Lessons Learned About Electric Vehicle Consumers Who Rated the U.S. Federal Tax Credit "Extremely Important" in Enabling Their Purchase

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Summary

The U.S. federal tax credit (FTC) for electric vehicles (EVs) was phased out for GM and Tesla vehicles in 2019. To better understand the role the FTC played and inform incentive design, we do logistic regression using data from 6,391 recipients of California's EV rebate. We identify demographic, motivational, and other characteristics associated with consumers rating the FTC "Extremely Important" to making their EV purchase possible. A growing majority of consumers were found to be "*FTC Extremes*." Odds-increasing factors included younger age, non-white race/ethnicity, and importance given to fuel-cost savings, carpool-lane access, and charging availability. Notably *not* significant were income, residential solar, and the importance of environmental impacts. Evidence is discussed for recommendations including eliminating the need for sufficient tax liability to fully benefit, limiting eligible vehicle price, and moving incentives closer to the point of sale. Additional findings and recommendations are provided to inform incentive outreach and optimization.

Keywords: incentive, market development, marketing, policy, promotion

1   Introduction

1.1   Problem

The U.S. federal tax credit (FTC) for plug-in electric vehicles (EVs) provides up to $7,500 to reduce the costs of acquisition [1]—a potentially powerful enabler. A phase-down process is triggered once an automaker sells 200,000 EVs, initially leading to the halving of the FTC, followed by a subsequent halving, and ultimately to the elimination of the credit for all vehicles that automaker sells [1]. FTC phase out began January 2019 for Tesla consumers and April 2019 for GM consumers. Assessment of who the FTC has most influenced can calibrate impact assessments and inform discussions about optimal policies moving forward.

1.2 Literature Characterizing Recipients of the EV Federal Tax Credit

In contrast to prior research characterizing *recipients* of the FTC [2,3], this work adds to the modest body of research characterizing not only those who received the FTC, but who were *most highly influenced* by it to buy an EV [4,5]. The former category (recipients) helps answer the question "Who has benefitted from the FTC?", whether they needed it or not. The latter category (highly influenced) helps focus attention away from program "free riders" and towards a better understanding of the intended targets of public support aimed to shift behavior and create "true additions" to the EV market. Past examples of research in the latter category of characterizing FTC importance include those published by Tal and Nicholas in 2016 and by Jenn, Lee, Hardman, and Tal in 2019 [4,5]. Tal and Nicholas (2016) analyzed a survey of 2,882 consumers in 11 states and Washington D.C. who purchased their EV between 2011 and 2014. The states were diverse, but no West Coast consumers were included due to unavailability of contact information. Further, 56% of their sample purchased an EV in 2013. Of EV owners analyzed, 98% reported living in detached homes (including duplexes or similar houses). Battery electric vehicle (BEV) owners analyzed included those that purchased either the Tesla Model S (with an average annual income of $376,000, much higher than the other EV owners) or the Nissan LEAF. They attribute 49% of the Nissan LEAF purchases examined to the FTC, compared to < 15% for the Tesla Model S, but did not find the FTC's impact directly correlated with income.

Jenn et al. (2019) analyzed a post-purchase survey of over 14,000 CVRP rebate recipients who bought or leased their EV in California between 2010 and 2017. They used latent-class analysis to produce clusters based upon respondent ratings of the importance of a variety of incentives. They characterize the cluster with the highest importance rating for the federal tax credit as relatively lower income, homeowning males that purchased non-Tesla EVs relatively recently. They also used multinomial logistic regression to associate characteristics with stated alternative behaviors had the FTC not existed. When compared to consumers that would have bought the same EV or another EV in absence of the FTC, consumers who claimed they would have instead acquired a non-EV or not bought/leased a vehicle at all tended to have lower incomes. Additionally, PHEV consumers were more likely to purchase a non-EV in absence of the FTC than BEV consumers, but it is unclear how much that finding might relate to the influence of the high income of Tesla consumers. The pattern of other findings of direct relevance to this work were more complex or difficult to generalize across the groups.

