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Targeting Incentives Cost Effectively: "*Rebate Essential*" Consumers in the New York State Electric Vehicle Rebate Program

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Summary

To increase the cost-effectiveness of electric vehicle (EV) incentives and outreach, this research examined consumers who would not have purchased/leased their EV without New York State's Drive Clean Rebate—or "*Rebate Essentials.*" Using survey responses from 5,191 participants rebated for 2017–2019 adoption, it analyzed consumers of plug-in hybrid EVs (PHEVs), Tesla battery EVs (BEVs), and non-Tesla BEVs separately. Weighted descriptive statistics and logistic regressions identified factors that increase the odds of a consumer being *Rebate Essential*, and dominance analysis rank-ordered factors for prioritization. Profiles generated for each vehicle category summarize characteristics and describe top opportunities for reinforcing *Rebate Essential* adoption through incentive design and outreach. Recommendations are provided. Among the factors discussed are: 1) interest in EVs at the beginning of the car search, 2) rebate awareness before visiting the dealership, 3) other perks for EVs, 4) having lower income, and 5) giving relatively lower importance to environmental impacts.

Keywords: incentive, market development, marketing, policy, state government

1 Background

The New York State Drive Clean Rebate Program (NY DCRP) offers up to $2,000 as a point-of-sale rebate for the purchase or lease of a new EV [1]. This paper seeks to help target outreach and incentive design away from free riders (who would buy an EV without the incentive) and toward consumers most highly influenced by financial incentives to become "true additions" to the EV market. It does so by identifying and rank-ordering characteristics that statistically distinguish past NY DCRP rebate recipients who would not have acquired their vehicle without the rebate, or "*Rebate Essential"* program participants.

In contrast to prior examinations of EV purchase incentives in the literature that establish their importance to, or magnitude of effect on, vehicle markets (e.g., [2,3]), this work characterizes incentive recipients. In contrast to prior research characterizing recipients of EV purchase incentives generally (e.g., [4–7]), this work adds to the more modest body of research characterizing specifically those who were *most highly influenced* to buy an EV (e.g., [5,7]). Compared to [5]—which examined the influence of the U.S. federal tax credit on consumers, the

majority of which acquired a Tesla Model S or Nissan LEAF in 2013—this work examines the influence of the New York State rebate on a wide variety of EV consumers in 2017–2019. Compared to [7]—which analyzed characteristics associated with data-determined clusters produced using latent class analysis—this work examines a consumer segment of predetermined interest (*Rebate Essentials*), with the hope that amplifying such adoption will increase incentive cost-effectiveness. Further discussion of the incentive literature and its findings relative to another, similar examination by the authors of the federal tax credit is available in another EVS35 paper [8].

Prior study of *Rebate Essentials* specifically [9–11] examined participants in a post-purchase rebate program in California who purchased or leased their EV in 2013–2017. This work is the first that examines *Rebate Essential* consumers 1) outside of California, 2) who participated in a dealer-based, point-of-sale rebate program, and/or 3) that purchased or leased their EVs in 2017–2019. It also further develops the methodology and pushes the results farther toward actionability than prior analyses.

2 Data and Representativeness

The analysis primarily utilized NY DCRP program data, described next. National Household Travel Survey data [12] and vehicle registration data [13] were also used to provide context and baseline metrics. The program data analyzed included application and survey data. Application data provided the basic characteristics of 21,843 rebated EVs purchased or leased from late March 2017 (the launch of NY DCRP) through the end of 2019. Data from the program's Adoption Survey—which all rebate recipients are invited to take within a few months of their application approval— included a total of 5,474 survey responses from those 21,842 rebated adopters (25%). Weights were generated using iterative proportional fitting (raking) to make the survey responses more precisely represent the program population. After data processing for logistic regression, 5,191 of those survey responses were used in vehicle-category-specific modelling (see Section 3).

