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# New York State's Drive Clean Rebate for Electric Vehicles: Measures of Impact

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**Executive Summary**

New York State offers point-of-sale rebates for purchases and leases of new electric vehicles (EVs). Important questions include: "Who and what do rebates benefit?", "Are rebates impactful?", and "Do rebates influence the market?" We examine data characterizing nearly 58,000 consumers rebated for EVs acquired March 2017 through December 2021, emphasizing 2021 purchases/leases (the most recent data available). Over 14,000 survey responses are weighted for representativeness. Findings include distributions of rebates by model-minimum manufacturer suggested price (60% <$40,000 in 2021) and funding by household income (71% <$200,000). Comparisons with new-vehicle buyers calibrate conversations about progress toward mainstream markets and equity (e.g., some race/ethnicity metrics are already comparable, and 42% of disparities in an income metric reflect inequities in new-car buying, not EVs particularly). Vehicle replacement rates remain high. Metrics quantify rebate influence and reveal patterns. Findings inform program design, outreach, and other measures supportive of cost-effective EV market growth and diversification.

*Keywords: demand, electric vehicle (EV), incentive, policy, state government.*

## 1 Introduction

Since March 2017, the New York State Drive Clean Rebate Program (NY DCRP) has offered point-of-sale rebates ranging from $500 to $2,000 for the purchase or lease of a new electric vehicle (EV) [1]. Important questions for program transparency and evaluation include: "What types of consumers and which types of vehicles do rebates benefit?", "Are rebated EVs impactful?", and "Are rebates effectively influencing the market?" Prior related research has included the examination of EV incentive beneficiaries. These have typically focused on the federal tax credit (e.g., [2–6]) or rebates EV consumers claim post-purchase in California (e.g., [7–11]) or Massachusetts [12]. They also may depend on proxies to characterize incentive recipients, such as census tracts with high EV and rebate volumes [7,10]. Recent research has also examined vehicle replacement, for example, modeling replacement behavior indirectly [13] or focusing on California EV discontinuance (what replaces an EV) [14].

This research builds upon past program reporting in California, Massachusetts, Connecticut, and New York (e.g., [15,16]), but focuses on painting a more recent picture (through 2021) of the impacts of NY DCRP.

This is the first such analysis of vehicles and consumers rebated in New York and the first known analysis that characterizes 2021 rebate impacts for any state. Uniquely, DCRP is a dealer-based, point-of-sale rebate program in a state with a cold-weather climate and a greater predominance of plug-in hybrid electric vehicles (PHEVs). Further, the dollar amount of the DCRP rebate is a unique function of the EV's all-electric range capability [1] (see below).

# 2 Data & Methods

**Rebate Application and Survey Data.** We examine consumers rebated for EV purchases or leases from the program launch in March 2017 through the end of 2021 (the most recent data available), emphasizing 2021 purchases/leases. All told, over 14,000 survey responses were weighted to represent nearly 58,000 program participants along the dimensions of vehicle model, vehicle technology (PHEV vs. battery EV [BEV]), buy vs. lease, and county (Table 1). The data through 2019 were weighted and filtered to produce results for individual years. Weights for 2020 and 2021 were created specifically for each dataset. (In somewhat larger datasets for California, year-specific weights produced results with relatively little difference from results based on weights produced using multiple years and then filtered for each year.) Rebated EVs comprised nearly two-thirds of all new EVs registered in New York during a similar time frame (Table 1).

**Table 1: Program data**

| Vehicle Purchase/Lease Dates | 3/23/2017–12/31/2019 | 1/2/2020–12/31/2020 | 1/1/2021–12/31/2021 | **All** |
|---|---|---|---|---|
| Survey Responses (*n*) ¶ | 5,474 | 3,480 | 5,087 | **14,041** |
| Program Population (*N*) § | 21,843 | 13,038 | 23,098 | **57,979** |
| Program Pop. as a % of Market * | ~56% | ~72% | ~65% | **~63%** |

¶ *Subsequently weighted to represent the program population along the dimensions of vehicle technology (PHEV vs. BEV), model, buy vs. lease, and county.* § *Small numbers of rebated vehicles are not represented in the time frames due to application lags.* * *Based on approximate comparisons to total EV sales from* [17].

**New York State New-Vehicle Buyers.** To develop appropriate baselines of comparison, rebate recipients were compared not just to population statistics from the 2020 U.S. Census (2016–2020 American Community Survey PUMS data) but also to measures characterizing new-vehicle buyers specifically (2017 National Household Travel Survey, or NHTS [18]). (All datasets were the most recent available at the time of analysis.) NHTS data were filtered to New York State and to the most recent vehicle purchases available to analyze—model years (MYs) 2016–17. These new-vehicle buyers were identified by a within-100-mile match between their odometer readings and the miles they stated they had driven the vehicle while owned. Note that the NHTS is weighted to represent its overall population, not the subset of new-vehicle buyers.

**Manufacturer Suggested Vehicle Prices.** To enable comparison, each MY of each vehicle model analyzed was assigned the minimum manufacturer's suggested retail price (MSRP) for that MY (or its nearest alternative) using U.S. EPA data from fueleconomy.gov. Note that this does not reflect the final sales price, which can vary considerably based on the options selected, particularly for Tesla vehicles.