In addition to those studies, previous related analysis by the authors of the research described herein includes a 2017 report that summarized the responses to the CVRP Consumer Survey, 2013–15 Edition—which includes ratings of FTC importance [6]. Additionally, a 2019 presentation expands that perspective somewhat with slides summarizing more recent data from California and from three other state-wide EV programs (Massachusetts, Connecticut, and New York) [7]. The more recent data used in that presentation highlighted an important trend in FTC importance over time. Figure 1 provides the percentage of program participants who rated the FTC as "Extremely Important" in response to the survey question, "How important were each of the following factors in <u>making it possible</u> for you to acquire your clean vehicle? [Federal tax incentives]."
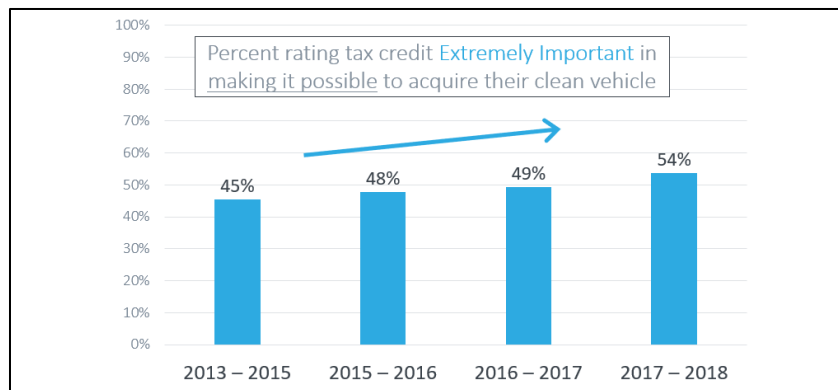

Figure 1: The Increasing Importance of the Federal Tax Credit to CVRP Participants (from [7])

The percentage of these participants—termed "*FTC Extreme*" consumers or *FTC Extremes*—has increased over time. This is notably in contrast to the "phase-down" paradigm embodied in the FTC program design. Similar trends were observed in 2016 and subsequent analysis of the those most highly influenced by California's state EV rebate, or "*Rebate Essentials*" [8–10]. Taken with trends in program demographics, data indicate that it may have been premature to phase down incentives when increasingly mainstream consumers find them more important than ever before, further motivating this investigation.

Finally, and of most direct relevance, is a precursor juried conference paper [11] (not presented due to the COVID pandemic) that examined plug-in hybrid EV (PHEV) *FTC Extremes*. Results of that work are compared to those for BEV consumers, presented herein.

1.3   Contributions of This Work

In summary, this research built on a precursor examination of PHEV consumers that identified characteristics associated with rating the FTC "Extremely Important" to making PHEV acquisition possible [11]. It examined BEV consumers—analysing consumers of Tesla BEVs ($n=7,061$) and non-Tesla BEVs ($n=1,997$) separately. Compared to previous tax-credit research, it not only characterizes *recipients* of the FTC (e.g., [2,3]), it adds to a more modest body of research examining those most highly *influenced* by it [4,5]. Additionally, it uses relatively more recent (but pre-phase-down) data—gathered from rebated consumers in California who purchased a BEV from November 2016 through December 2018 ($N=43,368$ rebates, $n=9,058$ survey responses).

Factors examined using descriptive statistics and logistic regression include: demographic, household, and regional characteristics; motivations; and vehicle-transaction details. Significant and nonsignificant factors are discussed. Significant factors are rank-ordered for prioritization using dominance analysis. Recommendations are provided to inform FTC assessment and incentive design. Finally, caveats and next steps are described.

2   Data and Representativeness

The analysis primarily utilized CVRP program data, described next. National Household Travel Survey data [12] were also used to provide context and baseline metrics. The program data analysed included application and survey data. Application data provided the basic characteristics of 66,263 rebated EVs purchased or leased from November 2016 (the date of major program changes) through the end of 2018 (just prior to FTC phase-down for Tesla EVs) and that had been approved for a rebate as of 5 April 2019. Data from the program's Consumer Survey—which all rebate recipients are invited to take upon approval of their application— included a total of 13,876 survey responses from those 66,263 rebated adopters. Consumers of PHEVs ($n=4,818$), Tesla BEVs ($n=7,061$) and non-Tesla BEVs ($n=1,997$) were analysed separately. A modest number of BMW i3 REx vehicles are counted among the non-Tesla BEVs because CVRP treats them similarly to BEVs rather than as PHEVs.