Compared to 39,029 EVs sold in the state from April 2017 through the end of 2019 [14], these rebate recipients amount to roughly 56% of the total New York EV market during the period examined. The top rebates by model were for the Toyota Prius Prime (25%), Tesla Model 3 (18%), Honda Clarity Plug-in Hybrid (10%), Chevrolet Volt (7%), Ford Fusion Energi (7%), and the Chevrolet Bolt (6%). It is notable that 61% of the DCRP rebates studied were for plug-in hybrid electric vehicles (PHEVs). The high proportion of PHEVs draws a sharp contrast to other markets like California where all-battery electric vehicles (BEVs) make up the majority of EV sales and incentives issued. For example, from 24 March 2017 through 31 December 2019, only 32% of applications received and approved for rebates by California's Clean Vehicle Rebate Project (CVRP) were for PHEVs [15]. Further details about the data used can be found in a related project report [16].

3 Methodology

3.1 Separate Modelling for Each Vehicle Category

Following previous analysis of *Rebate Essentials* in California [9–11], consumers of PHEVs and BEVs were examined separately to account for their unique qualities, including differing program participation rates [17,18], demographic and housing characteristics [19,20], purchase motivations [19], and so forth. Indeed, rebated consumers of these two distinct product types differ in their responses to a wide variety of the survey questions that form the basis of characterizing them in California [21,22].

Similarly, Tesla products and consumers have been found to be distinct from other BEV products and consumers, for example in their purchase motivations [19], vehicle pricing [23,24], charging requirements, etc. Further, interpretation of previous demographic [9] and consumer-segmentation [25] analysis that examined all BEVs as a single group has been complicated by "counter-currents" running beneath the surface of BEV averages and program averages. These and other muddied findings are caused by conflating conflicting trends that differ between Tesla and non-Tesla BEV consumers. Additionally, after years of disproportionate headlines, Tesla came

to truly dominate the EV market in mid-2018 with the rollout of the Model 3, resulting in similar dominance of rebate program funding [23]. For these and other reasons, Tesla is also treated as its own vehicle category in this analysis, alongside non-Tesla BEVs (which need to be collectively grouped for sample size reasons) and PHEVs.

3.2 The Grouping/Dependent Variable: *Rebate Essentiality*

Survey respondents were asked, "Would you have purchased/leased your electric car without the State car rebate (Drive Clean Rebate)?" Respondents who selected "No" are considered *Rebate Essential*.[9–11] This dichotomous variable will serve as both a grouping variable in the descriptive results and as the dependent variable in the binary logistic regressions. Data were filtered to remove cases where no response was received for the dependent variable question (14 PHEV cases, 2 Tesla cases, 0 non-Tesla BEV cases). Eleven cases were also removed where the respondent indicated they were from 16 to 20 years of age.

3.3 Independent Variable Selection and Preparation

Program data fields (e.g., survey questions) were selected for use as independent variables based upon theoretical relevance and for anticipated "actionability" of the results. The total number of independent variables for each vehicle category was capped based upon sample size (typically < 35 variables). Further details are available in a related program report [16]. When less than 50 responses were available for a survey response option, or when needed to reduce interpretation complexity, adjacent or conceptually similar response bins were combined.

3.4 Analysis

Following data cleaning, weighted descriptive statistics by vehicle category and *Rebate Essential* status were obtained. Weighted descriptive statistics were used to summarize the data, characterize participants, test for significant differences across vehicle categories and consumer segments, and compare groups to metrics characterizing new-vehicle buyers in New York State.

Missing data are problematic for logistic regression, for which cases missing data in variables of interest are often deleted. To keep case-wise deletion losses limited to less than 5% of the sample available for each vehicle-category-specific model, multiple imputation was used for variables where more than 0.8% of cases were missing data [26]. Twenty datasets were created with 20 iterations for each vehicle-category's modelling.

After preparing the data for analysis (filtering, combining bins, and creating datasets with imputed missing scores), a total of 5,191 survey respondents were analyzed. "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 *Rebate Essentiality* 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 an open-source journal article that took a similar approach to analyzing a different consumer segment with a different dependent variable [25].

