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Vehicle Replacement: Findings from California's Clean Vehicle Rebate Project

Nicholas Pallonetti, Brett D.H. Williams

Center for Sustainable Energy, 3980 Sherman St Suite 170, San Diego CA 92110, USA
nicholas.pallonetti@energycenter.org, brett.williams@energycenter.org

Executive Summary

California offers cash rebates for the purchase or lease of new electric vehicles (EVs). With an aim to enrich thinking about program impacts and market dynamics, we examine 72,552 survey responses statistically weighted to characterize 376,800 rebated consumers from September 2012 through November 2020. Vehicle replacement metrics include the extent to which rebated vehicles enter household fleets as additions versus replacements, the characteristics of the vehicles they replaced, and what purchase decisions would alternatively have been made in absence of the rebate program. The data indicate that a large majority of rebated EVs replaced older, gasoline-fueled vehicles and that most consumers would have altered their purchase decision had the rebate program not been available. These results are broadly consistent over the period analyzed, yet significant changes over time and variation between consumer groups are identified. We discuss the emissions implications of these data and their relation to future research.

Keywords: electric vehicle (EV), emissions, incentive, policy, user behaviour.

1 Introduction

1.1 Background, Motivation, and Previous Related Work

Since March 2010, the California Air Resources Board's Clean Vehicle Rebate Project (CVRP) has issued post-purchase cash rebates for the purchase or lease of new electric vehicles (EVs) [1]. As public investment in EV deployment continues to grow, a deeper understanding of the emission and market impacts of that investment is needed. This work aims to enrich thinking about program impacts by providing a more recent examination of program data related to vehicle replacement.

To date, most assessments of EV emission impacts and subsidy cost-effectiveness have been based on calculation of greenhouse-gas reductions relative to characterizations of new gasoline-fueled vehicles. These assessments include those associated with the CVRP [2], [3] and EV adoption more broadly [4]–[6]. For example, Archsmith et al. [4] assess emissions benefits of EVs by comparing them to an internal combustion engine vehicle "with similar attributes", and Holland et al. [5] assess benefits by comparing "the closest substitute in terms of non-price attributes to each electric vehicle."

While these studies are helpful in developing an understanding of how EV emissions compare to conventional vehicles, an important but less-studied component of EV impact stems from what may have happened had a given EV *not* been acquired. In the context of CVRP, assessment of impacts relies on what would have alternatively occurred had the program not existed. This is the "counterfactual behavior" of program participants. In previous analyses, 21–23% of rebated consumers over time indicated that, had the rebate not been available, they would not have made any purchase/lease at all [7]. This response was among the most frequent and was more frequent than the behavior typically assumed (purchased or leased a new non-EV instead, 12–14%). In these cases, the household vehicles that rebated EVs replaced may be the best initial comparison point from which to assess EV emission impacts if those replaced vehicles would have continued to be used instead. Further, previous work [3], [6] has demonstrated that EV emission reduction estimates are highly sensitive to the fuel efficiency of the vehicle to which EVs are compared, indicating that this component warrants further investigation.

Literature aimed at improving the comparison point from which EV benefits are assessed in other contexts has begun to emerge. These studies involve estimating the "counterfactual vehicles" likely to have been acquired alternatively, as opposed to assuming everyone would have purchased a new gasoline vehicle instead. For example, Sheldon and Dua [8] and Xing et al. [9] predict what would have been purchased had EVs not been available and estimate resulting gasoline savings and emission reductions, respectively. Muehlegger and Rapson note that "environmental benefits of EVs must be measured relative to the (likely gasoline) car that would have been bought instead" and perform a quasi-experiment to estimate the fuel economy of vehicles that would have been purchased in absence of another EV subsidy program in California called the Enhanced Fleet Modernization Program [10]. A related topic of emerging research includes literature focused on EV discontinuance [11]—when EV adopters replace their EV with a conventional vehicle.

1.2 Contribution and Overview

This work aims to enrich thinking about program impacts, program cost-effectiveness, and market dynamics by providing a more recent examination of program data related to vehicle replacement. Specifically, we explore the extent to which CVRP-rebated vehicles enter household fleets as additions versus replacements, the characteristics of the vehicles they replaced (which may have continued to be used if a new vehicle hadn't been acquired), and what purchase decisions would alternatively have been made had CVRP rebates not been available. Focusing on CVRP Consumer Survey data characterizing calendar year (CY) 2020 purchases/leases, it updates and advances precursor work analyzing vehicle replacement through 2018 [7] and 2019 [12].

This work supplements the growing body of literature aimed at improving the comparison point from which EV benefits are assessed. This effort contrasts to the recent related works described above (that have created models to predict what consumers would purchase in counterfactual no-EV or no-subsidy scenarios) in two main ways: 1) by bringing to bear self-reported evidence from the CVRP Consumer Survey that directly asks participants about their real-world vehicle replacements and expected counterfactual behavior in absence of the CVRP rebate and 2) by focusing on counterfactual behaviors, this work includes analysis of non-acquisition options often excluded in prior analyses. We discuss how the counterfactual data can inform refinement of the emissions comparison point in future research and what replaced-vehicle data might mean for the share of participants who would not have made any purchase/lease at all had the rebate not been available.

