

# **Home Charging Accessibility Trends within the Clean Vehicle Rebate Project**

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## **Executive Summary**

To promote clean vehicle adoption, California has provided rebates for various plug-in electric vehicles (PEVs) through the Clean Vehicle Rebate Project (CVRP). This study tracked CVRP participants' access to charging over time by comparing rebate recipient data over multiple years. It examined the following key question: Is the program still serving only those with convenient home charging, or are people in multi-unit dwellings (MUDs) and those who rely on public charging increasingly participating? Differences between low- to moderate-income vs. standard rebate participants, plug-in hybrid electric vehicle (PHEV) vs. battery electric vehicle (BEV) consumers, and differences across survey years were also further explored in the analysis.

Findings include, over half of all CVRP respondents at 56 percent say that a barrier to charging at home is "I rent or have a homeowners association and am not authorized to make changes at my residence." Coming in with the second highest percentage is "I can charge for free or at a lower cost somewhere else" at 32 percent. The third highest percentage when looking at barriers is "Adding an outlet or charging station would be too expensive" at 20.7 percent. Further, two of the top three greatest concerns about driving a PEV are range and charging away from home.

After isolating results by home charging access distinct demographic and household characteristics between the two groups were then visible. For example, home charging applicants more often tend to be older in age, homeowners, and have higher rates of pre-existing solar panels. While participants who cannot charge at home, are more frequently renters, with higher rates living in apartments/condominiums. Non-home charging participants also have higher rates of residency in low-income communities (LICs) than their home charging accessible counterparts.

*Keywords: charging, incentive, electric vehicle (EV), research, user behaviour*

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## **1 Introduction**

In 2020, California established a goal of all new vehicle sales to be zero emission by 2035. Since then, California has continued to make considerable progress toward reaching that goal with 16% of all new vehicles sold in 2022 being zero-emission vehicles [1]. While there has been consistent growth in the electric vehicle market, it is safe to say that 100% plug-in electric vehicle (PEV) adoption will not be achieved until charging is accessible to all, otherwise, gasoline-powered vehicles will continue to remain the majority preference.

### **1.1 Data**

The Clean Vehicle Rebate Project is a California program that provides rebate incentives to those purchasing a plug-in electric vehicle. The program's initialization began in 2010 and since then has awarded over 490,000 rebates [2]. To better understand the participants of the program, each participant is then invited to

complete a survey asking questions ranging from demographic and housing characteristics to which factors were most important in influencing their purchase decision.

For this analysis, we focused on the most recent survey edition of the program which was administered from August 1, 2017 – March 24, 2021, and encompasses CVRP applicants who purchased or leased their vehicle from June 1, 2017 – November 20, 2020. Additionally, the survey data was weighted to ensure that it is representative of the entire program. Responses were weighted using the raking method along the following response fields: vehicle category, vehicle model, vehicle purchase year, purchase vs. lease, and county of residence.

Since 2016, the project has awarded additional incentive amounts to participants with low- to moderate-income which are determined by the participant’s household income with respect to the federal poverty level. In our analysis, we refer to the additional incentives as increased rebates while the original rebate amounts are termed standard rebates. These two rebate types are also used as a proxy in the analysis for participants with differing income.

While not every new PEV purchaser is required (or eligible) to participate in the CVRP, 43% of PEV purchasers in the state between June 2017 to November 2020 participated in the program. Albeit the survey is not representative of the entire California PEV consumer market, the survey provides a robust snapshot of new PEV consumers and the hurdles they face in charging their vehicles at home.

Lastly, the analysis focuses on participants who have the possibility of home charging access, so fuel cell electric vehicle (FCEV) respondents were excluded from the analysis.

*Table 1: CVRP 2017-2020 survey edition summary.*

Purchase/Lease Dates	1 June 2017 – 30 November 2020
Program Participants (Applications)	N = 198,922
	PHEV: 57,162 (29%)
	BEV: 136,005 (68%)
	FCEV: 5,755 (3%)
Survey Response Dates	August 1, 2017 – March 23, 2021
Survey Respondents (17% of program participants)	n = 33,524
	PHEV: 9,599 (29%)
	BEV: 22,925 (68%)
	FCEV: 1,000 (3%)
Program as % of EV Market	43% (with FCEV, 42% without FCEV)

## 2 Results

The analysis was divided into two phases. The first phase of analysis was developed to identify which CVRP participants can and cannot charge at home (Section 2.1), while the second phase focuses on the demographics and characteristics that are specific to those who cannot charge at home (Section 2.2).