Significance and notable non-significance are discussed and summarized along with descriptive findings into profiles specific to each of PHEV, Tesla, and non-Tesla BEV consumers. Caveats, recommendations, and other concluding thoughts are provided.

4 Descriptive Findings About *Rebate Essentials*

Among the rebated consumers represented by the weighted survey results, 52% of PHEV consumers were found to be *Rebate Essential*, as were 40% of Tesla consumers and 60% of non-Tesla BEV consumers (Figure 1). These percentages are discussed further in Section 6.

Comparing *Rebate Essentials* to their counterparts within their vehicle category (Table 1), descriptive statistics highlight several differences: 1) *Rebate Essential* PHEV and non-Tesla BEV consumers are male more frequently than their non-*Rebate Essential* counterparts, 2) PHEV and Tesla *Rebate Essential* participants tend to be younger, and 3) PHEV *Rebate Essentials* more frequently rent and less frequently identify solely as white/Caucasian.

Overall, **each *Rebate Essential* group tends to more closely resemble New York new-vehicle buyers than non-*Rebate Essentials* do**, based on metrics developed to characterize mainstream markets using NHTS data. Notable exceptions include: *Rebate Essentials* are more frequently male, Tesla *Rebate Essentials* more frequently own homes, and **Tesla consumers as a whole already *less* frequently identify as solely white/Caucasian**.

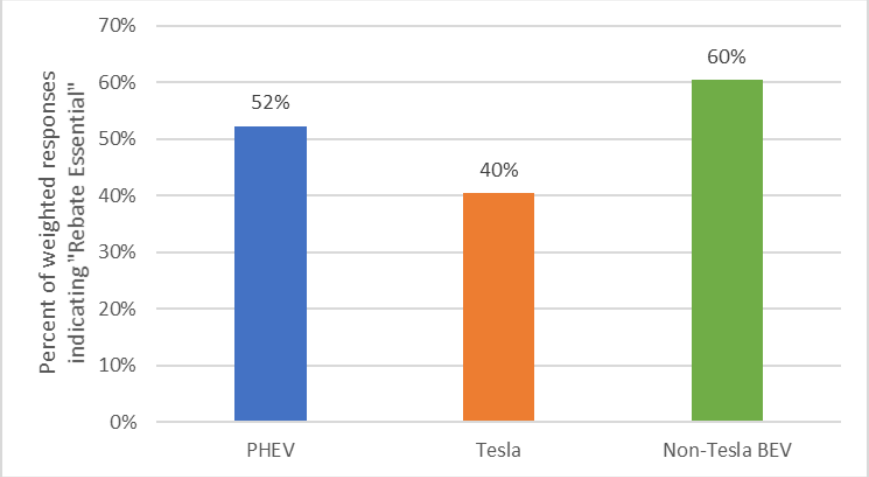

Figure 1: Percent of weighted responses indicating they would not have acquired their vehicle without the rebate.

Table 1: Weighted Descriptive Statistics Summary †

Characteristic	**PHEV** (*n* = 2,766)		**Tesla** (*n* = 1,430)		**Non-Tesla BEV** (*n* = 995)		**New-Vehicle Buyers**
	Not *Rebate Essential*	***Rebate Essential*** *(52%)*	Not *Rebate Essential*	***Rebate Essential*** (40%)	Not *Rebate Essential*	***Rebate Essential*** (60%)	(NY Responses, 2017 NHTS‡)
Selected only white	88%**	83%**	71%	68%	87%	84%	74%
Greater than 40 years old	82%**	77%**	72%**	65%**	74%	71%	69%
Bachelor's degree or more	75%	75%	84%	84%	82%*	77%*	64%
Own home	92%**	88%**	85%	88%	91%	88%	73%
≥ $100k HH income	61%	61%	85%	84%	66%	60%	53%
Selected female	37%**	30%**	18%	15%	30%**	24%**	51%

† Percentages are weighted to represent the program population along the dimensions of technology type (PHEV vs. BEV), model, purchase vs. lease, and residence county. ‡ NHTS 2017 is weighted to represent population, not new-vehicle subset. New-vehicle buyers identified based on within-100-mile match between odometer and miles driven while owned.