In addition to the emission implications, the real-world vehicle replacement data provide broad insights into the evolving EV market. As such, this work begins by examining changes over time in the rates at which rebated EVs are replacing other household vehicles and the characteristics of vehicles replaced. Vehicle replacement rates speak to the role EVs play in a household fleet: as EV technology matures, so too does the perception of them and their usage, which bear out in these data. Similarly, the fuel types and age of vehicles consumers are replacing when they acquire a new EV provide insight into what types of consumers the rebated EV market is serving as it expands from early-adopters into the mainstream. Further, by evaluating how these metrics vary between consumers of two rebated EV technology types and between recipients of two rebate types (one Standard and one Increased available to lower-income participants), we aim to enhance understanding of EV market participants.

The remainder of the paper is organized as follows. Section 2 introduces the CVRP Consumer Survey, characterizes the survey population and respondents, describes survey and project representativeness—including the response weights used to ensure the sample accurately represents all CVRP participants, and describes the methods used to summarize and analyze the data. Section 3 reports and discusses the results and their relevance to future works. Section 4 presents summarizing thoughts and next steps.

2 Data and Methods

The California Air Resources Board's Clean Vehicle Rebate Project (CVRP) provides rebates to California consumers for the purchase or lease of light-duty EVs. CVRP has administered voluntary surveys of participants since 2012 to better understand EV consumers, the evolving EV market, and program impacts. This investigation examines 72,552 responses to the CVRP Consumer Survey, collected over four survey editions. It includes consumers of plug-in hybrid electric vehicles (PHEVs) and battery electric vehicle (BEVs). As of March 29, 2016, CVRP included an additional increased rebate level for low-/moderate-income consumers [13]. These will be referred to as Increased Rebates, as compared to Standard Rebates. Survey administration details, representativeness and statistical weighting, and methods are described below; additional details are in documentation summarizing the responses to the first survey edition [14].

2.1 Survey Administration

The CVRP Consumer Survey was administered to individual program participants (i.e., excluding governmental, business, and nonprofit participants) who purchased or leased a PHEV or BEV from September 1, 2012 through November 30, 2020. CVRP participants generally received a survey invitation by email as part of their application approval notice. They also received an email reminder when they were notified their rebate check had been mailed. Important survey dates by edition are summarized in Table 1.

Table 1: CVRP Consumer Survey Dates by Edition

	2013–2015 Edition	2015–2016 Edition	2016–2017 Edition	2017–2020 Edition
Survey Administration Dates	10/25/2013–06/23/2015	06/17/2015–07/31/2016	07/19/2016–08/31/2017	08/01/2017–03/26/2021
Vehicle Purchase/Lease Dates of Survey Sample	09/01/2012–05/31/2015	04/01/2015–05/31/2016	05/01/2016–05/31/2017	06/01/2017–11/30/2020

2.2 Survey Representativeness and Statistical Weighting

As previously described in [14], the Consumer Survey is voluntary and not everyone chose to complete it. As such, responses may not be representative of the entire 376,800 CVRP participant population during this period. The program population, survey sample size, and response rate associated with each survey edition are provided in Table 2, and further detail is available in precursor work [15]. Responses were weighted to make the survey data more representative of all rebate recipients within each survey edition period using the raking method (iterative proportional fitting) along the dimensions of vehicle category, vehicle model, purchase vs. lease, and county of residence.[1] These weights were used to calculate the descriptive statistics in this report, though they have tended to impact results only modestly (e.g., by a few percentage points or less) compared to using unweighted data.

While *CVRP participants* have comprised large percentages of the California EV market during much of the analyzed period, it should not be assumed that they fully represent all *EV consumers* in the state. Over the course of the first five years of the project, a large majority of electric vehicle purchases/leases were eligible for CVRP rebates and more than three-quarters of eligible purchases and leases in the state received rebates [16]. Following the implementation of income-based consumer eligibility requirements in 2016, program

[1] Vehicle category was included as a weighting dimension starting in the 2015–2016 Edition. Weighting for the 2017–20 Edition also included year of purchase/lease. The 2020 subset was also independently weighted, producing only minor differences compared to full Edition weighting.

participation dropped to slightly more than half of eligible vehicles [17]. In 2020, the program is estimated to have rebated approximately one-third of the market when compared to the light-duty EV registration total for the state [18].

While the results of this work may be useful for informing the assessment of other EV deployments and providing broader insights into the EV market, CVRP participants may not be a representative sample for these other use cases. Lack of insight into non-participant characteristics and behavior may limit the ability to appropriately extrapolate results outside the context of the program. Further, program eligibility requirements cause the CVRP population to systematically differ from the general EV-buying population, and changes in program eligibility over time (discussed further in Section 3.4) may affect results.

