

**Impact of the Clean Vehicle Rebate Project's increased outreach on California's ZEV Market****ISSUE PAPER**  
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A research summary whitepaper for the California Air Resources Board\*

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**ABSTRACT**

This paper reviews and summarizes the research regarding California's Clean Vehicle Rebate Project's (CVRP) increased outreach efforts that began in 2016. Due to the recent nature of the program, no peer-reviewed research has been published about the specific effects of CVRP. Consequently, we review the literature regarding similar past and present programs and the success or failure of their outreach efforts. We also consider studies that identify the marked importance of outreach on the efficiency of an incentive program. While we are limited in determining the specific effects of CVRP's increased outreach, the literature suggests that outreach can have either a positive or negative effect on individuals' purchase intentions. This paper also recommends future research to identify the specific impacts of CVRP's outreach efforts.

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## 1 Purpose

Assembly Bill (AB) 615 requires the California Air Resources Board (CARB) to “prepare and submit to the Legislature a report on the impact of the Clean Vehicle Rebate Project [CVRP] on the state’s zero-emission vehicle market...The report shall include, but is not limited to, the impact of income caps, increased rebates for low-income consumers, and increased outreach on the electric vehicle market.” This whitepaper supports CARB in fulfilling AB 615’s mandate by assessing the impact of CVRP implementation and increase of income caps in 2016. The assessment is based on a review of literature related to zero-emission vehicle (ZEV) incentive programs, including general findings, research gaps, and policy implications of both.

## 2 Policy description

California is a leader on combating climate change. The state has set bold goals of reducing statewide greenhouse gas (GHG) emissions to 80% below 1990 levels by 2050, as well as achieving 5 million ZEVs on the road by 2030. Reaching these goals will require effective policies and programs and periodic assessment of both. A key state effort to incentivize ZEV adoption, and thus reduce emissions from the light-duty transportation sector, is the CVRP.

The CVRP was created by AB 118 in 2007 to incentivize ZEV purchasing and leasing. The CVRP’s primary purpose is to support widespread commercialization of the cleanest vehicles by helping to motivate consumer purchase decisions. The program was originally designed to be “first-come, first-served” and only expected to be funded through 2015. Consequently, the program had no means-testing requirement at its inception, leading to a significant portion of incentives concentrated among high-income individuals.<sup>1</sup>

Senate Bill (SB) 1275, passed in 2014, was designed to address these issues. SB 1275 required CARB to develop a plan for realizing California’s then-goal of achieving 1 million ZEVs on the road by 2023 without excluding low-income individuals. This bill required CARB “to adopt, no later than June 30, 2015, specified revisions to the criteria and other requirements for the Clean Vehicle Rebate Project; and to establish programs that further increase access to and direct benefits for disadvantaged, low-income, and moderate-income communities and consumers from electric transportation.”<sup>2</sup> In March 2016, acting on CARB’s recommendations, the CVRP expanded its general outreach efforts. Specifically, as stated in the CVRP 2014–2015 report, the Center for Sustainable Energy (CSE) “hired additional staff with experience in outreach to disadvantaged populations and developed a set of outreach and education activities to meet the needs of this population, while continuing general consumer outreach and education to car-buying consumers.” As a result of this effort, CVRP outreach increased from 3,600 direct interactions with stakeholders in 2013 to 13,000 in 2014.

CVRP outreach included working with community-based organizations to host more ZEV “ride-and-drive” events in low-income areas and to increase participation in such events. CVRP also expanded outreach to car dealerships in low-income areas and created a new webpage designed to provide low-income consumers with information about purchasing EVs. In 2018, CARB, in collaboration with California’s Department of Motor Vehicles (DMV), included information about ZEV purchase incentives in 700,000 DMV title notices distributed to vehicle owners who had either purchased their vehicles outright or had finishing paying off their car loans.

## 3 Designing incentive programs

As seen in Figure 1, incentives are critical for spurring increased adoption in the first three generations of plug-in electric vehicles (PEVs).<sup>3</sup> Well-designed incentives should be efficient and equitable. Increasing ZEV incentive efficiency requires increasing the percentage of recipients who are induced to purchase a ZEV because of the incentive while decreasing the percentage of recipients who would have purchased a ZEV anyways. Increasing ZEV

<sup>1</sup> Means testing is any requirement for a program that uses an individual’s financial status to determine eligibility (normally income subset by tax filing status).