* $p < 0.10$, ** $p < 0.05$: two-sample test (with continuity correction) for equality of proportions between *Rebate Essential* and Not *Rebate Essential* segments.

5 Logistic Modelling Findings About *Rebate Essentials*

Table 2 provides the factors found to significantly increase the odds of being *Rebate Essential* for each vehicle category. To facilitate prioritization of strategic efforts, results are rank-ordered by importance using dominance analysis (see Section 3) and sorted into "high," "medium," and "low" importance groups. To facilitate comparison, factors common across vehicle categories are color-coded.

The results indicate that factors such as consumer awareness of the rebate before the first dealership visit and having some initial interest in an EV significantly increased the odds of being *Rebate Essential* across vehicle categories. Rating other incentives important, both financial and convenience-related, also appears to be highly related to *Rebate Essentiality.* PHEV and non-Tesla BEV *Rebate Essentials* also shared as significant factors dealer awareness of the rebate on the first visit, the importance of free charging away from home, lower income, and male gender. Giving lower importance to environmental impacts was found to increase the odds of being *Rebate Essential* for Tesla consumers, as well as for PHEV consumers in alternative PHEV modelling.

Table 2: Summary of Rank-Ordered Factors that Increase the Odds of Being *Rebate Essential*

PHEV	Tesla	Non-Tesla BEV
	"High-ranked" [> 0.01]	
1. Initial interest in an EV is some or very interested (vs. no knowledge or interest) [0.037]	1. Green Pass or similar toll/E-ZPass discounts are more important (vs. not important) [0.04]	1. Consumer aware of the rebate before visiting a dealership (vs. not aware) [0.029]
2. Consumer aware of the rebate before visiting the dealership [0.026]	2. Consumer aware of the rebate before visiting a dealership (vs. not aware) [0.038]	2. Free charging away from home is very or extremely important (vs. not important) [0.027]
3. Age 40–49 (vs. 21–29) [0.014]	3. Special EV electricity rates are extremely important or not applicable (vs. not important) [0.023]	3. Initial interest in an EV is some interest or very interested (vs. no knowledge or no interest) [0.027]
4. Special EV electricity rates are extremely important or n.a. (vs. not important) [0.0119]	4. Saving money on fuel is more important (vs. not important) [0.012]	4. Lower household income (vs. higher incomes) [0.023]
5. Free charging away from home is extremely important or n.a. (vs. not at all important) [0.0118]		5. Vehicle make is not Chevrolet (Nissan or other makes) [0.012]
6. Slightly satisfied with the rebate amount (vs. not at all satisfied) [0.011]		6. Dealer aware of rebate on first visit (vs. not aware or don't know) [0.01]
	"Medium-ranked" [> 0.005]	
7. Lower household income (vs. higher income) [0.008]	5 (tied). Race/ethnicity is white/Caucasian, relative to non-Latinx, non-Asian other selections (individual or multiple) [0.009]	7 (tied). Male (vs. female) [0.006]
8. Dealer is extremely knowledgeable about home charging (vs. very knowledgeable) [0.006]	5 (tied). Initial interest in an EV is some or very interested (vs. no knowledge or interest) [0.009]	7 (tied). Number of cars in household - multiple cars (vs. 1 car) [0.006]
9. EV is an additional vehicle (vs. replacement) [0.005]	7. Reducing environ. impact is slightly or not important (vs. more important) [0.006]	