Where MY 2021 MSRPs were unavailable, MY 2020 MSRPs or MY 2022 MSRPs were used. Tesla MSRPs frequently changed within MY 2021; MSRPs were assigned as follows: Model 3 = $30,000 to $39,999; Model Y = $40,000 to $49,999 for MY 2020 and $50,000 to $59,999 for MY 2021; Model S & Model X = $60,000 or more. We note that the Model Y was available in lower price tiers until at least early April 2021 and that Model 3 prices increased into the $40,000 to $49,999 tier in Oct. 2021. The Model 3 was assigned to the $40,000 to $49,999 tier for MY 2022.

# 3 Select Findings & Discussion

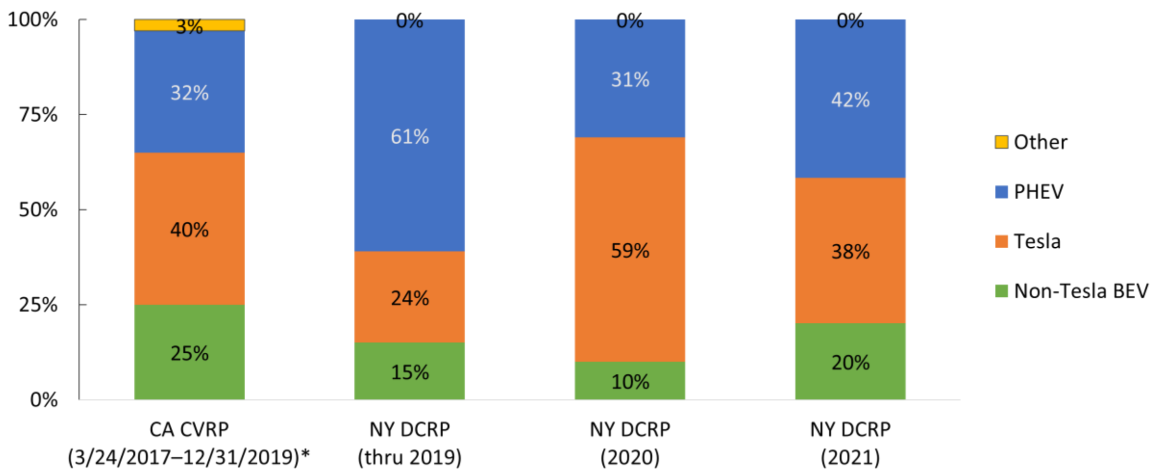
## 3.1 Context shapes outcomes

It is important to note that context shapes the program impacts analyzed herein. This includes both program features and market dynamics. Important program design features include DCRP's MSRP-based rebate amounts and the program's first change, in mid-2021, to its electric-range-based rebate schedule (Table 2). Important market dynamics include those resulting from the Tesla Model 3 & Model Y release, which began to disrupt the program picture in Q4 2018. Figure 1 provides the distribution of rebates by vehicle category over time. (Note that all Tesla vehicles are BEVs.) Compared to California's BEV-dominated Clean Vehicle Rebate Program (CVRP, the first column), New York's DCRP was dominated by PHEVs through 2019 (second column). The DCRP proportions of PHEV and Tesla vehicles nearly reversed in 2020 and then nearly balanced out in 2021 to comprise roughly two-fifths of rebated vehicles each.

**Table 2: Rebate design changed mid-2021**

| | Rebate Amount (Purchase dates thru 6/30/2021) | Rebate Amount (Purchase dates after 6/30/2021) |
|---|---|---|
| Fuel-Cell EVs*, Battery EVs, and Plug-in Hybrid EVs | ≥ 120 e-miles†: \$2,000<br>≥ 40 e-miles: \$1,700<br>≥ 20 e-miles: \$1,100<br>< 20 e-miles: \$500 | ≥ 200 e-miles: \$2,000<br>≥ 40 e-miles: \$1,000<br>< 40 e-miles: \$500 |
| Additional Elements | MSRP > \$60,000: \$500<br>Point-of-sale | MSRP > \$42,000: \$500<br>Point-of-sale |

** FCEVs eligible but unavailable in NY; none rebated. † Electric miles (e-miles) are U.S.-EPA-rated all-electric miles.*




**CVRP statistics align with a comparable time frame (24 Mar. 2017 – 31 Dec. 2021) but the source [19] filters based on dates applications were received; DCRP values are based on the year of purchase/lease. 2017–2019 values for DCRP are from [20].*

