



Analysis of LMI CVRP Participation

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Executive Summary

To understand the extent to which low- and moderate-income (LMI) Californians participate in the Clean Vehicle Rebate Program (CVRP) and what barriers prevent them from choosing electric vehicles (EVs), the Center for Sustainable Energy (CSE) analyzed the demographic characteristics of participants in the program. The analysis evaluated program participants who received the Increased Rebate within years 2017-2019 (LMI participants whose income was at or below 300% of the Federal Poverty Level). CSE then conducted a series of focus groups in 2021 with LMI individuals¹ to better understand their overall vehicle buying tendencies and views toward electric vehicles.

We first compared LMI EV adopters to LMI New Vehicle Buyers in California and found that the following groups are proportionally underrepresented in the CVRP Increased Rebate group:

- Those who are 21–29 and 30–39 in age
- Those who have less than a high school education, only a high school education or some college
- Those who rent their homes
- Those who identify as female
- Individuals who identify as Hispanic and Latino
- Those who indicate their race is White or Caucasian or Black or African American

Tables 2-7 provide more details about these comparisons, including additional comparisons to the LMI population represented in the California census. We then focused on only those who have received CVRP rebates and compare higher-income participants against those who are part of CVRP's Increased Rebate program. The pattern generally reinforces the findings of the first comparison: individuals who are less educated, who rent their homes, who identify as women and who rebate vehicles other than Teslas are more likely to have received the Increased Rebate as compared to the Standard Rebate. These findings highlight the groups who may require alternative strategies for marketing and outreach.

To better understand the nuances regarding why LMI individuals identified in the demographic analysis may not have the same interest level in EVs, we conducted focus groups of LMI Californians (six groups of 5-6 people each: 31 in total). We facilitated discussion to understand their perceptions of EVs and why they may or may not want to purchase or lease an EV. The main concerns of participants were a lack of access to charging, the cost of vehicles and the cost of charging. Specifically, the top five categories of concern are the following:²

- Costs (e.g., EVs, charging, maintenance): 27%
- Charging (e.g., lack of charging stations, charging takes too long): 25%

¹ LMI individuals within the focus groups were those with incomes at or below the 400% Federal Poverty Level, the threshold for the Increased Rebate as of January 27, 2021. Information about eligibility can be found online: <https://cleanvehiclerebate.org/eng/income-eligibility>.

² For the full list of categories, see Table 14.

- Range (e.g., fear of being stranded, range is too short): 10%
- Information (e.g., lack of comprehensive EV sources, uninformative ads): 9%
- Dealerships (e.g., dealers pressure customers, salespeople are not knowledgeable about EVs): 8%

Tables 14–22 provide more details about these categories of concerns. Within the focus group analysis, we examine differences among people by education and dwelling type. We found the following:

- College-educated individuals are primarily concerned with charging issues and costs (primarily costs of purchasing or leasing EVs), while high school graduates and those with associate degrees are more concerned about costs (primarily costs of charging) and to a lesser extent charging logistics.
- People who live in detached houses are most concerned about costs (primarily costs of EVs), whereas those in attached houses or townhomes are most concerned about charging.
- The barriers to adoption had many similarities to a 2016 focus group funded by CVRP. Cost and charging barriers were of significant concern, and freedom and spontaneity were identified as important aspects of purchasing vehicles in both focus groups. However, while most barriers remained the same, the 2021 participants largely did not express concerns about attractiveness of vehicles; none brought up the idea that EVs were reserved for only a small group of people and were more focused on the logistical aspects of driving EVs.

In addition to barriers, we asked participants how they preferred to learn about vehicles, and most of the preferences included the desire to understand and experience how to drive and maintain EV models. Most participants prefer doing online research, and while reading information about various models was popular, many enjoyed reading and watching videos of reviews comparing the features of various models. Many participants were also enthusiastic about interactive experiences with vehicles such as non-pressured test drives. Other preferences included social media, discussing with personal contacts and personal mechanics and going to dealers to learn more about vehicles and EVs.

Recognizing that some demographic groups are proportionally underrepresented and listening to the concerns LMI individuals have and the resources they prefer, we suggest the following approaches:

- Evaluate outreach and marketing and determine if there are opportunities for increasing awareness of the CVRP among underrepresented populations. Similarly determine if there are opportunities for experiential learning about EVs in conjunction with CVRP outreach, particularly non-pressured test drive events and media discussing features and logistics of driving various EV models.
- Expand the informational resources about concerns identified by LMI individuals including costs of EVs and charging, lack of or accessibility of charging stations and time commitments for charging. Similarly, provide additional information or suggestions about the logistics of EV maintenance and charging practices for those of various dwelling types, including those that may not have chargers at their residences.

In summary, our analysis provides information about the demographics of the CVRP: (1) identification of underrepresented demographics in the CVRP Increased Rebate group, (2) demographic factors that may

indicate whether an individual is likely to be in the Increased Rebate group versus the Standard Rebate group, (3) ranking of concerns LMI individuals have about EVs and (4) preferred information sources of LMI individuals. When this insight is taken into consideration in the development of outreach and marketing strategies, this may assist in improving equity within the CVRP.

Introduction and Goals

The CVRP, administered by CSE for the California Air Resources Board (CARB), provides rebates to California residents who purchase qualifying Zero Emissions Vehicles.³ The CVRP Increased Rebate provides an additional rebate incentive to CVRP participants who are of LMI status.⁴ As of January 27, 2021, Increased Rebates were made available to individuals with incomes up to 400% FPL. However, the applications analyzed in this study were submitted prior to the policy change, when Increased Rebates were available to individuals with incomes up to 300% FPL.

CARB is interested in increasing the participation of LMI individuals in CVRP to foster adoption of EVs among those who can benefit the most from EVs' operational cost savings, reduced pollution and to ensure the equity of the program. To inform CARB's efforts, this report seeks to answer two research questions:

1. Does the Increased Rebate program reach Californians of low- and moderate-income in a proportional fashion based on the current composition of vehicle owners and population of California? In other words, are the many demographic subgroups who reside in California taking advantage of the Increased Rebate program proportionally to overall program participation? Or are certain groups statistically over- or underrepresented? To answer this question, we will first characterize and compare the demographic characteristics of those who are participating in the Increased Rebate program against the demographics of broader LMI populations in California. We will then compare the demographics of those who participate in CVRP's Increased Rebate program against the general CVRP population.
2. What factors are important to LMI communities when purchasing or leasing a vehicle? What barriers are holding them back from purchasing EVs? To answer this question, CSE analyzed responses from focus groups with LMI communities in California discussing their sentiments about vehicle purchasing and EVs.

Understanding the demographic differences among these groups can be used to segment the eligible Increased Rebate population and better develop strategies to market to underrepresented groups. Segmentation is the practice of dividing a group of consumers who might adopt a product into subgroups that share certain key characteristics. Segmenting consumers can help program

³ Program information can be found online: <https://cleanvehiclerebate.org/eng/about-cvrp>.

⁴ Eligibility for Increased Rebate can be found online:

https://cleanvehiclerebate.org/sites/default/files/attachments/Income_Considerations_Flyer_0.pdf.

administrators better understand how to appeal to specific groups within a program.⁵ Segmentation has long been considered a fundamental practice of marketing because within a large group of consumers there are often many subgroups who have different motivations and levels of knowledge about a product.⁶

Understanding the perceived barriers to adopting EVs and what LMI individuals prefer to use as information sources is useful in identifying alternative marketing and outreach strategies. We are interested in the reasoning supporting LMI individuals' perspectives described in the individuals' own voice because this information may help CVRP develop more nuanced and culturally appropriate communication strategies. The next section describe how we answered these research questions and what we found in more detail.

Statistical Analysis and Discussion

Demographic Comparison of California LMI Groups

Adoption of electric vehicles as reflected by participation in CVRP is not proportionate among low- and moderate-income demographic subgroups in California. In other words, certain demographic subgroups are far more or less likely to participate in CVRP than comparison population distributions suggest. To target individuals who are most in need of incentives to purchase an EV, CVRP has implemented income caps of \$150,000/\$204,000/\$300,000 gross annual income for single/head-of-household/joint tax filers, respectively, along with offering the Increased Rebate to the LMI population.

To establish expected proportion of LMI participation in CVRP, we first use Census data from the state and then the 2017 National Highway Travel Survey (NHTS) to create comparison groups. Census data provide demographics of LMI citizens of California over 20 years old.⁷ Because not all LMI citizens are likely to buy new vehicles, we analyze an additional comparison group of LMI NHTS respondents who own new vehicles, referred to as "New Vehicle Buyers," a method previously used to compare characteristics of CVRP participants against a similar population.⁸ Comparing CVRP respondents with this

⁵ Antil, J. H. (1984). Socially Responsible Consumers: Profile and Implications for Public Policy. *Journal of Macromarketing*, 5(2), 18–39. <https://doi.org/10.1177/027614678400500203>.

⁶ Tynan, A. C. & Drayton, J. (1987). Market Segmentation. *Journal of Marketing Management*, 2(3), 301-335. <https://doi.org/10.1080/0267257X.1987.9964020>.

⁷ NHTS data collection occurred between March 2016 and April 2017. NHTS User Guide, <https://nhts.ornl.gov/assets/2017UsersGuide.pdf>

⁸ Williams, B. D. H. & Anderson, J. B. (2021). Strategically Targeting Plug-in Electric Vehicle Rebates and Outreach Using 'EV Convert' Characteristics. *Energies* 2021, 14(7), 1899. <https://doi.org/10.3390/en14071899>. Williams, B.

group may provide a more accurate view of the expected demographic composition of individuals participating in CVRP because of their common ground; both groups have sought out leasing or buying cars.

The CVRP LMI group is made up of respondents to the CVRP Consumer Survey (2017-19) who received an Increased Rebate. This means that their household income was at or below 300% of the Federal Poverty Level (FPL) and that they purchased an electric vehicle that was rebated through CVRP. Table 1 provides details on the sources of data we used to determine the demographic makeup of all Californians, New Vehicle Buyers and CVRP Increased Rebate participants.

Table 1. Descriptions of datasets used to compare to CVRP rebate recipients.

Dataset Name	Description	Formal Name
Census (LMI)	Census Bureau’s American Community Survey (ACS) Public Use Microdata Sample (2014–2018)	2018 ACS 5-Year PUMS
New Vehicle Buyers (LMI)	Federal Highway Administration (FHWA) survey of household travel behavior (2016–17)	2017 National Household Travel Survey
CVRP (LMI)	CVRP survey administered to rebate recipients (2017–2019)	CVRP Consumer and Ownership Survey

After comparing with LMI individuals in the California Census, we compared Increased Rebate participants against New Vehicle Buyers using a set of common demographic indicators: age, highest household education, resident status (renting versus owning), ethnicity, race and gender.

We began by looking at age because prior research has shown that age correlates with vehicle preferences. As shown in Table 2, the largest proportion of New Vehicle Buyers (LMI only) are in the 30-39 age range; however, the largest cohort of CVRP Increased Rebate participants are in the 40-49 range, with the 50-59 and 30-39 groups close behind.

