless than their nonrural counterparts. Moreover, the share of rural zero-car households facing housing cost burdens is 1.6 times greater than nonrural zero-car households (10.1% vs. 6.3%), indicating exaggerated challenges that rural zero-car residents face as a combination of not having car access and earning lower incomes (Appendix A, Table A3).

Mobility Characteristics

Living environments matter to how people without a ready household car get around. Stark differences in transportation means to work appear between rural and nonrural areas among zero-car and car-deficit households. Overall, the differences in driving to work between rural residents and nonrural residents are relatively small: 77 percent of rural residents statewide

drive alone for work trips, while 74 percent of nonrural residents do so. However, the greatest difference is in public transit use. Rural residents are about 6 times less likely to use public transit for work trips than their nonrural peers, in which rural carless residents are 5 times more likely than the rural population to do so (Figure 16).

Nevertheless, car use is still prevalent among carless rural households—and more so compared to carless nonrural households. About half of rural zero-car residents still drive alone while only one-fourth of their nonrural peers do so, signaling that car access is practically a necessity in getting around rural areas. This difference carries over to carpooling as well; rural zero-car residents are 1.8 times more likely to drive or ride in a shared vehicle than their nonrural peers. Conversely, rural zero-car residents are 7 times less likely to use public transit relative to their nonrural peers. Similar patterns exist among car-deficit residents, but to a lesser degree. Compared to their nonrural peers, rural car-deficit residents are more likely to drive alone or carpool but less likely to use public transit (4.8 times) for work trips. However, the share of zero-car and car-deficit residents who bike or walk appear to be similar between rural and nonrural California.

These rural-nonrural differences collectively signal that for zero-car and car-deficit residents, alternative modes do play a significant role in meeting their daily travel needs, however, the availability, quality, and accessibility of such alternative services are essential determinants to the decision of using sustainable modes rather than driving alone. Future policy and funding interventions for advancing mobility, sustainability, and equity and justice should pay particular and great attention on public infrastructure supporting bike, walk, and public transit in rural California.

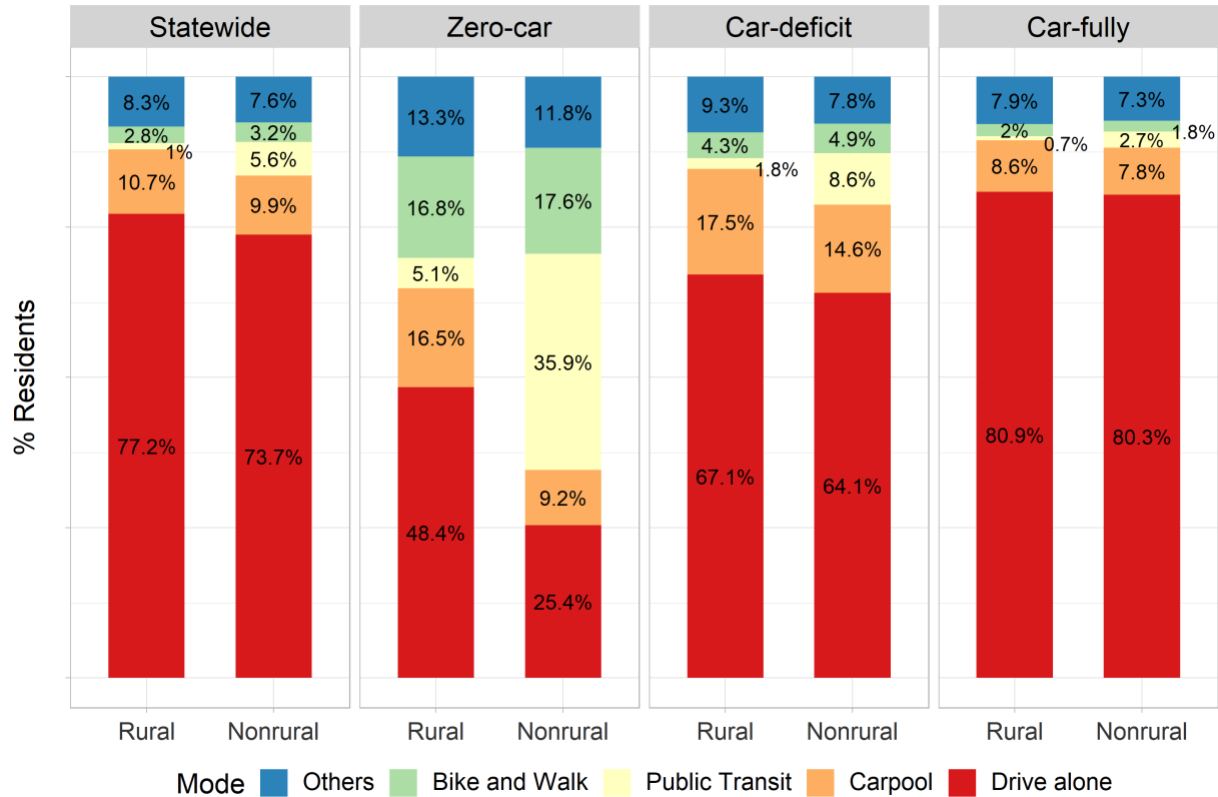


Figure 16. Distribution of transportation mode to work by car access for rural and nonrural areas

Barriers, Burdens, and Adaptations: Qualitative Results

Interview sample

Summary statistics from the 22 pre-interview questionnaires are found in Table 2. All but one participant in the sample identified as Hispanic, Latino/a, or Mexican, and four in five were women. They had lived in their communities an average of 11 years. Half the participants lived in Visalia; other residential locations included Biola, Farmersville, Fresno, Le Grand, Merced, and Woodlake (Figure 17). Interviewees averaged one car per household; six participants had no car. Traveling by vehicle was still the most common mode of transportation regardless of car ownership. Thirteen participants had gotten a ride somewhere in the previous week, seven had driven their own vehicle, and two drove a shared vehicle. All but two individuals had traveled in a vehicle as a driver or a passenger. Four individuals had taken transit, including fixed-route transit and dial-a-ride or non-emergency medical transport services.

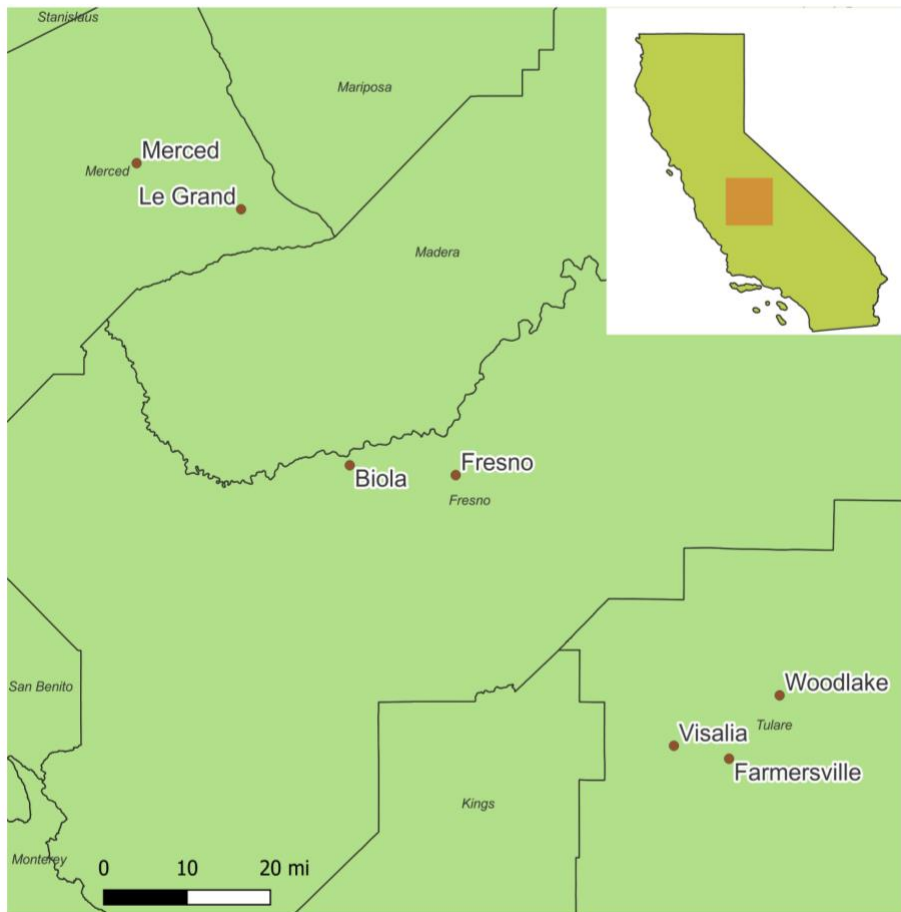


Figure 17. Residential locations of interview participants

Transportation resource sharing in terms of car borrowing, getting rides, and using car share was prevalent among the sample. The median frequency of borrowing a car was a few times a year, while nine individuals (42%) reported borrowing a car at least once a week. People in the sample were more likely to get rides, where the median response was one or two days a week, with seven (31%) reporting getting a ride half the work week or more. Car sharing was less common, with the median interviewee using car share a few times a year, but eight individuals (37%) still used car share at least a few times a month.