**Figure 1: State rebates by technology type over time (California and New York)**

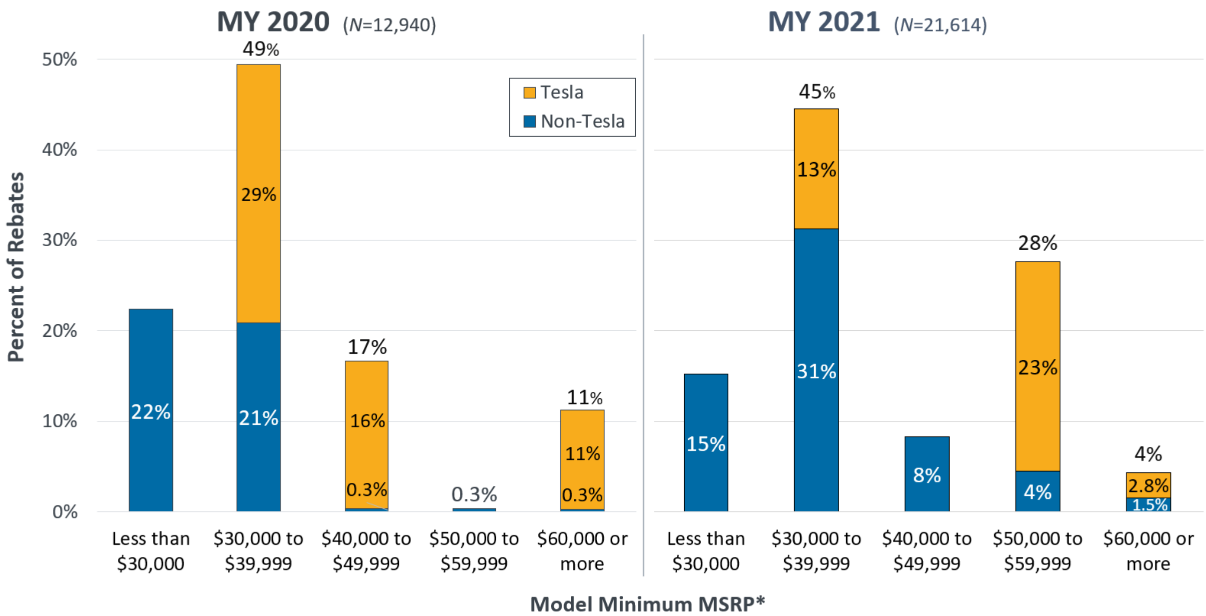
Also critically important and particularly pertinent to this first analysis of 2020 and 2021 impacts were the dramatic economic downturn and other effects resulting from the COVID-19 pandemic, which began to take root in March 2020 and continued through the end of the period examined. Questions remain not only about "What might have been?" in absence of the pandemic, but also about "Who was (or was not yet) able to participate in the car market during COVID?" and "Who needed a car during this time and was in a position to choose an EV?" At a minimum, it will be interesting to see how things fare and compare for rebated EVs in 2022, further enriching efforts to provide updated inputs to conversations about EV policy and equity.

## 3.2 What do rebates benefit?

Despite valid concerns about the cost of EVs, rebates in New York have predominantly gone to moderately priced EVs. For MY 2018 vehicles, the percentage of rebates going to vehicles with model-minimum MSRPs of less than \$40,000 (before incentives) was 72%. Further, that metric remained robust even into the onset of COVID-19: for MY 2020, the percent of rebates going to EVs under \$40,000 (\$40k) was also 72%. More broadly, the overall MSRP distribution for MY 2020 was remarkably similar to that for MY 2018, even though the predominance of Tesla rebates had increased by MY 2020. (Within that general shape, the Tesla distribution widened as the Model 3 fell in price and cannibalized the non-Tesla share in the $30k–40k category.)

For MY 2021, the MSRP distribution changed more markedly: the percentage under $40k fell to 60% as Tesla lost Model 3 share but grew Model Y share at a higher price, in the $50k–60k category (Fig. 2). The non-Tesla price distribution also shifted up and widened, although not as dramatically as Tesla's distribution. Price distribution increases in MY 2021 may be reflective of larger supply-chain and inflationary pressures that began to rise as COVID-19 progressed. It is also important to keep in mind that rebate amounts changed in mid-2021 in two differing ways, complicating interpretation: 1) the minimum electric range required for a given rebate amount essentially increased (to oversimply Table 2) and 2) the MSRP criterion lowered from $60k to $42k (Table 2).

These price dynamics contrast with California in at least two major ways. First, the greater predominance of lower-cost PHEVs in New York through 2019 (Fig. 1) initially helped keep the MSRP distribution anchored at lower levels. The mode in California's distribution was significantly higher (above $45,000) due to the higher prices of the initial Model 3 release. (Initial supply was focused in California starting in mid-2018 before expanding substantially nationwide.) On the other hand, by 2020, California's "hard" MSRP cap (effective December 2019) made EVs with MSRP above $60,000 ineligible, whereas New York's "soft" cap continued to provide reduced rebates ($500) to such luxury vehicles, which amounted to roughly 11% of rebates for 2020. By MY 2021, interestingly, the percentage of New York rebates over $60k had fallen to an apparent all-time low of 4%, possibly in favor of the emergence of Model Y prominence in the $50k–60k category. The category rose to an all-time high of 28%, including non-Tesla vehicles (Fig. 2).