D. H. & Anderson, J. B. (2016). Electric Vehicle Rebates in Disadvantaged Communities: Evaluating Progress with Appropriate Comparisons. Evaluation 2916. American Evaluation Association. <https://cleanvehiclerebate.org/eng/content/presentation-electric-vehicle-rebates-disadvantaged-communities-evaluating-progress>. Santulli, C. & Williams, B. D. H. (2015). CVRP Implementation Status Update. Center for Sustainable Energy. <https://cleanvehiclerebate.org/sites/default/files/attachments/2015-12-08%20Implementation%20Update.pdf>

Table 2. Age of CVRP Increased Rebate participants compared to other groups.

Age Range	Census (LMI only)	New Vehicle Buyers (LMI only)	CVRP (LMI only)	CVRP vs New Vehicle Buyers
21–29	20.8%	17.5%	10.9%	-6.6%
30–39	19.7%	26.5%	19.9%	-6.5%
40–49	17.5%	16.3%	21.6%	5.2%
50–59	15.0%	19.1%	21.1%	2.0%
60–69	12.7%	12.7%	16.4%	3.8%
70–79	8.3%	6.5%	6.6%	0.1%
80+	5.9%	1.5%	1.6%	0.2%
Prefer not to answer	N/A	N/A	1.8%	N/A

We then considered the participants’ level of education (see Table 3). Compared to LMI New Vehicle Buyers, a higher proportion of CVRP Increased Rebate participants are in households in which the highest educated individual has a postgraduate or bachelor’s degree, and a lower proportion are in households in which the highest educated individual has had some college or less education. Because these data are filtered for LMI groups, higher levels of household income, which are often positively associated with education, are excluded from the analysis. Nonetheless, we see that Californians with a higher level of education are more frequently participating in the CVRP program. Our analysis shows that this trend extends to LMI households as well.

Table 3. Education level of CVRP Increased Rebate participants compared to other groups.

Highest Educated Member of Household	Census (LMI only)	New Vehicle Buyers (LMI only)	CVRP (LMI only)	CVRP vs New Vehicle Buyers
Not High School Graduate	12.1%	3.3%	1.4%	-2.0%
High School Graduate or Equivalent	22.8%	18.4%	5.8%	-12.6%
Some College Education	41.5%	38.6%	26.4%	-12.2%
Bachelor's Degree	16.7%	23.8%	37.7%	13.9%
Postgraduate Degree	6.8%	15.8%	25.6%	9.8%
Prefer not to answer	N/A	N/A	3.1%	N/A

We then looked at whether respondents own or rent their residence. In Table 4 we found that a far higher proportion of CVRP program participants own their own homes compared to both New Vehicle Buyers or LMI Californians in general. This may show that it is usually easier for those who own their homes to install and access EV charging equipment. Additionally, homeowners may tend to have a longer time horizon in terms of investing in fixed equipment. Furthermore, as discussed in the Focus Group section below and Table 20, access to charging is a common concern among LMI individuals, especially those that live in attached homes, apartments or condominiums.

Table 4. Rent or own rate for CVRP Increased Rebate participants compared to other groups.

Rent or Own Residence	Census (LMI only)	New Vehicle Buyers (LMI only)	CVRP (LMI only)	CVRP vs New Vehicle Buyers
Rent	57.1%	60.1%	34.3%	-25.8%
Own	41.0%	39.6%	57.9%	18.3%
Occupy, no rent	1.9%	N/A	N/A	N/A
Some other	N/A	0.3%	N/A	N/A
Prefer not to answer	N/A	N/A	7.8%	N/A

Tables 5-7 provide comparisons of the proportion of CVRP Increased Rebate participants against the comparison groups by gender, ethnicity, and race. The tables below show a lower proportion of LMI women, Hispanic and White Californians participate in the Increased Rebate program.

Table 5. Gender of CVRP Increased Rebate participants compared to other groups.

Gender	Census (LMI only)	New Vehicle Buyers (LMI only)	CVRP (LMI only)	CVRP vs New Vehicle Buyers
Male	46.2%	46.6%	63.6%	16.9%
Female	53.8%	53.4%	33.3%	-20.0%
Transgender	N/A	N/A	0.2%	N/A
Not listed	N/A	N/A	0.0%	N/A
Prefer not to answer	N/A	N/A	2.9%	N/A

Table 6. Ethnicity of CVRP Increased Rebate participants compared to other groups.

Hispanic or Latino	Census (LMI only)	New Vehicle Buyers (LMI only)	CVRP (LMI only)	CVRP vs New Vehicle Buyers
Not Hispanic or Latino	51.2%	53.7%	74.0%	20.3%
Hispanic or Latino	48.8%	46.2%	15.4%	-30.9%
Prefer not to answer		0.04%	10.6%	N/A

Looking at Table 7 we can see that people who identify as Asian, Middle Eastern or Two or More Races had greater participation rates in CVRP, while those who identified as White or Caucasian, Black or African American, Native Hawaiian or other Pacific Islander or Other Race participated at a lower rate. However, more than 10% of respondents to the CVRP survey chose not to provide an answer on race, so a complete race distribution cannot be calculated. There are limits to the racial data presented below including a low number of participants of certain racial subgroups and a high proportion of respondents who prefer not to answer this question in CVRP surveys.

Table 7. Race of CVRP Increased Rebate participants compared to other groups.

Race	Census (LMI only)	New Vehicle Buyers (LMI only)	CVRP (LMI only)	CVRP vs New Vehicle Buyers
White or Caucasian	57.5%	53.8%	37.0%	-16.9%
Asian	12.4%	17.2%	25.1%	7.9%
Hispanic or Latino			13.2%	-
Black or African American	6.6%	6.0%	2.4%	-3.6%
American Indian or Alaskan Native	1.0%	0.1%	0.3%	0.2%
Native Hawaiian or other Pacific Islander	0.4%	1.4%	0.4%	-1.0%
Middle Eastern			2.8%	-
Two or More Races	3.1%	3.7%	5.0%	1.3%
Other	19.0%	14.8%	3.2%	-11.5%
Prefer not to answer	N/A	N/A	10.6%	N/A
Don't know	N/A	1.4%	N/A	N/A
Refused to answer	N/A	1.6%	N/A	N/A

From examining the demographics of those who participate in the Increased Rebate program against New Vehicle Buyers in California, we found results that confirm the trends identified in empirical research on EV adoption: Younger, less educated people adopt EVs at a lower rate as compared to New Vehicle Buyers as a whole.⁹ Women, renters and those who identify as Hispanic or Latino are also represented at lower-than-expected rates in the Increased Rebate program. Finally, looking at racial identity, we see that those who indicate that they are White or Caucasian, Black or African American, Native Hawaiian or Other Pacific Islander or Other Race are represented at lower-than-expected rates in CVRP.

The previous findings contribute to our understanding of the unique demographics of CVRP LMI participants to help us generalize low-income EV adopters compared to more comprehensive LMI populations and thus understand demographics that are not represented at expected rates. This knowledge may inform marketing and outreach strategies to enhance participation of specific groups in the Increased Rebate program. If marketing and information could be more specifically targeted to underrepresented groups, we may see an increase in participation and greater equity within the CVRP Increased Rebate.

⁹ See papers such as Johnson and Williams (2016), Axsen et al (2018), and Nayum, et al (2016) as discussed in CSE's comprehensive literature review: Cain, N. L., Williams, B., & Boughton, J. (2020). Plug-in Electric Vehicle Consumer Segmentation: A Bibliograph and Overview of the Research Literature. Center for Sustainable Energy.

In the following section we analyze demographic differences between higher income and LMI CVRP participants. These differences point to barriers associated with income specifically and thus highlight barriers that may be more difficult to break down due to current EV cost thresholds.

Statistical Comparison of CVRP Increased Rebate vs Standard Rebate Populations

In this section, we focus on CVRP participants and compare those who fall in the LMI category against those whose incomes are above 300% FPL. The goal of this section is to better understand the barriers that are specific to income level.

We used logistic regression to assess how demographic characteristics are distributed between LMI Increased Rebate participants, and Standard Rebate participants with higher incomes. Full model results are provided in Appendix A.

A preliminary dominance analysis showed that race is the most important predictor of Increased and Standard Rebate populations. Because the White and Caucasian population makes up a substantial portion of the LMI group, and to a greater extent the higher income group, we decided to model all races aside from White or Caucasian separately and focus our analysis on these groups. Thus, the following findings exclude White or Caucasian participants.

In Tables 8-13 the log odds ratio is the likelihood of a respondent belonging to each “Comparison Category” as compared to the “Reference Category.” A positive value in the “Log Odds” column means that members of a given group — for instance, those who have less than a postgraduate degree — are more likely to fall into the LMI category of Increased Rebate recipient than higher income individuals. A negative value conversely indicates that members of a given group are more likely to be part of the Standard Rebate group. The significance level is given in the “P-value” column, and where asterisks are present, the “P-value” is <0.05 and the “Log Odds” value is statistically significant. In summary, “Comparison Categories” having positive “Log Odds” and <0.05 “P-value” are associated with low-income CVRP participants compared to the “Reference Category.”

To understand the characteristics of age groups we used ages 50-59 as our reference category because it is the largest respondent age group in the survey. Compared to that reference group, respondents who are 60-69 and 70+ are more likely to be LMI, suggesting retirees that are low-income, but potentially with financial resources other than income are taking advantage of the Increased Rebate. The 30-39 and 40-49 age group respondents are less likely to be LMI than the 50-59 age group. Though the 20-29 age group is more likely to be LMI, the data was not statistically significant.

Table 8. Impact of age on income level.

Age Range Reference Category	Age Range Comparison Category	Log Odds	Std. Error	P-value
50-59	21-29	0.20	0.13	0.11
50-59	30-39	-0.26	0.10	<0.01***
50-59	40-49	-0.39	0.09	<0.01***
50-59	60-69	0.37	0.11	<0.01***
50-59	+70	0.65	0.16	<0.01***

Notes: Positive log odds indicate increased likelihood of being an Increased Rebate CVRP participant; those who indicated a race of White or Caucasian are filtered out.

Compared to postgraduate degree respondents, all other levels of educational attainment are more likely to be in the LMI group of rebate participants. The odds ratio from postgraduate degree to subsequently lower levels of education increase in a stepwise fashion, illustrating that within CVRP participants higher education is associated with higher income. The previous comparisons found the CVRP LMI population have higher education levels than comparison LMI groups, and here we see evidence that links educational attainment to higher income and thus may be evidence that LMI participants with other financial resources are within the CVRP LMI group.

Table 9. Impact of household educational attainment on income level.

Education Reference Category	Education Comparison Category	Log Odds	Std. Error	P-value
Postgraduate Degree	Bachelor's Degree	0.71	0.08	<0.01***
Postgraduate Degree	Associate Degree	1.27	0.12	<0.01***
Postgraduate Degree	Some College, no Degree	1.22	0.10	<0.01***
Postgraduate Degree	High School Degree or Less	1.78	0.12	<0.01***

Notes: Positive log odds indicate increased likelihood of being an Increased Rebate CVRP participant; those who indicated a race of White or Caucasian are filtered out.