Table 2: CVRP Consumer Survey Sample Size and Representativeness by Edition

	2013–2015 Edition	2015–2016 Edition	2016–2017 Edition	2017–2020 Edition
Project Participant Population*	$N = 91{,}100$	$N = 45{,}700$	$N = 46{,}800$	$N = 193{,}200$
Responses in Survey Dataset	$n = 19{,}460$	$n = 11{,}611$	$n = 8{,}957$	$n = 32{,}524$
Response Rate	21%	25%	19%	17%

*Values rounded to the nearest 100

2.3 Methods

Survey statistics (e.g., response frequencies and proportions) are weighted in order to be more representative of the project participant population during each survey edition's administration period. Due to rounding, summing the weighted proportions may not add to 100%.

In some instances, categorical data are analyzed using two-sample chi-square tests to understand the similarities and differences between groups of interest. Differences in weighted frequencies between vehicle technology types or survey editions (over time) that have been identified as statistically significant will have been determined at the 95% level ($p < 0.05$)

3 Results & Discussion

3.1 Vehicle Replacement Rates

In each edition of the survey, most CVRP-rebated EVs were found to replace another household vehicle rather than serve as an addition to the household fleet. Survey responses indicate that 86% of rebated EVs purchased/leased in 2020 replaced an older, typically more polluting vehicle. This continues a trend of growth in vehicle replacement rates that started at 65% in the 2013–15 Edition of the survey (Figure 1).

Vehicle replacement rates speak to the role EVs play in a household fleet. As EV technology has improved and matured over time, so too has the perception of them and their usage. The lowest rates of vehicle replacement were during the early era of demand by early-adopting enthusiasts and less-capable EVs that were therefore less likely to be perceived as suitable to fully substitute for another vehicle. Similarly, early EVs were found to be driven fewer miles [19]. This is also consistent with other indicators that EVs continue to make inroads into more mainstream consumer markets with less flexibility to simply add desired technologies to their household fleet [20].

PHEVs were found to achieve higher replacement rates earlier than BEVs (Figure 2). For example, PHEVs replaced vehicles 84% of the time during the era of the 2015–2016 survey, whereas it took BEVs until 2018 to reach that level. This may be expected, as the total range capability of PHEVs, and therefore consumer confidence in them, has generally been closer to that of conventional vehicles. Early BEVs with shorter ranges were more subject to range anxiety. We see the gap between the two technologies effectively closed in 2018, following on the heels of the breakout of the longer-ranged Chevrolet Bolt and Tesla Models 3 & Y to a wider consumer base.

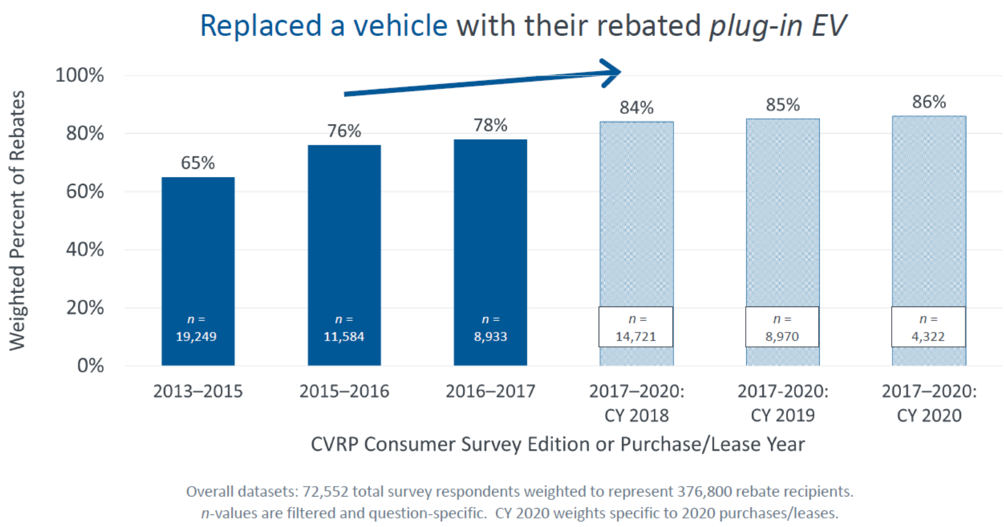

Figure 1: Vehicle Replacement Rate Over Time [2]