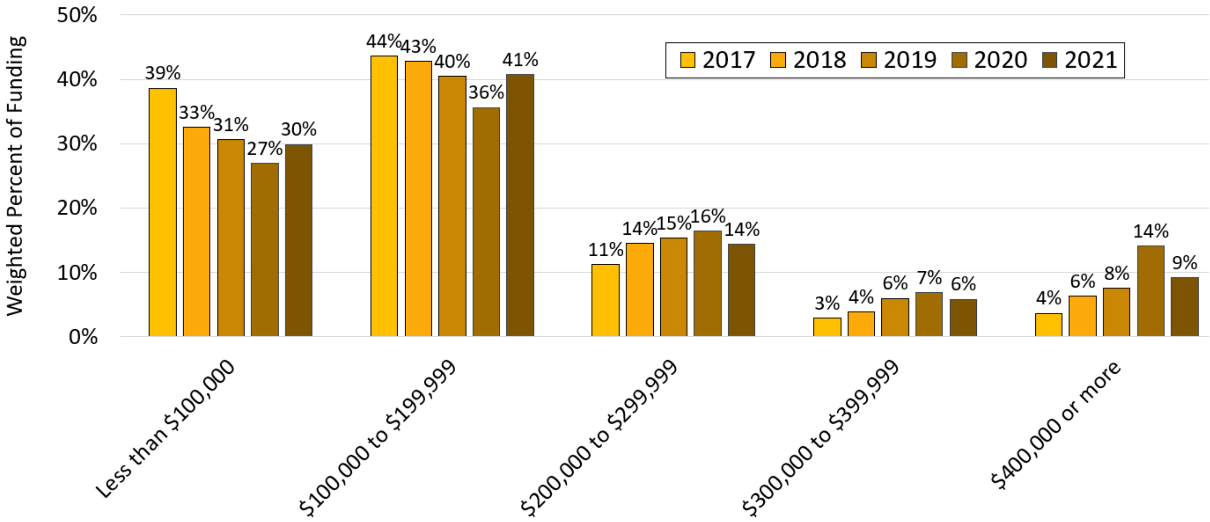

**Each vehicle was assigned the minimum MSRP for that model as described in the methods section.*

**Figure 2: Moderately priced vehicles received most rebates**

Overall, it is notable that, despite dramatic reductions in battery costs, average vehicle *prices* seen by rebated consumers (particularly non-Tesla consumers) remained largely steady in the early years of the market and have increased in recent years [21]. The relative consistency of prices over time can be attributed to automakers reinvesting cost savings in other priorities, such as increased vehicle range, amortization of R&D expenditures, reduced cross-platform subsidization of EV losses, and so forth [8,21,22]. The recent price increases may be related to chip shortages, other supply-chain challenges, and other precursors to broader inflationary pressures as the pandemic progressed. Further, the program noticed significant dealer markups (e.g., $5,000) starting in late 2020. Regardless of the reasons, consumers continue to face challenges when it comes to the affordability of EV acquisition. Just because battery costs fall, if vehicle prices do not, the need for upfront purchase-price incentives may remain. Policy support may remain necessary even on a simple techno-economic basis, setting aside the various other reasons upon which public support of a transformative technology may be considered justified (e.g., rapid market acceleration, equity, supply-chain maturation).

### 3.3 Who do rebates benefit?

For 2021 purchases/leases, nearly 71% of rebate funding went to households with annual incomes totaling less than $200,000. When grouped into $100,000 buckets (Fig. 3), nearly 41% of rebate funding fell within the mode ($100,000–$199,999), and households with incomes below $100,000 claimed 30%. (As will be explained below, roughly 49% of new-vehicle buyers in New York are estimated to be in households with income below $100,000.) Nine percent of funding went to households with incomes over $400,000. Note that 11% percent of *rebates* went to households over $400,000, but 9% of funding did, indicating the impact of the reduced rebate for luxury vehicles. (Note too that when high-income households purchase non-luxury vehicles, they increase the volume of non-luxury EV sales and thus, in due course, increase the supply of affordable used EVs.)




*NYSERDA Consumer Survey. 2017(Mar.–Dec.)* n *= 842. 2018* n *= 1,813. 2019* n *= 1,817. 2020* n *= 2,852. 2021* n *= 4,237.* n*-values are filtered and question-specific.*

**Figure 3: Plug-in EV household income: Distribution of funding over time**

Figure 3 also illustrates a shift to higher incomes from the program launch in March 2017 through 2020. The first portion of that shift may be reflective of vehicle price dynamics surrounding the introduction of the relatively high-priced Model 3, which came to dominate the program over time. Few Teslas were rebated by the program in its first partial year (2017), and it was not until Q4 of 2018 that Model 3 rebate volumes began to pick up. Volumes doubled from 2018 to 2019 and continued to grow, but at a decreasing rate, into 2021 (by which time Model Y volumes had grown considerably). The Model 3 did decrease in price but never reached levels consistent with average non-Tesla EV price levels before its introduction; rather, non-Tesla EV prices rose to a certain degree to match the Model 3 prices (and range) [12,23]. The latter portion of the shift, reflected in the large drop between 2019 and 2020 in the share of participants with household incomes below $200,000 per year, may have been the combination of that ongoing growth in Tesla's market share with the effects of COVID-19. With a widespread drop in economic activity and great uncertainty about the future, it is not surprising that higher-income households would be in a better position to participate in the EV market during the first nine months of the pandemic. Nevertheless, while the pandemic continued into 2021, the rebate program's income distribution rebounded quickly in that year to match 2019 percentages. There has been some discussion in the media that the air-quality benefits visible during COVID-19's mobility downturn might help spur a desire for clean technologies (for those in a position to invest in them). Perhaps more broadly, assuming considerable COVID-based risks and uncertainties remained for most individuals in

2021, the rapid bounce back in the income distribution may indicate that EV markets have been accelerating and, in the absence of the pandemic, might have progressed even further into the mainstream.