Weights were generated using iterative proportional fitting (raking) to make the survey responses more precisely represent the program population. Similar weights are regularly used elsewhere [6,13–15] and typically change results only modestly (e.g., response-frequency percentages typically only change by 0–2 percentage points). For purposes of understanding the past and future impacts of the FTC on CVRP, program participants are the population of direct interest. For those with broader market interests, CVRP is not necessarily representative. However, CVRP-rebated vehicles constituted about half of California EV sales [16]. The top rebates by model were for the Tesla Model 3 (41%), Toyota Prius Prime (16%), Tesla Model S (8%), and the Chevrolet Bolt (6%). Of the rebates studied, 65% were for BEVs. Further details about application and survey data can be found online in program dashboards and reporting [15,17].

3 Methodology

Consumers of PHEVs, Tesla BEVs, and non-Tesla BEVs were examined separately to account for their unique qualities, as further described in an analysis of *Rebate Essential* consumers in New York State [18].

Grouping/Dependent Variable. CVRP program participants were asked, "How important were each of the following factors in <u>making it possible</u> for you to acquire your clean vehicle? [Federal tax incentives]." Consumers who responded, "Extremely Important" constitute the "*FTC Extreme"* segment. Respondents who selected, "Not at all important," "Slightly important," or "Moderately important" were grouped to form the *Not FTC Extreme* status. This dichotomous variable will serve as both a grouping variable in the descriptive results and as the dependent variable in the binary logistic regressions. Because the *FTC Extreme* group is sufficiently large—constituting over half of the responses (see Section 4) and growing (Figure 1)—and to remove ambiguity from the binary contrast between *FTC Extremes* and those *not* highly influenced, consumers responding, "Very Important" and "Not Applicable" were removed from the analytical dataset. Lessees were also removed because leasing companies can claim the FTC to provide lower lease rates, potentially clouding lessee awareness and understanding of the FTC and making their rating of FTC importance inconsistent and/or difficult to interpret.

Independent Variables. Survey and application questions were selected as independent variables based upon theoretical relevance and anticipated "actionability" of the results. The precursor PHEV *FTC Extremes* study provides further detail [11].

Descriptive Analysis. Following data cleaning, weighted descriptive statistics by vehicle category and *FTC Extreme* status were obtained, and metrics characterizing new-vehicle buyers in California were created for comparison. Descriptive statistics were used to test for significant differences between *FTC Extreme* and *Not FTC Extreme* groups within a vehicle category,

Logistic Regressions and Dominance Analysis. Binomial logistic regression was used to allow for identification and exploration of characteristics associated with *FTC Extreme* status while controlling for other characteristics. Ordered logistic regression was not used due to concerns about model assumptions, such as the requirement that the parallel regressions assumption is met [19]. Generalized ordered logistic regression was determined to add excessive complexity to the interpretation of the results [19]—particularly when informing policymaking decisions—in contrast to intuitive "odds ratios." Multinomial logistic regression was also considered and determined to be inappropriate for this analysis because it does not factor in the ordinal nature of the dependent variable.

Missing data are problematic for logistic regression, for which cases missing data in variables of interest are often deleted. Case-wise deletion losses were limited to less than 5% of the sample available for each vehicle-category-specific model, and multiple imputation was used provide the remaining missing scores [20]. Fifteen datasets were created for each vehicle-category's modelling.

Preparing the data for analysis included: a) filtering out partial surveys, cases lacking an FTC importance response or responding "very important" or not applicable, leases, and a small number of 16–20-year-olds; b) combining bins to assure sufficient sample size; and c) creating datasets with case-wise deletion and imputed missing scores). After data preparation, a total of 6,391 survey respondents were analysed.

"Full" binary logistic regression models were specified (using unweighted data) for each dataset. Full models utilized all independent variables to identify factors that significantly contribute to predicting *FTC Extreme* status while controlling for other variables. Full models were then reduced to "parsimonious" models consisting of only significant factors. To facilitate prioritization and comparison, the relative importance of factors was determined using dominance analysis. Factors were rank-ordered by the average of their average explanatory contributions to the modelling for each dataset (using Estrella's pseudo-R^2).