### 2.1 Who Can and Cannot Charge at Home

Analyses in this section help explain how many participants do or do not have access to home charging, while further exploring potential home charging barriers.

#### 2.1.1 Home Charging within CVRP

Home charging convenience may be a deciding factor for those considering purchasing a PEV, especially when range anxiety may be a lingering concern. However, CVRP participants have displayed a wide range in their access to charging at home. For example, 36.2% of total applicants rely on a 120V outlet for home charging while 25.2% and 23.3% use a 240V outlet or a Level 2 charging station, respectively (see Table 2). Further, at the time of taking the survey, 13.6% of applicants did not have access to charging their vehicle at home due to factors that will be explored in more detail in subsequent sections.

For those who can charge at home, there are additional conveniences that come with a dedicated charging station vs using a 120V or 240V outlet. For instance, a charging station typically has features to schedule charging times at non-peak hours allowing for additional savings compared to charging during the day when rates tend to be higher [3]. Applicants who charge via a charging station were also asked, “About how much did/will you pay (after any incentives) to purchase and install your charging station, including any electrical upgrades that were needed?” to which the average response was \$1,051. Given the fact that installing a dedicated home charging station provides financial and convenience benefits, the upfront cost and potential installation planning may be a larger deterrent.

Table 2: CVRP survey respondents home charging characteristics.

Do you charge at home?	All (n=32,292)	BEV (n=22,737)	PHEV (n=9,555)
No	13.6%	13.8%	13.0%
Yes, I’m using a 120V outlet	36.2%	23.8%	65.5%
Yes, I’m using a Level 1 charging station	1.8%	1.9%	1.6%
Yes, I’m using a 240V outlet	25.2%	32.2%	8.5%
Yes, I’m using a Level 2 charging station	23.3%	28.3%	11.4%

### 2.1.2 Barriers to Charging at Home

Aside from the installation costs that come with charging, there are other barriers that limit people from charging at home (see Table 3). For example, when applicants were asked why they won’t be charging at home, 56.0% of total respondents stated, “I rent or have a homeowners association and am not authorized to make changes at my residence.” The second most frequent response among 32.0% of applicants was that they could charge for free or at a lower cost somewhere else. Further, the third most frequent response option at 20.7% was “Adding an outlet or charging station would be too expensive”, which reiterates that for some applicants, the upfront cost of installing a charger may not outweigh the benefits of convenience and fuel price savings.

Table 3: CVRP survey respondents home charging barriers.

Why won’t you be charging at home?*	All (n=2,783)	BEV (n=1,909)	PHEV (n=874)
I rent or have a homeowner’s association and am not authorized to make changes at my residence	56.0%	54.9%	58.5%
My residence has no off-street parking	8.0%	6.6%	11.0%
I can charge for free or at a lower cost somewhere else	32.0%	36.5%	22.0%
Adding an outlet or charging station would be too expensive	20.7%	21.9%	18.1%
Adding an outlet or charging station would be too complicated	15.1%	15.4%	14.5%
I only plan to have my PEV for a few years	0.8%	0.8%	0.9%
I will be moving soon	4.6%	4.9%	3.9%
I never charge my vehicle (just use it as a hybrid)	0.6%	0.1%	1.6%
I am currently in the process of adding an outlet or charging station	0.8%	0.9%	0.5%
Other, please specify	6.6%	6.6%	6.6%

\*Note that each response is a "check all that apply" field so the percentage totals may not add up to 100%.

### 2.1.3 Workplace Charging Access

Among CVRP rebate participants there is a fairly even split between 20-30 percent across four out of the five categories regarding who has access to charging at work (see Table 4). Over 40% of applicants have some form to access of workplace charging, whether it’s free charging or at a cost. Additionally, over 50% of applicants don’t have workplace charging or the question doesn’t apply since they work from home or don’t work. Similar results translate over when the results are split between BEV and PHEV owners, but greater differences form when isolating the question among standard rebate and increased rebate applicants. For example, 44.8% of standard rebate applicants have some form of workplace charging while 31.9% of increased rebate applicants have the same access. Similarly, 37.0% of increased rebates applicants responded,

“No” to workplace charging while 28.9% of standard rebate applicants also selected “No”. Differences between standard and increased applicants allude that there may be additional charging barriers linked to those in lower financial brackets.