Despite the partial bounce back in 2021, overall, participant incomes have retreated up and away from the lower incomes of mainstream car consumers rather than advanced toward them. (Progression toward the mainstream was observed in income metrics characterizing California's rebate program in 2013–2020 [11,24].) Any overall progression in the EV market in New York may have been obscured, as just discussed, by both 1) the growth in the market-share dominance of still expensive Tesla products that have attracted the most consumers into the EV market in recent years and 2) the risks and uncertainties created by COVID-19 that changed the composition of market participation in general. But have these factors inhibited the progression of EV consumer characteristics toward the mainstream in ways other than income? More broadly, how do program participants compare to mainstream car buyers and other populations of interest? What metrics can help calibrate our understanding of the progression of EV markets toward, and distance yet remaining to, the mainstream?

Table 3 helps quantify and calibrate progress toward the mainstream along various consumer dimensions. First, to provide an appropriate baseline of comparison, each row in Table 3 starts with a "majority characteristic" of the new-vehicle-buying population in New York; at least half of new-vehicle buyers fall into the category described in the first column (in blue). For example, the majority of new-vehicle buyers in New York are over 40 years of age. The precise percentage of new-vehicle buyers falling into that "majority category" is provided in the fourth column (also in blue). For example, 70% are 40 years or greater in age. Leading up to those percentages are comparable percentages for rebated EV consumers (in gold). (Note that Table 3 shows the percent of *rebates*, whereas Figure 3 showed the percent of funding, leading to some differences between the income metrics presented in each.)

**Table 3: Assessing EV rebate recipient differences with appropriate comparisons: Some differences between rebate recipients and new-vehicle buyers have faded away, while others remain**

| | NY DCRP, Purchase/Lease Year: (weighted consumer survey results) | | | | | NY New-Vehicle Buyers | NY Population  |
|---|---|---|---|---|---|---|---|
| The majority of new-car buyers | 2017* n = 1,014 | 2018 n = 2,210 | 2019 n = 2,250 | 2020 n = 3,480 | 2021 n = 5,087 | MYs 2016–17 (2017 NHTS) | (Census 2020) |
| Selected solely white/Caucasian | 86% | 82% | 78% | 75% | 75% | 75% | 55% |
| ≥ 40 years old | 79% | 76% | 74% | 71% | 71% | 70% | 49% |
| ≥ Bachelor's degree | 73% | 80% | 77% | 80% | 78% | 65% | 29% |
| Own residence | 90% | 90% | 88% | 85% | 83% | 75% § | 54% § |
| ≥ $100k household income | 63% | 68% | 69% | 72% | 71% | 51% § | 36% § |
| Selected male | 68% | 71% | 73% | 75% | 68% | 51% | 49% |

** From program launch in March 2017. § Based upon household-level data.*
*"Prefer not to answer," "I don't know," and similar responses are excluded throughout.*

By examining the progression of the percentages in gold over time, Table 3 shows that program participants have steadily progressed and come to resemble new-vehicle buyers as a whole on two dimensions examined: 1) the portion identifying solely as white race/ethnicity and 2) the portion over 40 years of age. A similar steady progression *toward* equivalency with the mainstream can be seen in home ownership, but, as of 2021, program participants still more frequently owned their residence than new-vehicle buyers as a whole.

On the other hand, the metrics used in Table 3 for household income and sex/gender both retreated away from the mainstream through 2020. This is consistent with an increasing prevalence of Tesla consumers, which have been found in New York to be more frequently male and/or have higher incomes [25]. (Interestingly, the same can be said of race/ethnicity and home ownership—Tesla consumers less frequently identify solely as white and, despite more frequently having higher incomes, have been associated with less frequent home ownership than other EV consumers [26].) However, the retreat reversed in 2021, as did Tesla's share of rebates. In the case of sex/gender identification, program participants ended closer to the mainstream than in 2018 when the retreat began. This latter finding is also notable because the predominance of male sex/gender has been one of the largest and most persistent differences between EV consumers and new-vehicle buyers across multiple state programs and over time [11,12,20,24]. Nevertheless, substantial absolute differences remain for the income and sex/gender metrics.

Turning attention from the trends over time to the absolute difference remaining—or the "length of the road ahead" to reach the mainstream [20,24]—Table 4 focuses on 2020, the most recent year of census data available at the time of analysis. By comparing the DCRP percentages (in yellow) and the new-vehicle buyer percentages (in blue), Table 4 helps update the answer to an important equity question: To what extent are EVs and rebates disproportionately benefiting the majority (e.g., white, male, older, higher income, etc.)?

In the media and third-party research evaluating EV rebates, such questions are typically answered using more readily available information, such as census data (e.g., [7,10]). Note how different the new-vehicle-buyer metrics in Table 4 (in blue) are when compared to similar metrics developed using census data (in grey in the last column). For example, compared to the 70% of new-vehicle buyers who were 40 years or greater in age, only 49% of the 2020 New York State population fell into that category. Table 4 thus helps answer another important question: How misleading might comparisons to census data be?