<sup>2</sup> It should be noted that while CVRP was an integral part of the state’s efforts to increase ZEV adoption, the program was not the sole focus of SB 1275. For example, the mandate helped lead to the creation of EFMP Plus-Up, BlueLA, and Our Community Car Share.

<sup>3</sup> PEVs are a subset of ZEVs that excludes fuel-cell vehicles.

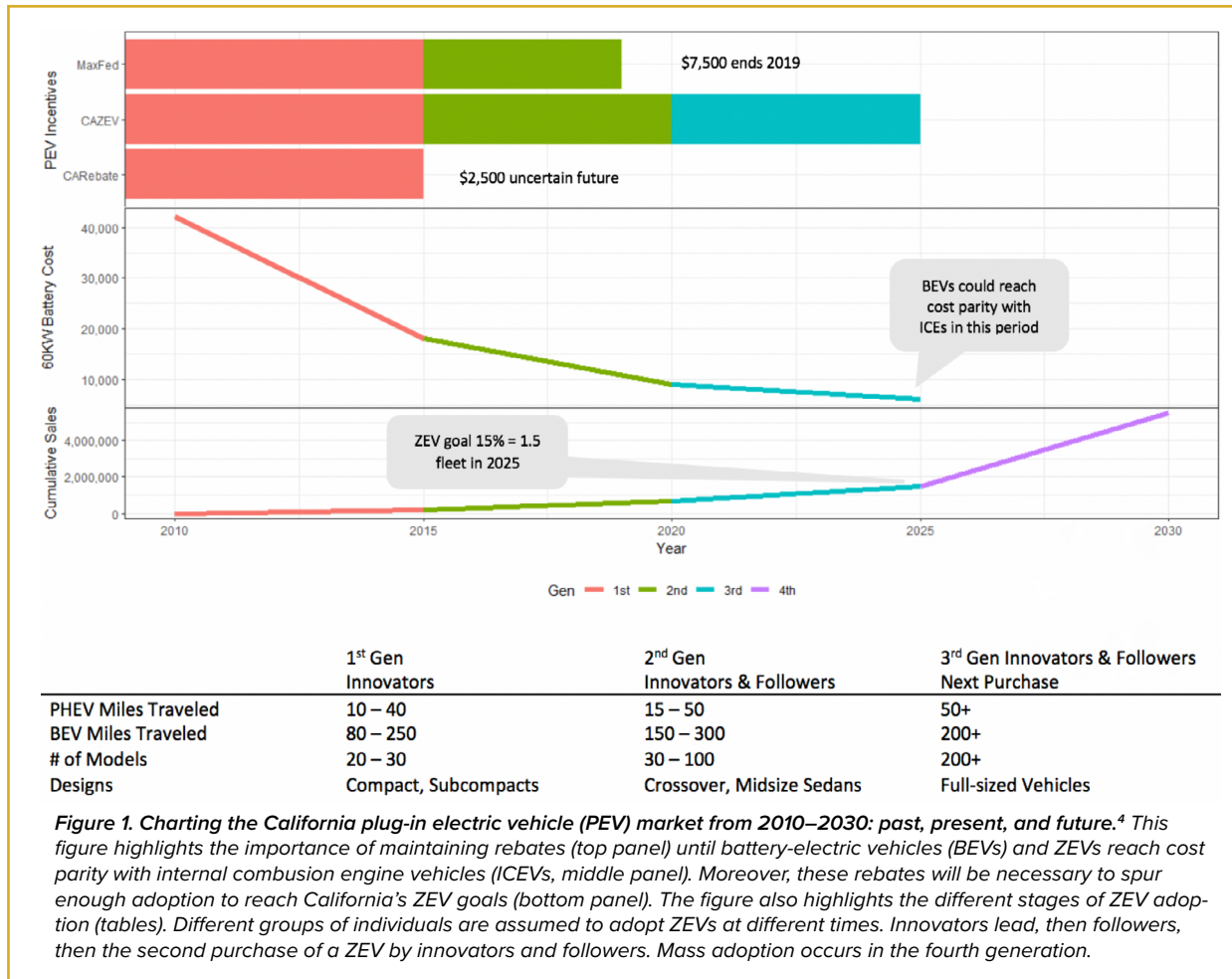


Figure 1. Charting the California plug-in electric vehicle (PEV) market from 2010–2030: past, present, and future.<sup>4</sup> This figure highlights the importance of maintaining rebates (top panel) until battery-electric vehicles (BEVs) and ZEVs reach cost parity with internal combustion engine vehicles (ICEVs, middle panel). Moreover, these rebates will be necessary to spur enough adoption to reach California’s ZEV goals (bottom panel). The figure also highlights the different stages of ZEV adoption (tables). Different groups of individuals are assumed to adopt ZEVs at different times. Innovators lead, then followers, then the second purchase of a ZEV by innovators and followers. Mass adoption occurs in the fourth generation.

incentive equity means ensuring that incentives are evenly distributed across a range of demographics, especially income. These two objectives often go hand-in-hand, as low- and moderate-income individuals are the most likely to be influenced by incentives that reduce the financial impact of buying a ZEV. Failing to reach low- and moderate-income individuals will likely result in California missing its 5 million ZEVs by 2030 goal.

Multiple options exist for tackling both of these significant issues. Some have already been implemented in other states, such as manufacturer’s suggested retail price (MSRP) caps on EV rebates in New York, Massachusetts, and Connecticut.<sup>5</sup> Two different approaches were implemented in California in 2016: (1) income caps and (2) increased incentives for low- and moderate-income individuals. Income caps are designed to prevent subsidizing ZEV purchases for high-income individuals, since these individuals have the means to purchase a ZEV without assistance and will hence ascribe less value to financial purchase incentives. By preventing resources from being “wasted” on the wealthy, income caps increase incentive availability for low- and moderate-income individuals. This increases incentive efficiency and equity alike.

Another critical determinant of incentive efficiency and equity is outreach. For incentives to reach target populations, individuals in those populations must be aware of both the qualifying product and the existence of the incentive. Hence outreach around ZEVs in general as well as ZEV purchase incentives is an essential aspect of efforts to increase ZEV deployment.

<sup>4</sup> Figure adapted from Turrentine et al. (2018). Note that CAZEV is comprised of all CA ZEV programs, including CVRP.