	8. Access to the latest technology is slightly or not important (vs. very or extremely) [0.005]
	"Low-ranked" [< 0.005]
10. Dealer aware of rebate on first visit (vs. not aware or don't know) [0.0048]	9. Vehicle performance is moderately, slightly, or not important (vs. very or extremely important) [0.003]
11. Male (vs. female) [0.0044]	
12. HOV lane access is slightly important (vs. not at all) [0.0038]	
13. Bachelor's degree or postgraduate (vs. high school or other) [0.0024]	
14. Rent residence (vs. own) [0.0022]	

Notably *not* significant were residence type (e.g., multi-unit vs. single family**) and access to charging**. If rebates help compensate for the complexities of charging in multi-unit dwellings (MUDs), residence type might be expected to be significant. It was not for any consumer group. Similarly, access to charging at home or near work was not found to be significantly associated with *Rebate Essentiality.* This could be partially explained by the significance of rent-vs.-own status for PHEV consumers, and the possibility that rebated EVs have not penetrated deeply enough into MUDs in general for sufficient variation to exist yet in the data.

More broadly, few factors categorized as "household" factors were significant. **This puts a greater emphasis on demographics (particularly for PHEV consumers) and motivational findings (particularly for Tesla consumers).** On the other hand, **most demographic factors were not significant for Tesla consumers**, nor were many motivational factors significant for non-Tesla BEV consumers.

6 Summary of Findings into Vehicle-Category Profiles

Profiles specific to each vehicle category (PHEV, Tesla, and non-Tesla BEV consumers) were generated. Each begin by setting the stage with a summary of additional information characterizing the consumers in the program dataset as a whole, for example the portion of rebates received by the category, their vehicle replacement behaviours, and which adoption-enabling factors they most frequently rated extremely important. This is followed by vehicle-category-specific breakdowns of the highly ranked predictors of *Rebate Essentiality* from Table 2. With this information, the cost-effectiveness of supporting each vehicle category can then be reinforced by either targeting potential consumers with similar characteristics or increasing the prevalence of certain characteristics (e.g., awareness of the rebate) in order to "unlock" additional similar consumers who might otherwise be highly influenced by the rebate. Descriptive characteristics help us better understand what type of consumer was most highly influenced by the Drive Clean Rebate to purchase or lease an electric vehicle. The results from Table 2, in turn, help us rank-order the most robustly significant *distinguishing* factors and tell us where to focus first and most. Cumulatively, these findings inform the best guess of how to avoid program free riders and target additional consumers that the rebate has the greatest chance of influencing, thereby increasing program cost-effectiveness.

6.1 PHEV *Rebate Essentials* Summary Profile

Rebates received for PHEVs constitute 61% of the rebated vehicles analyzed, nearly double the share received in California over a similar time frame (Section 2), making PHEV rebates an important consideration. Nearly 90% of rebated PHEVs replaced a household car, the highest replacement rate among vehicle categories, making

PHEV rebates impactful (e.g., from the perspective of greenhouse gases avoided). Over half (52%) of PHEV rebates were given to PHEV *Rebate Essential* consumers in New York State (Figure 1) higher than the 40% of rebates given for Tesla vehicles and lower than the 60% of rebates for non-Tesla BEVs.

Compared to other vehicle categories, PHEV consumers most frequently rated carpool-lane access and the Green Pass or similar toll discounts as extremely important, tend to be older, more frequently female, and/or less frequently have a college degree. The frequency of rating environmental impacts as extremely important is the lowest for PHEV consumers (58%), as is the presence of residential solar, initial interest in an EV at the beginning of the car search, and awareness of the rebate prior to visiting a dealership.

Based on Table 2, the most impactful and straightforward ways to reinforce the cost-effectiveness of PHEV rebates include targeting potential PHEV consumers who already have one or more of the following characteristics (in order of decreasing importance). Alternatively, measures that increase the prevalence of some of the following characteristics (e.g., rebate awareness) may "unlock" consumers who would otherwise be highly influenced by the rebate. PHEV *Rebate Essentials* tend to:

1. Have some (32%) or a lot (56%) of interest in EVs at the beginning of their car search.
2. Be aware of the rebate before visiting a dealer (55%).
3. Be in their 40s (22%) rather than their 20s (6%).
4. Rate electricity rates for charging either extremely important (22%) or not applicable (21%), rather than not at all important (18%).
5. Rate free charging away from home either extremely important (28%) or not applicable (9%), rather than not at all important (13%).
6. Be satisfied with the rebate amount (that ranged $500–1,700), rather than not (2%), particularly those slightly satisfied (10%).