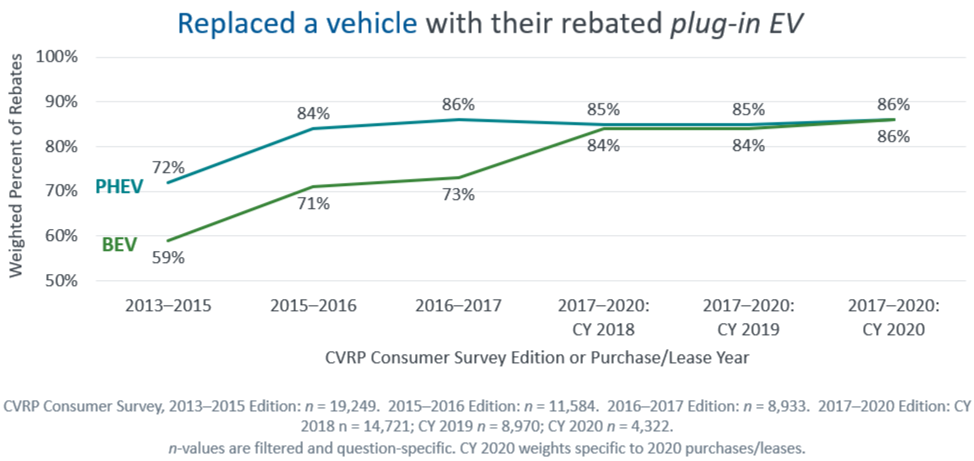

Figure 2: Vehicle Replacement Rate Over Time by Rebated Technology Type

3.2 Replaced Vehicle Details

Another set of survey questions ask the respondents who replaced a previous household vehicle with their rebated EV to describe the model year and technology/fuel type of the vehicle that was replaced.

One-half of vehicles replaced by rebated EVs purchased/leased in 2020 were model year (MY) 2014 or older (Figure 3). Counting back from 2020, that is roughly six or more years old. Over one-quarter of replaced vehicles were older than MY 2009, or greater than eleven years old. This oldest age bucket (>11 years) has steadily composed a 25–30% share of the vehicles replaced over time [7], indicating a consistent contribution to the replacement of the oldest and most polluting vehicles. The next stage for these replaced vehicles is unknown—they may be resold or retired. However, the reasonably high replacement rate of these high-polluters presents a natural opportunity to increase impact by encouraging replaced-vehicle scrapping with related programs.

[2] All figures adapted from precursor work [15], [21].

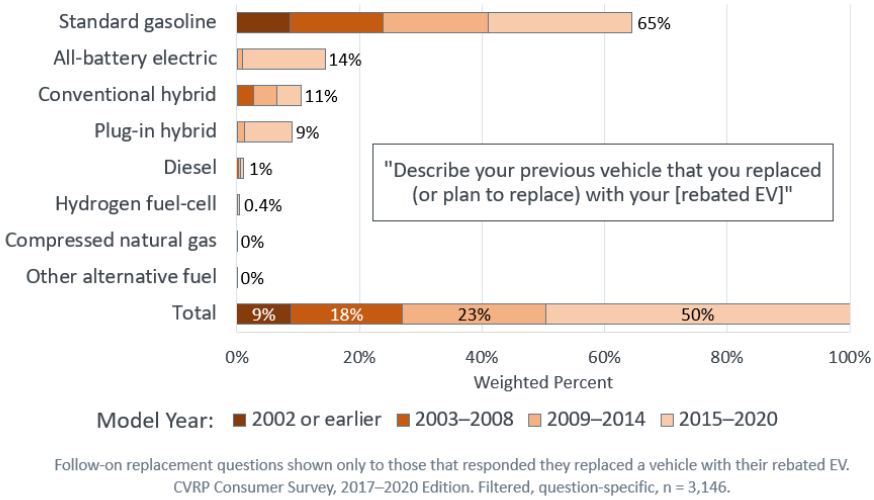

Figure 3: Replaced-Vehicle Model Year and Technology Type, 2020 purchases/leases [3]

Though the average age was much older, three-year old replacements were by far the most common (Figure 4). These vehicles were likely replaced after coming off lease. Furthermore, the spike in three-year-old vehicle replacements is driven by consumers replacing a previously-owned *EV*, and might represent the large source of EVs entering the used vehicle market generated by so-called repeat buyers [22]. (Note that replaced EVs include BEVs, PHEVs, and fuel-cell EVs.)