Tables 10 and 11 show that renting rather than owning a residence is an important indicator of the LMI group, but dwelling type is not significantly different between LMI and higher income groups. Both comparisons can provide context to home charging. Here we see that home ownership is associated with higher income CVRP participants. However, housing type is somewhat surprisingly not associated with income level. One hypothesis is that dwelling type is important for EV users at all levels of income due to the importance of home charging capabilities. Because housing type is not available in the NHTS data used to find the New Vehicle Buyer population, we did not assess the differences among LMI populations for this metric here, but it is likely that EV adopters of all incomes trend toward homes that EV charging capability can more easily be added.

Table 10. Impact of renting versus owning residence on income level.

Rent or Own Reference Category	Rent or Own Comparison Category	Log Odds	Std. Error	P-value
Own	Rent	0.92	0.09	<0.01***

Notes: Positive log odds indicate increased likelihood of being an Increased Rebate CVRP participant; those who indicated a race of White or Caucasian are filtered out.

Table 11. Impact of dwelling type on income level.

Dwelling Type Reference Category	Dwelling Type Comparison Category	Log Odds	Std. Error	P-value
One-family house detached	One-family house attached	-0.07	0.10	0.50
One-family house detached	Apartment	-0.03	0.10	0.73
One-family house detached	Other	0.26	0.28	0.35

Notes: Positive log odds indicate increased likelihood of being an Increased Rebate CVRP participant; those who indicated a race of White or Caucasian are filtered out.

Female participants in CVRP were more likely to be of lower income than males, suggesting that income may be a barrier to female participants (see Table 12). In general, male participants make up a larger portion of CVRP Increased Rebate recipients than Census and New Vehicle Buyers groups (See Table 5). Here we see that the Increased Rebate population has a higher ratio of females than the Standard Rebate population. Thus the underrepresented female Increased Rebate recipients are actually more represented within CVRP. (Standard Rebate – 25.3%, n = 11,319; Increased Rebate – 32.6%, n = 1,289).

Table 12. Impact of gender identity on income level.

Gender Reference Category	Gender Comparison Category	Log Odds	Std. Error	P-value
Male	Female	0.23	0.07	<0.01***
Male	Not binary	-0.21	0.67	0.75

Notes: Positive log odds indicate increased likelihood of being an Increased Rebate CVRP participant; those who indicated a race of White or Caucasian are filtered out.

Teslas, which were used as the reference category, are more commonly rebated through CVRP by the higher income group while PHEVs and non-Tesla BEVs are more common among LMI CVRP participants (see Table 13). Teslas have made up a substantial portion of CVRP rebates in recent years, so this distinction is important to note as the program continues to mature.

Table 13. Impact of vehicle type on income level.

Vehicle Type Reference Category	Vehicle Type Comparison Category	Log Odds	Std. Error	P-value
Tesla	BEV (non-Tesla)	0.77	0.08	<0.01***
Tesla	PHEV	0.71	0.07	<0.01***
Tesla	FCEV	0.23	0.18	0.20

Notes: Positive log odds indicate increased likelihood of being an Increased Rebate CVRP participant; those who indicated a race of White or Caucasian are filtered out.

In summary, we can see that some demographic groups are not represented at expected rates in the CVRP Increased Rebate program, and that several population demographics that are underrepresented are associated with income. In the next section, we use our understanding of the populations discussed above to set up focus groups and ask LMI Californians directly about their attitudes towards EVs, the barriers they perceive and how they gather information to inform their purchases.

Focus Group Analysis and Discussion

Focus groups allow us to “look beyond” the statistics of survey research and to gather more detailed, nuanced data directly from a small group of participants in their own words.¹⁰ In the previous section, our analysis showed that within the CVRP LMI participant group, some demographics are statistically underrepresented when compared to New Vehicle Buyers within the same income bracket. In this section, informed by the statistical analysis, we present the results from 6 focus groups consisting of 31 total participants. The goal of these focus groups is to better understand LMI individuals’ perceptions of EVs and perceptions of barriers to EV adoption and how they may impact their vehicle decision making.¹¹ We also ask participants to describe their preferred information sources for learning about EVs and vehicles in general to develop additional strategies to reach various groups.

Using findings noted above, for the focus groups we recruited individuals that largely reflect the LMI population of California with a slightly higher proportion of underrepresented groups. The focus groups were conducted virtually with between 4-6 participants in each. The demographics of the participants are presented in Appendix B.

We note that gathering a few responses from Californians of specific demographics such as apartment dwellers does not necessarily mean that we are capturing a representative sample of apartment dwellers’ sentiment; however, what the focus group approach lacks in generalizability, it makes up for in narrative detail.

We design questions to encourage discussion of LMI individuals’ preferred sources of information for learning about vehicles and their barriers toward purchasing or leasing EVs.¹² Questions introduced by the moderator include:

- What is your most frequent type of transportation and why?
- When you are thinking about getting a vehicle, whether its leasing or purchasing, where do you find information? Online? Newspapers? Friends or family? Car dealers?

¹⁰ Leung, F. H., & Savithiri, R. (2009). Spotlight on focus groups. *Canadian family physician Medecin de famille canadien*, 55(2), 218–219. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2642503/>

¹¹ Focus groups were conducted in March and April 2021 by CSE’s Transparency and Insights team.

¹² Noel, L., Zarazua de Rubens, G., Kester, J., & Sovacool, B. K. (2020). Understanding the socio-technical nexus of Nordic electric vehicle (EV) barriers: A qualitative discussion of range, price, charging and knowledge. *Energy Policy*, 138(111292). <https://doi.org/10.1016/j.enpol.2020.111292>.

- Have you considered purchasing or leasing electric vehicles before? Why or why not?
- What would you need or what would need to change in order for you to consider an EV?
- What ideas do you have about ways your city, state or electricity provider could do to help you purchase or lease an EV?
- What ideas do you have that dealerships or manufacturers could do to help you buy an EV?
- How do you prefer to learn about EVs? Do you think you'd look at the same places as you do for car shopping or would you prefer something else?

After transcribing the responses, we code them and associate them with each participant's demographics. We use our knowledge of the literature to create categories of barriers and information sources discussed. See Appendix C for categories, specific barriers and preferred information sources. Frequency of barriers and information sources discussed are mapped to specific demographics, identifying which LMI groups tended to voice those opinions more frequently than others.

Analysis of Barriers

To complete the analysis, we count the number of mentions of each barrier within the focus group discussions; we approximate the level of concern for a barrier by how many times it is mentioned. The numbers should be interpreted with caution and used as suggested interpretations of the data rather than absolute conclusions about barriers within the LMI population of California. In many cases, there are alternate reasons that may explain the frequency of some concerns.

For example, without prompting, often the first concern brought up is charging. While this could indicate that charging is the main concern, it could also indicate that people feel less comfortable discussing costs, a generally sensitive topic. Additionally, other barriers like maintenance, range, etc. may be less understood among consumers in general and thus may not be prevalent topics of conversation. Furthermore, while the moderator worked to include all participants equally in the conversation, more talkative participants may still contribute more to the number of mentions than their peers.

Analyzing the frequency of barriers mentioned, we find strong evidence that barriers regarding charging and costs are the most prevalent concerns among the focus group participants. Range concerns, lack of information, issues with dealerships and battery concerns are less prevalent but still widely discussed by focus group participants. Unfamiliarity with EVs, maintenance concerns, personal reasons and safety are the least mentioned. Table 14 presents the barrier categories by frequency.

Table 14. Categories of barriers ranked by frequency of mentions.

Barrier Category	Frequency of Mentions (n=327)
Costs (e.g., EVs, charging, maintenance)	27% (n=89)
Charging (e.g., lack of charging stations, charging time too long)	25% (n=83)
Range (e.g., fear of being stranded, range is too short)	10% (n=32)
Information (e.g., lack of comprehensive EV sources, ads are uninformative)	9% (n=29)
Dealerships (e.g., dealers pressure customers, salespeople are unknowledgeable about EVs)	8% (n=26)
Battery (e.g., concern about battery life, concern about manufacturing and recycling affecting the environment)	6% (n=20)
Unfamiliarity with EVs (e.g., unsure about trying new technology)	5% (n=15)
Maintenance (e.g., do not know what maintenance entails, cannot diagnose problems in the car as easily as a gasoline car)	4% (n=13)
Personal (e.g., EVs are not easily hobbies, not interested, already content)	3% (n=11)
Safety (e.g., unsure about reliability and safety)	3% (n=9)

In addition to these major categories, we also identify specific barriers within the broader categories (e.g., lack of charging stations, charging time, costs of maintenance, content with current vehicle, etc.). These specific barriers can provide insights for CVRP program managers when developing marketing and outreach strategies. For example, several of the barriers included issues regarding lack of information (e.g., lack of comprehensive information, the information is inaccessible, consumers do not know where to look, etc.). See the list of 71 specific barriers ranked in order of mentions in Appendix D. Among these, top concerns include lack of charging stations, EV costs, charging costs, time to charge, lack of comprehensive information and the fear of being stranded.

Given that costs and charging concerns appear to be at a similar level of concern for participants, we take a moment to further examine the concerns that comprise these two barriers. First, we look at cost concerns. Table 15 breaks down the specific barriers related to costs into specific categories: vehicle, charging and maintenance costs. Costs of EVs are predominant, followed by concerns about charging and maintenance.

Table 15. Cost barriers identified by various categories.

Cost Categories	Cost Barriers	Frequency of Mentions (n=100)
EV Costs	Costs of EVs are too expensive	37% (n=37)
EV Costs	Do not know the costs of EVs	4% (n=4)
EV Costs	Concern there are hidden costs due to new technologies	1% (n=1)
EV Costs	Would like lifetime warranties	1% (n=1)
EV Costs	Down payment is too costly	5% (n=5)
EV Costs	Particular models are not eligible for incentives	1% (n=1)
Charging Costs	Charging is too expensive	27% (n=27)
Charging Costs	Wary about electricity prices changing	7% (n=7)
Maintenance Costs	Concern that maintenance is expensive	12% (n=12)
Maintenance Costs	Batteries are too expensive	5% (n=5)

The following are quotes selected from the focus groups that demonstrate concerns among the various cost categories. These quotes are typical of the focus groups; most individuals assume the costs of EVs are higher than gasoline vehicles and that maintenance is bound to cost more due to concerns about battery reliability. Most individuals are concerned about the cost of charging not only because they think their electricity bill will increase but also because they are concerned rates will increase and public charging stations will charge a premium.

- Quoted by a focus group participant with the following characteristics: female, age 54, resident of Riverside County in a household of 2, high school graduate, prefers to speak English, identifies as Other Race, lives in a detached house

“I would love an electric car. I would love it. And the reason I don't have [one] is because they cost so much more than a regular gas car. That's the only reason. I would love it. I love all my new stuff. It's just fun. And now they have all those charging stations like at malls and at rest stops. That's flipping cool, like, seriously. So that's the only reason why not, honey. I would love to.”