**Table 4: Assessing EV rebate recipient differences with appropriate comparisons: Population statistics do not tell the story accurately**

| The majority of new-car buyers | Drive Clean Rebate Program 2020 purchases/leases *n* = 3,480 | Portion of total difference attributable to EVs | NY New-Vehicle Buyers MYs 2016–17 (2017 NHTS) | Portion of total difference explained by car buying | NY Population 2020 (Census) |
|---|---|---|---|---|---|
| Selected solely white/Caucasian | 75% | ← 0% → | 75% | ← 100% → | 55% |
| ≥ 40 years old | 71% | ← 5% → | 70% | ← 95% → | 49% |
| ≥ Bachelor's degree | 80% | ← 29% → | 65% | ← 71% → | 29% |
| Own Residence | 85% | ← 32% → | 75% § | ← 68% → | 54% § |
| ≥ $100k Household Income | 72% | ← 58% → | 51% § | ← 42% → | 36% § |
| Selected Male | 75% | ← 92% → | 51% | ← 8% → | 49% |

*§ Based upon household-level data.*
*"Prefer not to answer," "I don't know," and similar responses are excluded throughout.*

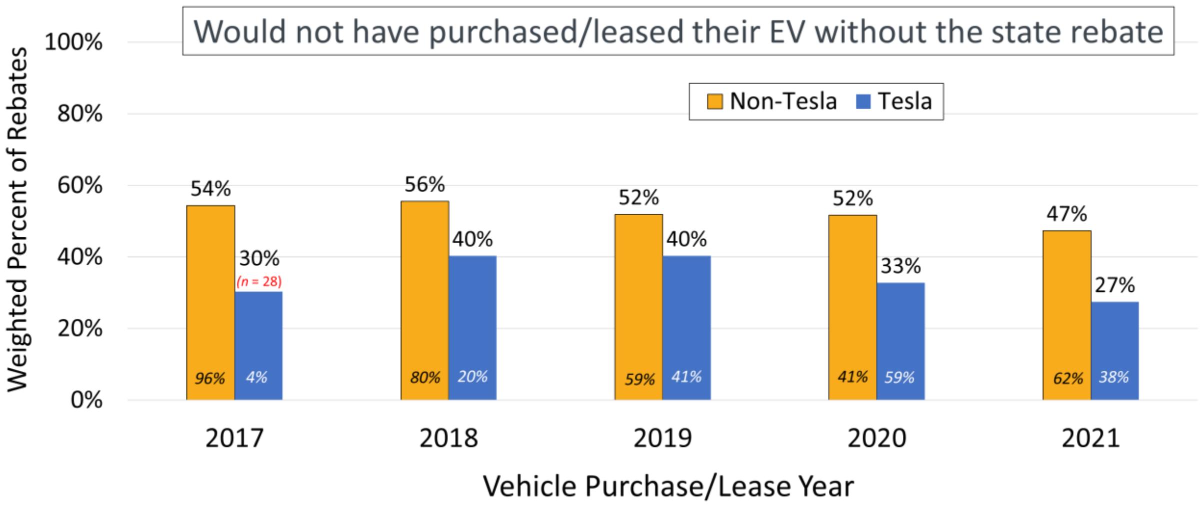
The characteristics in the top rows of Table 4 are those where rebated EV consumers (in gold) already resemble new-vehicle buyers (in blue), and findings of differences based on census data may more simply be attributed to the structural inequities in new-car buying rather than particular to EVs (the difference between the values in blue and grey). The characteristics at the bottom of the table are those where differences particular to rebated EV consumers remain prominent. Depending on the characteristic, up to 100% of the difference between rebate recipients and the population can be explained by new-vehicle buying. For example, 42% of the income difference in 2020 was not particular to EVs (but a sizable distance remains).

## 3.4 Are rebates effective and impactful?

Do rebated EVs replace older vehicles or are they potentially less-impactful additions to household fleets? Consistent with other states over time [27–29], EVs in New York have been *replacing* vehicles at high rates (80% in 2021). This fell somewhat during COVID-19 (from 84% in 2019 to 79% in 2020). Are rebated vehicles replacing more polluting vehicles? In 2019 (a more recent analysis is forthcoming), four-fifths of replaced vehicles were gasoline-fueled (including conventional hybrid). Over one-fourth were at least 15 years old and over one-half were at least 5 years old.