Interviewees appeared to face significant challenges with respect to transportation costs. They reported an average monthly bill of \$261 for transportation expenses. Nearly all the respondents would have to make significant changes in their household budgets to be able to afford a 10% increase in transportation expenses, and eight (36%) reported they would also have to change their usual transportation modes. This question was not theoretical at the time the survey was fielded, as it took place during a period of high gas prices. Less than half the sample reported any plans to purchase a car in the next five years, either because they felt they had a sufficient number of vehicles in their household or because they would not be able to afford the expense. Of those who were planning to purchase a vehicle, most would choose a gasoline-powered car, although three reported planning to buy an electric vehicle (EV).

Table 2. Summary statistics of interview participants (N = 22)

Characteristic	Mean or %
Household vehicles	1.0
Mode in the previous week	
Drove own car	36%
Drove shared car	9%
Got a ride	59%
Transit	18%
Walk	9%
None	5%
Frequency of car borrowing	
Every day	5%
3-6 days per week	14%
1-2 days per week	23%
A few times a month	5%
A few times a year	27%
Never	27%
Frequency of getting a ride	
Every day	9%
3-6 days per week	23%
1-2 days per week	27%
A few times a month	5%
A few times a year	23%
Never	9%
Frequency of car share	
Every day	5%
3-6 days per week	0%
1-2 days per week	27%
A few times a month	5%
A few times a year	23%
Never	27%
Average monthly transportation expenses	\$261
Handling 10% increase in transportation expenses	
Just fine	0%
Make small changes	9%
Make major changes, use same modes	55%
Make major changes, use different modes	36%
Vehicle purchase plans	
None	55%
New gas car	9%
Used gas car	23%
New or used electric car	14%
Years in community	11

Characteristic	Mean or %
Race/ethnicity	
Hispanic, Latino/a, or Mexican	95%
White	5%
Female	82%

Interview summaries

This section describes some of the common themes that emerged from the interviews with people from carless and limited-vehicle households in the rural Central Valley. The interview findings are not meant to be representative of all such individuals but instead reflect a range of experiences that disadvantaged groups face and highlight the particular burdens and adaptations in obtaining transportation access. Interviewees are denoted in the text by city or town of residence and interview number.

Practices of getting around and negotiating vehicle access

Interview participants used a variety of modes to get around day-to-day. Across the interview sample, they described driving themselves in their own cars, using their spouse’s shared vehicles, using a car-share vehicle, using public transit or medical transport, or getting rides from others. Some also walked to certain places, though not for long distances and grudgingly in the Central Valley summer heat, which many had mentioned because some interviews took place during the heat wave in September 2022.

Nearly all the interviewees spoke about relying on family and friends for rides or to borrow a car if they did not have their own car access. For those that shared cars with family, interviewees described a delicate process in which they negotiated vehicle access. Some built their daily routines precisely around when the car would be available for their use. For these individuals, that often meant scheduling appointments during certain windows of time or only running errands before their partner had to go to work:

I have to make sure I get things done like if my son has to go to a doctor’s appointment or if I have to go shopping and I need to use the car, I have to use it in the morning so that my husband can have it during the afternoon. That’s when I take advantage of it. Then if there’s really important things, like I said, I schedule them in the morning so that I have the car available. (Merced 2)

For others, it was more likely they would get rides from friends or family. But the process of getting a ride put stress on those seeking them. The discomfort was often reported as a minor inconvenience or point of struggle between the party getting the ride and the party offering the ride:

When I can’t go, [my daughter] will drive me there or she’ll go to pick up my meds. She basically tells me where we’re going, which way we’re going, and what we’re going to going to do that day. She left her job in Orange County because she said she was going

to come and live with me. I wish she wouldn't have done that, but anyway so she lives here now. (Visalia 2)

This person appreciated their daughter's sacrifice to provide the needed help but was clearly conflicted in having to rely on her all the time. Another interviewee talked more directly about the challenges of getting access to a vehicle with multiple family members who were sharing a single car:

I would say maybe just tension with my family. Maybe I will just get upset, not at them but just the fact that we have to share a car as opposed to having your own car, it's a little more difficult. If my mom or grandma or even grandpa, if I have the car, they'll sometimes get mad and be like, "Oh, why didn't you tell me? I need it to do this." Small stuff like that, but it's minor. (Fresno 1)

Many lived with family members with whom they would share their vehicles, but others obtained car access by relying on family members and friends outside their immediate households. The sense of community among the predominantly Mexican and Mexican-American interview participants was evident in the practice of getting and giving rides and borrowing vehicles. For example, a car owner felt a sense of duty to provide rides to those in his social network:

When they ask me if I can take them somewhere, I remember the time when I didn't have a car and I also try to help them if they need to go somewhere. I try, now that I have a car, to return the favor they did me. (Woodlake 1)

This person went on to describe a particular time when discovering that the last bus of the day had already passed by, and needing to call someone for a ride to get him to his final destination. Another described the "solidarity" in the community, while not universal among everyone within their circle of family and friends, still undergirded the desire to be a reliable resource to others because of their fortunate circumstances:

There are people who say, "Whatever you need, you can always count on me for support," or, "If you need something, just tell me." For that I do feel grateful and happy, even if I need it, but I say, "There are other people who are worse off than I am." (Farmersville 2)

Yet despite this sense of community and obligation, there were still negotiations in getting rides from among multiple people that someone might know. One interviewee described some of the struggles faced when relying on others to get around:

If my husband has to go out or something and the place where I am going is far away, I can't walk. Then I have to ask a family member to do me the favor of taking me on an errand and I have to see if that family member is available to take me, and if not, I look for someone else. Sometimes I don't have many people close to me, I have only a few...it's difficult (Farmersville 1)

Another put it plainly, in not wanting to be a burden on others for their transportation needs: “I don’t like being dependent on other people” (Merced 2).

Often, the sense of burden came down to costs. A few interviewees discussed giving gas money to those giving them a ride, which was a financial struggle for all involved:

I don’t want to rely on my family often just because I need a car and make them come. And then they have to pay gas and I end up paying gas for them because they’re picking me up. (Merced 2)

And for some, this meant reducing the number of trips they take. One interviewee described the back-and-forth conversation in trying to get a ride somewhere over the expense, which many times led them to just stay home:

If I even have to get a ride from somebody, which is rare, they want literally \$40 for gas, because the only people that I know are in Hanford and like, Hanford’s 13 miles away from here, and everybody’s like, “Oh, it’s far.” Really technically it’s not. I got to pretty much bribe them. (Visalia 1)

The shared resources among social networks in the interview communities help those without cars, or ready access to a vehicle, fulfill their daily travel needs. Social networks are often a key source of transportation for immigrants and low-income individuals (33–35); the findings here are consistent with previous research. This sharing does not come without cost—whether that is a monetary cost associated with paying for gas or a ride, or a psychological cost in the added stress of negotiating for vehicle access among friends and family who may be stretched thin themselves. Interviewees who relied on others felt less independent and may have cut back on trips to avoid the need to burdened others. Nevertheless, the community was a critical resource in helping carless and car-deficit households obtain mobility.

Travel expenses

When asked about major challenges in getting around day-to-day, the cost of vehicle access often rose to the top. Some expressed wanting to buy a vehicle, but recognized that it was far out of reach for their budget. For some, this meant purchase costs, as one Visalia resident remarked: “I really need a car, but I can’t have one. Because I don’t have money, and right now, it’s very hard to buy a car” (Visalia 6). Some felt the pressure on their budgets with increases in day-to-day prices during the period of relatively high inflation in which the interviews took place, and made sacrifices to get by, even when car ownership would alleviate their struggles:

We are not able to afford those expenses right now, because you see, the cost of living is very expensive right now. So, we try to adjust with one [car] and struggle a little bit rather than having a second one. (Farmersville 2)

For others, ongoing expenses like insurance or repairs would be a challenge to keep up with:

To be paying your rent plus food and just your bills, a lot of times I don’t see myself being able to budget for an additional increase in insurance for having a new car and

also the car itself....So unless the government came out with something where they're not going to be that expensive, but I wouldn't be able to afford to buy a car. (Merced 1)

These concerns reflected the economic precarity in which many of the interviewees found themselves. It meant that they could not be certain they would get where they needed to go, particularly if they had an older vehicle in need of repair or constant attention:

I'm afraid that one day that I have to go locally here to a doctor or to pick up meds that the car won't start, and that's being honest. From being able, I'm not going to say a hundred percent reliable, but I would say at least what, 55 to 60% reliable. I am afraid that what are we going to do if the car ever breaks down, it's not like I have the money to fix it. What am I going to do? (Visalia 5)