Table 4: CVRP survey respondents workplace charging characteristics.

Do you charge your PEV at work?	All (n=32,211)	BEV (n=22,680)	PHEV (n=9,531)	Std. Rebate (n=29,236)	Inc. Rebate (n=2,975)
I'm not sure whether PEV charging is available.	3.7%	3.5%	4.3%	3.5%	5.7%
I work from home, or I don't work so this question doesn't apply to me	23.0%	23.6%	21.4%	22.7%	25.4%
No	29.7%	28.3%	32.9%	28.9%	37.0%
Yes, and I can charge for free	23.0%	23.1%	22.9%	23.7%	16.2%
Yes, and I must pay to charge	20.6%	21.5%	18.6%	21.1%	15.7%

The responses were also separated by the application received year to show how charging at work has changed over time in Table 5. Initially, the distribution of responses remained consistent over the course of 2017, 2018, and 2019, but in 2020 there was a moderate increase in the percentage of applicants who work from home or don't work. For the first three years, 21-23 percent of respondents worked from home or didn't work, but that percentage rose to 30.5% in 2020 most likely in response to California's stay-at-home order in March 2020 [4]. As the percentage of work-from-home applicants initially rose in response to COVID it is possible that those workers are continuing to work from home due to some employers adopting hybrid work culture. Shift in work culture should be monitored to find the appropriate balance between workplace charging and public infrastructure to accommodate those who are not able to charge at home or at work. This is especially important as charging infrastructure and grid management continue to develop in the future [5].

Table 5: CVRP survey respondents workplace charging characteristics by application received year.

Do you charge your PEV at work?	2017 (n=4,729)	2018 (n=12,881)	2019 (n=10,343)	2020 (n=4,258)
I'm not sure whether PEV charging is available.	3.1%	3.3%	3.9%	5.2%
I work from home, or I don't work so this question doesn't apply to me	23.0%	21.3%	22.0%	30.5%
No	28.9%	30.0%	30.6%	27.3%
Yes, and I can charge for free	26.1%	24.4%	22.2%	17.4%
Yes, and I must pay to charge	19.0%	20.9%	21.4%	19.5%

The survey question was further filtered by specifically analysing results for respondents who do not have home charging access (see Table 6). Of those who do not currently charge at home, most of these applicants have access to charge at their work for free or through payments (69.8%), which may explain why they do not charge at home. If we focus solely on those who received an increased rebate, 47.7% of these respondents cannot charge at work or home compared to the 24.8% of standard rebate applicants. Again, the difference between standard and increased rebate applicants highlights how lower-income applicants with no home charging access are less likely to charge at work and have a greater reliance on public charging.

Table 6: CVRP survey respondents workplace charging characteristics. Values have been further filtered to participants who do not have home charging access.

Do you charge your PEV at work?	All (n=4,365)	Std. Rebate (n=3,836)	Inc. Rebate (n=530)
I'm not sure whether PEV charging is available.	2.5%	2.4%	3.8%
I work from home, or I don't work so this question doesn't apply to me	9.6%	8.8%	14.9%
No	18.0%	16.0%	32.8%
Yes, and I can charge for free	43.2%	44.9%	31.1%

Yes, and I must pay to charge | 26.6% | 27.9% | 17.5%

### 2.1.4 Home Charging Electrical Upgrades

Survey applicants who charge at home with either a 120V or 240V outlet were asked the following follow-up question, "Did you have to make any electrical upgrades to be able to charge your vehicle at home?" The majority (68%) of total applicants had the pre-existing electrical structure for their vehicle and did not have to make electrical upgrades (see Table 7). Similarly, when isolating the results by vehicle technology type, we find that most participants who drive BEVs (57.4%) and PHEVs (87.2%) also did not have to make electrical upgrades to be able to charge at home. Although, there is a 29.8 percentage point difference between these two technology-type owners indicating that BEV and PHEV owners have different charging needs.