- Quoted by a focus group participant with the following characteristics: male, age 56, resident of San Joaquin County in a household of 2, some college or associate degree, Hispanic or Latino, prefers to speak English, identifies as Bi-racial or Multi-racial, lives in an attached house or townhome

“So they're going to have to- they're going to have to really make the cost of charging that almost nonexistent. I mean, if I didn't get charged to use electricity to do it, I'd really consider an electric vehicle, assuming we had the range and the capacity, and, you know, stuff like that. But I think that the cost of charging is going to be cost-prohibitive.”

- Quoted by a focus group participant with the following characteristics: female, age 26, resident of Shasta County in a household of 4, college graduate, prefers to speak English, identifies as White or Caucasian, lives in a detached house

“Is it just more expensive to have those pieces fixed? Or is it cheaper than usual? I mean, I just, I don't understand that. I haven't done much research into electric vehicles, but all I heard was that batteries were crazy expensive.”

Common among these quotes is the theme that considering an EV is an interesting idea but the practicalities of paying for and maintaining a vehicle are concerns. This may indicate that OEMs and CVRP program managers can modify their information and marketing strategies to better eliminate these concerns. Preferred information sources among focus group participants are discussed in the next section.

Table 16 breaks down charging barriers into various categories: location issues, time constraints, reliability concerns and unfamiliarity with charging. Concerns regarding the location and frequency of charging stations along routes are mentioned most frequently among the focus group participants. Time associated with charging is less frequently mentioned. Lesser mentioned concerns include issues regarding reliability and unfamiliarity with charging.

Table 16. Charging barriers identified by various categories.

Charging Categories	Charging Barriers	Frequency of Mentions (n=101)
Location Issues	Lack of charging stations	38% (n=38)
Location Issues	Do not know where or how many chargers are available	9% (n=9)
Location Issues	Do not want to look for places to charge	2% (n=2)
Location Issues	Does not know if installing a charger at home is possible	12% (n=12)
Time Constraints	Charging time is too long	19% (n=19)
Time Constraints	Takes too much time to charge elsewhere because cannot charge at home	1% (n=1)
Reliability Concerns	Charging stations are unreliable	2% (n=2)
Reliability Concerns	Concern about where to charge if power is shut off	1% (n=1)
Unfamiliarity with Charging	Concern about charging in general	1% (n=1)
Unfamiliarity with Charging	Do not know how charging works	6% (n=6)
Unfamiliarity with Charging	Needs more information about charging	4% (n=4)
Unfamiliarity with Charging	Would like ease and/or assistance with installation	2% (n=2)
Unfamiliarity with Charging	Do not know how to acquire chargers	1% (n=1)
Unfamiliarity with Charging	Do not know how payment works	3% (n=3)

The following quotes are those of focus group participants who describe scenarios in which charging an EV appears to be inconvenient or anxiety-inducing. Participants are concerned about the placement of charging stations along their routes and the possibility there may not be a charging station when you need one. Additionally, participants are concerned about the time it takes to charge, especially on long trips.

- Quoted by a focus group participant with the following characteristics: male, age 32, resident of Shasta County in a household of 4, some college or associate degree, Hispanic or Latino, prefers to speak English, identifies as Other Race, lives in an attached house or townhome

“Well, maybe [charging stations do] not necessarily [need to be] as often because I do understand it; there is a transitioning point. It’s not going to be like a gas station that had

like a 80-year head start or 50 years or something like that so. But at least enough to know that I don't have to have the worry in the back of my head that, 'Hey, if I skip this charging station, am I going to miss out and be stranded on the side because I'm not going to be able to find another charging station?' That on top of, 'Am I going to have to wait an hour or two hours to have a full charge when baby girl is crying because she wants to get out and she's tired of driving?'"

- Quoted by a focus group participant with the following characteristics: male, age 23, resident of Los Angeles County in a household of 2, college graduate, prefers to speak English, identifies as South Asian, lives in an apartment or condominium

"I think kind of what everyone else said, it is kind of scary because you see charging stations more but you don't see that many and you know, sometimes I forget to get gas, so it's like you have to be really on top of it if you have an electric car so I don't - you can't be as spontaneous probably with your travel so that too."

Uncertainty about driving and charging are characterized in these quotes. The participants value the freedom and ease of driving a gasoline car; EVs appear to be restrictive due to the time it takes to charge and the perception that there is lack of infrastructure to charge EVs at will.

We then analyzed the frequency of mentions of barriers by participants of different education levels and dwelling types. As determined in previous section, participants of both the CVRP Standard Rebate and Increased Rebate tend to be in households in which the highest educated individual is a college graduate or has a postgraduate degree. We then analyzed the barriers mentioned by college graduates separately from participants with less education (see Figure 1) to determine if there were differences in perceived barriers. When comparing the two groups of educational backgrounds, cost concerns are more prevalent for individuals with some college education or high school degrees.

Figure 1. Barriers grouped by educational background.

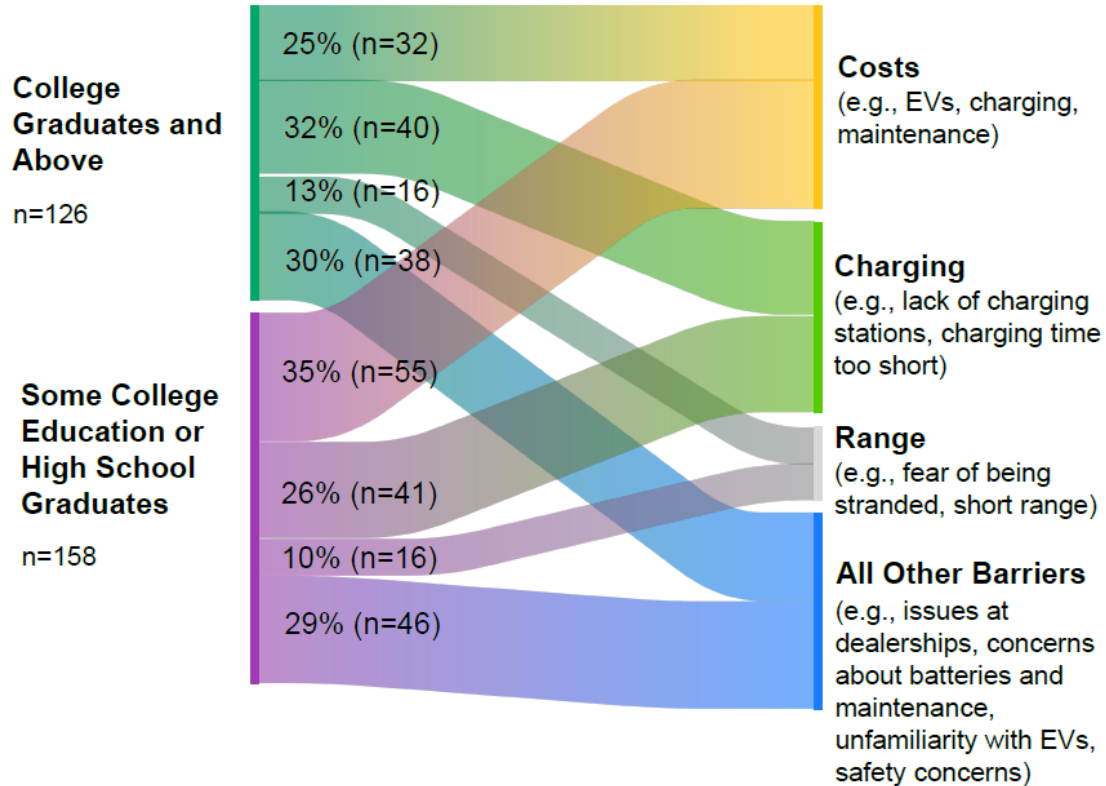


Table 17. Concerns of focus group participants of differing educational backgrounds.

Categories	College Graduates and Above (n=126)	Some College Education and Below (n=158)
Costs (e.g., EVs, charging, maintenance)	25% (n=32)	35% (n=55)
Charging (e.g., lack of charging stations, charging time too short)	32% (n=40)	26% (n=41)
Range (e.g., fear of being stranded, short range)	13% (n=16)	10% (n=16)
All Other Barriers (e.g., issues at dealerships, concerns about batteries and maintenance, unfamiliarity with EVs, safety concerns)	30% (n=38)	29% (n=46)

The following are quotes regarding cost from both educational groups. Note the quotes show concerns about the costs of EVs and charging. The participants have several questions and suggestions regarding the topics, and the common theme is that using an EV, whether the cost is associated with charging or the EV itself, feels unaffordable. Assistance with charging and/or the EV itself may help individuals consider EVs more seriously.

- Quoted by a focus group participant with the following characteristics: female, age 33, resident of Alameda County in a household of 2, college graduate, prefers to speak English, identifies as Black or African American, lives in an apartment or condominium

“I feel like it should be affordable and it should be marketed affordable. We don't even really know the real price of all these vehicles. We're just assuming. And I don't think that it's marketed to be affordable. So when you think of electric cars, you think of the Teslas or the very expensive cars and the Elon Musks, but you don't know there's other brands, there's other affordable options. So I think just making it be more like an everyday thing in your household and having people, like you said, I guess it's your environment.”

- Quoted by a focus group participant with the following characteristics: male, age 28, resident of San Diego County in a household of 3, postgraduate education, prefers to speak English, identifies as South Asian, lives in a detached house

“And trust me, a lot of people don't know anything about federal tax rates or anything when they go on to purchase a vehicle. When they see this \$45,000 price tag, they'll be like backing out because it's too much for a nearly coming up technology because the cells are not manufactured here. They're manufactured somewhere else; they are imported. There are importing charges; there is production issue. There are so many factors we need to consider.”

- Quoted by a focus group participant with the following characteristics: male, age 41, resident of San Diego County in a household of 3, some college or associate degree, prefers to speak English, identifies as Bi-Racial, lives in a detached house

“Well, I feel everything would be electric. I still don't know if I'm charging the car publicly, am I paying somebody? Is there a credit card slot? And if I'm living in Texas, and they shut off my power, where do I charge my car? It can get real pricey to charge the car, I imagine, I don't know. Not things I want to have to consider, but got to. Yeah. There's not a whole lot of charging stations around here. I've never used one and I don't know how they work.”

- Quoted by a focus group participant with the following characteristics: female, age 39, resident of Riverside County in a household of four, some college or associate degree, Hispanic or Latina, prefers to speak Spanish, identifies as Other Race, lives in a detached house

“Maybe put in charging stations that are free.”

We now look at the frequency of mentions of costs within the two educational groups. Table 18 compares the frequency of mentions. It appears that the focus group participants with college education are more concerned about the costs of EVs whereas those with some college education or less, while still concerned about the costs of EVs, may be slightly more concerned about charging costs. Note also

that battery costs were only discussed by college graduates. These findings may suggest that individuals with some college education or less may be more concerned with the logistics regarding EVs than those with college degrees. Those with some college education or less may have more varied concerns perhaps due to their earning potential or lifestyle whereas those with college degrees may be able to afford more choice and flexibility.