Further methodological details can be found in the precursor PHEV *FTC Extreme* analysis [11] and an open-source journal article that took a similar approach to analyzing a different consumer segment with a different dependent variable [21].

4   Select Findings

Among the rebated consumers examined, 54% of PHEV consumers were found to be *FTC Extremes*, as were 56% of Tesla consumers and 62% of non-Tesla BEV consumers (Figure 2).
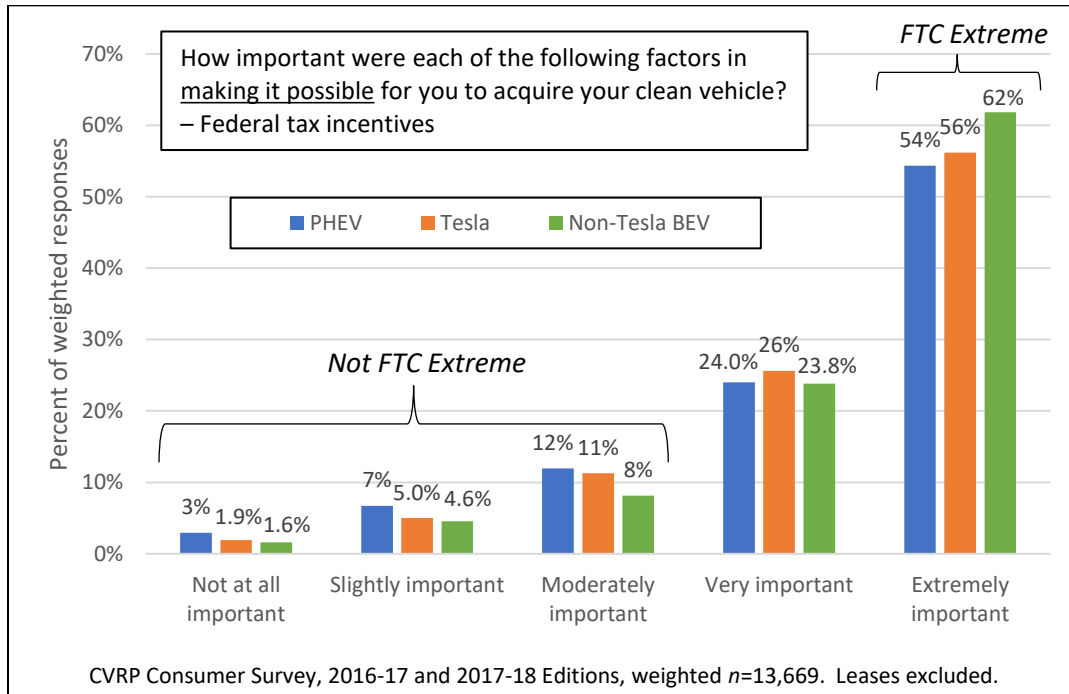

Figure 2: The Importance of the Federal Tax Credit in Enabling the Plug-in EV Purchases

4.1   Significant Factors: Descriptive and Rank-Ordered Logistic Analysis

Descriptive statistics indicate that *FTC Extremes* largely resemble EV consumers as a whole in a given vehicle category (PHEV, Tesla, or non-Tesla BEV). However, Table 1 highlights some differences. For example, testing indicates that **FTC Extremes are less frequently white and more frequently younger than *Not FTC Extremes*** in a given vehicle category. Indeed, Tesla *FTC Extremes* identify solely as white less frequently than even new-car buyers—taking them "beyond the mainstream" on that dimension. Further, they tend to be younger than non-Tesla BEV consumers. However, they more frequently have higher incomes and identify as male.

The rank-ordered logistic regression results (Table 2) indicate that the importance of saving money on fuel, charging availability, and/or carpool-lane access significantly increased the odds of being an *FTC Extreme* across vehicle categories. Further, the later in the year the vehicle was purchased, and thus **the less time between the purchase and realizing the tax benefit, the greater the odds of being highly influenced by the FTC**.