When the results are segregated by charging type, we find a dramatic difference in the percentage of applicants who had to make electrical upgrades between 120V outlet and 240V outlet home chargers. Only 8.2% of applicants who charge with a 120V outlet had to make upgrades while 66.1% of 240V outlet-charging applicants had to make upgrades. This considerable difference between charger type applicants has some dependence on the technology type of the vehicle owner since BEV owners tend to have a greater need for quicker charging as that is the primary source of fuel for their vehicle.

Table 7: CVRP survey respondents need for electrical upgrades.

Do you have to make electrical upgrades to be able to charge your vehicle at home?*	All (n=19,744)	BEV (n=12,704)	PHEV (n=7,040)	120V Outlet (n=11,632)	240V Outlet (n=8,112)
Did not make electrical upgrades	68.0%	57.4%	87.2%	91.8%	33.9%
Made electrical upgrades	32.0%	42.6%	12.8%	8.2%	66.1%

\*Note this question was only provided to applicants who stated they charge at home with a 120V or 240V outlet.

Most CVRP participants across all program years did not have to make electrical upgrades to charge at home with 2017 being the highest year in which electrical upgrades were not made at 75.3%. These percentages exhibited a slight decline over the years (see Table 8). Again, the increase in electrical upgrades may be partially explained by the growing share of BEVs compared to PHEVs in the program. BEVs rely solely on electricity so there is a greater need for 240V charging, which is less common in households compared to standard 120V outlets. In other words, as more BEVs enter the program there is higher demand for faster charger which led to the larger increase of electrical upgrades.

Table 8: CVRP survey respondents need for electrical upgrades by application received year.

Did you have to make electrical upgrades to be able to charge your vehicle at home?	2017 (n=3,048)	2018 (n=7,735)	2019 (n=6,456)	2020 (n=2,504)
Did not make electrical upgrades	75.3%	67.8%	66.3%	64.3%
Made electrical upgrades	24.7%	32.2%	33.7%	35.7%

\*Note this question was only provided to applicants who stated they charge at home with a 120V or 240V outlet.

## 2.2 Home Charging Access Participant Comparisons

In the second portion of this analysis, we explore the relations between home charging access and additional survey questions based on the following themes: applicant demographics, household characteristics, and regional location. We begin by first analysing the relationship between age and access to home charging.

### 2.2.1 Home Charging Access by Age

From Table 9, the top four most common age groups are: 30-39, 40-49, 50-59, and 60-69. The percentage of total applicants within each of these age groups was fairly uniform, with each group ranging from 18-22%. When separating the results between home and non-home charging applicants, there are some differences between the two groups. Applicants with no home charging access typically are younger in age with 48.0% of applicants being between the age of 21-39 whereas 20.9% of home charging applicants fall in that range. Oppositely, 42.5% of home-charging applicants are between the age of 50-69 while 25.1% of non-home

chargers are within the same age group which indicates that lower-age applicants are more commonly not able to charge at home.

Table 9: CVRP survey respondents age characteristics.

Age	All (n=32,290)	Home Charging (n=27,933)	No Home Charging (n=4,357)
Prefer not to answer	2.2%	2.2%	1.8%
16-20	0.1%	0.1%	0.1%
21-29	5.9%	4.3%	15.9%
30-39	18.6%	16.6%	32.1%
40-49	22.0%	22.1%	21.5%
50-59	21.7%	22.5%	16.4%
60-69	18.4%	20.0%	8.7%
70-79	9.6%	10.6%	3.2%
80+	1.5%	1.7%	0.5%

### 2.2.2 Home Charging Access by Home Ownership

Overall, the majority of the participants own their residence (78.4%), but there are modest differences after disaggregating by home charging access (see Table 10). For those who can charge at home, most are homeowners (83.9%) while alternatively, those who cannot charge at home tend to be renters (52.6%).

Further filtering respondents by their vehicle technology type, home charging participants and vehicle owners of BEVs and PHEVs continue to be mostly homeowners, 85.4% and 80.3%, respectively. For non-home charging participants, BEV and PHEV owners continue to be primarily renters, but there is a 15-percentage point difference between the two EV consumers. Specifically, 63.3% of non-home charging PHEV owners are renters while 48.3% of BEV owners who don't charge at home are renters.