But the most prominent concern was about the price of gas. During the interview period, gas prices had recently recovered from a spike of over \$6 per gallon but still remained high relative to the previous year, averaging around \$5.50 per gallon across the state. Nearly every participant mentioned the high gas prices as a significant barrier to getting around. Most cut back on their travel or chose not to go places, stating that they "don't travel as much because of the gas prices" (Biola 1) or that they "think about it three times if [they] have to go anywhere" (Visalia 11). Leisure trips, in particular, were the kinds of trips most often forgone; for example, beach trips, camping trips, and other out-of-town trips were some of the kinds of trips mentioned as no longer taken. Some had to take additional measures, such as giving up the chance to see family. One interviewee spoke of the specific strain on their family:

Yes, [the increase in gas prices] has affected me very, very much. My mother lives in [another town], which is about 20 miles away. I go see her maybe once a month. My daughter and my grandkids live about, I don't know, 14 miles from us. I don't go see them because the gas is too expensive. I just can't go just to— I can't go. I used to be able to take the kids to school. I'd leave from here, from Visalia, pick them up and take them to school. I can't do that anymore. (Visalia 2)

Though less commonly mentioned than vehicle ownership and operating costs, other transportation costs were a challenge for some as well. One interviewee wanted to see more public transportation options, because private personal transportation was too costly: "If I were to take a cab, it would be very expensive. There are times when you don't have food or other things, you would rather have food at home" (Farmersville 1). Another faced barriers to accessing car sharing options because of the high upfront costs associated with reserving vehicles: "Yes, I could get a rental car right now, but I just don't have the deposit. I do have 40 bucks to rent it, but I don't have the deposit. Yes, that's what holding me up" (Visalia 1). Notably, only one interview participant who lived near transit options mentioned the benefits of public transit as a way to save on travel costs. This suggests more fundamental challenges with using transit as a reliable transportation option, discussed in more detail below.

Additional barriers

Those without vehicle access relied on public transit—both fixed route and demand-response options—and getting rides with others, but with great difficulty. The chief complaints about transit were availability and reliability. In the areas where there was fixed-route transit, stop locations were sparse and service was infrequent. The most severe consequence of lack of availability was social isolation, in which people would not make trips or appointments. A Biola resident described such a result of the unreliable service: “Without a vehicle and buses taking long, sometimes missing a bus or whatnot, it would make me late for events. Basically, I would just not want to go anywhere” (Biola 1). Long travel distances in rural settings combined with long distances to access bus stops created significant challenges for families that had to rely on transit for any trips. One interviewee described the hardship, exacerbated by the harsh weather in the Central Valley summer:

It’s really terrible. It’s a long way away for me to walk to....It’s at least a good mile, but it’s freaking 104 degrees outside, and it’s pretty far to walk there for me and my children. By the time we get there, it takes the bus forever to get there. Then not only that, when you get on the bus...it takes literally like an hour just to get to Visalia from Goshen, and it’s pretty terrible. (Visalia 1)

The resident noted that the bus stop in Goshen was “a streetlight away from Visalia,” the adjacent town, but it was still difficult to get between the two locations. Another Visalia resident also faced difficulty in accessing transit, living a long distance from the bus stop served by a single route: “Three or four miles to get to the little bench where you have to wait” (Visalia 2). The bus stop amenities were substandard for this resident, who wanted decision makers to experience the hardship for themselves in the hopes of bringing improvement.

Others talked about transit as an option they would like to have for non-essentials. One interviewee from Merced spoke of wanting transit connections to popular recreational areas like Yosemite National Park or coastal beaches, but did not find those services to be available. However, Yosemite National Park is served by public transit (Yosemite Area Regional Transportation System), with five daily trips to Yosemite Valley from Merced as of this writing. This person’s experience speaks to either a lack of awareness of the transit option or a lack of outreach about transit availability to the park.

Issues with transit reliability extended to dial-a-ride, non-emergency medical transport services (NEMT), and non-medical transportation (NMT) services. Some interviewees used the Central California Alliance for Health as a transportation provider to get to medical appointments. While they appreciated the service they provided, they described the process to book and ride the service as difficult and limiting. One individual spoke about having to cancel a medical procedure because they were unable to book a guaranteed ride with the service:

Yes, I had a procedure that I had to have done a month ago in Fresno [about 40 miles away].... I called medical transportation, but they were too full and they really couldn’t guarantee me a ride back. They could barely get me over there, but they didn’t. In the

long run, they didn't. Nobody came for me. Well, I didn't go. I didn't go because nobody came to get me. (Visalia 2)

Similarly, an interviewee had to cancel a medical procedure twice because they could not drive afterward, could not rely on a family member to pick them up, and could not get the NEMT service to provide a ride:

I couldn't get medical transportation because they told me that it would be an hour to prepare me, and from the hour that they prepare me for the procedure, it could be anywhere from three to four hours. They don't have a driver that is ready at the time that I'm done or whenever I'm done, because if I have any problems, they have to wait longer....The program didn't have the staffing to be waiting out there anywhere from three to four hours because whoever was going to take me could not go into the office because of the COVID [procedures]. (Visalia 5)

The examples illustrate the consequences of the long distances that rural residents must travel to reach essential services. In both cases, medical patients had what they described as route outpatient procedures yet were denied health care services because they had no reliable form of transportation.

In other circumstances, lack of vehicle access car also results in missed or forgone trips. One interviewee put it succinctly, from their experience: "A lot of people don't go out because they don't have a car" (Le Grand 2). A Merced resident talked about the multiple challenges faced without ready access to a vehicle, either not going out or carefully scheduling trips when they were able to access a vehicle:

I don't get to travel often because my husband has the car five days a week for work. I have to make sure I get things done like if my son has to go to a doctor's appointment or if I have to go shopping and I need to use the car, I have to use it in the morning so that my husband can have it during the afternoon. That's when I take advantage of it. Then if there's really important things, like I said, I schedule them in the morning so that I have the car available...[but] if he's at work or if his boss— My husband's boss calls him last minute to go in, then I would have to ask my mom to come pick me up and take me food shopping, you know what I'm saying? Those situations are not easy to deal with. (Merced 2)

The same individual spoke of missing out on family gatherings because of limited car access:

For example, on the weekend, if there's an event, a fun event, my family has parties, or something like that going on somewhere in the community and I really wanted to go, but I didn't have a car and I missed out on all of those types of events and I wish I could have gone, but I was stuck. I didn't have a car. (Merced 2)

Unlike the transportation options provided by friends and family when getting rides and sharing vehicles, formal options appeared to be less desired because of uncertainty with respect to available and frequency. While these services were often lifelines when no other options were

available, travel routes could be long and circuitous, bus stop amenities were minimal, and distances to get to transit could be long and uncomfortable. Missed trips were not uncommon because a bus did not come, because medical transportation was unavailable for a long-distance appointment, or because it was impossible to get access to a vehicle. The next section describes solutions to several of these challenges from the perspectives of those experiencing them.

Solutions

Community-focused transportation

Interview participants offered several kinds of solutions that would help them overcome their mobility and access challenges. Overall, the sentiment was not for more or easier car ownership, but for transportation alternatives that would provide them access on their terms without requiring a privately owned vehicle. One common request was for flexible, community-oriented microtransit-like options to job sites and shopping destinations, recalling *camioneta* services run for and by Latino immigrants (36). Interviewees imagined these services would serve different destinations on a regular schedule and implied they should provide door-to-door or near door-to-door service:

If we had somebody with a bus or something smaller and who knows the whole community here— Because there are many people in this area, and we're all farm workers. On a certain day, so to speak, they could take us to Walmart. There, we can buy many things. It's cheaper. On another day, for example, they can take us to Food 4 Less or WinCo.... For example, "On Monday, we'll go to Walmart. They'll give us an hour and a half to buy." An hour and a half, imagine that. It would be great if they could take us and bring us back. On another day, they can take us to a food store....It would be enough if we could have that just two or three times a week. (Visalia 6)

In addition to these kinds of services, some specifically mentioned specialized medical transportation. Although such options exist in the region, there was a sense of frustration that they were not sufficient to provide access to medical appointments far away or for outpatient procedures that might take several hours to complete. As one interviewee described, "I can't get medical transport from the clinic that I go to because I'm over 50 miles" away (Visalia 5). Some thought that these kinds of services could be combined with the flexible community-oriented transportation services, in which they provided access to shopping on a regular schedule and access to medical appointments on demand (Visalia 7). Another thought that transportation services should be arranged by the doctor's office or medical clinic when it was clear that the patient did not have another reliable form of transportation to get there (Visalia 8). Unlike informal *camioneta* or jitney services, one interviewee mentioned specifically that these kinds of services should be regulated and would be a welcome addition to the few transportation options available. In response to the interviewer's question about how planners could help the community, an interviewee responded:

If there was a little truck or something. If there was transportation. For example, we have known of crews that have their own ride with permits and everything, and it picks

them up, sometimes in a certain area, sometimes house to house. At other times, it may take you to certain places at a certain time. That would be a relief for all of us, for all of us who have that problem. (Visalia 8)

Still others focused on even less formal forms of ride giving and carpooling. One participant recalled a college experience of wanting a ride to campus after a weekend home, and thought the system could work on a community-oriented basis:

I feel like maybe a carpool system. If I look back at my college days, I wish I would have had some type of network of being able to post like, “Hey, does anybody want to commute on Mondays or Tuesdays,” and just having maybe that type of system or within town. Maybe every Thursday, there’s a van that goes to WinCo at 3:00 PM. Maybe those services would also be helpful for stay-at-home moms that maybe the husbands are at work, and that’s the best time to go. (Visalia 3)

Another saw a need for an informal system like the San Francisco Bay Area’s casual carpool, in which pickup spots are organized in a decentralized fashion but drew on community resources to maintain the system:

I just say that we’re limited, we’re limited to our resources in our community, that we need to expand on other stuff for transportation or even have in the Bay where they do [casual carpooling]....Instead of using your car, maybe developing something in our community where they’ll pick you up and you guys all ride together to work or things like that. (Merced 1)

Yet another thought employer-organized transportation should be more common, such as employer-provided work vans as a means for farmworkers to carpool to field sites (Visalia 4). In each of these cases, the notion of transportation access centered around community to specific, essential destinations, was seen a clear need to improve access in rural areas.