The importance of vehicle performance distinguished both categories of BEV consumer. **Lower purchase price was associated with being an *FTC Extreme* for both PHEV and Tesla participants**, as was male gender identification—although gender was ranked last for both. Identifying as Asian (vs. white) and/or having owned fewer EVs helped distinguish Tesla *FTC Extremes*, and younger age and/or larger household fleet size distinguished non-Tesla *FTC Extremes*. Note that descriptive differences found in Tesla *FTC Extreme* age, household income, and home ownership when examined one at a time (Table 1) did not significantly distinguish Tesla *FTC Extremes* when controlling for the other variables in the model.

Table 1: Weighted Descriptive Statistics Summary of *FTC Extreme* Segments

	Populations & Segments the Analytical Dataset Represents						**CA New-Vehicle Buyers** MYs 2016–17 (2017 NHTS CA add-on [12][a])
	All PHEV Purchases (weighted *n*=4,695)	*FTC Extremely Important to PHEV Purchase* (weighted *n*=2,551)	**All Tesla Purchases** (weighted *n*=7,398)	*FTC Extremely Important to Tesla Purchase* (weighted *n*=4,155)	**All Non-Tesla BEV Purchases** (weighted *n*=1,577)	*FTC Extremely Important to Non-Tesla BEV Purchase* (weighted *n*=975)	
Selected solely white/Caucasian	55%	50%[**]	51%	44%[**]	68%	64%[**]	51%
≥ 40 Years Old	77%	73%[**]	77%	73%[**]	82%	78%[**]	68%
≥ Bachelor's Degree in HH	80%	81%[**]	86%	86%	85%	84%	58% [b]
Own Residence	82%	81%	88%	87%[**]	89%	89%	63%
≥ $100k HH Income	66%	66%	80%	81%[**]	77%	77%	56%
Selected Male	69%	70%	78%	79%	73%	73%	50%

[a] NHTS new-vehicle buyers identified based on a within-100-mile match between odometer and miles driven while owned. [b] NHTS data characterize individual education, whereas other data characterize highest household attainment.

[**] Significant difference (p < 0.05) between *FTC Extremes* and *Not FTC Extremes*.

Table 2: Comparison of Rank-Ordered Odd-Increasing Factors

PHEV [11]	**Tesla**	**Non-Tesla BEV**
"High" Contribution > 0.02		
P01. Saving money on fuel Very or Extremely important (vs. Not)	T01. Saving money on fuel more important	N01. Saving money on fuel Very or Extremely important (vs. Not/Slightly)
P02. Work charging availability Very or Extremely important (vs. Not)	T02. Work charging availability more important	N02. Carpool-lane access more important
P03. Carpool-lane access more important	T03. Carpool-lane access more important	N03. Age younger
P04. Charging availability other than home/work Very or Extremely important (vs. Not)	T04. Charging availability other than home/work more important	N04. Home charging availability Extremely important (vs. Not/Slightly)
P05. FTC incentive amount larger	T05. Home charging availability Extremely important (vs. Not) or Not important (vs. Slightly/Moderately)	
P06. Home charging availability Extremely important (vs. Not) or Not important (vs. Slightly)		
"Medium" Contribution > 0.01		
P07. Make not Chevy nor Honda (vs. others)	T06. Racial/ethnic identification Asian (vs. white)	N05. Charging availability other than home/work more important
	T07. Vehicle performance more important	N06. Make not Chevrolet

	T08. Purchase price lower	N07. Vehicle performance Extremely important (vs. Not/Slightly)
	"Low" Contribution < 0.01	
P08. Energy independence Extremely important	T09. Purchase quarter later in year	N08. No. of household vehicles more
P09. Purchase quarter later in year	T10. Tax filing status not single	N09. Purchase quarter later in year
P10. Educational attainment higher	T11 Number of previous EVs owned fewer	
P11. Purchase price lower	T12. Gender identification Male	
P12. Tax filing status Single (vs. Married Filing Separately)		
P13. Gender identification Male		

All factors significant (p < 0.05)

4.2 Notable Nonsignificance

Nonsignificance should not be taken as definitive proof of the unimportance of a predictor, but rather as a failure to detect any significance, if any exists. Factors included but not found to significantly distinguish *FTC Extremes* include educational attainment, the presence or absence of residential solar power, region, and motivations including the importance of environmental impacts, energy independence, and the desire for new technology. Also notably *not* significant in analysis of the FTC was household income, which was significant in analysis of the state rebate [10]. This may be due to the income cap on eligibility for the state rebate program, the need for sufficient tax liability to benefit fully from the FTC, or the income needed to be in the new-car market.