The high percentages of non-home charging participants who are renters may be partially attributed to barriers by residence type. In Barriers to Charging at Home one of the most common reasons for not having home charging access at home is "I rent or have a homeowners association and am not authorized to make changes at my residence." Furthermore, those who can't charge at home are most likely directly affected by their homeownership status.

Table 10: CVRP survey respondents home ownership characteristics.

Own or Rent	All (n=32,292)	Home Charging (n=27,914)	No Home Charging (n=4,378)	Home Charging & BEV (n=19,600)	Home Charging & PHEV (n=8,314)	No Home Charging & BEV (n=3,137)	No Home Charging & PHEV (n=1,241)
Prefer not to answer	3.3%	3.1%	4.0%	3.0%	3.5%	3.9%	4.2%
Own	78.4%	83.9%	43.4%	85.4%	80.3%	47.8%	32.5%
Rent	18.3%	13.0%	52.6%	11.6%	16.2%	48.3%	63.3%

### 2.2.3 Home Charging Access by Residence Type

From **Error! Reference source not found.**, the majority of CVRP respondents reside in detached homes (75.3%), but there is a difference in residence type between those with and without home charging access. Those with home charging access mainly reside in detached houses (82.2%) while only 39.1% of those with no home charging access live in detached houses. For those without home charging, the most frequent residence type is apartments or condominiums (47.2%).

Table 11: CVRP survey respondents residence type characteristics.



Residence Type	All (n=32,292)	Home Charging (n=27,914)	No Home Charging (n=4,378)	Home Charging & BEV (n=19,600)	Home Charging & PHEV (n=8,314)	No Home Charging & BEV (n=3,137)	No Home Charging & PHEV (n=1,241)
Other, please specify	0.9%	0.9%	1.3%	0.8%	1.2%	1.1%	1.8%
Prefer not to answer	1.3%	1.3%	1.8%	1.1%	1.5%	1.7%	2.0%
Detached house (single family home)	75.3%	81.0%	39.1%	82.2 %	78.5%	42.5%	30.6%
Attached house (e.g. townhouse, duplex, triplex)	9.5%	9.3%	10.7%	9.0%	9.9%	11.4%	8.8%
Apartment/condominium	12.9%	7.5%	47.2%	6.9%	9.0%	43.3%	56.8%

When further isolating residence type by home charging access and vehicle type, the responses remain fairly similar. For example, the total participants who charge at home with a BEV mainly live in a detached house (82.2%) and similarly, home-charging PHEV owners also reside in detached houses (78.5%). Although, for BEV owners with no home charging access, there is almost an even divide within detached house residents (42.5%) and apartments or condominiums residents (43.3%). When looking at PHEV owners with no home charging access there is a greater difference among detached house residents (39.1%) compared to apartment or condominium residents (47.2%).

Table 12 displays the reasons why applicants are not charging home separated by their residence type. Isolating by residence type helps identify the charging obstacles that different residents face. For example, the most frequent response for not charging at home for apartment or condominium residents is “I rent or have a homeowner’s association...” with 75.0% of applicants selecting this option. There is also a high response for this reason among attached house residents (51.2%), but for detached home residents, the response of selecting this option dwindles to 19.4%. Conversely, detached house and attached house residents have greater opportunities to charge elsewhere “for free or at a lower cost” with 53.9% or 40.3% of applicants selecting this option, respectively.

Table 12: CVRP survey respondents home charging barriers.

Reasons Not Charging at Home	Detached house (single family home) (n=766)	Attached house (e.g. townhome, duplex, triplex) (n=294)	Apartment or condominium (n=1,632)
I rent or have a homeowner’s association and am not authorized to make changes at my residence	19.4%	51.2%	75.0%
My residence has no off-street parking	6.5%	12.3%	7.4%
I can charge for free or at a lower cost somewhere else	53.9%	40.3%	19.7%
Adding an outlet or charging station would be too expensive	34.0%	24.4%	13.5%
Adding an outlet or charging station would be too complicated	19.1%	17.3%	12.7%
I only plan to have my PEV for a few years	1.7%	0.3%	0.5%
I will be moving soon	4.1%	5.7%	4.7%

I never charge my vehicle (just use it as a hybrid)	1.0%	0.0%	0.4%
I am currently in the process of adding an outlet or charging station	1.6%	0.6%	0.4%
Other, please specify	7.0%	5.6%	6.5%

Lastly from Table 13, detached house and attached house residents had the highest percentage of home charging at 93.0% and 84.7%, respectively, while apartment or condominium residents may be facing the greatest charging barriers with only 50.5% of residents charging at home.