<sup>5</sup> MSRP caps essentially prevent expensive ZEVs like the Tesla Model X from qualifying for rebates, such that cheaper vehicles like the Chevy Bolt are the only subsidized ZEVs. These caps are designed to encourage manufacturers to produce vehicles that are more accessible to low- and moderate-income individuals. MSRP caps do not preclude high-income individuals from purchasing (and realizing subsidies on) eligible vehicles.

This whitepaper focuses on literature and analysis relevant to the potential impacts of increased CVRP outreach. For more information on CVRP's means-testing policies, see the other this series: "[Impact of the Clean Vehicle Rebate Project's Income Cap on California's ZEV Market](#)" and "[Impact of the Clean Vehicle Rebate Project's Increased Rebates for Low- and Moderate-Income Individuals on California's ZEV Market.](#)"

## 4 Key findings

These are the top findings based on our review of relevant literature.

- Awareness of electric vehicles (as measured by individuals' knowledge of at least one EV) is low, even in California.
  - Awareness of EVs (as defined by the ability to correctly name a single available model) in California has not increased between 2014 and 2017.<sup>6</sup>
- Investment in outreach likely needs to be significantly higher than current levels to match general vehicle advertising expenditures.
- Dealers have very low levels of knowledge about and interest in selling ZEVs.
  - Selling ZEVs has potential to deliver financial benefits for car dealerships, but this potential is largely unrealized due to a lack of knowledge at most dealerships and a lack of ZEV sales incentives (Cahill 2015; Lunetta & Coplon-Neufield 2018; Matthews et al. 2017).
- Using EVs (e.g., through test drives) can increase the strength of positive consumer impressions (Buhler et al. 2014; Rezvani et al; Skippon et al. 2016). Test drive can also increase purchase intentions (Schmalfuss et al. 2017).
  - One study found a decrease in purchase intentions, but an increase in positive impressions after significant EV usage (Skippon et al. 2016).
- Range anxiety is a significant barrier to ZEV adoption for most individuals (Egbue & Long 2012; Franke & Krems 2013; Rauh et al. 2015).
  - Individuals tend to overestimate their actual range needs. Testing an EV can help alleviate range anxiety (Franke & Krems 2013; Rauh et al. 2015).
- "Green" characteristics of EVs only address a small segment of consumers. General uncertainty about EVs deters potential buyers (Egbue & Long 2012; Ottman et al. 2006; Rezvani et al. 2015).
  - Providing information on the full costs of ownership for EVs relative to ownership of conventional vehicles is more effective in increasing EV adoption than providing information on relative fuel costs alone (Dumortier et al. 2015; Sanguinetti et al. 2017).