Table 18. Cost concerns of focus group participants of differing educational backgrounds.

Cost Categories	Cost Barriers	College Graduates and Above (n=33)	Some College Education and Below (n=55)
EV Costs	Costs of EVs are too expensive	55% (n=18)	31% (n=17)
EV Costs	Do not know the costs of EVs	3% (n=1)	2% (n=1)
EV Costs	Concern there are hidden costs due to new technologies	0% (n=0)	2% (n=1)
EV Costs	Would like lifetime warranties	0% (n=0)	2% (n=1)
EV Costs	Down payment is too costly	0% (n=0)	7% (n=4)
EV Costs	Particular models are not eligible for incentives	3% (n=1)	0% (n=0)
Charging Costs	Charging is too expensive	9% (n=3)	40% (n=22)
Charging Costs	Wary about electricity prices changing	9% (n=3)	7% (n=4)
Maintenance Costs	Concern that maintenance is expensive	9% (n=3)	9% (n=5)
Maintenance Costs	Batteries are too expensive	12% (n=4)	0% (n=0)

We also examine the barriers discussed by residents of various dwelling types. We group the focus group participants into three resident types: those who live in detached homes, those who live in apartments or condominiums and those who live in attached homes or townhouses (See Figure 2). Those in detached houses are most concerned about costs, whereas those in attached houses or townhomes are most concerned about charging. Note also that residents of apartments or condominiums have many varied concerns; charging and costs are important but there are other barriers that come to the surface. Note also that apartment and condominium dwellers have very low concerns about range.

Figure 2. Barriers grouped by dwelling type.

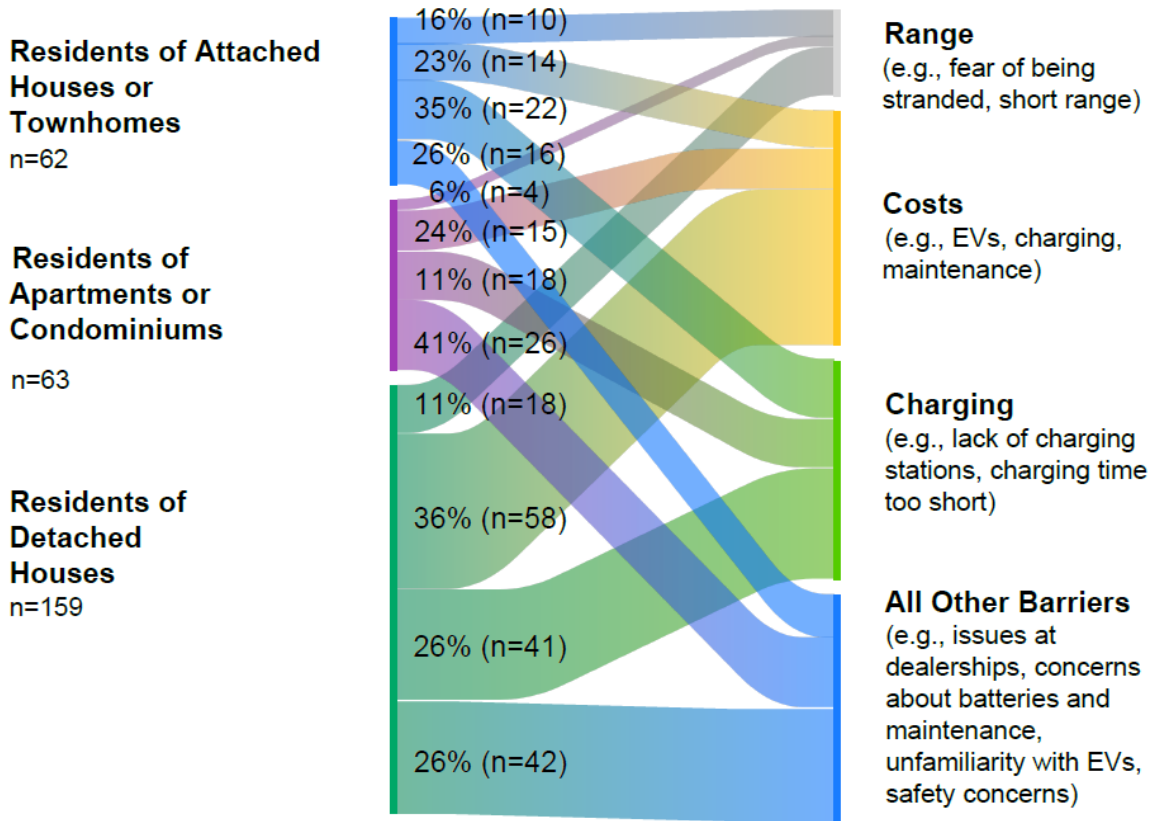


Table 19. Concerns of focus group participants of differing dwelling types.

Categories	Residents of Attached Houses or Townhomes (n=62)	Residents of Apartments or Condominiums (n=63)	Residents of Detached Houses (n=159)
Range (e.g., fear of being stranded, short range)	16% (n=10)	6% (n=4)	11% (n=18)
Costs (e.g., EVs, charging, maintenance)	23% (n=14)	24% (n=15)	36% (n=58)
Charging (e.g., lack of charging stations, charging time too short)	35% (n=22)	11% (n=18)	26% (n=41)
All Other Barriers (e.g., issues at dealerships, concerns about batteries and maintenance, unfamiliarity with EVs, safety concerns)	26% (n=16)	41% (n=26)	26% (n=42)

The following are quotes from apartment or condominium dwellers about their cost concerns. Affordability of charging and costs are common themes; this is consistent with data in Table 20 that shows charging affordability and EV costs are top concerns within the cost barrier category. Those in detached homes are more concerned about the costs of EVs in comparison to other costs, and those in attached houses or townhomes have a variety of cost concerns.

- Quoted by a focus group participant with the following characteristics: female, age 52, resident of San Jose County in a household of four, some college or associate degree, Hispanic or Latina, prefers to speak Spanish, identifies as Other Race, lives in an apartment or condominium

“If they only give it to you – you buy the car, and that year that you’re going to pay taxes, they give you that incentive. But what about the other years that you’re going to keep paying for the car? Also, as far as the light bill goes, if they were to give you – for example, with my electric company, I’m in a program where I pay less for the electricity. If they did it like that, where they give it to you for a whole year, and you’re going to have your car, maybe it would benefit you. Otherwise, you’d be paying a lot of electricity because of charging your car. Well, that’s my way of thinking. I don’t know.”

- Quoted by a focus group participant with the following characteristics: male, age 48, resident of Imperial County in a household of 4, high school graduate, Hispanic or Latino, prefers to speak English, identifies as Other Race, lives in an apartment or condominium

“But like, for example, first new buyers they get discounts. Or if they're buying a year- Like, a car has been sitting there- a new car is sitting there for a year and the new one came. But they give all those deductions like \$5,000 rebate, something like that. I believe like on electric cars they should do something like that. Like first-time buyers should get probably, I don't know, a discount or they can charge their car at the dealership if they live near, like, for a whole year. I don't know. It's just something that can stimulate to buy a car.”

Table 20. Cost concerns by residence type.

Cost Categories	Cost Barriers	Residents of Attached Houses or Townhomes (n=14)	Residents of Apartments or Condominiums (n=15)	Residents of Detached Houses (n=59)
EV Costs	Costs of EVs are too expensive	29% (n=4)	40% (n=6)	42% (n=25)
EV Costs	Do not know the costs of EVs	7% (n=1)	0% (n=0)	2% (n=1)
EV Costs	Concern there are hidden costs due to new technologies	0% (n=0)	0% (n=0)	2% (n=1)
EV Costs	Would like lifetime warranties	0% (n=0)	0% (n=0)	2% (n=1)
EV Costs	Down payment is too costly	14% (n=2)	0% (n=0)	3% (n=2)
EV Costs	Particular models are not eligible for incentives	0% (n=0)	0% (n=0)	2% (n=1)
Charging Costs	Charging is too expensive	21% (n=3)	40% (n=6)	27% (n=16)
Charging Costs	Wary about electricity prices changing	21% (n=3)	0% (n=0)	7% (n=4)
Maintenance Costs	Concern that maintenance is expensive	7% (n=1)	13% (n=2)	8% (n=5)
Maintenance Costs	Batteries are too expensive	0% (n=0)	7% (n=1)	5% (n=3)

Table 21 outlines the charging concerns by residence type and shows that those who live in detached homes and apartments or condominiums are most concerned about lack of charging stations. Those who live in attached homes are concerned about lack of charging stations as well but to a greater extent are concerned that charging times are too long. The common theme is that charging infrastructure is not yet ideal, for residents of all dwelling types.

Table 21. Charging concerns by residence type.

Charging Categories	Charging Barriers	Residents of Attached Houses or Townhomes (n=23)	Residents of Apartments or Condominiums (n=18)	Residents of Detached Houses (n=44)
Location Issues	Lack of charging stations	17% (n=4)	50% (n=9)	48% (n=21)
Location Issues	Do not know where or how many chargers are available	4% (n=1)	17% (n=3)	7% (n=3)
Location Issues	Do not want to look for places to charge	4% (n=1)	0% (n=0)	2% (n=1)
Location Issues	Does not know if installing a charger at home is possible	9% (n=2)	17% (n=3)	9% (n=4)
Time Constraints	Charging time is too long	43% (n=10)	11% (n=2)	11% (n=5)
Time Constraints	Takes too much time to charge elsewhere because cannot charge at home	0% (n=0)	0% (n=0)	2% (n=1)
Reliability Concerns	Charging stations are unreliable	4% (n=1)	0% (n=0)	2% (n=1)
Reliability Concerns	Concern about where to charge if power is shut off	0% (n=0)	0% (n=0)	2% (n=1)
Unfamiliarity with Charging	Concern about charging in general	0% (n=0)	0% (n=0)	2% (n=1)
Unfamiliarity with Charging	Do not know how charging works	9% (n=2)	0% (n=0)	5% (n=2)
Unfamiliarity with Charging	Needs more information about charging	0% (n=0)	6% (n=1)	2% (n=1)
Unfamiliarity with Charging	Would like ease and/or assistance with installation	4% (n=1)	0% (n=0)	2% (n=1)
Unfamiliarity with Charging	Do not know how to acquire chargers	4% (n=1)	0% (n=0)	0% (n=0)
Unfamiliarity with Charging	Do not know how payment works	0% (n=0)	0% (n=0)	5% (n=2)

The following are quotes that describe charging issues among various residents.

- Quoted by a focus group participant with the following characteristics: female, age 32, resident of Fresno County in a household of 6, high school graduate, Hispanic or Latina, prefers to speak English, identifies as Other Race, lives in an attached house or townhome

“If I have to recharge it every day then yes, it'd be an issue. You pump gas, you're in and out within 10-20 minutes to max, imagine being stuck there for an hour, two hours. It's just not OK for me at the moment.”