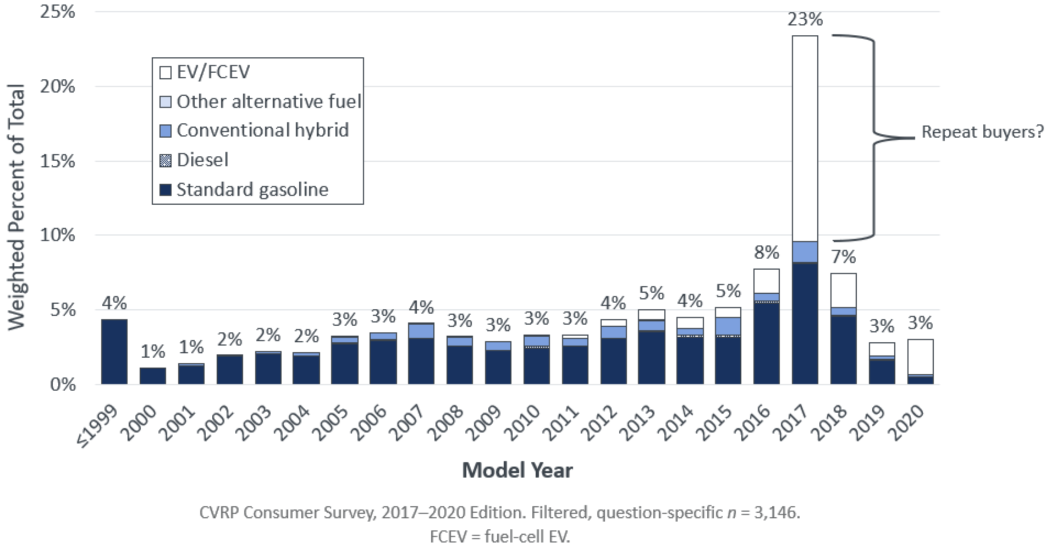

Figure 4: Model-Year Distribution of Vehicles Replaced by 2020 purchases/leases

The large majority of consumers got rid of a gasoline vehicle when they acquired their rebated EV, as three-quarters of vehicles replaced by calendar-year 2020 EVs were gasoline fueled. Of those gasoline-fueled vehicles, 10% were conventional hybrid and 65% were standard (non-hybrid) gasoline vehicles. Those repeat EV buyers replacing their old EV with a new one composed 24% of all replaced vehicles in 2020 (Figure 5). Thus we see a fair share of rebated EV consumers contributing to the used EV market, expanding EV access to the majority of consumers who do not tend to purchase new cars.

[3] Excludes vehicles for which model year was not reported, therefore results may differ slightly from those reported elsewhere.

The primary dynamic in replaced vehicle fuel types over time can be described as an initial decrease in the replacement of fossil-fuel-only vehicles as replacement of previously owned EVs increased over time up until the 2016–17 survey era (Figure 5). Early years saw the fossil-fuel-replacement percentage decline from a high of over 90% to a low of 74% as EVs replaced increasing numbers of other EVs. Interestingly, fossil-fuel replacement did then start to bounce back in calendar-year 2018 and has since remained 76% or above.

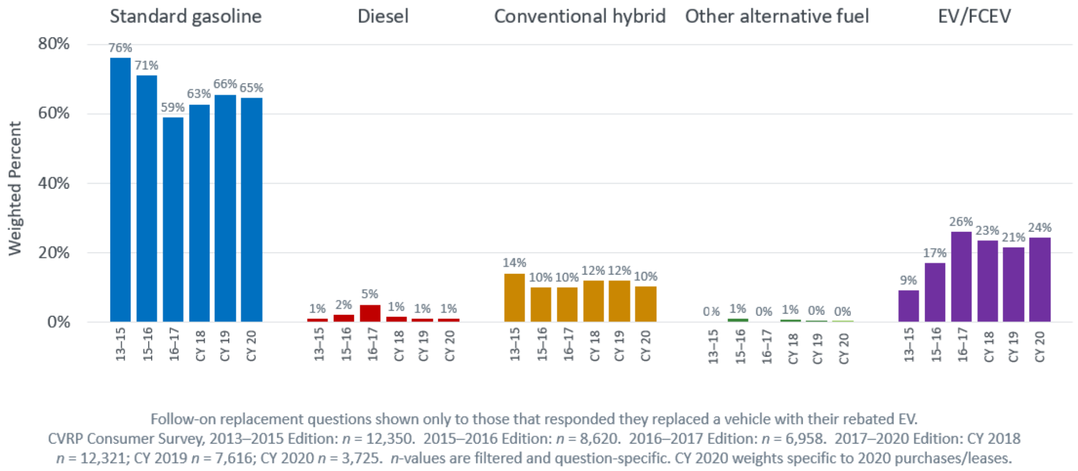

Figure 5: Replaced-Vehicle Technology Types Over Time

Important and statistically significant ($p < 0.05$) differences are present between the types of vehicles replaced by PHEVs versus BEVs (Figure 6), indicative of the different consumer bases these different EV types are serving. Among those that replaced a vehicle in 2020, rebated BEVs more frequently replaced standard gasoline vehicles (66%) and other BEVs (17%) than rebated PHEVs did (59% and 3%, respectively). Meanwhile, PHEVs replaced conventional hybrids (20%) and other PHEVs (17%) more frequently than BEVs did (8% and 7%, respectively). These findings vary notably when Tesla vehicles are examined separately. Tesla consumers were those most frequently replacing standard gasoline vehicles, consistent with prior findings for New York State [23]. They were also least frequently replacing previously owned EVs. These findings are perhaps indicative of differences in the consumers adopting Tesla products—potentially a less fuel- and/or eco-conscious consumer that is more likely to be a first-time EV buyer. Because Tesla composed the majority of the BEV cohort in 2020, they have an outsized influence on the BEV results. Indeed, PHEVs are found to replace standard gasoline vehicles at a higher rate than non-Tesla BEVs.