Significant distinguishing factors for PHEV *Rebate Essentials* tend to be related to demographics and not household characteristics (e.g., housing type and access to charging at home). Unlike in California, the importance of saving money on fuel and the absence of residential solar were *not* distinguishing factors for New York PHEV *Rebate Essentials*.

Several other factors with modest contributions are listed detailed in Table 2. These may reinforce, if somewhat weakly, the pertinence of, for example, targeting lower-income renters with college degrees.

Overall, rebated PHEV consumers have the lowest relative levels of initial interest in EVs and pre-dealership awareness of the rebate among the vehicle categories. However, these two factors rank at the top of the list of factors associated with increased odds of being a *Rebate Essential* PHEV consumer. A substantial opportunity would appear to exist to increase PHEV cost-effectiveness and market adoption through education and outreach about the benefits of PHEVs and availability of the rebate.

6.2 Tesla *Rebate Essentials* Summary Profile

Rebates received for Teslas constitute 24% of the rebated vehicles analyzed, making Tesla products the most prominent brand rebated. Eighty-one percent of rebated Teslas replaced a household car, midway between PHEVs (87%) and non-Tesla BEVs (75%), perhaps indicating the greater confidence in, and impact of, long-range BEVs. Further, Teslas replaced *gasoline* vehicles the most frequently (85% vs. 83% for PHEVs and 74% for non-Tesla BEVs). On the flip side, Teslas more frequently replace newer vehicles, and their confidence-inspiring high-performance and less-compromised products may be reflected in Tesla consumers reporting being *Rebate Essential* less frequently than the other vehicle categories (40% vs. 52% for PHEV consumers and 60% for non-Tesla consumers, Figure 1).

Overall, in comparison to PHEV and non-Tesla consumers, Tesla consumers most frequently were very interested in EVs at the start of their car search (80%) and their Tesla was their first EV (81%), indicating the brand may be pre-converting consumers to EV interest and adoption. Tesla consumers also most frequently rated extremely

important: the convenience of charging, vehicle performance, vehicle styling and comfort, the desire for new technology, parking incentives, and special electricity rates for charging. They also most frequently use Level 2 charging at home (73%), but least frequently live in a single-family home (74%) and least frequently own their residence (86%). Notably, Tesla *Rebate Essentials* more frequently are homeowners, making them *less* like new-car buyers on this one dimension, but bringing them to equivalence with the frequency of home ownership among PHEV and non-Tesla BEV *Rebate Essentials* (88%, see Table 1). They most frequently identify as male (83%) and have annual gross household incomes greater than $150,000 (66%) but are least frequently white (70%—lower than even new-vehicle buyers in general, per Table 1).

Based on Table 2, the most impactful and straightforward ways to reinforce the cost-effectiveness of Tesla rebates include targeting potential Tesla consumers who already have one or more of the following characteristics (in order of decreasing importance). Alternatively, measures that increase the prevalence of some of the following characteristics (e.g., rebate awareness) may "unlock" consumers who would otherwise be highly influenced by the rebate. Tesla *Rebate Essentials* tend to:

1. Rate the Green Pass or similar toll/E-ZPass discounts important (79%) vs. not at all important (13%).
2. Be aware of the rebate before visiting a dealer (78%).
3. Rate electricity rates for charging either extremely important (28%) or not applicable (18%) rather than not at all important (13%).
4. Rate saving money on fuel costs moderately to extremely important (90%) rather than slightly or not important (10%).