In sum, the research indicates major awareness and engagement issues when it comes to consumer perception of EVs. Even in California, most people have very low levels of engagement with EVs. This problem is compounded by the fact that most car dealerships exhibit a low level of education and enthusiasm around EVs. The literature is less conclusive when it comes to the effectiveness of specific outreach efforts. Some studies have shown that using an EV increases an individual's willingness to buy, but at least one study found that the opposite is true. Many people exhibit "range anxiety" when it comes to EVs, though people tend to overestimate their range needs. Giving people the opportunity to test EVs in person can help people learn their true range needs and hence alleviate range anxiety. Some studies have found that stressing the environmental benefits of EVs increases the likelihood of consumer adoption, while other studies have found the opposite (Rezvani et al. 2015; Ottman et al.

<sup>6</sup>For more on this topic, see the UC Davis Institute of Transportation Studies blog post "[Automakers and Policymakers May Be on a Path to Electric Vehicles; Consumers Aren't.](#)"

2006). Adoption tends to increase when individuals have high self-congruity<sup>7</sup> and when environmental issues are salient (Rezvani et al. 2015). Adoption tends to decrease when environmental issues are overemphasized. This may be due to a “crowding out” of information about the significant cost-savings that EVs can offer (Ottman et al. 2006).

One common thread in the outreach literature is that information is important. Providing comparisons of total costs of ownership between EVs and conventional vehicles (Dumortier et al. 2015) and having informed car salesmen selling EVs (Cahill 2015; Matthews et al. 2017; Lunetta & Coplon-Neufield 2018) have been demonstrated to increase ZEV adoption. Information about the total cost of ownership is particularly important for potential buyers, and has more influence over purchase decisions than information about only fuel costs (Dumortier et al. 2015). One study suggests that providing potential buyers with information about total cost of ownership may help overcome initial “sticker shock” at high ZEV purchase and lease prices (Rezvani et al. 2015). The amount of knowledge that car dealerships and salespeople have on EVs is a second key determinant of EV adoption. The likelihood that a consumer purchases an EV drops significantly if the consumer interacts with an uninformed dealership (Cahill 2015; Matthews et al. 2017; Lunetta & Coplon-Neufield 2018). Data from future outreach efforts will be very helpful in determining best practices for increasing ZEV engagement and awareness.

## 5 Policy implications

### Low awareness is a key barrier to EV deployment, increasing the importance of outreach

Awareness of and engagement with ZEVs are precursors to ZEV purchases. Unfortunately, ZEV awareness and engagement remains low, even in California. Awareness and engagement levels have remained stagnant over the past several years, even as EV deployment has increased severalfold. If outreach does not expand soon, adoption rates will decrease as the pool of informed potential buyers who have not yet purchased a ZEV diminishes. Several studies have observed that people often learn about clean energy technology, including EVs, from others in their social group (such as neighbors and friends). Leveraging social effects could be useful in ZEV outreach efforts.

### Focusing on cost savings may help spur EV purchases for those who are already aware of EVs

For the minority who are already aware of EVs, outreach can increase propensity to purchase. Some studies have shown that the most effective outreach methods for these consumers focus on the financial benefits of EV ownership relative to conventional vehicles, though the literature in this area is inconclusive. Findings are convincing enough to indicate that financial benefits of EVs should be included in outreach efforts along with environmental benefits.

### Evaluation should be included in outreach efforts

Very little quantitative information is available about the effects of various EV outreach efforts. No published study estimates the direct effects of increased ZEV outreach by CARB. Coupling outreach efforts with high-quality evaluation strategies is critical for accurate assessments.

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<sup>7</sup> Self-congruity is defined as the match between a brand image and an individual's self-concept (Sirgy and Su, 2000).

## 6 Highlighted works

This section summarizes some top findings and key methodological choices for studies reviewed in this whitepaper.