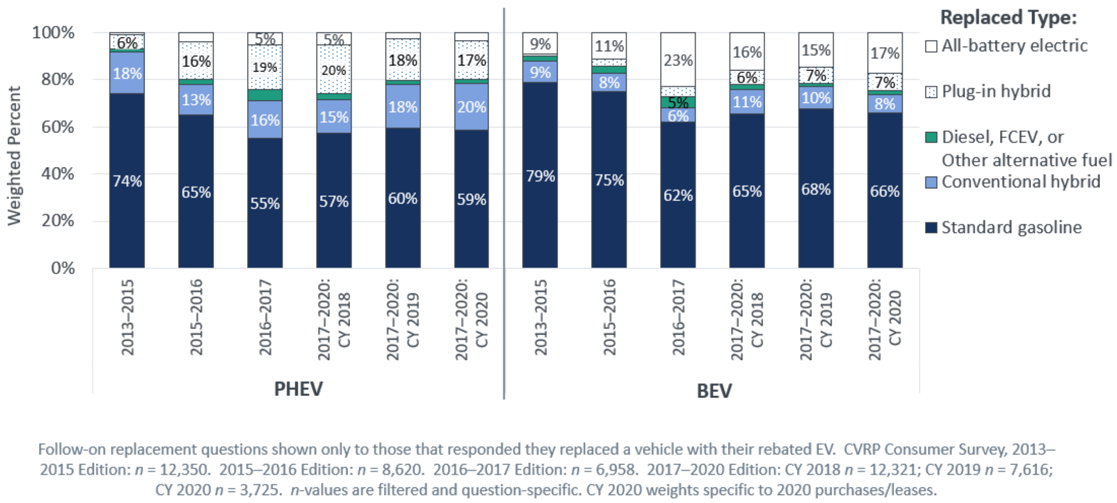

Figure 6: Replaced-Vehicle Technology Types Over Time by Rebated-Vehicle Type

Standard and Increased Rebate recipients in 2020 were found to replace vehicles and various vehicle technologies at similar rates. The largest difference between the two was in replacement of standard gasoline vehicles at rates of 64% and 66%, respectively. This may be influenced by who was participating in the market in 2020 during the onset of COVID-19, however, as Increased Rebate recipients replaced standard gasoline vehicles at an even higher rate (73%) in 2019. Vehicles replaced by Increased Rebate recipients did skew older in both years, however, with 17% of 2020 replacements in the “2002 or earlier” model year bucket, compared to 8% of Standard Rebates.

3.3 Alternative Purchase Decision Without CVRP

Respondents were asked what purchase decision they think they would have alternatively made if CVRP rebates had not been available. This helps identify the counterfactual behavior that may be the most appropriate comparison point for rebated EVs in the context of evaluating EV impacts attributable to the program. The overall distribution of responses from the 2017–2020 Edition are presented in Figure 7. These results have remained relatively consistent over time, though not asked in the first survey edition. Among the most common responses were the 33–37% who indicated that they would have purchased the exact same vehicle anyway, and the 19–23% who would not have made any purchase at all.

While program-wide results have been relatively stable, there have been changes over time within rebated vehicle types. In earlier eras, PHEV consumers reported that they would have purchased their exact EV anyway more frequently than BEV consumers. However in the 2017–2020 Edition, 37% of each reported that response (another instance of differences between PHEV and BEV consumers minimizing over time). While BEV consumers in the latest survey continued to respond that they would not have made any purchase at all more frequently, PHEV consumers reported that they would have purchased a non-EV in absence of CVRP rebate more frequently (by six percentage points and five percentage points, respectively, $p < 0.05$).

Significant differences ($p < 0.05$) are also found between participants that received a Standard Rebate versus an Increased Rebate. In the latest data, Increased Rebate recipients reported less frequently that they would have purchased the same exact vehicle in absence of the rebate (25% vs 38%), and more frequently that they would have not purchased a vehicle at all (24% vs 18%) or purchased a non-EV (20% vs 15%).

These results and their relevance to emissions impacts are discussed further below.