Table 13: CVRP survey respondents home charging access.

Home Charging Access	Detached House (n=24,331)	Attached House (n=3,507)	Apartment/Condominium (n=4,171)
Home charging	93.0%	84.7%	50.5%
No home charging	7.0%	15.3%	49.5%

#### 2.2.4 Home Charging Access by Solar Panel Access

Another metric of interest was comparing the number of respondents who have solar panels installed at their place of residence across vehicle types and home charging access. In total, the most frequent solar response option was “No, and I have no plans to install solar panels” with 28.5% of respondents selecting this option (see Table 14). Similarly, those who drive a BEV stand at 26.8% while those who drive a PHEV stand at 32.8%. Coming in at a slightly lower percentage are those who do have solar panels that were already installed prior to any plug-in electric vehicle purchase (23.5% of total respondents). After isolating by vehicle type, 24.9% of BEV owners and 20.1% of PHEV owners also have pre-existing solar access.

Table 14: CVRP survey respondents solar panel access.

Status of Solar Panels Installation at Residence	All (n=30,515)	BEV (n=22,841)	PHEV (n=9,601)	Home Charging (n=27,871)	No Home Charging (n=4,367)
Other, please specify	5.3%	5.4%	5.1%	5.5%	4.2%
Yes, solar panels were already installed prior to any plug-in electric vehicle purchase	23.5%	24.9%	20.1%	26.2%	6.5%
Yes, solar panels were installed together with a plug-in electric vehicle purchase	3.4%	4.0%	2.0%	3.8%	0.5%
No, but I am planning to install solar panels within the next year	14.8%	15.8%	12.5%	15.8%	8.6%
No, and I have no plans to install solar panels	28.5%	26.8%	32.8%	29.4%	23.5%
No, I am unable to install solar panels	24.4%	23.1%	27.5%	19.3%	56.7%

Similar comparisons were made between home charging access compared with solar panel access. The largest difference between the home charging and non-home charging group was that most non-home charging applicants are unable to install solar panels, 59.2%, compared to the 20.4% of home charging applicants who are also not able to install solar panels. This difference between the two charging groups may be partly explained by the residence type of non-home charging program participants who tend to have greater barriers from their homeowner’s associations. Another difference between the two charging groups is the fact that over a quarter of home charging accessible applicants already installed solar prior to purchasing a vehicle. For those with pre-existing solar, the transition from a non-PEV to a PEV may be a smoother next step especially due to the immediate fuel savings. On the other hand, those without solar may be less likely to transition from a non-PEV to a PEV.

#### 2.2.5 Home Charging Access by Household Size

More than half of CVRP survey applicants are members of 2–3 person households with the remaining percentages tapering off as household size increases or decreases (see Table 15). After disaggregating the



household membership between those with home charging access and those without home charging access, the 2–3-person household distribution remained relatively the same between the two charging groups. Although, there is a considerable difference within single-member households separated by home charging access. More specifically, 19.8% of those who don’t charge at home are single-member households, while 8.7% percent of those with home charging access are single-member households. It is plausible that single-family households are more commonly renters who reside in apartments/condominiums that tend to face greater barriers to having home charging access.

After isolating the results between PHEV and BEV drivers, there were a few differences between the two. For example, when comparing respondents with BEVs and home charging access to PHEV owners with home charging access, the differences in household size were all within 2 percentage points of each other. Of home charging BEV owners, 39.5% live in two-person households while 37.9% of PHEV owners who charge at home also live in two-person households.

Table 15: CVRP survey respondents number of household members.