### General (non-California-focused) studies

#### **Bühler et al. (2014)**

**Study type:** Observed data analysis

**Geography:** Germany

The authors found that using EVs positively affects consumer perceptions of EVs and the likelihood that a consumer recommends an EV. This indicates that giving consumers an opportunity to test EVs in person is a good outreach and marketing strategy. The authors further found that using EVs does not significantly affect individual purchase intentions. Simply giving consumers EV testing opportunities does not appear sufficient to increase EV adoption.

#### **Dumortier et al. (2015)**

**Study type:** Survey (experimental)

**Geography:** United States

The authors found that providing information on the full cost of ownership for EVs relative to conventional vehicles led those who used small to mid-sized cars to have a higher probability of selecting an EV relative to providing information only on relative fuel costs. This result is not observed for those who use small sport utility vehicles. The authors conclude that providing full-cost-of-ownership information at point of sale could be very effective in selling more expensive EVs.

#### **Egbue & Long (2012)**

**Study type:** Survey, stated preference

**Geography:** United States

Using a survey, the authors attempted to identify “socio-technical” barriers to adoption of new EV technologies, with a focus on a likely first-adopter demographic: tech enthusiasts. The authors concluded that uncertainty around EV attributes (e.g., ranges, costs of ownership, reliability) impedes EV adoption. The authors further found that sustainability concerns are much less important for most potential EV buyers than cost and range concerns.

#### **Franke & Krems (2013)**

**Study type:** Experimental

**Geography:** Germany

The authors attempted to determine what factors influence range preferences for vehicles, including EVs. The authors found that people who have little to no experience with EVs tend to have preferences that far exceed their actual needs. The more exposure individuals have to using EVs, the closer their preferences become to reflecting their actual needs. This study suggests that consumer preferences for EV-relevant characteristics are malleable.

#### **Matthews et al. (2017)**

**Study type:** Qualitative data analysis

**Geography:** United States

The authors found that EV availability is limited at many dealerships and that EV salespeople frequently provide inaccurate information. This underscores the importance of dealerships and salespeople in driving or deterring EV adoption.

**Ottman et al. (2006)****Study type:** Qualitative data analysis**Geography:** United States

The authors discuss how marketing for certain products with distinct environmental benefits can overemphasize those benefits such that cost savings of using the product are neglected. This finding is highly relevant to outreach concerning EVs.

**Rauh et al. (2015)****Study type:** Experimental**Geography:** Germany

The authors compared 12 motorists who had high levels of experience with battery-electric vehicles (BEVs) to 12 motorists with no experience. The comparison centered on a test drive where the trip length exceeded the remaining range—i.e., a drive designed to lead to a “critical range situation.” The authors compared range appraisal and range stress (range anxiety) on cognitive, emotional, and behavioral levels between the two driver groups. They found that drivers with BEV experience exhibited far lower negative appraisals of range and range anxiety than those without experience. This indicates that experience with BEVs leads to a better understanding of and ability to adapt to range issues. This study also indicates that learned experience can decrease range anxiety.

**Rezvani et al. (2015)****Study type:** Literature review**Geography:** United States

The authors found that drivers of EV adoption include pro-environmental attitudes, symbolic meanings, identity, innovativeness, and emotions. The low cost of using EVs is a driver of positive feelings, but the high cost of purchase is a significant barrier. The authors found that using an EV positively affects consumer feelings towards EVs, but not enough to affect purchase intentions.

**Schmalfuss et al. (2017)****Study type:** Survey, stated preference**Geography:** United States

Using a survey and field test, the authors found that direct usage of EVs positively impacts preferences of EVs, including purchase intentions. This finding stands in direct contrast to Bühler et al. (2014) and Rezvani et al. (2015). Schmalfuss et al. also found that extending “trial periods” to individuals considering EV purchases could be a good marketing/outreach strategy.

**Skippon et al. (2016)****Study type:** Experimental**Geography:** United States

The authors used a randomized control trial of mass-market car consumers—where the treatment group was given a modern BEV and the control group given an equivalent combustion-engine vehicle—to determine the effect of exposure to BEVs on attitudes and purchase intentions. Although individuals’ self-reported feeling ratings of the BEV were higher than the ratings of the conventional vehicle, people’s willingness to adopt a BEV decreased overall after use. The exception was an increase in purchase proclivity among a subset of subjects who expressed high self-congruity, attributed to these individuals using the BEV to express their identity (i.e. using this vehicle outwardly tells others that the user is environmentally conscious).<sup>8</sup>

<sup>8</sup> Again, self-congruity is defined as the match between a brand image and an individual’s self-concept (Sirgy and Su, 2000).