- Quoted by a focus group participant with the following characteristics: female, age 23, resident of Fresno County in a household of 1, college graduate, prefers to speak English, identifies as Black or African American, lives in an attached house or townhome

"I've thought about it but ... like just the unknown factor of how long it takes to charge, the unknown factor of how far you could go. I think if you're a person like me, likes to travel, who likes to drive, it becomes more of a hindrance because you can't really go that far with the battery before you have to stop and then you have to stop for a while and then you have to get to where you're going and you have to charge again. So it's just like it sounds cool but I need them to get further into it before I can just say, 'I want one.'"

"I think that the price being expensive is a key factor in the rebates, make it more of an incentive to get it. But I also think that the rebates don't overshadow those concerns on the range of the battery and how fast it is to charge, because it's all about having something that is quick, something that you can be efficient in So, it's like, you don't want to have to rush somewhere and it's like, 'Oh, shoot. My car battery is about to die. What am I going to do? I need two hours to charge it.' Whereas in the gas car's like, 'OK, I'm about to run out of gas. Let me stop right here get some gas going about my way.' Five minutes, 10 minutes out of your day, that might have - being their cause of problem."

Comparison with Barriers Found in Previous Focus Groups

A 2016 study by Carol H. Williams¹³ funded by the CVRP held focus groups for African American and Hispanic individuals in California with household incomes of \$55,000 or less¹⁴ found similar barriers to 2021 focus groups with one exception: EVs were perceived as unattractive with few options for personalization. Participants in 2016 communicated that they thought EVs were boxy and ugly and not vehicles they would aspire to own. Participants found EVs to be unattractive in other ways as well: EVs appeared too small and unable to accommodate families, EVs had limited model options thus preventing drivers from expressing personal style, and EVs appeared to be made for "techie, affluent, white guys." In other words, participants perceived EVs as vehicles for people unlike them.

Leaders of the focus groups educated the participants about their concerns, and participants learned that there were several models of EVs available. This piqued the groups' interest and participants had a new openness to learning about the various models available. Hall & Partners expressed that (1)

¹³ Hall & Partners. 2016. Electric Vehicles: Multi-cultural Assessment.

¹⁴ Three 90-minute focus groups were held in October 2016 in Fremont, Fresno and Long Beach. Participants were ages 25-44 years old and African American or Hispanic with household incomes of \$40-\$50,000 for families of 2 or less and \$40-\$55,000 for families of 3 or more. Those interviewed intended to purchase or lease a new or used vehicle in the next 24 months. Half of the participants were male, and half were female.

creating experiences in which individuals can test drive vehicles and (2) highlighting the range of vehicles to challenge the boxy stereotype may be ways in which to increase the appeal of EVs.

Despite this difference regarding the appeal of EVs, several top barriers in 2016 remained the same in 2021, notably cost and charging. Participants in 2016 were concerned about the costs of vehicles; many identified Tesla as the main EV available, assuming that Tesla models would be out of their price range. Participants were also concerned that the cost of maintenance would be very expensive. This perception was seen in the 2021 focus groups as well.

In both focus groups participants were concerned that there were not enough charging stations to make up for EVs more limited range compared to traditional gasoline vehicles. Participants in 2016 were also concerned about remembering to plug in a vehicle. Note that this particular concern was not discussed in the 2021 focus groups.

The 2016 focus groups identified freedom and self expression as important factors for choosing models of vehicles. While self expression was rarely discussed within the 2021 focus groups, freedom was discussed frequently, especially regarding range of EVs. For both groups in 2016 and 2021, participants identified freedom to travel whenever and wherever they wanted as important. It was feared by both groups that EVs would prevent self-sufficiency and spontaneity.

When comparing these two focus groups, we conclude that EV options and EVs as means of self expression are lesser concerns in 2021. Many of the major logistical concerns of costs, range and charging remain, but the idea that an EV is viable for only certain groups has diminished since 2016.

Preferred Information Sources

The focus groups also discuss preferred resources for learning about EVs and vehicles in general. Online resources prevail most during the discussion. In-person experiences with EVs are also largely preferred. Social media, personal contacts and working with dealers are on par with each other. There are a few other sources like TV, apps, print and phone that are mentioned but are not the overwhelming preferences. See Table 22 for the categories of information sources preferred. A complete list of specific information sources is in Appendix D. Top preferences include doing online research, talking to people one knows and taking test drives in non-pressured environments (not a dealership).

Table 22. Information source categories preferred by focus groups.

Information Source Category	Frequency of Mentions (n=109)
Online (e.g., doing online research, YouTube videos, reviews of vehicles)	34% (n=37)
Experience (e.g., test drives in non-pressured environments, seeing EVs on display, informational events)	17% (n=19)
Social Media (e.g., campaigns and ads on Facebook, Instagram, Twitter, TikTok)	13% (n=14)
Personal Contacts (e.g., talking to people and mechanics the customer already knows)	12% (n=13)
Dealer (e.g., test drives at dealerships and talking with dealer)	11% (n=12)
TV (e.g., informative, engaging ads)	5% (n=5)
Print (e.g., Autotrader and Consumer Reports magazines)	4% (n=4)
Online Dealer (e.g., CarMax)	3% (n=3)
App (e.g., apps that compare vehicle features)	1% (n=1)
Phone (e.g., receiving calls about new vehicle models)	1% (n=1)

The following are comments from participants that comment on preferred information sources.

Participants are interested in various methods with online resources prevailing. Common among these sources is the desire to compare specifications among various models. Participants appear interested in comprehensive and accessible information about EVs as well as interactive experiences with EVs (e.g. test drives, seeing models, etc.).

- Quote from a focus group participant with the following characteristics: male, age 45, resident of San Joaquin County in a household of 1, college graduate, Hispanic or Latino, prefers to speak English, identifies as Other Race, lives in a detached house

“I do my research online, I compare the cars I look at what kind of car I might want, what might be out there. I will do also ... the YouTube videos because there are experts out there that actually get the cars, I don’t know how they get all these cars, maybe they make a deal with the dealership, but they test drive it, they have video cameras in the car telling you what they think about it, what their thought is, how’s it compared to other cars, if you’re looking for a hybrid, they compare it to other hybrids, or plug-in hybrids, and vice versa. So I do all that ahead of time so I can be well informed and the final step is going into [the] dealership, even if I’m just still in the research phase, and you have to deal with [it] but it’s better to go to the dealership being well informed and then when you get there, you just have to deal with their pushback...”

- Quoted by a focus group participant with the following characteristics: male, age 42, resident of Fresno County, high school graduate, prefers to speak English, White or Caucasian, lives in a detached house

“It's a lot easier to buy something that you actually sat in, tried out, versus just reading the specs and comments. Comments from honest people are really, really helpful, but any more, you don't know what's a comment and what's a paid advertisement.”

- Quoted by a focus group participant with the following characteristics: female, age 54, resident of San Joaquin County in a household of 1, college graduate, prefers to speak English, identifies as White or Caucasian, lives in an apartment or condominium

“...if you did something like [an informational event] at the state level, I would think it would be much easier to have multiple manufacturers in the same place as opposed to a dealer who only focuses on their brand. So it would be much easier to compare across brands in something like that where there's multiple dealers or multiple manufacturers in the same place. ... Because if somebody's looking at an electric car, I would think they would mainly be looking at electric cars. So they'd want an easy way to compare the different kinds of cars without having to do all the research here for one and all the research here for another if there was an easier way to compare them against each other.”

- Quoted by a focus group participant with the following characteristics: female, age 52, resident of San Jose County in a household of 4, some college or associate degree, Hispanic or Latina, prefers to speak Spanish, identifies as Other Race, lives in an apartment or condominium

“You always watch commercials on TV or the internet. It's much easier. That way, you go, and you're sure about what you like. You just go to the dealership, and look at it, and decide what's good for you to buy.”

- Quoted by a focus group participant with the following characteristics: female, age 23, resident of Fresno County in a household of 1, college graduate, prefers to speak English, identifies as Black or African American, lives in an attached house or townhome

“I think it's very important to make the knowledge accessible. When you walk into a car dealership, they're going to show you the newest car, but most of the time it's not going to be an electric car. They're not going to go into detail with that type of information. So, I think those details need to be more accessible. They need to be more promoted so people know, and we're not ignorant towards the fact of what an electric car can do. And we don't just think of the what-ifs.”

- Quoted by a focus group participant with the following characteristics: male, age 41, resident of San Diego in a household of 4, some college or associate degree, Hispanic or Latino, prefers to speak Spanish, identifies as Other Race, lives in a detached house

“I think the internet is fine as well. It’d be nice if they put an electric car on display and let you see it. Just let us see them more.”

Conclusions

In this memo, we described how the participation in the CVRP Increased Rebate program differs from the LMI population of California and LMI New Vehicle Buyers. We anticipate that these findings may be useful when reviewing CVRP marketing and outreach strategies. We find that people in the following demographic groups are underrepresented in the CVRP Increased Rebate when compared to the other LMI groups as above. Targeted marketing for these groups may yield increased participation in groups that are currently not participating at the same levels.

- People aged 21-29 and 30-39 years
- People with education levels of some college or less (includes high school graduates)
- People who rent their homes instead of owning them
- People who identify as women
- People who identify as Hispanic or Latino
- People who identify as White or Caucasian and Black or African American

In addition to identifying demographics that are underrepresented, we also determined which demographic factors are indicative of CVRP participants in the Increased Rebate group. In doing so, we characterize the current group composition in demographic terms. Individuals with such demographic factors may be more inclined to consider an EV or perhaps may have been more exposed to CVRP marketing. The following characteristics are predictive of the CVRP Increased Rebate group:

- Age: Compared to the most prevalent age group among all CVRP groups (50-59), ages 60-69 and 70+ are more likely to be in the Increased Rebate group.
- Education: Compared to the highest education level (postgraduate), all other educational levels are more likely to be in the Increased Rebate group.
- Residence Status: Compared to homeowners, renters are more likely to be in the Increased Rebate group.
- Gender: Compared to males, females are more likely to be in the Increased Rebate group.
- Vehicle Type: Compared to Tesla drivers, non-Tesla drivers are more likely to be in the Increased Rebate group.

After determining the demographic characteristics of the Increased Rebate group, we decided to conduct focus groups to better understand what LMI Californians think of EVs and what barriers they perceive when considering adopting EVs. Our team asked questions about how they choose vehicles and how they prefer to learn about vehicles.

As observed in a previous study, concerns about the cost of EVs, charging, and maintenance are barriers to EV adoption. Focus group participants continue to have concerns about access to charging stations, which limits the freedom and spontaneity of driving that remains important.

Focusing on the demographics of education and dwelling types, we learned that all groups share similar concerns, but some concerns are more important to certain groups. For example, college-educated individuals are primarily concerned with charging issues and the costs of EVs, while high school graduates and those with associate degrees are more concerned about the costs of charging and the availability of charging. Similarly, people who live in detached houses are most concerned about the costs of EVs, whereas those in attached houses or townhomes are most concerned about lack of charging stations and to a lesser extent the time it takes to charge. In addition to understanding concerns participants had about EVs, we wanted to understand how participants preferred to learn about vehicles and consequently, how we may consider outreach and marketing for LMI individuals. Most participants prefer doing online research (e.g., reading and comparing models, watching YouTube reviews, etc.). They also have an interest in interactive experiences with vehicles such as non-pressured test drives, social media, discussing with personal contacts and personal mechanics and going to dealers to learn more about vehicles and EVs.