Alternatives to private car ownership

In addition to the community-oriented options, interviewees also saw a need for more formal kinds of transportation provision to improve access in rural areas. In places where there was fixed-route transit, several interviewees wanted more frequent and available service. One recognized that service was poor in their area and would need to improve for drivers to make the switch to transit:

I would say my idea would be is to have a bus route and improve it with the times. I know that there are many people that don’t use bus routes and those that do, they have to wait a long time because of the times that they are coming into the community....In Merced, there’s not a lot of bus service here and so people are waiting forever to get on the bus and then people they just want to drive. (Merced 2)

Some had hoped for higher-speed transit in the form of trains or trolleys (Farmersville 1), while others mentioned transit discounts should be afforded to students or other low-income riders (Fresno 1).

Interviewees saw value in on-demand services, such as ridehailing and delivery services. Uber and Lyft were mentioned as potential options in the larger cities of Fresno and Merced, but their expense was too great to use more than occasionally, leading to suggestions of discounts for passengers (Fresno 1, Merced 2). Others saw the value in delivery services for food and essential items. Access to medicine was a critical issue for one interviewee, who often experienced uncertainty with delivery times and availability: “Sometimes when I call to see where my meds are at, they’ll tell me, ‘Oh, I’m so sorry. We only have one person that delivers and they only deliver on this day and they’re trying to get over to your area’” (Visalia 5). Experiences with expanded delivery of food and groceries during the Covid-19 shelter-in-place orders buoyed enthusiasm for continued delivery options.

Car sharing or rentals were options some interviewees thought could serve their transportation needs. Some had experience with Míocar, an EV car sharing service co-located at some of the housing developments that some of the interviewees lived in. Those who had used it liked the ability to get a car when they needed it and wanted to see more of them:

I think [Míocar] is a cool thing. I was actually trying to do one earlier, but there’s no vehicles available. There’s nothing. There’s two vehicles that they do right there I guess. Of course, there are always, they’re going to be rented out quickly. Yes, there’s not even probably any available dates for those cars. If they did more, that’d probably be great. (Visalia 1)

Others who had learned of the service during our interviews were excited to try it out the next time they had the need to use a car. Still others who did not live near Míocar locations saw the need for car sharing, but it was important to them that the service be affordable for low-income individuals:

They could help by getting city cars in, where they could maybe support like a program, like a budget that would be half of what the transport costs, the other half would be the person’s cost of where they had to go. It would be much better, cheaper and more accessible, that if we have something to support us to transport us when we don’t have the means. (Farmersville 1)

All of these options were seen as means to an end. The desire for more ridehailing, delivery, and car sharing services were seen as ways to get places or goods more efficiently, “so they won’t have to spend the entire day on the road to get to an appointment and come home late,” as one interviewee put it (Le Grand 3).

Other solutions

Interview participants saw a wide variety of transportation options as solutions to their mobility and access challenges. While most spoke of alternatives to car ownership, a few did express a desire to get a car. Some explicitly indicated EVs were a potential solution. Although there was some uncertainty about specific features and qualities of electric vehicles in comparison to

traditional gasoline-powered vehicles, such as maintenance expenses, costs of fuel were top of mind for some as a reason why they would choose an EV:

If I could afford [an electric vehicle], if somebody came and told me this is a reliable car and if I could afford it, I'd go for it. I honestly would because I would think the payment and the gas that I would save on, I'd be able to be to get to my own appointments and not have to rely on the bus, my daughter, medical transportation, I could make my appointments whenever I wanted to not whenever medical transportation takes me. Yes, I would consider it for the reliability, the economics, of it. (Visalia 5)

Transportation subsidies for multiple options, like transit, ridehailing, and car sharing, were also commonly mentioned solutions. But perhaps most fundamental, there was a sense that transportation planners and decision makers needed to experience the conditions that the interview participants were facing so they could better design solutions that would meet the public's needs. Many interviewees expressed their appreciation that they were being listened to and that their experiences and opinions could serve to improve their options. One offered a specific call to action:

I'm going to be very blunt with this. I want those councilors, I want all of those people who are doing this survey to come. They wear flip flops or wear whatever they wear, high heel boots, dress shoes, it doesn't matter and I want them to be waiting outside at the transit stop or at the little— they have the little benches and sometimes you're in the sun, sometimes you're in the rain, and I want them to wait for the buses. When they get on the bus, I don't want them to be afraid to sit wherever there is an extra seat because there have been times that I'm afraid to sit down because I don't know who I'm sitting next to.

I actually want them to get on the bus. I want them to wait. I want them to sit there and wait for the bus. I want them to get the bus coming because I have a doctor's appointment, is the bus coming. I've got to go to Dinuba and pick some papers up. Is the bus coming? Is it coming? Is it coming? (Visalia 2)

The frustration of waiting for a bus not knowing whether it would come, with inadequate amenities like seating and shelter, combined with the apparent inattentiveness of transit and city leaders, was evident in this person's experience. The sentiment speaks to a need for sustained and broad community engagement around transportation challenges in these and similar communities.

Summary and Policy Implications

Summary

This report describes the scope and scale of car access in rural areas, identifies barriers that rural zero-car and car-deficit households face in their mobility and access, and proposes personal and policy-level adaptations that would help these households achieve their mobility and access needs.

Across California, 7% of households have no vehicle at home, while 22% have fewer cars than adults. A higher share of households in rural areas have complete access to a vehicle, but 5% are fully carless and 18% live in a car-deficit household with less than one vehicle per adult. Both zero-car and car-deficit households tend to be located in the Central Valley—particularly in Fresno County, Tulare County, and Kern County—with significant shares of zero-car households in rural Northern California and significant shares of both in the Imperial Valley.

Zero-car and car-deficit households in rural areas tend to be more socioeconomically disadvantaged than in nonrural areas. Both groups earn lower household incomes, are more likely to be Black, Latino, or Asian, have lower educational attainment, have more disabilities, have higher housing-cost burdens, and are more likely to be unemployed than their counterparts in nonrural areas.

Differences in the means of transportation to work are particularly pronounced for zero-car households. Almost half of workers in rural zero-car households drive alone to work compared to about a quarter in nonrural zero-car households, while mode shares are similar for car-deficit and car fully equipped households. Rural zero-car households are more likely to carpool and far less likely to take public transit.

Interview participants tended to have at least one car at home, but 27% lived in a household without a vehicle. Most had gotten rides in the previous week to get places and borrowed cars frequently. Household budgets were tight and nearly all participants would have to make major changes to their lifestyles if they had an unexpected increase in transportation expenses. Less than half planned to purchase a vehicle in the next five years.

A commonality uniting the interview participants was the practice of relying on their social networks to get rides or obtain vehicle access. Friends, family, and neighbors often gave rides to those without cars or shared their cars with others so they could drive themselves. Negotiating for vehicle access required careful planning around fixed work schedules and was often a delicate negotiation given that the households providing the cars or rides were in similar financial situations. Some individuals would choose to not make a discretionary trip rather than deal with the stress of placing additional burdens on those in their social circles.

Much of the reason for this added stress was the high cost of car ownership and operation. Ongoing expenses like insurance and car repairs were seen as significant challenges to purchasing or maintaining a car, and the high price of gasoline—particularly those experienced in the summer of 2022—placed economic pressures on those who did operate a vehicle and was an insurmountable barrier to car access for those who did not. Those who relied on others to give them rides were challenged here as well because those providing the rides asked for more gas money or limited their own travel.