## California-focused studies

### **Sanguinetti et al. (2017)**

**Study type:** Experimental

**Geography:** California

The authors evaluated an online tool called “EV Explorer” that enables personalized cost comparisons of different vehicles. The evaluation involved an online experiment that measured users’ perceptions of the tool. The authors found that tools like “EV Explorer” have significant positive effects on individual perceptions of EVs relative to conventional vehicles.

## Dealership studies

### **Cahill (2015)**

**Study type:** Observed and qualitative data analysis

**Geography:** United States

The authors found that due to a high learning curve on how to sell EVs and uncertainty in profiting from selling EVs, many dealers may choose to forego opportunities to sell PEVs or to make PEV-specific investments. Pervasive state franchise laws further ban manufacturers from selling PEVs directly to customers and restrict options by which manufacturers might bolster the PEV retail experience through existing dealer channels. This paper suggests (1) aligning government-funded incentive programs with industry practices through more “retail-friendly” policies, and (2) empowering manufacturers to pursue alternative market introduction approaches for distributing PEVs.

### **Lunetta & Coplon-Neufield (2018)**

**Study type:** Qualitative data analysis

**Geography:** United States

The authors examined consumer EV-shopping experiences in multiple states. The study was based on surveys conducted by volunteers who called or visited 308 different auto dealerships and stores across ten states to inquire about EVs. The report found that there is “tremendous room for improvement among the dealerships and the automakers” in providing information about EVs. The study did identify some dealers that provided excellent information. These dealers could serve as models for dealer outreach programs.

## 7 Ongoing research

Ongoing research at UC Davis related to outreach and awareness is focused on collecting data for California to continue tracking consumer awareness of PEVs, knowledge of incentives, and how changes in awareness and knowledge affect intent to purchase and actual purchase of PEVs. Early results show very limited changes in awareness levels between 2014–2017 and 2019. Early results also show static spatial differences in awareness levels between California and the United States. Because this may begin to change as EV deployment continues and further investments are made in awareness and outreach, more research in this area is key.

## 8 Research gaps

Gaps in the research that could be filled by more targeted research efforts resulting from collaboration between academic researchers and regulatory agencies include:

- Scientific evaluation of past and ongoing outreach investments (like nonprofit ZEV promoters Forth and Veloz).
- Research on best practices to inform dealers about EVs and incentivize selling.



- Further study of how to best ameliorate EV anxieties (e.g., range & high purchase costs).
- Direct evaluation of California investments in outreach.

Very little quantitative information is available about the effects of various EV outreach efforts. No published study estimates the direct effects of increased ZEV outreach by CARB. Coupling outreach efforts with high-quality evaluation strategies is hence critical. In most cases, the ability to conduct a high-quality evaluation will depend on the quality of data collected before, during, and after outreach. Specifically, tracking whether individuals who were contacted through outreach efforts ended up purchasing a ZEV is a very useful metric for determining outreach effectiveness. Surveying ZEV purchasers about what factors drove their purchase (e.g., rebate, overall cost of ownership, environmental impact) is also useful. Surveying dealerships that have high ZEV sales to find out what information they provide and how they provide it could help less-informed dealerships improve sales. Finally, surveying individuals who considered purchasing a ZEV but ultimately decided against it could help identify barriers to adoption that could be addressed through future outreach efforts.

Researchers should work with outreach providers to evaluate the effectiveness of a wide variety of outreach methods. One possible approach is giving some car buyers certain information about ZEVs information (e.g., total cost of ownership relative to conventional vehicles) while withholding such information from others. This would be an even more useful experiment if done at point of vehicle sale. Another approach is sending out mailers or hosting informational events in one area but not another similar area, to see if the general rate of EV purchases increases over a set time (i.e., a differences-in-differences approach).

Finally, there has yet to be any academic, peer-reviewed research on the effect of CARB's mailers on individuals' purchase intentions. This is a notable gap as specific research on outreach specific to California and/or the CVRP could and should inform any future state efforts.

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