5 Summary & Discussion

How important has the Federal Tax Credit (FTC) been, and who found it most enabling of their purchase of an EV? This research used descriptive statistics and logistic regression to identify characteristics associated with rating the FTC "Extremely Important." Factors explored for their ability to help predict which consumers might be "*FTC Extremes*" included demographic, household, and regional characteristics; purchase motivations; and vehicle-transaction details. **A majority of rebated survey respondents rate the FTC as extremely influential** (Figure 1). **This majority is increasing, running counter to typical paradigms about phasing-out of EV incentives over time** [7]. Summarized descriptively (Table 1), *FTC Extremes* appear more similar to new-car buyers than EV adopters in general do when it comes to race/ethnicity and age. (Indeed, **Tesla *FTC Extremes*, and to a lesser extent PHEV *FTC Extremes*, are even less frequently white than new-car buyers as a whole**). However, when *FTC Extreme* segment membership is analysed while controlling for other variables, findings were inconsistent: younger age was found to be an important odds-increasing factor for non-Tesla BEV *FTC Extremes* and Asian race/ethnicity a moderate odds-increasing factor for Tesla *FTC Extremes*.

Interestingly, household income was not found to significantly predict FTC extreme importance, whether for PHEV consumers [11] or BEV consumers (Table 2). This may be due to the income cap on eligibility for CVRP, the need for sufficient tax liability to benefit fully from the FTC, and/or the incomes necessary to be in the new-car/EV market at all. No regional characteristics examined were found to be significant. Neither were: whether or not the consumer had solar, the importance placed on reducing environmental impact, the appeal of energy independence (low-ranked only for PHEV consumers), nor desire for the newest technology (although the importance of vehicle performance was significant predictor for BEV *FTC Extremes*). Nor were only consumers with graduate degrees the most influenced (low-ranked only for PHEVs). Collectively, these factors are **often associated with enthusiastic early adopters of EVs, and no evidence was found that the FTC is simply amplifying those tendencies**, which might indicate a high level of free-ridership and low program cost-effectiveness if they had been found. Indeed, among non-Tesla BEV consumers specifically, evidence indicates the FTC had particular influence on younger consumers and among Tesla consumers, evidence indicates the FTC

had particular importance to consumers who were Asian, purchasing lower-priced vehicles, and/or purchasing vehicles later in the year. These findings provide evidence that **the FTC might be modestly supporting the ongoing evolution away from a predominately older, white consumer base** as EV products become more mainstream.

FTC Extremes were found to be **highly motivated by financial-saving- and convenience-related factors** such as charging availability and carpool-lane access (Table 2). It is not surprising that placing extreme importance on an incentive goes hand-in-hand the importance of other financial benefits such as saving money on fuel, and prerequisites for realizing those benefits, such as charging availability. But the predominance of these factors in explaining segment membership is such that it paints a very practical, arguably single-minded, focus on EVs as metaphorical vehicles of tangible, direct benefits rather than the reduced environmental impacts that highly motivate EV adopters overall. This financial and convenience-of-use focus is also reinforced by findings indicating reduced odds of being *FTC Extreme* when buying non-Tesla BEV brands with long electric ranges (the Chevrolet Bolt compared to other non-Tesla BEV brands).

Finally, *FTC Extremes* exhibit very faint echoes of additional characteristics seen in *Rebate Essentials,* such as younger age (non-Tesla BEV consumers), higher educational attainment (PHEV consumers), purchase of lower-priced vehicles (PHEV and Tesla consumers), and being somewhat more frequently male (PHEV and Tesla consumers, albeit with almost trivial contributions being made by those factors).