Members of Household	All Participants (n=31,856)	Home Charging (n=27,529)	No Home Charging (n=4,327)	Home Charging & BEV (n=19,333)	Home Charging & PHEV (n=8,196)	No Home Charging & BEV (n=3,103)	No Home Charging & PHEV (n=1,224)
1	10.2%	8.7%	19.8%	8.4%	9.3%	19.6%	20.2%
2	38.8%	39.0%	37.6%	39.5%	37.9%	37.1%	38.7%
3	19.8%	20.0%	18.4%	20.1%	19.6%	18.7%	17.9%
4	21.3%	22.0%	16.9%	21.9%	22.0%	17.5%	15.3%
5	6.7%	7.1%	4.5%	7.0%	7.1%	4.3%	5.1%
6	2.3%	2.3%	1.8%	2.2%	2.3%	1.8%	1.6%
7	0.5%	0.6%	0.5%	0.5%	0.6%	0.4%	0.7%
8	0.2%	0.2%	0.3%	0.2%	0.3%	0.3%	0.2%
9 or more	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%

## 2.2.6 Home Charging Access by Low-income Community Classification

In addition to analysing survey respondent income, we also focused on the differences between home charging access between those who live inside and outside of LICs (see Table 16). LICs are census tracts that are at or below the 80 percent state-wide median income. The minority of total survey respondents live within low-income communities (20.1%), but when filtering the survey respondents to those without home charging access the percentage of those residing in LICs increased to 28.5%.

After further disaggregating the results between PHEV and BEV owners, we found that 33.6% of PHEV drivers with no home charging reside in LICs while 26.5% of BEV drivers without home charging live in LICs. When looking at those with home charging and splitting by technology type there is less of a gap between BEV owners (17.7%) and PHEV owners (21.5%) who reside in LICs. It follows that those without home charging more frequently reside in LICs compared to those with home charging, which may be influenced by the financial differences among the two groups.

Table 16: CVRP survey respondents by LIC classification.

LIC vs. Non-LIC	All (n=32,292)	Home Charging (n=27,914)	No Home Charging (n=4,378)	Home Charging & BEV (n=19,600)	Home Charging & PHEV (n=8,314)	No Home Charging & BEV (n=3,137)	No Home Charging & PHEV (n=1,241)
Non LIC	79.9%	81.2%	71.5%	82.3%	78.5%	73.5%	66.4%
LIC	20.1%	18.8%	28.5%	17.7%	21.5%	26.5%	33.6%

### 2.2.7 Home Charging Access by Disadvantaged Community Classification

In addition to LICs, applicants were also segmented by whether they lived within or outside a DAC (see Table 17).<sup>1</sup> DACs are regions that suffer from economic, health, and environmental burdens. Like LICs, the minority of participants live inside of DACs (8.3%), and when filtering for survey respondents who do not charge at home the percentage increases to 11.6%. While the percentage difference between home charging access within DACs is smaller than the home charging access gap between LICs, it is still worth noting the differences among the two groups.

Most home-charging participants who drive BEVs (92.6%) and PHEVs (91.1%) do not live in DACs. Likewise, 90.2% of home-charging BEV owners and 84.1% of home-charging PHEV owners (84.1%) do not live in a DAC. Aligning with LICs, there are higher percentages of non-home charging applicants who reside in DACs compared to those with home charging which highlights the differences among participant resident location and regional hurdles to home charging.

Table 17: CVRP survey respondents by DAC classification.

DAC vs. Non-DAC	All (n=32,292)	Home Charging (n=27,914)	No Home Charging (n=4,378)	Home Charging & BEV (n=19,600)	Home Charging & PHEV (n=8,314)	No Home Charging & BEV (n=3,137)	No Home Charging & PHEV (n=1,241)
Non-DAC	91.7%	92.2%	88.4%	92.6%	91.1%	90.2%	84.1%
DAC	8.3%	7.8%	11.6%	7.4%	8.9%	9.8%	15.9%

### 2.2.8 Home Charging Access by Greatest Concern about Driving a PEV

We also analysed the greatest concern that owners had when shopping for their PEV (see Table 18). Of the eleven possible options, the most frequent concern for all applicants was the price of the vehicle being too expensive (33.6%) while the second most frequent response was the range of the vehicle on a single charge is too limited (27.4%). When focusing on vehicle type, those who drive BEVs and have access to home charging came in at 36.7 percent selecting price as their top concern while the top answer among those who drive PHEVs came in at 29.2 percent and selected range. For those who had no access to home charging, 35.1% of BEV drivers selected range as their top concern while PHEV drivers selected “Price too expensive” most frequently at 27.0%.