Significant distinguishing factors for Tesla *Rebate Essentials* tend to be related to motivations and not demographics or household characteristics (e.g., housing type and access to charging at home). Notably, income was *not* a distinguishing factor for New York Tesla *Rebate Essentials*.

Several other factors with modest contributions are detailed in Table 2. These may reinforce, if somewhat weakly, the pertinence of targeting potential Tesla consumers placing lower importance on reducing environmental impacts, the latest technology, and vehicle performance.

Although not a significant predictor of segment status, Tesla *Rebate Essentials* are typically the youngest of the *Rebate Essentials* among the vehicle categories. For example, they had the highest percentage under 50 years old and the highest percentage in each of the 20-, 30-, and 40-year-old buckets.

6.3 Non-Tesla *Rebate Essentials* Summary Profile

Rebates received for non-Tesla BEVs constitute the smallest portion of the rebated vehicles analyzed (15%). Non-Tesla BEV consumers are most-frequently *Rebate Essential* (60%, Figure 1) and aware of the rebate before visiting a dealership (70%). Perhaps because of historically more-compromised/lower-performance vehicles, non-Tesla vehicles least frequently: replaced a household car (75%) and replaced gasoline vehicles (74%).

Overall, in comparison to PHEV and Tesla consumers, non-Tesla consumers most frequently rated extremely important reducing environmental impacts (65%), the state rebate (53%), and the federal tax credit (56%). They least frequently rated extremely important carpool-lane access (7%), vehicle performance (26%), vehicle styling and comfort (14%), and the Green Pass or similar toll/E-ZPass discounts (13%).

They also most frequently had workplace charging (28%) and residential solar (22%).

Based on Table 2, the most impactful and straightforward ways to reinforce the cost-effectiveness of non-Tesla BEV rebates include targeting potential consumers who already have one or more of the following characteristics (in order of decreasing importance). Alternatively, measures that increase the prevalence of some of the following characteristics (e.g., rebate awareness) may "unlock" consumers who would otherwise be highly influenced by the rebate. Non-Tesla BEV *Rebate Essentials* tend to:

1. Be aware of the rebate before visiting a dealer (76%).

2. Rate free charging away from home either extremely important (29%) or very important (22%) rather than not at all important (9%).
3. Have some (22%) or a lot (66%) of interest in EVs at the beginning of their car search.
4. Have lower annual gross household income.
5. Acquire non-Chevrolet makes (67%).
6. Find their dealer was aware of the rebate on their first visit (83%).

Significant distinguishing factors for this group tend *not* to be related to household factors (e.g., housing type and access to charging at home) or motivations. Unlike in California, the importance of environmental impacts was *not* a distinguishing factor for New York non-Tesla BEV *Rebate Essentials*.

Two other factors with modest contributions are listed in Table 2. These may reinforce, if somewhat weakly, the pertinence of targeting potential BEV consumers that are male or have multiple cars in the household.

7 Recommendations & Concluding Thoughts

To supplement the summary profiles in Section 6, and in an effort to push the findings of this research toward "actionable" recommendations for outreach and incentive design, six additional recommendations are provided, each after a brief description of the findings from which they stem.

Findings Summary: The odds of being *Rebate Essential* was not found to be associated with whether the rebated EV was the consumer's first EV or not.

Conclusion/Recommendation 1: No evidence was found to support limiting the number of rebates per individual on the basis of rebate influence. Reassess over time as the market matures.

Findings Summary: *Rebate Essentiality* was associated with importance given to a variety of other financial and convenience-based incentives.

Recommendation 2: Support or advertise other incentive programs (e.g., free charging, toll discounts, EV charging rates) that reinforce the influence of the rebate.

Findings Summary: Descriptively, *Rebate Essentials* trend *relatively* younger and lower-income and rent housing somewhat more frequently than non-*Rebate Essentials* (Table 1). PHEV *Rebate Essentials* specifically identify less frequently as white than their counterparts. Predictively, *Rebate Essentials* are most highly distinguished by having initial interest in EVs at the start of the new-car search and by consumer and dealer awareness of the rebate before their first dealership visit (Table 2).