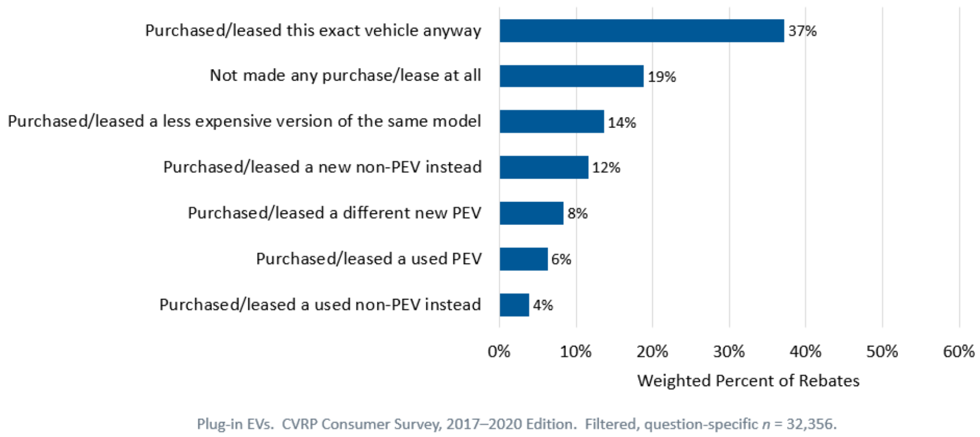

Figure 7: Alternative Purchase Decision Without CVRP, 2017–2020 Edition

3.4 Program and Market Context

It is important to note that program and market context shaped the behaviors described. Impactful program design features include CVRP’s income and MSRP caps and Standard and Increased rebate amounts [13]. Important market dynamics include the disruptive release of Tesla’s Models 3 & Y and the onset of COVID-19. EVs are considered to have fared relatively well during 2020, but some year-over-year changes in 2020 pose questions about who was able, and who was not yet able, to return to the car market in 2020.

3.5 Emissions Implications

The results reported above have particular relevance for quantifying the impact that CVRP has on greenhouse-gas and other emissions. As described in the Introduction, previous work [3], [6] has demonstrated that EV emission reduction estimates are highly sensitive to the fuel efficiency of the vehicle to which EVs are compared. However, most assessments of EV impacts and subsidy cost-effectiveness to date have compared EVs to a new gasoline vehicle, rather than a vehicle empirically estimated to have been used otherwise. In the latest CVRP survey data, respondents continued to report that they would have alternatively purchased a new conventional vehicle at a relatively low rate (12%). This indicates an opportunity to improve understanding of the emission impacts attributable to the CVRP by applying the context-specific data presented above.

Revisiting the responses to the counterfactual survey question described in Section 3.3 (that asks participants what they think they would have done if the CVRP rebate were not available), 37% reported they would have purchased/leased their same exact EV in absence of the CVRP rebate. Those participants (and perhaps also those who would have alternatively acquired “a less expensive version of the same model”) should be attributed no emissions savings when analyzing program impact. In contrast, the 19% who would have “not made any purchase/lease at all” should have their emission reductions assessed compared to their previous/alternative means of transportation (e.g., the typically older gasoline-fueled vehicle their EV replaced, Figures 3 and 4). Case-specific emissions impact assessment could include the remaining, less frequently selected options as well (various different EVs or used cars).

This information is more useful still to help understand what subgroups have the most emissions impact attributable to the program. To illustrate, we’ll focus on the two most frequently selected responses in the 2017–2020 survey data: “Purchased/leased this exact vehicle anyway” and “Not made any purchase/lease at all.” Figure 8 displays frequencies of those two responses across six subgroups of interest: PHEV, non-Tesla BEV, and Tesla BEV, each split by Standard Rebate and Increased Rebate.

While 37% of respondents think they would have purchased the same exact EV in absence of the rebate, this varies from as low as 18% of non-Tesla BEV Increased Rebate recipients to as high as 42% of Tesla Standard Rebate recipients. This result has significant implications for emissions impacts when interpreting this group of respondents as those from whom no emission savings should be attributed to the program. This indicates that over twice as many participants within the cohort who received a Standard Rebate for a Tesla should be attributed no emissions savings as compared to participants who received an Increased Rebate for a non-Tesla BEV.

While 19% of respondents think they would not have purchased any vehicle at all in absence of the rebate, this varies from as low as 14% of PHEV Standard Rebate recipients to as high as 30% of non-Tesla BEV Increased Rebate recipients. Again, these are the consumers for whom emissions impact should be assessed compared to their previous/alternative means of transportation—at least for whatever length of time they would have kept traveling via their previous mode of transportation holds. To the extent that the means of travel those EVs are replacing was less-efficient than a new gasoline vehicle, the emission reductions that should be attributed to these consumers will be even more than the behavior typically assumed. To the extent that the mode of travel can be characterized by the replaced vehicles, the replaced vehicle data can be used directly as the counterfactual.

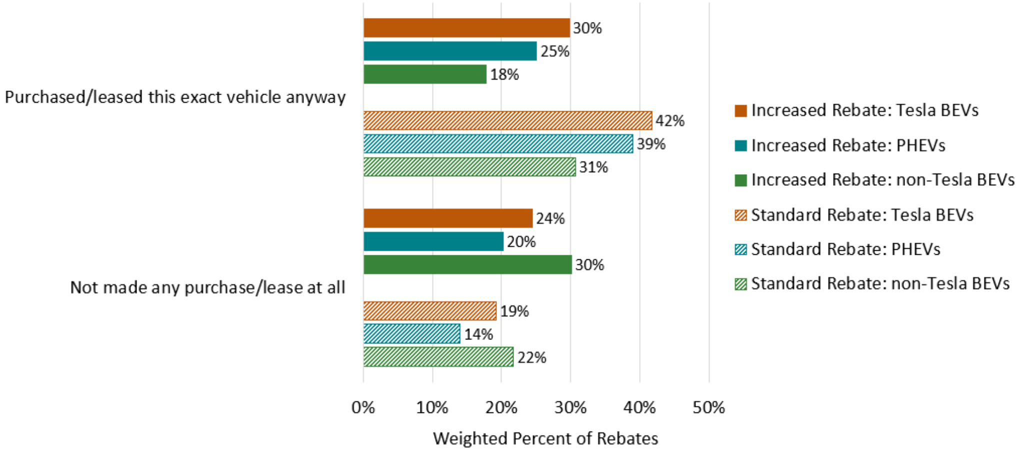

Figure 8: Top Alternative Purchase Decisions Without CVRP by Vehicle and Rebate Type, 2017–2020 Edition