Alternatives to car ownership included public transit, medical transportation services, and car sharing. In the rural setting, however, transit service is limited to larger population centers with infrequent service and long distances to travel to bus stops. Amenities are also limited, creating challenges for those who must walk in summer heat or winter rains to get to bus stops. Medical

transportation was a lifeline to those who used it, but often did not afford its users the opportunity to travel for medical procedures at facilities in cities and major population centers because the round-trip travel distances were too great. The limited options increased the social exclusion of those without ready access to a vehicle, as they would sometimes choose to stay at home and not take the trip at all.

Interview participants shared a variety of options they saw as solutions to overcoming their barriers to lack of car access. While obtaining a vehicle was not absent from their preferred solutions, most preferred better personal access to transportation without the burden of private car ownership. For many, especially those in the farmworker community, community-focused transportation options like jitney services, shuttles to grocery stores, and self-organized carpooling services would provide a lifeline for transportation to work, shopping, and medical appointments. Others saw community-based car sharing, increased transit options, and ridehailing and delivery services and important additions to their transportation options. Some express optimism for the transition to electric vehicles and wanted to be part of the transition. Finally, several individuals stressed the importance of political leaders in spending time using public transit or other transportation options in their communities so their decisions could be based in the experiences of people who rely on alternatives to car ownership to get around.

Policy Implications

The findings from this research demonstrate some of the complexities to consider when addressing transportation barriers in rural areas, where carlessness is less prevalent but solutions may be harder to implement than in urban areas where density and population size can afford investment in traditional mobility options that work better at scale, like public transit, paratransit, and active transportation infrastructure. Zero-car and car-deficit households start from more intense disadvantage as well, pointing to the need to approach solutions by centering principles of justice and equity. Several laws and policies in the state require greenhouse gas (GHG) reductions through limiting or reversing the growth in vehicle miles traveled (VMT). The state anticipates these gains will come from the transition to zero-emission vehicles and land use efficiency (37), though progress has been limited or non-existent because planning, programming, and funding has continued to favor auto-oriented uses (38, 39). Land use efficiency is particularly difficult to implement in rural areas, which almost by definition preclude dense land uses, and which have shown more VMT increases and less compact development over the past two decades than urban areas (39). This means that the effort to reduce GHG emissions while provide access will have to come from transformation in the transportation system.

A strong focus on alternatives to private car ownership with investment in zero-emission shared and public options can be one way to improve access to opportunities for households with few mobility options. A significant finding of this work points to community-oriented options as a preferred solution for residents of disadvantaged communities; informal carpooling and community-directed jitney operations, for example, would fulfill gaps for many carless and car-deficit residents and would be generated from people who understand community needs best. Models of community participation in decision making that delegate power and authority to

community members, such as participatory budgeting, can yield meaningful equity benefits, particularly if they are attentive to equity in decision making processes as well as outcomes (40, 41). Legislative directives require at least 25% of cap-and-trade funds to be invested in disadvantaged and low-income communities to remedy environmental justice problems—a set of funds that could yield significant equity outcomes in a community-oriented decision-making process. For example, a portion of the budget could be directed toward community-organized transportation options under the umbrella of a social service agency, transportation agency, or community-based organization. This sort of model could maintain the community feel of informal options while providing the backstop of a formal structure to ensure safety and continuity of operations.

Another example of investment in community-oriented transportation options is the Clean Mobility Options (CMO) program administered by the California Air Resources Board (42). The program provides up to \$1 million to community organizations and governmental agencies to fund clean transportation projects like electric vehicle car sharing, zero-emission microtransit, e-bike sharing, and charging infrastructure. Several of these clean transportation options are located in the Central Valley. Míocar, an electric car sharing service in Kern and Tulare Counties that several research participants had used, was initially funded from the California Climate Investments fund and has expanded its operations to Richmond because of additional CMO funding. The service has been successful by providing a stopgap mobility option for system users, in addition to lowering personal vehicle use and associated greenhouse gas emissions (43, 44). Míocar sites are located primarily at affordable housing units, making them most available for the lowest-income community residents. The partnership between a university and community-based organizations for the initial design of the service and continued operation has ensured that the service meets community needs based on evidence-based evaluation and local knowledge. Continued support of this and similar models of zero-emission transportation, including through public investment, technical assistance, and community-based leadership, would help fulfill critical community mobility needs.

Expanded car sharing and microtransit services are important investments for personal mobility, but not everyone is able to drive or can use demand-response transit options. As the interview respondents indicated, on demand rides like medical transportation, paratransit, and ridehailing address access gaps because they provide point-to-point options for people with limited mobility. However, the operation of specialized transportation services costs several times more than traditional transit service, despite large society benefits of paratransit, putting a strain on public operators' budgets and prompting searches for private solutions (45, 46). There are other limits to specialized transportation services as well; service areas may not allow users to reach far destinations and trips must be scheduled in advance, prohibiting flexibility in changing appointments or seeking last-minute urgent care. While ridehailing may not serve as a perfect substitute for people with mobility limitations or disabilities because vehicles tend to be less available for them, they make more trips than those who do not have a disability when they do get access to the service (47, 48). These patterns support the idea that the need for specialized, flexible, on-demand options are vital to ensuring the most vulnerable have sufficient levels of access to meet their needs. This would require re-thinking how such services

are provided, examining the structural barriers to providing specialized transportation that better meets the needs of users while operating within budget and regulatory constraints. Some evidence shows that providing transportation wallets to low-income individuals that allow them to choose transportation options that work best for them in each particular situation help improve access and make trips they would otherwise not be able to make (49). Better coordination between medical transportation providers, medical clinics, and public transit agencies could also help eliminate transportation barriers to medical care specifically.

In urban areas, public transit remains the most cost-effective way to provide transportation service to those who need it. But traditional public transit is difficult to operate in rural areas, and in the population centers where transit was available, research participants found service inadequate to meet their needs. For example, in Visalia, where half of the interviewees lived, most lines operate at 30-minute frequency or less. Particularly near the edges of the city, bus stops are located along high-speed roads and have few amenities like shelters and benches. These qualities make transit the option of last resort even when population and activity density can support a robust transit system. Addressing these challenges is not easy, with limited available funding and operational challenges coming out of the Covid-19 pandemic. Nevertheless, community-led discussions to revision the purpose and function of public transit to better serve needs could lead to innovative solutions. Neighborhood shuttles that provide first- and last-mile service or on-demand services that connect to trunk routes are ways to provide services that approach door-to-door service for transit riders. “Our Community, Our Shuttle” is an example of how a community-led visioning process led to a new shuttle program for Bayview-Hunters Point, a transit-poor area of San Francisco (50).

While investment in public and shared transportation options is necessary, it is inevitable that a high degree of car ownership will persist for matters of ease and convenience. As the fleet converts to zero-emission vehicles (ZEVs) over the next decade, principles of equity should guide policy and investment in the infrastructure needed to support the transition in disadvantaged communities. As several research participants mentioned, there is an appetite for purchasing electric vehicles for environmental reasons and because of a perception of lower ongoing maintenance costs. Electric vehicles have higher upfront costs, and the used market is not robust yet, putting these vehicles out of reach of lower-income individuals. Programs to make these vehicles more affordable should be supported and expanded judiciously. In California, the Clean Vehicle Rebate Project offers substantial financial incentives for ZEVs and low-emission vehicle purchases that would lower out-of-pocket costs for a vehicle purchase. However, income caps for program eligibility remain high; rebates in higher amounts that target lower-income consumers and greater flexibility in applying the rebates to used vehicles could improve access. Other programs target low-income households, such as Clean Cars 4 All that incentivizes trade-ins of older polluting vehicles for ZEVs and the Clean Vehicle Assistance Program that offers loans and grants to low-income households for ZEV purchase, are promising models for improving access to ZEVs.

The logistics of vehicle charging must be addressed at the same time that ZEV access is expanded. DC fast chargers are available at the same per-capita proportion in disadvantaged

communities as in other communities (4), but, at least in the Central Valley, these are located primarily along the freeways that run through the valley rather than within communities themselves. Federal and state investment in public charging infrastructure can help make chargers more ubiquitous in locations where lower-income residents can charge overnight. This is an important consideration because it is more difficult for lower-income residents in multifamily developments and rented units to have at-home charging. Regulation or incentive programs to encourage building owners may be needed to expand the supply of at-home chargers that would make it easier for ZEV owners to charge when needed.

A variety of transportation options are necessary to meet the access needs of rural carless residents. Alternatives to car access are important for keeping costs low for the lowest-income residents, while strong engagement with communities and community-led processes can help ensure that equity remains central to the solutions.

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Data Summary

Products of Research

Quantitative data collected included the 2015-2019 five-year American Community Survey 1% Public Use Microdata Sample (PUMS), published by the US Census. Qualitative data collected included pre-interview questionnaires, interview recordings, and summary memos of the interviews.

Data Format and Content

Census data were accessed via the Census Bureau Application Programming Interface and stored in native R data format. Interview data were recorded in m4a audio files and then transcribed to Word documents.

Data Access and Sharing

The general public can access PUMS data through the US Census Bureau API at the following link: https://www.census.gov/data/developers/data-sets/census-microdata-api.ACS_5-Year_PUMS.html#list-tab-71345371. Interview data may not be shared per Institutional Review Board guidance.