6   Select Recommendations

Based on these findings, several recommendations for program design and outreach are offered:

- FTC influence was *increasing,* indicating **it was too early to phase the incentive out**.
- The odds of being an *FTC Extreme* decreased with the number of EVs previously owned only for Tesla consumers and was ranked low, providing **insufficient evidence upon which to limit the number of times an individual or household is eligible for incentives**.
- Having lower income either was not significant (BEV consumers) or was associated with *decreased* FTC influence (PHEV consumers [11]), indicating that **incentives should not depend on tax liability.** (This is reinforced by the finding that the odds of being a Tesla *FTC Extreme* were lower for single tax filers, who may less-frequently have sufficient tax liability, than for married consumers filing jointly.)
- FTC influence increases with purchase quarter, indicating the **incentives might be more effective if moved closer to the point of sale**.
- FTC influence increases with credit amount for PHEV consumers (for whom it is based upon battery size), indicating the **incentive was not too big for impactful vehicles**.
- **Outreach profile: Resonant messages** include financial savings, convenience benefits (e.g., carpool-lane access) and charging availability—and to a lesser extent, vehicle performance (BEVs) and energy independence (PHEVs). **Messages lacking distinguishing resonance**: environmental impacts, solar, energy independence (low-ranked for PHEVs), latest technology, vehicle style.
- FTC influence increases for lower-priced PHEVs and Teslas, indicating an opportunity to **limit the benefit for luxury-priced EVs and/or increase the benefit for lower-priced EVs**. Even if a cap were set on the manufacturer's suggested retail price of eligible vehicles at a "backstop" level considered "high"— to not be *overly* exclusionary—eliminating the most highly priced vehicles from FTC eligibility would tend to exclude consumers rating the FTC less important rather than those particularly influenced by it. Both intuitive and reinforced by similar findings for state rebate programs [10,16], this provides an opportunity to increase program cost-effectiveness and equity.

7 Caveats & Next Steps

7.1 Caveat: Interpret and Extrapolate with Caution

Although based upon large datasets characterizing major portions of California's nation leading EV market, this work is first and foremost applicable to efforts to optimize CVRP by taking into account the FTC and its influence. Promisingly, analyses of other topics using similar rebate-program datasets from three Northeastern U.S. states (Massachusetts, Connecticut, and New York) have tended to show more commonalities across states than differences, at least to-date using relatively aggregated measures of program participation and impact [22]. However, interpretation should be done with caution and be mindful of CVRP's program features and California's unique market. Further, extrapolation to future market conditions may not be appropriate as a changing consumer base interacts with maturing products and in a COVID context. Indeed, this analysis intentionally examines the FTC before it began phasing out, to analyse its influence free of the complications introduced by reduced and changing incentive levels. However, program, economic, and market changes could all affect the "structure" of the FTC's influence in the future. Finally, analysis of program non-participants is critical to understanding key barriers to market entry that may be standing in the way of "potential *FTC Extremes*."

7.2 Next Steps: Validate results

While the work summarized herein focuses on describing the relationships between various transactional, household and consumer characteristics, and motivations, it does not assess how well the model performs at predicting *FTC Extreme* membership. Future work may be improved by including goodness-of-fit metrics or more sophisticated cross validation techniques, such as k-folds cross validation.

7.3 Next Steps: Examine Ongoing Importance During Phase-Out

Although this analysis was intentionally framed to examine FTC importance before the tax credit amounts themselves became variable over time and by automaker, examination of the phase out itself is of course an important and related topic. Indeed, forthcoming analysis of incentive influence over time [23] confirms the expectation that FTC influence decreased for Tesla consumers starting in Q1 of 2019 and for GM consumers starting in Q2 of 2019 (Figure 2). (Note that Figure 2 includes both purchases and leases, and other findings in that analysis confirm the expectation that FTC influence on consumers is lower for leases [which are often claimed by the leasing company] than for purchases.) Interestingly, FTC extreme importance remained relatively steady for non-Tesla/non-GM consumers and ended 2020 at close to peak levels.

7.4 Factors (Not) Examined

Even within the focus of the research described in this paper, the range of topics explored was limited by sample size, which effects the number of independent variables that can be effectively explored per vehicle category, and the availability of data characterizing any given topic of interest. Although the CVRP Consumer Survey, which is summarized in program reporting on the program website [14,15], is an extremely rich source of options, additional topics can of course be of interest and relevance.