Recommendation 3: Use these characteristics and others provided in the detailed summary profiles in Section 6 to *target outreach and incentive design* toward consumers with *Rebate Essential* characteristics. This will increase the odds of *reinforcing and amplifying* adoption by those most highly influenced by supportive resources to adopt an EV and minimize free ridership.

Recommendation: Identify ways to *increase the prevalence* of one or more characteristics associated with *Rebate Essentiality* (see Section 6), in order to unlock more *Rebate Essentials.* For example, findings support the need for rebate awareness campaigns (see next).

Findings Summary: To date, the rebate has been most influential as a tool for bringing people into the EV market when presented to consumers during the information gathering phase prior to a dealership visit, rather than as a sales tool at the dealership.

Recommendation 4: Support consumer awareness of the rebate during the information gathering phase (especially for potential consumers of PHEV products, who have the lowest awareness).

Findings Summary: However, dealer awareness is also a (lower-ranked) significant predictor.

Recommendation 5: Support rebate awareness among dealers, who may act as a "backstop" and either reinforce consumer awareness or use the incentive to convert non-aware consumers into EV adopters.

Findings Summary: The goal of increasing cost-effectiveness both overlaps with, and has trade-offs with, the goal of expanding EV markets more toward the mainstream. As described in a related project report [16], a disproportionate amount of *Rebate Essentials* are also *EV Converts*—consumers with low or no initial interest at the beginning of their car search [9,25]. There is particular overlap among those consumers with "some" initial interest in EVs, which comprise 76% of *EV Converts* and 28% of *Rebate Essentials*, compared to 23% of the program overall. (Those "very interested," by definition, are not *EV Converts*, and those having no initial interest were found to have lower odds of being *Rebate Essential*.) An even larger percentage of *EV Converts* are also *Rebate Essentials*: 61% (vs. 51% for the program overall).

Recommendation 6: Findings indicate an opportunity to improve program cost-effectiveness by seeking out consumers with lower initial interest in EVs and "converting" them to EV interest with the incentive and other means.

Further discussion of the evidence that rebates are converting consumers into EV adopters, as well as other ways to expand EV market frontiers outside of the enthusiastic core of early adopters, is currently in the process of publication. In the meantime, additional details are available in a related project report [16]. It discusses the integration of various consumer segments, including *Rebate Essentials* and *EV Converts*, into a roadmap of sorts aimed at progressing EVs toward the mainstream and beyond to equitable access to transformative transportation electrification.

8 Caveats & Next Steps

This work is centred on consumers who overcame their barriers to adoption, purchased/leased an EV, and participated in the NY DCRP. Extrapolating these findings should be done with caution. Additional research is required to understand consumers highly influenced by the incentive who did not overcome other barriers to acquiring an EV or chose not to acquire one.

Even within the focus of the research, the range of topics explored is 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 NY DCRP Adoption Survey, which is summarized in program reporting on the program website [1], is an extremely rich source of options, additional topics can of course be of interest and relevance. One example that proved significant in related work in California was the association found between *Rebate Essentiality* and lower vehicle price. This finding is particularly relevant in the context of equity and incentive design features—such as the NY DCRP's MSRP-based rebate amount or other programs' MSRP-based rebate eligibility (aka "MSRP caps"). These features cost-effectively support the volume production of affordable new EVs—and, subsequently, affordable used EVs. Data characterizing the MSRP of rebated vehicles was not readily available for this analysis but could be generated for follow-on analysis.

From a more technical modelling perspective, additional analysis could further examine the relationship between PHEV *Rebate Essentiality* and the importance of reducing environmental impacts, which was problematic due to multicollinearity. For example, additional modelling could use moderator variables or a variable that combines a variety of social factors (e.g., environmental impacts and energy independence) into a single factor.

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