Reuse and Redistribution

The Census data are publicly available and redistributable. Interview data may not be shared with the public per Institutional Review Board guidance.

Appendix A: Detailed Analysis Tables

The detailed tables for the descriptive analysis are shown below. The tables correspond with the charts shown in quantitative results section.

Table A1. Socioeconomic characteristics by car access statewide

Person Characteristics	Overall, 35,985,931 (100%)	Zero-car, 1,651,653 (4.6%)	Car-deficit, 10,960,419 (30.5%)	Car-fully equipped, 23,373,859 (65.0%)
Gender				
Male	17,617,742 (49.0%)	731,411 (4.2%)	5,388,824 (30.6%)	11,497,507 (65.3%)
Female	18,368,189 (51.0%)	920,242 (5.0%)	5,571,595 (30.3%)	11,876,352 (64.7%)
Age	38	46	37	38
Race and Ethnicity				
Black or African American	1,856,553 (5.0%)	202,128 (10.9%)	582,449 (31.4%)	1,071,976 (57.7%)
Hispanic or Latino	13,856,550 (39.0%)	580,062 (4.2%)	5,524,305 (39.9%)	7,752,183 (56.0%)
Asian	5,212,537 (14.0%)	260,593 (5.0%)	1,881,471 (36.1%)	3,070,473 (58.9%)
White	13,647,832 (38.0%)	542,335 (4.0%)	2,600,369 (19.1%)	10,505,128 (77.0%)
Others	1,412,459 (4.0%)	66,535 (4.7%)	371,825 (26.3%)	974,099 (69.0%)
Limited English Proficiency	3,259,681 (22.0%)	287,073 (8.8%)	1,745,397 (53.6%)	1,227,211 (37.7%)
Non-citizen	4,700,398 (13.0%)	298,095 (6.3%)	2,315,806 (49.3%)	2,086,497 (44.4%)
Foreign-born	9,844,716 (27.0%)	568,021 (5.8%)	4,172,598 (42.4%)	5,104,097 (51.9%)
Disabled	3,734,621 (10.0%)	486,714 (13.0%)	1,365,145 (36.6%)	1,882,762 (50.4%)
Unemployed	1,039,299 (6.0%)	65,803 (6.3%)	432,765 (41.6%)	540,731 (52.0%)
Educational Attainment				
Bachelor's or above	8,894,573 (26.0%)	320,714 (3.6%)	1,878,564 (21.1%)	6,695,295 (75.3%)
Some College or Equivalent	8,557,624 (25.0%)	362,777 (4.2%)	2,468,743 (28.9%)	5,726,104 (66.9%)
High School or Equivalent	5,861,026 (17.0%)	328,929 (5.6%)	2,242,370 (38.3%)	3,289,727 (56.1%)
Less than High School	9,954,071 (29.0%)	494,581 (5.0%)	3,409,308 (34.3%)	6,050,182 (60.8%)

Person Characteristics	Overall, 35,985,931 (100%)	Zero-car, 1,651,653 (4.6%)	Car-deficit, 10,960,419 (30.5%)	Car-fully equipped, 23,373,859 (65.0%)
No Schooling	1,493,100 (4.0%)	103,367 (6.9%)	593,384 (39.7%)	796,349 (53.3%)
Not Married	21,531,932 (60.0%)	1,301,158 (6.0%)	6,655,861 (30.9%)	13,574,913 (63.1%)
Household Characteristics	Overall, 13,044,270 (100%)	Zero-car, 931,403 (7.1%)	Car-deficit, 2,883,867 (22.1%)	Car-fully equipped, 9,229,000 (70.8%)
Owned Unit	7,094,371 (54.4%)	182,286 (2.6%)	1,284,030 (18.1%)	5,628,055 (79.3%)
Single-parent Household	2,948,442 (23.8%)	48,794 (1.7%)	691,675 (23.5%)	2,207,973 (74.9%)
Presence of Children	4,450,092 (34.1%)	139,603 (3.1%)	1,172,064 (26.3%)	3,138,425 (70.5%)
Presence of Older Adults	3,809,335 (29.2%)	408,918 (10.7%)	998,824 (26.2%)	2,401,593 (63.0%)
Household Income (\$)	101,774	44,991	92,066	110,538
% Owner Cost	15.0	6.7	11.9	16.8
% Gross Rent	17.9	39.0	20.9	14.8

Note: All differences statistically significant (p < 0.001)

Table A2. Mobility characteristics across transportation means to work statewide

Mobility Characteristics	Overall, 35,985,931 (100%)	Zero-car, 1,651,653 (100%)	Car-deficit, 10,960,419 (100%)	Car-fully equipped, 23,373,859 (100%)
Transportation to Work				
Drive Alone	12,523,632 (74.0%)	145,404 (27.3%)	3,077,958 (64.4%)	9,300,270 (80.4%)
Carpool	1,684,688 (10.0%)	52,023 (9.8%)	714,048 (14.9%)	918,617 (7.9%)
Public Transit	827,001 (4.9%)	177,382 (33.4%)	374,729 (7.8%)	274,890 (2.4%)
Bike and Walk	535,531 (3.2%)	93,468 (17.6%)	229,645 (4.8%)	212,418 (1.8%)
Others	1,301,367 (7.7%)	63,525 (11.9%)	381,025 (8.0%)	856,817 (7.4%)

Note: All differences statistically significant (p < 0.001)

Table A3. Rural-nonrural differences in socioeconomic characteristics

Person Characteristics	Overall		Zero-car		Car-deficit		Car-fully equipped	
	Rural, 5,762,882 (16.0%)	Nonrural, 30,223,049 (84.0%)	Rural, 193,212 (11.7%)	Nonrural, 1,458,441 (88.3%)	Rural, 1,442,199 (13.2%)	Nonrural, 9,518,220 (86.8%)	Rural, 4,127,471 (17.7%)	Nonrural, 19,246,38 (82.3%)
Gender								
Male	2,843,938 (49.3%)	14,773,804 (48.9%)	86,547 (44.8%)	644,864 (44.2%)	717,095 (49.7%)	4,671,729 (49.1%)	2,040,296 (49.4%)	9,457,211 (49.1%)
Female	2,918,944 (50.7%)	15,449,245 (51.1%)	106,665 (55.2%)	813,577 (55.8%)	725,104 (50.3%)	4,846,491 (50.9%)	2,087,175 (50.6%)	9,789,177 (50.9%)
Age	39	38	47	46	38	37	39	37
Race and Ethnicity								
Black or African American	103,785 (1.8%)	1,752,768 (5.8%)	8,282 (4.3%)	193,846 (13.3%)	31,926 (2.2%)	550,523 (5.8%)	63,577 (1.5%)	1,008,399 (5.2%)
Hispanic or Latino	2,196,547 (38.1%)	11,660,003 (38.6%)	70,688 (36.6%)	509,374 (34.9%)	765,511 (53.1%)	4,758,794 (50.0%)	1,360,348 (33.0%)	6,391,835 (33.2%)
Asian	244,340 (4.2%)	4,968,197 (16.4%)	7,620 (3.9%)	252,973 (17.3%)	85,636 (5.9%)	1,795,835 (18.9%)	151,084 (3.7%)	2,919,389 (15.2%)
White	2,985,030 (51.8%)	10,662,802 (35.3%)	95,876 (49.6%)	446,459 (30.6%)	501,123 (34.7%)	2,099,246 (22.1%)	2,388,031 (57.9%)	8,117,097 (42.2%)
Others	233,180 (4.0%)	1,179,279 (3.9%)	10,746 (5.6%)	55,789 (3.8%)	58,003 (4.0%)	313,822 (3.3%)	164,431 (4.0%)	809,668 (4.2%)
Speak English Well								
No	461,490 (25.6%)	2,798,191 (21.2%)	23,566 (39.9%)	263,507 (38.5%)	222,563 (33.1%)	1,522,834 (27.2%)	215,361 (20.1%)	1,011,850 (14.6%)
Yes	1,343,818 (74.4%)	10,418,652 (78.8%)	35,500 (60.1%)	420,795 (61.5%)	450,100 (66.9%)	4,074,287 (72.8%)	858,218 (79.9%)	5,923,570 (85.4%)
Citizenship (US-Citizen)								
No	574,836 (10.0%)	4,125,562 (13.7%)	23,128 (12.0%)	274,967 (18.9%)	263,453 (18.3%)	2,052,353 (21.6%)	288,255 (7.0%)	1,798,242 (9.3%)
Yes	5,188,046 (90.0%)	26,097,487 (86.3%)	170,084 (88.0%)	1,183,474 (81.1%)	1,178,746 (81.7%)	7,465,867 (78.4%)	3,839,216 (93.0%)	17,448,146 (90.7%)