7.5 Next Steps: Further Explanation of Actionable Factors, Even if Not Top Factors

Some of the predictors that were examined are easier to leverage into action than others. Even though demographics were found to play a secondary role to the importance of financial savings, charging and carpool-lane access in distinguishing *FTC Extremes*, it may be considerably more difficult for the outreach strategist or program designer to distinguish consumers based upon those motivations than on demographic or other profiles. A counter-intuitive but reasonable step in a resource-constrained decision-making environment might

be to "dig deeper" into the modelling to see what emerges in the absence of unactionable factors. Although the risks of producing inferior statistical models should be carefully balanced against the necessity of producing actionable results, further research could explore the continued removal or rebalancing of financial-savings and charging-availability predictors currently in the model. This could further amplify a more complete, nuanced, and actionable array of consumer characteristics associated with being highly influenced by the FTC.
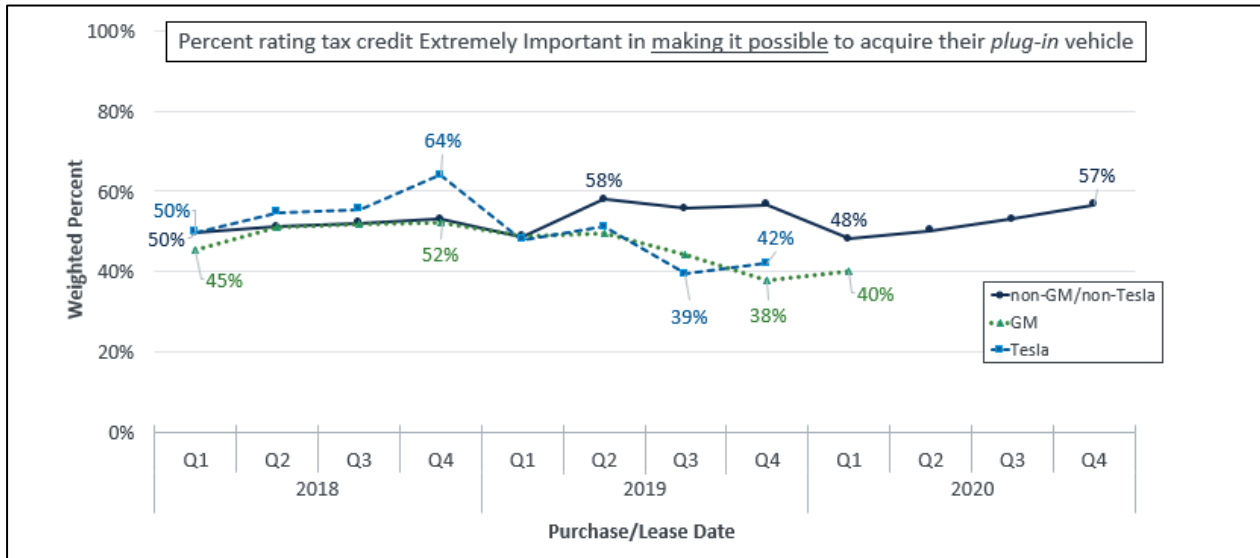

Figure 2: Declining Extreme Importance of FTC During Phase Out; Sustained Importance Overall (from [23])

7.6   Next Steps: Comparison of *FTC Extremes* to Related Strategic Consumer Segments

The findings described here also allow comparison to recent findings about other strategic market segments, such as *Rebate Essentials* [9,10,18]—who are cost-effective targets for incentive programs aimed at reducing free ridership and encouraging true additions to join the EV market—and *EV Converts* [21]—who had low initial interest in EVs and represent a path toward more mainstream markets.

Like *Rebate Essentials*, *FTC Extremes* may be a reasonable proxy for *FTC Essentials*: they may *need* such benefits to get them to act on their interest to join the EV market. Having done so, *FTC Extremes* bring with them a unique combination of market-expanding characteristics. For example, they are more mainstream than enthusiastic early adopters of EVs along some dimensions, but not to the same extent as *EV Converts*. Similarly, they share some but not all features with *Rebate Essentials*, and the contribution of some of those shared features to the odds of being *FTC Extreme* are faint.

Like research on *Rebate Essentials*, increasingly sophisticated profiles of *FTC Extremes* will similarly increase understanding of who is most highly influenced by incentives. This will not only improve assessments of the impact of the FTC, it will improve incentive designs that cost-effectively stretch the boundaries of current adoption and grow EV markets further into the mainstream.

Acknowledgements

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