Common among these preferences was the desire to understand and experience how it would be to drive and maintain various EV models. Participants were enthusiastic about test drive events in which consumers could test various makes and models and ask questions about EVs without being pressured to lease or buy right away. Similarly, participants expressed that same enthusiasm for video reviews on YouTube or related media in which reviewers compared and contrasted the features of various models. Offering such experiential outreach and marketing for LMI individuals may be an ideal strategy to consider as a method to increase LMI participation in the CVRP Increased Rebate group.

Integrating our findings, we suggest that CVRP consider the following approaches:

- Evaluate outreach and marketing toward underrepresented groups to determine if there are opportunities for increasing awareness of the CVRP among these populations. Similarly, determine if there are opportunities for experiential learning about EVs including non-pressured test drive events and videos discussing the features and logistics of driving various EV models.
- Along with information about the CVRP, provide additional information about concerns identified by LMI individuals including costs of EVs and charging, lack of or accessibility of charging stations and time commitments for charging. Similarly, provide information or suggestions about the logistics of EV maintenance and charging practices for those of various dwelling types, including those that may not be able to have chargers at their residences. Alternatively, increase partnership or engagement with educational organizations to address these concerns.

In summary, our analysis has highlighted the LMI demographic groups CVRP is currently reaching and which groups are statistically underrepresented when compared to LMI new car buyers and non-LMI CVRP participants. It has also highlighted the concerns of LMI Californians regarding EVs and what information sources they use to research car purchases or leases. Our research finds that targeting

underrepresented groups and tailoring information on EVs for these groups could address some equity concerns by expanding the participation of LMI individuals in the EV market.

Appendix A: Logistic Regression Model Results

Table A1. Logistic regression model results.

Feature	Estimate	Std. Error	z value	P-value	Sig.
(Intercept)	-4.08	0.15	-27.83	1.8E-170	***
Rent.or.OwnRent	0.91	0.08	11.15	7.1E-29	***
Housing.TypeOne-family house attached	-0.07	0.10	-0.67	5.0E-01	
Housing.TypeApartment	-0.03	0.10	-0.34	7.3E-01	
Housing.TypeOther	0.26	0.28	0.94	3.5E-01	
Age40-49	-0.39	0.09	-4.18	2.9E-05	***
Age60-69	0.37	0.11	3.27	1.1E-03	**
Age30-39	-0.26	0.10	-2.65	8.2E-03	**
Age21-29	0.20	0.13	1.60	1.1E-01	
Age70+	0.65	0.16	3.98	6.8E-05	***
GenderFemale	0.23	0.07	3.30	9.8E-04	***
GenderNot binary	-0.21	0.67	-0.32	7.5E-01	
Education.LevelBachelor's degree	0.71	0.08	9.08	1.1E-19	***
Education.LevelAssociate degree	1.27	0.12	10.63	2.2E-26	***
Education.LevelSome college, no degree	1.22	0.10	11.88	1.6E-32	***
Education.LevelHigh School or Less	1.78	0.12	14.25	4.6E-46	***
Tax.Filing.StatusMarried filing separately	0.21	0.18	1.17	2.4E-01	
Tax.Filing.StatusSingle	0.45	0.09	5.26	1.5E-07	***
Tax.Filing.StatusHead of household	0.72	0.12	6.24	4.5E-10	***
RaceSouth Asian	-0.28	0.09	-2.99	2.8E-03	**
RaceLatino(a) or Hispanic	0.12	0.09	1.27	2.1E-01	
RaceTwo or more races	-0.22	0.11	-2.01	4.5E-02	*
RaceOther and Self Report	-0.05	0.13	-0.43	6.7E-01	
RaceBlack or African American	-0.24	0.17	-1.40	1.6E-01	
RaceMiddle Eastern	0.54	0.15	3.58	3.4E-04	***
RaceNative Hawaiian or other Pacific Islander	-0.50	0.18	-2.79	5.3E-03	**
RaceNative American or Alaska Native	0.04	0.23	0.18	8.6E-01	
Vehicle.TypeBEV	0.77	0.08	9.06	1.3E-19	***
Vehicle.TypePHEV	0.71	0.07	9.55	1.3E-21	***

Vehicle.TypeFCEV	0.23	0.18	1.27	2.0E-01	
Household.Size	0.42	0.03	13.38	7.4E-41	***
Licensed.Drivers	-0.37	0.04	-8.52	1.6E-17	***

Cross-Validation Results

The model produced Type I Errors (misclassification of Increased Rebate participants) and had low Specificity ($26/354 = 7.3\%$) when cross validated using a training set of 70% of the dataset. The threshold for prediction in Table A2 below is 0.5, meaning that if the predicted value is 0.5 or greater, the predicted class for that data point is Increased Rebate.

Table A2. Confusion Matrix at Prediction Threshold of 0.5.

	Standard Rebate (True)	Increased Rebate (True)
Standard Rebate (Predicted)	3,323	328
Increased Rebate (Predicted)	18	26

* Predicted Class Threshold = 0.5

Because the data have many more Standard Rebate recipients than Increased Rebate recipients, the response classes are imbalanced. Moving the threshold to 0.4 increases model Specificity to 14.4%.

Table A3. Confusion Matrix at Prediction Threshold of 0.4.

	Standard Rebate (True)	Increased Rebate (True)
Standard Rebate (Predicted)	3,292	303
Increased Rebate (Predicted)	49	51

* Predicted Class Threshold = 0.4

Cramer's V Test for Multicollinearity

Table A3 below illustrates the association between categorical variables having more than 2 categories. Values closer to 0 are less correlated and values closer to 1 are more closely associated. Here the largest value is 0.52 between Rent or Own and Housing Type (i.e. Dwelling Type).

Table A4. Multicollinearity among demographic factors.

Factor Name	Education Level	Gender	Household Size	Housing Type	Increased Rebate	Licensed Drivers	Race	Rent or Own	Tax Filing Status	Vehicle Type
Age	0.05	0.04	0.17	0.17	0.08	0.14	0.07	0.34	0.24	0.05
Education Level		0.04	0.05	0.04	0.20	0.06	0.12	0.08	0.09	0.05
Gender			0.08	0.05	0.05	0.06	0.07	0.04	0.13	0.05
Household Size				0.17	0.14	0.43	0.06	0.18	0.29	0.05
Housing Type					0.07	0.17	0.05	0.52	0.15	0.05
Increased Rebate						0.10	0.10	0.16	0.12	0.12
Licensed Drivers							0.04	0.19	0.27	0.04
Race								0.10	0.09	0.07
Rent or Own									0.29	0.12
Tax Filing Status										0.03

Appendix B: Demographic Criteria for Focus Group Participants

Location of Residence: Participants were recruited from 10 areas of California that differed in income, geography, density and DAC status. One focus group was comprised of San Joaquin residents to provide insights for the recently launched rebate in that area. Other participants were recruited in approximately equal numbers from Shasta County, the city of Sacramento, the city of Fresno, more populated areas of San Bernardino and Riverside, Imperial County, the city of San Diego, the city of Los Angeles, the city of San Jose and the populated areas of Alameda County.

Table B1. Focus group participants' counties of residence.

County	Count	Percentage
Fresno	1	3%
Sacramento	1	3%
San Bernardino	1	3%
Alameda	2	6%
Los Angeles	2	6%
San Jose	2	6%
Fresno	3	10%
Imperial	3	10%
San Diego	3	10%
Shasta	3	10%
Riverside	4	13%
San Joaquin	6	19%
Grand Total	31	100%

Primary Language: One focus group comprised of Spanish-speaking individuals (6 individuals). The remaining focus groups were spoken in English (25 individuals).

Driver Status: Participants had a current driver's license and had either access to a car or interest in purchasing/leasing a car within a year.

Ethnicity and Race: We recruited for the following ethnicities and races: Hispanic and Latinx, Native American or Alaskan Native, East Asian, South Asian, Southeast Asian, Other Asian, Black or African American, Native Hawaiian or Pacific Islander, White or Caucasian and NOT Hispanic or Latinx and Bi-Racial or Multi-Racial. Ethnicities and races less represented in CVRP than expected were more heavily recruited.

Table B2. Focus group participants’ ethnicities and races.

Ethnicity and Race	Count	Percentage
Hispanic, Latino, Latina, or Latinx	14	45%
Bi-Racial or Multi-Racial	1	3%
Other	6	19%
Other Race	7	23%
Not Hispanic, Latino, Latina, or Latinx	17	55%
Bi-Racial or Multi-Racial	1	3%
Southeast Asian	1	3%
South Asian	2	6%
White or Caucasian AND NOT Hispanic or Latino	6	19%
Black or African American	7	23%
Grand Total	31	100%

Gender: Participants were comprised of a similar number of males (13 individuals) and females (18 individuals). The focus groups were also open to non-binary individuals.

Education: Participants with education no higher than a high school degree or GED were heavily recruited because LMI CVRP applicants tend to have higher education levels than LMI car lessees/buyers nationwide.

Table B3. Focus group participants’ education levels.

Education	Count	Percentage
Some Graduate School/Post-Graduate Degree	3	10%
College Graduate	11	35%
Some College	4	13%
Some College/2-year College/Technical School/Associate Degree	3	10%
High School Graduate	10	32%
Grand Total	31	100%

Dwelling Type: Participants were recruited from the following dwelling types in numbers proportional to LMI respondents to the California census: apartments or condominiums, attached houses, and detached houses.

Table B4. Focus group participants’ dwelling types.

Dwelling Type	Count	Percentage
An apartment or condominium	7	23%
An attached house, a townhome, or similar	7	23%
A detached house	17	55%
Grand Total	31	100%

Age: People aged 21 to 69 were recruited to match the bulk of people leasing or buying cars.¹⁵

Table B5. Focus group participants' ages.

Participants' Ages		
Age Range	Count	Percentage
20-29	5	16%
30-39	7	23%
40-49	11	35%
50-59	8	26%
Grand Total	31	100%

¹⁵ National Household Travel Survey data of car lessees/buyers.

Appendix C: Codes Used to Categories in Focus Group Discussions

Table C1. Codes used to identify barriers within focus group analysis.