Person Characteristics	Overall		Zero-car		Car-deficit		Car-fully equipped	
	Rural, 5,762,882 (16.0%)	Nonrural, 30,223,049 (84.0%)	Rural, 193,212 (11.7%)	Nonrural, 1,458,441 (88.3%)	Rural, 1,442,199 (13.2%)	Nonrural, 9,518,220 (86.8%)	Rural, 4,127,471 (17.7%)	Nonrural, 19,246,38 (82.3%)
Nativity (US-Born)								
No	1,022,023 (17.7%)	8,822,693 (29.2%)	38,232 (19.8%)	529,789 (36.3%)	400,816 (27.8%)	3,771,782 (39.6%)	582,975 (14.1%)	4,521,122 (23.5%)
Yes	4,740,859 (82.3%)	21,400,356 (70.8%)	154,980 (80.2%)	928,652 (63.7%)	1,041,383 (72.2%)	5,746,438 (60.4%)	3,544,496 (85.9%)	14,725,266 (76.5%)
Disabled								
Yes	747,343 (13.0%)	2,987,278 (9.9%)	69,397 (35.9%)	417,317 (28.6%)	230,691 (16.0%)	1,134,454 (11.9%)	447,255 (10.8%)	1,435,507 (7.5%)
No	5,015,539 (87.0%)	27,235,771 (90.1%)	123,815 (64.1%)	1,041,124 (71.4%)	1,211,508 (84.0%)	8,383,766 (88.1%)	3,680,216 (89.2%)	17,810,881 (92.5%)
Employment Status								
No	185,039 (6.9%)	854,260 (5.5%)	9,585 (17.4%)	56,218 (10.1%)	68,564 (10.9%)	364,201 (7.7%)	106,890 (5.4%)	433,841 (4.2%)
Yes	2,479,443 (93.1%)	14,808,758 (94.5%)	45,503 (82.6%)	501,122 (89.9%)	559,107 (89.1%)	4,354,100 (92.3%)	1,874,833 (94.6%)	9,953,536 (95.8%)
Educational Attainment								
Bachelor's or above	1,013,698 (18.2%)	7,880,875 (27.0%)	19,134 (10.2%)	301,580 (21.2%)	146,643 (10.6%)	1,731,921 (18.8%)	847,921 (21.3%)	5,847,374 (31.5%)
Some College or Equivalent	1,540,075 (27.7%)	7,017,549 (24.0%)	46,408 (24.8%)	316,369 (22.2%)	335,831 (24.2%)	2,132,912 (23.2%)	1,157,836 (29.1%)	4,568,268 (24.6%)
High School or Equivalent	1,074,144 (19.3%)	4,786,882 (16.4%)	45,019 (24.1%)	283,910 (19.9%)	324,266 (23.4%)	1,918,104 (20.8%)	704,859 (17.7%)	2,584,868 (13.9%)
Less than High School	1,690,520 (30.4%)	8,263,551 (28.3%)	62,860 (33.6%)	431,721 (30.3%)	497,987 (35.9%)	2,911,321 (31.6%)	1,129,673 (28.4%)	4,920,509 (26.5%)
No Schooling	238,956 (4.3%)	1,254,144 (4.3%)	13,618 (7.3%)	89,749 (6.3%)	81,553 (5.9%)	511,831 (5.6%)	143,785 (3.6%)	652,564 (3.5%)

Person Characteristics	Overall		Zero-car		Car-deficit		Car-fully equipped	
	Rural, 5,762,882 (16.0%)	Nonrural, 30,223,049 (84.0%)	Rural, 193,212 (11.7%)	Nonrural, 1,458,441 (88.3%)	Rural, 1,442,199 (13.2%)	Nonrural, 9,518,220 (86.8%)	Rural, 4,127,471 (17.7%)	Nonrural, 19,246,38 (82.3%)
Marital Status								
No	3,328,833 (57.8%)	18,203,099 (60.2%)	153,014 (79.2%)	1,148,144 (78.7%)	868,645 (60.2%)	5,787,216 (60.8%)	2,307,174 (55.9%)	11,267,739 (58.5%)
Yes	2,434,049 (42.2%)	12,019,950 (39.8%)	40,198 (20.8%)	310,297 (21.3%)	573,554 (39.8%)	3,731,004 (39.2%)	1,820,297 (44.1%)	7,978,649 (41.5%)

Household Characteristics	Overall		Zero-car		Car-deficit		Car-fully	
	Rural, 2,143,195 (16.4%)	Nonrural, 10,901,075 (83.6%)	Rural, 110,294 (11.8%)	Nonrural, 821,109 (88.2%)	Rural, 386,596 (13.4%)	Nonrural, 2,497,271 (86.6%)	Rural, 1,646,305 (17.8%)	Nonrural, 7,582,695 (82.2%)
Owned Unit								
Yes	1,370,256 (63.9%)	5,724,115 (52.5%)	33,019 (29.9%)	149,267 (18.2%)	200,199 (51.8%)	1,083,831 (43.4%)	1,137,038 (69.1%)	4,491,017 (59.2%)
No	772,939 (36.1%)	5,176,960 (47.5%)	77,275 (70.1%)	671,842 (81.8%)	186,397 (48.2%)	1,413,440 (56.6%)	509,267 (30.9%)	3,091,678 (40.8%)
Single-parent Household								
Yes	467,053 (22.8%)	2,481,389 (23.9%)	6,003 (5.8%)	42,791 (5.6%)	94,063 (25.3%)	597,612 (24.9%)	366,987 (23.4%)	1,840,986 (25.6%)
No	1,578,242 (77.2%)	7,886,936 (76.1%)	96,960 (94.2%)	725,388 (94.4%)	277,732 (74.7%)	1,797,642 (75.1%)	1,203,550 (76.6%)	5,363,906 (74.4%)
Presence of Children								
Yes	714,150 (33.3%)	3,735,942 (34.3%)	17,786 (16.1%)	121,817 (14.8%)	162,398 (42.0%)	1,009,666 (40.4%)	533,966 (32.4%)	2,604,459 (34.3%)
No	1,429,045 (66.7%)	7,165,133 (65.7%)	92,508 (83.9%)	699,292 (85.2%)	224,198 (58.0%)	1,487,605 (59.6%)	1,112,339 (67.6%)	4,978,236 (65.7%)
Presence of Older Adults								
Yes	719,734 (33.6%)	3,089,601 (28.3%)	52,216 (47.3%)	356,702 (43.4%)	140,781 (36.4%)	858,043 (34.4%)	526,737 (32.0%)	1,874,856 (24.7%)
No	1,423,461	7,811,474	58,078	464,407	245,815	1,639,228	1,119,568	5,707,839

Household Characteristics	Overall		Zero-car		Car-deficit		Car-fully	
	Rural, 2,143,195 (16.4%)	Nonrural, 10,901,075 (83.6%)	Rural, 110,294 (11.8%)	Nonrural, 821,109 (88.2%)	Rural, 386,596 (13.4%)	Nonrural, 2,497,271 (86.6%)	Rural, 1,646,305 (17.8%)	Nonrural, 7,582,695 (82.2%)
	(66.4%)	(71.7%)	(52.7%)	(56.6%)	(63.6%)	(65.6%)	(68.0%)	(75.3%)
Household Income (\$)	85,746	104,925	33,808	46,493	73,224	94,983	92,166	114,527
% Owner Cost	17.3	14.6	10.1	6.3	13.3	11.7	18.8	16.4
% Gross Rent	13.4	18.7	33.1	39.8	17.3	21.5	11.2	15.6

Table A4. Rural-nonrural differences in mobility characteristics

Mobility Characteristics	Overall		Zero-car		Car-deficit		Car-fully	
	Rural, 5,762,882 (16.0%)	Nonrural, 30,223,049 (84.0%)	Rural, 193,212 (11.7%)	Nonrural, 1,458,441 (88.3%)	Rural, 1,442,199 (13.2%)	Nonrural, 9,518,220 (86.8%)	Rural, 4,127,471 (17.7%)	Nonrural, 19,246,38 (82.3%)
Transportation to Work								
Drive Alone	1,874,465 (77.2%)	10,649,167 (73.7%)	21,341 (48.4%)	124,063 (25.4%)	366,106 (67.1%)	2,711,852 (64.1%)	1,487,018 (80.9%)	7,813,252 (80.3%)
Carpool	260,424 (10.7%)	1,424,264 (9.9%)	7,260 (16.5%)	44,763 (9.2%)	95,543 (17.5%)	618,505 (14.6%)	157,621 (8.6%)	760,996 (7.8%)
Public Transit	24,897 (1.0%)	802,104 (5.6%)	2,230 (5.1%)	175,152 (35.9%)	9,948 (1.8%)	364,781 (8.6%)	12,719 (0.7%)	262,171 (2.7%)
Bike and Walk	67,114 (2.8%)	468,417 (3.2%)	7,424 (16.8%)	86,044 (17.6%)	23,354 (4.3%)	206,291 (4.9%)	36,336 (2.0%)	176,082 (1.8%)
Others	201,456 (8.3%)	1,099,911 (7.6%)	5,863 (13.3%)	57,662 (11.8%)	50,477 (9.3%)	330,548 (7.8%)	145,116 (7.9%)	711,701 (7.3%)