Further focusing on the differences between those with and without home charging access, 23.1% of non-home chargers had selected range as a top concern while 28.1% of those with home charging access selected range. It’s plausible that those who feel comfortable with the range of their vehicle are less likely to install a home charger while those with range anxiety will take the extra effort to install home charging to alleviate that worry. Similarly, applicants could also select that “charging at home is too difficult and installing charging equipment is too expensive”. While only 3.7% of total respondents selected this option, 10.0% of those without home charging and 2.7% of those with home charging selected this option. The few applicants who had prior home-charging concerns are a reminder that installation may be intimidating at first, but there may be enough resources such as rebates, an increased amount of charging installations in the process of being built, and access to workplace charging to surpass those initial concerns and reduce home-charging barriers.

Table 18: CVRP survey respondents greatest concern about driving a PEV characteristics.

Greatest Concern About Driving a PEV	All Participants (n=31,666)	Home Charging (n=27,327)	No Home Charging (n=4,338)	Home Charging & BEV (n=19,159)	Home Charging & PHEV (n=8,169)	No Home Charging & BEV (n=3,109)	No Home Charging & PHEV (n=1,229)
Price too expensive	33.6%	33.7%	32.8%	36.7%	26.6%	35.1%	27.0%
Range	27.4%	28.1%	23.1%	27.6%	29.2%	23.1%	23.2%

<sup>1</sup> Disadvantage communities defined by SB 535 <https://oehha.ca.gov/calenviroscreen/sb535>

Charging away from home	9.0%	8.9%	9.2%	8.2%	10.6%	8.6%	10.7%
Battery life	6.7%	6.8%	6.0%	6.3%	7.8%	5.3%	7.8%
Time for recharging	5.1%	4.9%	6.5%	4.9%	4.9%	6.6%	6.2%
Technology too new	4.5%	4.7%	3.7%	4.4%	5.3%	3.7%	3.4%
Home charging too difficult	3.7%	2.7%	10.0%	2.5%	3.1%	9.4%	11.3%
Limited models	3.4%	3.5%	2.8%	3.0%	4.6%	2.4%	4.0%
Electricity cost	3.2%	3.3%	2.8%	2.8%	4.4%	2.7%	3.1%
Other	2.6%	2.7%	2.2%	2.7%	2.7%	2.2%	2.1%
Vehicle safety	0.8%	0.8%	0.9%	0.8%	0.8%	0.8%	1.2%

### 3 Conclusion

In summary, there have been multiple factors that directly affect home charging accessibility. Those factors fall into various themes such as applicant demographics, household characteristics, and regional location of the applicant. When isolating the survey responses between PHEV and BEV owners, consistent charging preferences begin to emerge between the two groups. BEV owners are more reliant on quicker charging and have a greater demand for installing Level 2 or 240V chargers, while PHEV owners are more frequently able to rely solely on a 120V outlet. While for those who can't charge at home, the most frequent response between the two groups as to why they can't charge was that they rent, or their HOA has restrictions.

When focusing on those with and without home charging access, the responses to household characteristic-themed questions have notable differences. The majority of those without home charging access continue to reside in apartments or condominiums and tend to lack solar while the home charging participants predominantly live in detached houses with higher percentages of pre-installed solar. Further, those with home charging tend to own their homes while applicants who can't charge at home tend to be renters. These differences in homeownership are heavily influenced by financial status, which is also visible in other dynamics such as the LIC location status of participants. For example, those who can't charge at home are more frequently in low-income communities than those who can charge at home.

With all these differences in home charging access, future goals for a 100% PEV adoption must also consider the many pathways, and barriers, for each different vehicle consumer to purchase a PEV. The current market of vehicle purchase and charging infrastructure incentives has allowed various groups to participate in purchasing a PEV, but to increase participation in groups such as lower-income multi-unit dwellers, evaluation of barriers must be continually assessed.

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