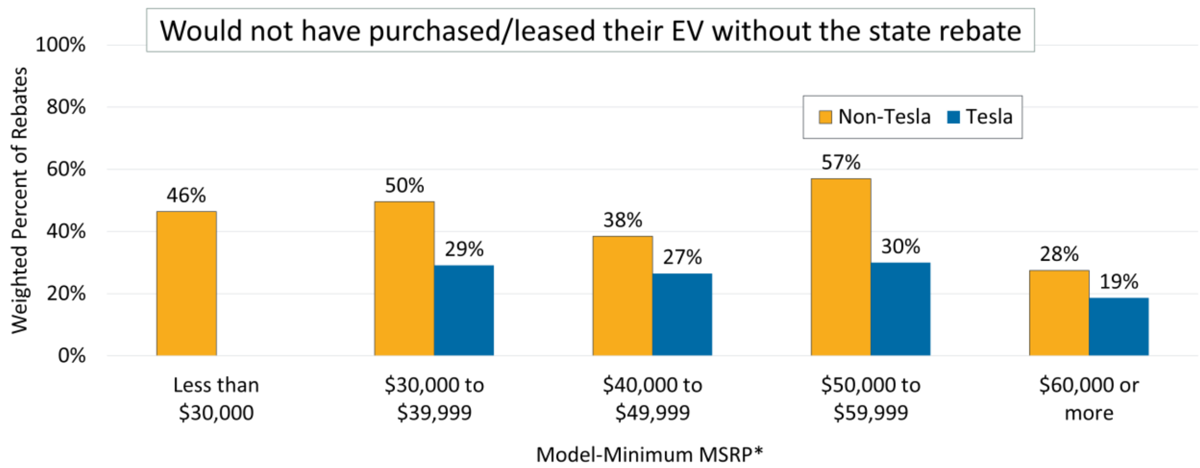
Are rebates influential? In 2021, 87% of rebate recipients rated the rebate “Moderately,” “Very,” or “Extremely important”—specifically in the context of making their EV acquisition *possible*. This is up from 85% in 2020 during the onset of COVID-19. So-called *Rebate Importance* is a metric that has exhibited reasonable behavior and proved useful across multiple state programs. Nevertheless, it can mean different things to different consumers and can be confounded by the influence of other factors.

Using a more direct and counterfactual metric that speaks more specifically to the influence of the rebate in isolation of other factors, “*Rebate Essentiality*” [30], 40% of consumers rebated for 2021 purchases/lease claimed they would not have purchased/leased without the rebate. This overall *Rebate Essentiality* percentage is lower (27%) for Tesla consumers and higher (47%) for non-Tesla consumers (Fig. 4).




*NY DCRP Consumer Survey. Mar.–Dec. 2017 n = 1,012. 2018 n = 2,201. 2019 n = 2,245. 2020 n = 3,401. 2021 n = 5,081. n-values are filtered and question-specific. 2020 & 2021 weights specific to 2020 & 2021 purchases/leases, respectively. Italicized percentages inside columns are the percent of total rebates given to individual consumers.*

**Figure 4: *Rebate Essentiality* over time: Decreased for Tesla in 2020 and overall in 2021 but remains high**




**Each vehicle was assigned the minimum MSRP for that model as described in the methods section*
*$n \geq 75$ for all columns. NY DCRP Consumer Survey. Filtered, question-specific n = 5,081.*

**Figure 5: *Rebate Essentiality* decreases above $60,000 model-minimum MSRP (2021 purchases/leases)**

Rebate influence decreased from 2018 to 2019 for non-Tesla consumers and from 2019 to 2020 for Tesla consumers (while Tesla predominance grew). Notably, unlike other metrics—like those for *Rebate Importance*, income (Fig. 3), and sex/gender (Table 3)—which “bounced back” from 2020 to 2021, *Rebate*

*Essentiality* decreased again in 2021. Perhaps this indicates a growing intrinsic interest in, and attractiveness of, EV products that is doing some of the work that might otherwise have to be done by the incentive.

Expectedly, 2021 *Rebate Essentiality* also decreases for luxury EVs, specifically those with a model-minimum MSRP above $60,000 ($60k) (Fig. 5). Interestingly, rebate influence remains high for vehicles in the $50k–60k category. Recalling the price dynamics described earlier and the new prevalence in 2021 of rebated EVs in this category, the Tesla Model Y has similar *Rebate Essentiality* as the Model 3, but non-Tesla products (and those price competitive with the Model Y in particular) much more frequently depend on the incentive to encourage adoption. This is the case for the newer Jeep Wrangler 4xe, which comprises the largest share of the non-Tesla rebates in the $50k–60k category.

Collectively, the patterns observed in *Rebate Essentiality* and other metrics of rebate influence can help program design, outreach, and other supportive measures to focus resources on those most highly influenced to adopt, thereby increasing program cost-effectiveness [8,20,30].

# 4 Summary & Conclusions

Building and expanding on past rebate program evaluation of similar impacts in California, Massachusetts, and New York (e.g., [12,16]), this is the first such examination of 2021 electric vehicle purchases and leases and rebate impacts for any of those states. It utilizes data characterizing nearly two-thirds of the EV market in New York from the time of program launch in March 2017 through the end of 2021. It focuses on important questions relating to rebate influence, incidence, beneficiaries, and impact. The metrics developed should be interpreted and compared to other findings in the context of various factors, including: the state's cold-weather climate (which reduces electric range), the market-disrupting release of the Tesla Model 3, the economy-disrupting impacts of the onset of COVID-19, and NYSERDA's point-of-sale, uniquely-designed, and dealer-based rebate program.

Originally dominated by plug-in hybrid EVs (61% through 2019), the majority of rebates flipped to Tesla battery EVs during the onset of COVID-19 in 2020 (59%). It then balanced out in 2021 to slightly favor PHEVs (42%) over Tesla BEVs (38%) in 2021. Even as Tesla vehicles came into preeminence, consistently more than 45% of rebated vehicles had model-minimum MSRPs between $30,000 and $40,000, before incentives. Surprisingly, the overall distribution of rebates by MSRP remained similar through model year 2020 and the onset of COVID-19, with 72% under $40k in that model year. The trend did not break down until MY 2021 with the rise of the more expensive Model Y to 23% of the rebates, which was the primary factor reducing the portion of the program under $40k to 60%.