BATTERY
Battery: Concern about battery in general
Battery: Concern about battery life
Battery: Concern battery charge is not in customer's control
Battery: Concern battery manufacturing or recycling is bad for environment
Battery: Concern some actions may kill battery
Battery: Do not know if battery would need to be replaced
CHARGING
Charging: Charging stations are unreliable
Charging: Charging time is too long
Charging: Concern about charging in general
Charging: Concern about where to charge if power is shut off
Charging: Do not know how charging works
Charging: Do not know how payment works
Charging: Do not know how to acquire chargers
Charging: Do not know where or how many chargers are available
Charging: Do not want to look for places to charge
Charging: Does not know if installing a charger at home is possible
Charging: Lack of charging stations
Charging: Needs more information about charging
Charging: Takes too much time to charge elsewhere because cannot charge at home
Charging: Would like ease and/or assistance with installation
COSTS
Costs: Batteries are too expensive
Costs: Charging is too expensive
Costs: Concern that maintenance is expensive
Costs: Concern there are hidden costs due to new technologies
Costs: Costs of EVs are too expensive
Costs: Do not know the costs of EVs
Costs: Down payment is too costly
Costs: Particular models are not eligible for incentives
Costs: Wary about electricity prices changing
Costs: Would like lifetime warranties

DEALERSHIPS
Dealerships: Customers feel too much pressure at dealerships or are uneasy at dealerships
Dealerships: Dealers dissuade purchasing EVs
Dealerships: Dealerships are not knowledgeable about EVs
Dealerships: Dealerships could have more EV options
Dealerships: Do not trust dealerships
Dealerships: Frustrating conversations about price of car
Dealerships: Not all dealerships offer EV incentives
INFORMATION
Information: Cities and communities do not provide information about EV infrastructure
Information: Commercials for EVs do not include convincing specs
Information: Customer needs to do much more research
Information: Lack of accessible information
Information: Lack of comprehensive EV sources
Information: Lack of unbiased information
Information: Not enough ads about EVs
Information: Utilities do not provide info about EVs
MAINTENANCE
Maintenance: Do not know what maintenance entails
Maintenance: Hard to find a mechanic unless you go to dealership
Maintenance: Would not know how to diagnose a problem with the car
Maintenance: Would not know where to go for EV maintenance
PERSONAL
Personal: Content with car they already have
Personal: Do not like the way EVs look
Personal: Do not trust the state
Personal: EVs are not easily hobbies like sports or gasoline cars
Personal: EVs do not reflect personal identity
Personal: Lack of EV model options
Personal: Not interested in EVs
Personal: Wants a big car
Personal: Wants to be able to haul items
RANGE
Range: Fear of being stranded
Range: Inability to be spontaneous
Range: Range anxiety

Range: Range is too short
Range: Traveling long distance does not seem like an option
SAFETY
Safety: Concern charger installation is insecure
Safety: Unsure about reliability
Safety: Unsure about safety
UNFAMILIARITY WITH EVS
Unfamiliarity with EVs: Do not know all EV models
Unfamiliarity with EVs: Do not trust car or batteries that are not made in the US
Unfamiliarity with EVs: Lack of exposure to EVs
Unfamiliarity with EVs: Unsure about the technology
Unfamiliarity with EVs: Unsure about trying something new

Table C2. Codes used to identify preferred information sources within focus group analysis.

APP
App: An app that compares vehicles
DEALER
Dealer: Dealership website
Dealer: Going to the dealer
Dealer: Talking with dealer
Dealer: Test drives with dealer
EXPERIENCE
Experience: EV rental options
Experience: Informational event
Experience: Riding in EV through Uber and Lyft and talking with driver
Experience: See EV on display
Experience: Test drive options in non-pressured environments (not dealerships or dealerships do not expect you to buy that day)
ONLINE
Online: Autotrader website
Online: Consumer Reports
Online: Doing online research
Online: Kelley Blue Book
Online: Manufacturer websites
Online: Reddit

Online: Reviews of vehicles
Online: TrueCar
Online: YouTube
Online: YouTube videos about bargaining for cars
Online: YouTube videos comparing models
Online: YouTube videos made by mechanics
Online: YouTube videos of test drives
ONLINE DEALER
Online Dealer: CarMax
PERSONAL CONTACTS
Personal Contacts: Talking to people you know
Personal Contacts: Talking with mechanics
Personal Contacts: Test drive a friend's car
PHONE
Phone: Receiving calls about new models
PRINT
Print: Autotrader magazine
Print: Consumer Reports magazine
SOCIAL MEDIA
Social Media: Facebook
Social Media: Instagram
Social Media: Social media ads in general
Social Media: Social media campaign
Social Media: TikTok
Social Media: Twitter
TV
TV: TV ads that are engaging and informative
TV: TV commercials and ads

Appendix D: Ranked Barriers and Preferred Information Sources from Focus Group Discussions

Table D1. Ranked barriers discussed in focus groups.

Category	Barrier	Frequency of Mentions (n=331)
Charging	Lack of charging stations	11% (n=36)
Costs	Costs of EVs are too expensive	11% (n=36)
Costs	Charging is too expensive	8% (n=25)
Charging	Charging time is too long	5% (n=17)
Information	Lack of comprehensive EV sources	5% (n=17)
Range	Fear of being stranded	5% (n=16)
Dealerships	Customers feel too much pressure at dealerships or are uneasy at dealerships	4% (n=13)
Charging	Do not know if installing a charger at home is possible	3% (n=9)
Costs	Concern that maintenance is expensive	3% (n=9)
Charging	Do not know where or how many chargers are available	2% (n=8)
Costs	Wary about electricity prices changing	2% (n=7)
Battery	Concern about battery life	2% (n=6)
Range	Range is too short	2% (n=6)
Unfamiliarity with EVs	Unsure about trying something new	2% (n=6)
Battery	Concern about battery in general	2% (n=5)
Range	Range anxiety	2% (n=5)
Range	Traveling long distance does not seem like an option	2% (n=5)
Safety	Unsure about reliability	2% (n=5)
Unfamiliarity with EVs	Lack of exposure to EVs	2% (n=5)
Charging	Do not know how charging works	1% (n=4)
Costs	Batteries are too expensive	1% (n=4)
Costs	Down payment is too costly	1% (n=4)
Dealerships	Dealerships are not knowledgeable about EVs	1% (n=4)
Dealerships	Do not trust dealerships	1% (n=4)
Maintenance	Do not know what maintenance entails	1% (n=4)
Battery	Concern battery manufacturing or recycling is bad for environment	1% (n=3)
Dealerships	Dealers dissuade purchasing EVs	1% (n=3)
Information	Commercials for EVs do not include convincing specs	1% (n=3)
Information	Lack of accessible information	1% (n=3)
Maintenance	Would not know how to diagnose a problem with the car	1% (n=3)
Safety	Unsure about safety	1% (n=3)
Battery	Concern some actions may kill battery	1% (n=2)
Battery	Do not know if battery would need to be replaced	1% (n=2)
Charging	Charging stations are unreliable	1% (n=2)

Charging	Do not know how payment works	1% (n=2)
Charging	Do not want to look for places to charge	1% (n=2)
Charging	Needs more information about charging	1% (n=2)
Charging	Would like ease and/or assistance with installation	1% (n=2)
Costs	Do not know the costs of EVs	1% (n=2)
Information	Lack of unbiased information	1% (n=2)
Maintenance	Hard to find a mechanic unless you go to dealership	1% (n=2)
Personal	EVs are not easily hobbies like sports or gasoline cars	1% (n=2)
Personal	Not interested in EVs	1% (n=2)
Unfamiliarity with EVs	Unfamiliarity with EVs: Unsure about the technology	1% (n=2)
Battery	Concern battery charge is not in customer's control	<1% (n=1)
Charging	Concern about charging in general	<1% (n=1)
Charging	Concern about where to charge if power is shut off	<1% (n=1)
Charging	Do not know how to acquire chargers	<1% (n=1)
Charging	Takes too much time to charge elsewhere because cannot charge at home	<1% (n=1)
Costs	Concern there are hidden costs due to new technologies	<1% (n=1)
Costs	Particular models are not eligible for incentives	<1% (n=1)
Costs	Would like lifetime warranties	<1% (n=1)
Dealerships	Dealerships could have more EV options	<1% (n=1)
Dealerships	Frustrating conversations about price of car	<1% (n=1)
Dealerships	Not all dealerships offer EV incentives	<1% (n=1)
Information	Cities and communities do not provide information about EV infrastructure	<1% (n=1)
Information	Customer needs to do much more research	<1% (n=1)
Information	Not enough ads about EVs	<1% (n=1)
Information	Utilities do not provide info about EVs	<1% (n=1)
Maintenance	Would not know where to go for EV maintenance	<1% (n=1)
Personal	Content with car they already have	<1% (n=1)
Personal	Do not like the way EVs look	<1% (n=1)
Personal	Do not trust the state	<1% (n=1)
Personal	EVs do not reflect personal identity	<1% (n=1)
Personal	Lack of EV model options	<1% (n=1)
Personal	Wants a big car	<1% (n=1)
Personal	Wants to be able to haul items	<1% (n=1)
Range	Inability to be spontaneous	<1% (n=1)
Safety	Concern charger installation is insecure	<1% (n=1)
Unfamiliarity with EVs	Do not know all EV models	<1% (n=1)
Unfamiliarity with EVs	Do not trust car or batteries that are not made in the US	<1% (n=1)

Table D2. Ranked preferred information sources discussed in focus groups.

Category	Preferred Information Source	Frequency of Mentions (n=115)
Online	Doing online research	20% (n=23)
Personal Contacts	Talking to people you know	8% (n=9)
Experience	Test drive options in non-pressured environments (not dealerships or dealerships do not expect you to buy that day)	6% (n=7)
Dealer	Test drives with dealer	4% (n=5)
Experience	See EV on display	4% (n=5)
Personal Contacts	Talking with mechanics	4% (n=5)
Social Media	Facebook	4% (n=5)
Dealer	Talking with dealer	4% (n=4)
Experience	Informational event	4% (n=4)
Social Media	Social media ads in general	4% (n=4)
Online Dealer	CarMax	3% (n=3)
Online	Reviews of vehicles	3% (n=3)
Print	Autotrader magazine	3% (n=3)
TV	TV commercials and ads	3% (n=3)
Dealer	Going to the dealer	2% (n=2)
Experience	Riding in EV through Uber and Lyft and talking with driver	2% (n=2)
Online	Autotrader website	2% (n=2)
Online	Reddit	2% (n=2)
Online	YouTube	2% (n=2)
Social Media	Instagram	2% (n=2)
Social Media	Twitter	2% (n=2)
TV	TV ads that are engaging and informative	2% (n=2)
App	An app that compares vehicles	1% (n=1)
Dealer	Dealer: Dealership website	1% (n=1)
Experience	EV rental options	1% (n=1)
Online	Consumer Reports	1% (n=1)
Online	Kelley Blue Book	1% (n=1)
Online	Manufacturer websites	1% (n=1)
Online	TrueCar	1% (n=1)
Online	YouTube videos about bargaining for cars	1% (n=1)

Online	YouTube videos comparing models	1% (n=1)
Online	YouTube videos made by mechanics	1% (n=1)
Online	YouTube videos of test drives	1% (n=1)
Personal Contacts	Test drive a friend's car	1% (n=1)
Phone	Receiving calls about new models	1% (n=1)
Print	Consumer Reports magazine	1% (n=1)
Social Media	Social media campaign	1% (n=1)
Social Media	TikTok	1% (n=1)



As a mission-driven nonprofit organization, CSE works with energy policymakers, regulators, public agencies and businesses as an expert implementation partner and trusted information resource. Together, we are the catalysts for sustainable energy market development and transformation.