4 Summary and Conclusions

This work aims to enrich thinking about program impacts, program cost-effectiveness, and market dynamics. By examining how replacement rates and the characteristics of vehicles replaced by rebated EVs have changed over time, we provide broad insights into the evolving EV market. By examining how these metrics vary across vehicle and rebate types, we enhance understanding of EV market participants. Tying these findings together with counterfactual behaviors, we identify opportunities to further refine emission reduction estimates by improving the comparison point from which to assess subsidized EVs.

Results show that rebated EVs have replaced a previous household vehicle at high rates. Replacement rates have increased over time from 65% of CVRP participants to 86%, signifying a shift in EV perception and usage as the technology became more capable and made inroads into more mainstream consumer markets. PHEVs achieved higher replacement rates earlier on, though BEVs reached parity in 2018 when longer ranged options became more widely available.

Of the vehicles that rebated EVs replaced, most were older and gasoline fueled. This characterized roughly three-quarters of replacements in 2020. Over time, there has been steady replacement of over eleven-year-old gasoline vehicles (25–30%), presenting a natural opportunity to reduce emissions even further by encouraging replaced-vehicle scrapping. Rebated EVs did start replacing other EVs more frequently over time through 2017, but this trend reversed somewhat starting in 2018. In 2020, about one-quarter of replaced vehicles were previously-owned EVs. The EVs being replaced were most often about three-years old, likely coming off lease. This repeat-buying among EV consumers accelerates the EV market further by generating opportunities for used car buyers to participate [22].

Results show differences between PHEV and BEV consumers indicating that these vehicles are serving different consumer bases. For instance, rebated BEVs more frequently replaced standard gasoline vehicles and other BEVs, while PHEVs replaced conventional hybrids and other PHEVs. Further, Tesla consumers, who composed the majority of the BEV cohort in 2020, were found to differ significantly from consumers of PHEVs and other BEVs. Compared to those groups, Tesla consumers were found to replace standard gasoline vehicles most frequently and replace other EVs least frequently. This is perhaps indicative of a less fuel- and/or eco-conscious consumer base that is more likely to be a first-time EV buyer (similar to findings in New York [23]).

We see similarities and differences between Standard and Increased Rebate recipients in 2020. The two replaced vehicles at similar rates, and replaced various technology types at similar rates, but Increased Rebate recipients tended to replace older vehicles than Standard Rebate recipients did.

The combination of vehicle replacement findings and counterfactual behaviors have important emissions and cost-effectiveness implications. The self-reported data on the alternative behaviors that participants think they would have proceeded with in absence of CVRP differ from the behavior typically assumed: that EV consumers would have purchased a new conventional vehicle instead. Only 12% reported this scenario in recent data, indicating that emissions estimation can be refined using case-specific data to inform the comparison point. Among the most common responses was the 19% who would not have made any purchase at all, for which the older, most commonly gasoline, replaced vehicles may be the best initial comparison point

This information is more useful still to help understand what subgroups have the most and least emissions impact attributable to the program. Various consumer cohorts exhibit different counterfactual and vehicle replacement characteristics. For example, over twice as many participants within the cohort who received a Standard Rebate for a Tesla would have purchased the same exact EV in absence of the rebate (and should therefore be attributed no emissions savings) as compared to participants who received an Increased Rebate for a non-Tesla BEV (42% vs. 18%, respectively). Meanwhile, the percentage of consumers that think they would not have purchased any vehicle at all in absence of the rebate varies from as low as 14% of PHEV Standard Rebate recipients to as high as 30% of non-Tesla BEV Increased Rebate recipients. Depending on the means of travel those EVs are offsetting, the emission reductions from these consumers could be more or less than the new gasoline vehicle alternative typically assumed. To the extent that the means of travel can be characterized by the replaced vehicles, the (typically older gasoline) replaced vehicle data can be used directly as the counterfactual.

Next steps include expanding the analysis of emissions implications of counterfactual and vehicle replacement data by incorporating these results into annual reporting of the cost-effectiveness of CVRP's GHG impacts, including usage of forthcoming survey data that identify more specifically how rebated EV mileage would have been travelled in absence of the CVRP rebate.

Acknowledgments

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Presenter Biography

Nicholas Pallonetti is a Research Analyst on the Transparency & Insights team at the Center for Sustainable Energy. His research focuses on clean transportation markets and programs. He conducts program evaluation with an emphasis on impacts assessment and energy/emissions modeling. Nicholas holds a B.A. in Economics from San Diego State University.