The income of consumers in a position to participate in the EV market and receive a rebate, however, did reach all-time highs during the uncertain times of 2020, but bounced back down to 2019 levels in 2021. In 2021, 71% of funding went to households with annual incomes less than $200k.

How do rebate recipients compare to new-vehicle buyers in New York as a whole? Table 4 shows that EV rebate recipients are comparable to new-car buyers on certain metrics of race/ethnicity and age. Note that this may not be the case for *other* metrics. For example, the distribution of rebates is in proportion to new-vehicle markets in terms of the percentage of consumers who do not identify solely as white, but the distribution among more specific categories, such as Black or Hispanic and/or Latinx/Latino/Latina consumers, may not be. Table 4 thus calibrates the conversation and encourages it to move on to the next layer of a deeper, more nuanced discussion of race/ethnicity.

In terms of the other characteristics in Table 4: graduate degrees and home ownership are somewhat more frequent among rebate recipients, whereas household income >$100k and male gender are much more frequent. Male gender in particular is a predominant and persistent difference over time in other states as well [11,12,20,24]. One of the factors underlying this was a trend reversal away from slow but steady increases in female prevalence. The reversal was driven by the growing predominance of Tesla products, which appears to be causing a shift back toward higher percentages of both male participation and higher incomes (but, interestingly, also toward renters and non-white race/ethnicity) [25].

It is important to note that these comparisons to new-vehicle buyers paint a different picture than comparisons that are commonly made using census data. New-vehicle buyers (the pool of consumers from which the rebate program draws) can be quite different from the population as a whole. Using 2020 data for example, depending on the characteristic, up to 100% of the difference between EV rebate recipients and the population can be explained by structural inequities in new-vehicle buying (Table 4). Forty-two percent of the income difference was not particular to EVs. On the other hand, the real *distinguishing* characteristic about EV rebate recipients filling out program surveys appears to be the high frequency of identification as male—even when compared to new-vehicle buyers and despite the significant step made toward the mainstream in 2021. More generally, metrics and baselines of comparison like those in Table 4 can help quantify the "length of road yet to travel" for electric vehicle markets as they march toward the mainstream and beyond to priority populations and more equitable access to the benefits of transportation electrification.

In the meantime, are rebated EVs impactful? Most rebated EVs have replaced older, more polluting vehicles. Replacement rates remain high (84% in 2019) but fell off somewhat from their peak during the onset of COVID-19 (79% in 2020 and 80% in 2021). Four-fifths of replaced vehicles were gasoline-fueled (including conventional hybrid) in 2019 (more recent analysis forthcoming). Over one-quarter were 15+ years old and over half were 5+ years old. Similar overall statistics for California characterize a program that has been shown to be cost-effective at reducing greenhouses gases (GHGs) when evaluated in greater detail using case-specific inputs [31,32]. Further exploration of vehicle replacement in California can be found in [28,33].

Similar parallels between rebate influence in New York and California at the onset of COVID-19 can be seen when examining analysis herein to that for California [8,34]. *Rebate Importance*, 89% in 2019 in both states, fell in 2020 (to 85% in New York and 82% in California). Newer data in New York show this bouncing back toward 2019 levels in 2021 (87%). On the other hand, *Rebate Essentiality* remained strong through 2020 for non-Tesla consumers in both states, particularly in New York where it maintained 2019 levels (52%). Not until 2021 did *Rebate Essentiality* ease for non-Tesla consumers in New York (from 52% to 47%). Tesla consumer *Rebate Essentiality,* however, experienced historic declines in 2020 in both states, falling from 40% to 33% in New York and even further in California (from 49% to 31%). Newer data in New York show Tesla *Rebate Essentiality* continued to fall in 2021, to an all-time low of 27% (Fig. 4). It will be illuminating to further unpack that decline in future analysis (ideally using logistic regressions that assess a variety of factors simultaneously). For example, to what degree is this related to Tesla consumer income, vehicle range [30], car vs. SUV body styles [8], and other factors? Interestingly, however, the decline does *not* appear to be related simply to vehicle price, as Tesla *Rebate Essentiality* dropped relatively uniformly across MSRP levels from 2020 to 2021 and has been relatively constant across MSRP levels all the way up to $60k in both years. Indeed, the Tesla consumer *Rebate Essentiality* was as high for the $50k–60k category (i.e., the Model Y) as it was for any MSRP category in 2021 (30%). Relatedly, rebate influence is strong all the way up to $60k for non-Tesla consumers, and also peaks in the $50k–60k category (57%). This remarkably high level appears to be driven by new product offerings, in particular the Jeep Wrangler 4xe, that are emerging and apparently still heavily dependent on the rebate to help them win over consumers. Regardless, *Rebate Essentiality* drops substantially for all vehicle types above $60k in both New York (Fig. 5) and California [8], supporting program designs that limit or restrict rebates for luxury vehicles above that level.

The level of, and patterns observed in, *Rebate Essentiality* can help efforts focus resources on those most highly influenced by the rebate to adopt, thereby increasing program cost-effectiveness [8,20,30]. More broadly, metrics like those examined here characterizing rebate influence, impact, incidence, and progress toward the mainstream collectively inform program design, outreach, and other supportive measures to commercialize EVs effectively, impactfully, and equitably.

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