Appendix B: Pre-interview Survey

English version

1. How many working cars, truck, or vans does your household own?
2. Did you use any of the following kinds of transportation to get around in the last seven days? Please mark those that you used.
 - I drove my own car
 - I drove a shared car
 - I got a ride from someone I know
 - I took transit
 - I bicycled to get somewhere
 - I walked to get somewhere
3. How often do you typically borrow a car from friends or family?
 - Every day
 - 3-6 days per week
 - 1-2 days per week
 - A few times a month
 - A few times a year
 - Never
4. How often do you typically get a ride from someone you know?
 - Every day
 - 3-6 days per week
 - 1-2 days per week
 - A few times a month
 - A few times a year
 - Never
5. How often do you typically use a car-sharing service (MioCar, Zipcar, or an informal arrangement with some other group)?
 - Every day
 - 3-6 days per week
 - 1-2 days per week
 - A few times a month
 - A few times a year
 - Never

6. On average, how much do you spend on transportation per month? Consider things like gas, insurance, tolls, transit fares, car-share memberships, and rental fees.
7. If the amount you spend on transportation were to increase 10% per month, what would happen?
 - I would be able to afford the increase just fine
 - I would have to make **small** changes in my budget to afford the increase
 - I would have to make **major** changes in my budget to afford the increase, like cutting out some activities or shorting some other bills, but I would still get around the same way
 - I would have to make **major** changes in my budget to afford the increase, like cutting out some activities or shorting some other bills, and I would have to change the way I get around or stop going some places
8. Do you plan to purchase a vehicle in the next 1-5 years?
 - No
 - Yes, I plan to purchase a new gasoline powered car
 - Yes, I plan to purchase a used gasoline powered car
 - Yes, I plan to purchase a new or used **electric** car
9. How many adults (18+) live in your household?
10. How long have you lived in your community?
11. How would you describe your racial or ethnic background?
12. How would you describe your gender?

Spanish version

1. ¿Cuántos vehículos que funcionen tienes? ¿De cuantos vehículos eres dueño?
2. ¿Has usado una de las siguientes formas de transporte en los últimos siete días? (Marque todos que le apliquen.)
 - Manejé mi carro
 - Manejé un carro que es compartido (MioCar, Zipcar, o un arreglo informal)
 - Alguien me llevó
 - Me fui en transporte público
 - Me fui en bicicleta
 - Caminé
3. ¿Qué tan seguido pides un carro prestado?
 - Todos los días
 - 3-6 días a la semana
 - 1-2 días a la semana
 - un par de veces al mes
 - un par de veces al año
 - nunca
4. ¿Qué tan seguido te lleva alguien?
 - todos los días
 - 3-6 días a la semana
 - 1-2 días a la semana
 - un par de veces al mes
 - un par de veces al año
 - nunca
5. ¿Qué tan seguido usas un servicio para autos compartidos? (MioCar, Zipcar, o un arreglo informal)
 - todos los días
 - 3-6 días a la semana
 - 1-2 días a la semana
 - un par de veces al mes
 - un par de veces al año
 - nunca

6. ¿Aproximadamente que tanto gasta para su rutina de transporte al mes? Piense en gasolina, renta de auto, membresías, y otros gastos?
7. Si la cantidad que gastas en tu transporte fuera a aumentar un 10% que pasaría? Si tuvieras que moverte 10% más al mes, ¿cómo afectará tu vida?
 - Yo pudiera con el aumento sin problema
 - Tuviera que hacer un par de ajustes para poder con el aumento
 - Tuviera que hacer varios ajustes en mi modo de transporte y/o de los lugares que voy para poder mantenerme con el aumento
 - Tuviera que hacer ajustes drásticos para poder mantenerme con el aumento... por ejemplo cambiar mi forma de vida, gastos de comida, de escuela
8. ¿Piensas comprar un carro en los próximos cinco años?
 - no
 - Si, pienso comprar un carro nuevo de gasolina
 - Si, pienso comprar un carro usado de gasolina
 - Si, pienso comprar un carro nuevo/usado eléctrico
9. ¿Cuántos adultos mayores de 18 viven en casa?
10. ¿Cuánto tiempo has vivido en tu vecindario?
11. ¿Cómo te identificas de nacionalidad y cultura?
12. ¿Cómo identificas tu género?

Appendix C: Interview Guide

English version

Current travel

1. Would you talk me through all the travel you did today? Start from when you got up this morning, and describe where you went and how you got there. [*Prompts: Is this a typical day? Do you often get around in ways other than those you have described (i.e., drive/borrow a car, get a ride, take transit or on-demand, take Uber/Lyft/taxi, bike, walk)?*]
2. How often do you feel you need a vehicle? Do you usually have access to a vehicle when you want one? If not, how do you negotiate vehicle access? [*Prompts: How does this affect your relationships with friends and family who lend a car or a ride? Ask about the use of carsharing if they're in an area with carsharing, **what about informal car sharing (formal, communal, informal)** ... **WhatsApp group** .]*]
3. Have you owned a vehicle in the past? [*Or more than one vehicle if they have one.*] Why do you no longer have it? (Or why did you never have one?)[why or why not]
4. [*Review pre-interview question*] For what reasons are you planning to purchase a vehicle OR not purchase a vehicle in the near future?

Travel burdens

5. How easy or difficult is it to get what you need on a day-to-day basis? [*Prompts: Jobs, Children/after-school activities, healthcare appointments, food access, recreation.*]
6. Have you ever missed a trip or been inconvenienced because you didn't have reliable transportation? Would you describe that experience? What did you do to make up for the inconvenience? [*Prompt: As about possible emergency experiences, like medical care or evacuation.*]
7. What concerns do you have about getting around day-to-day? [*Prompts: Cost of transportation, safety (collisions), security (policing)*]

Adaptations

8. How do you overcome your challenges in getting around day-to-day?
9. What resources or people have been helpful to you in helping you get around day-to-day?
10. Have you changed your travel due to changes in your community? Have changes in gas prices affected your travel? Did the pandemic affect your travel?

Policy solutions

11. What could transportation decision-makers do to make it easier for you and people in your community to get around?

12. How do you think new technologies or transportation options might make it easier for you to get around? [Prompts: Electric vehicles, micro mobility options, autonomous vehicles?]
13. Is there anything else about your transportation needs or experiences you'd like to share with us today?

Spanish version

Transporte actual

1. ¿Platícame sobre tu día? Tus rutas de transporte del día de hoy... Por favor empiece con su mañana y lo que hizo, como lo hizo? ¿Cómo llegaste al trabajo? ¿A la escuela? Fue un día normal o manejaste más de lo esperado?]
2. ¿Qué tan frecuente necesitas un vehículo para moverte? Tener un vehículo es muy necesario para tí? ¿Tienes uno propio? Cuando no tienes un vehículo disponible, ¿cómo consigues uno cuando lo necesitas? ¿Qué tanto trabajo es conseguir un vehículo? [Usas maneras formales como uber, zipcar, MioCarro, o informales como un grupo de whatsapp o "pidiendo ride"]]
3. ¿En algún momento has tenido un vehículo propio? Si si, cuantos tuviste? Porque ya no cuentas con él?
4. Por cuales razones compraras o no compraras un vehículo en el futuro?[*Basado en las respuestas anteriores*]

Retos en el transporte

5. ¿Qué tan fácil o difícil es cumplir con tus obligaciones del día a día? ¿Se te dificulta el transporte para conseguir tus necesidades? [Por ejemplo... llegar a la escuela, al trabajo, al supermercado, al doctor]
6. ¿En alguna ocasión has faltado a un compromiso o llegado tarde por dificultades de transporte? ¿Me pudieras contar más sobre esa(s) experiencia(s)?
7. ¿Qué complica tu transporte de día a día? [¿Te preocupa el costo de transporte? ¿Tu seguridad? ¿O la policía? ¿Algo más?]

Adaptaciones

8. ¿Cómo sobresaltas los retos que se te presentan en el día durante tu transporte?
9. ¿Qué recursos te han ayudado a solucionar estos problemas? ¿Qué personas te han ayudado?
10. ¿Has cambiado tu modo de transporte debido a algún cambio en tu comunidad? ¿Los cambios en los precios de gasolina ha afectado tu modo de transporte? ¿La pandemia afectó tu modo de transporte?

Soluciones de política

11. ¿Qué pudieran hacer los directores y planificadores de transporte para hacer su transporte personal más fácil? ¿Cómo crees que pudieran ayudar a toda la comunidad?
12. ¿Cómo crees que los avances en tecnologías y sistemas de transporte pudieran ayudarte a moverte del día a día? [Por ejemplo, el acceso a un carro eléctrico contra una ruta de transporte público, los patines electricos, bicicletas electricas]
13. Hay algo más sobre tu vida de transporte que te gustaría compartir? ¿Tienes preguntas o sugerencias?