

**Appendix C:**  
**Updated Three-Year Plan for CVRP and the ZEV Market**

As required by SB 1275 and the Supplemental Report of  
the 2018-19 Budget Act

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# Contents

<b>Introduction .....</b>	<b>2</b>
Overview .....	2
Statutory Goals and Requirements.....	2
Organization.....	3
<b>Evaluation of CVRP Funding Needs.....</b>	<b>3</b>
CVRP Projection Methodology .....	4
CVRP Funding Need for Next 3 Years .....	5
Impact of Proposed CVRP Program Changes on Funding Need.....	5
Trajectory Analysis to 2030 .....	6
Estimated Funding Need to Reach Five Million ZEVs.....	7
<b>ZEV Market and Technology Assessment .....</b>	<b>8</b>
Trends in the ZEV Market.....	8
ZEV Technology Assessment Update.....	9
Battery/Battery pack system cost and projections .....	9
Update on Incremental costs of PEVs.....	10
<b>A Sustainable ZEV Market.....</b>	<b>11</b>
Annual New ZEV Sales and ZEV Market Share.....	12
Vehicle Choice Diversity .....	14
Consumer Awareness and Assessment of ZEV Marketing Efforts by Automobile Manufacturers .....	17
Historical Consumer Awareness .....	19
Impacts of Federal Policies – Federal Tax Credit.....	20
Summary of a Sustainable ZEV Market Section.....	23
<b>CVRP and ZEV Market Long-Term Plan Conclusions.....</b>	<b>23</b>

## Introduction

### Overview

Since the introduction of the first Light-Duty Long-Term Plan in FY 2016-17, the zero-emission vehicle (ZEV) market has grown tremendously. Events over the few last years and the introduction of new vehicles (there are now over 80 electric vehicle models in the U.S.) and clean transportation equity programs (equity) have changed the ZEV market landscape. However, the global health and economic crisis disrupted the new vehicle market as a whole in 2020. Impacts to ZEV production, inventory, and dealerships coupled with decreased household income for many have made it difficult to analyze the impacts of these events on the assumptions, evaluations, and recommendations for light-duty ZEV and clean transportation programs. Major changes in the light-duty ZEV market and clean transportation equity programs will be required to allow for project sustainability within a limited budget and to better foster market growth from harder to reach market segments especially during times of economic uncertainty.

### *Statutory Goals and Requirements*

SB 1275 (De León, Chapter 530, Statute of 2014), signed into law in 2014, established the Charge Ahead California Initiative with the goals of placing one million zero-emission and near zero-emission vehicles in California by 2023 to establish a self-sustaining market and increasing access to these vehicles for lower-income consumers and consumers in disadvantaged communities. Among other requirements, SB 1275 requires CARB to include a long-term plan for the Clean Vehicle Rebate Project (CVRP) and related programs in the FY 2016-17 Funding Plan and to update the plan every three years. The plan must include: a three-year forecast of funding needs to support the goals of technology advancement, market readiness, and consumer acceptance of advanced vehicle technologies, a market and technology assessment for each funded vehicle technology, and an assessment of when a self-sustaining market is expected and how existing incentives may be modified to recognize expected changes in future market conditions.

In addition, the Supplemental Report to the 2018-19 Budget Act requires CARB to annually update the CVRP forecast until January 1, 2030 and include as part of its forecast the total State rebate investment necessary to facilitate reaching the goal of placing in service at least five million ZEVs by January 1, 2030, including:

- Models of the impacts of various rebate scenarios' ability to maximize the effectiveness of the rebates provided based on relevant data.
- Annual recommendations for changes for the project structure and various rebate levels based on market demand to reach the 2030 goal, including the project's income eligibility requirements to target moderate and low-income customers.

- Projected sales figures of electric vehicles.
- Impacts of federal policy changes on the adoption of electric vehicles.
- Sales price difference between electric vehicles and nonelectric vehicles.
- Assessment of marketing efforts of electric vehicles by automobile manufacturers.
- Survey results of consumer awareness and acceptance of electric vehicles and awareness of the benefits associated with ZEVs.

As part of the FY 2016-17 Funding Plan, staff in consultation with stakeholders proposed a framework for the three-year plan and provided the first three-year funding needs forecast along with a market and technology assessment. Staff also proposed a suite of indicators to measure ZEV market growth over time. Although SB 1275 required CARB to update the plan every three years, staff has provided updates to all components of the plan each year since 2016. This year's plan includes an update on the ZEV Market, including an updated long-term plan for CVRP.

### Organization

This appendix is organized as follows:

- Evaluation of CVRP Funding Needs
- ZEV Market and Technology Assessment
- A Sustainable ZEV Market
- CVRP and ZEV Market Long-Term Funding Need Conclusions

### **Evaluation of CVRP Funding Needs**

California's ZEV market has grown steadily in the last year. With the advancement of the technology, the current market trend indicates that ZEV costs and fueling time are likely to be reduced, while vehicle range and model choices are expected to increase. Consumer education and awareness of EVs and their benefits have improved and as a result, California EV market growth is expected to maintain a nearly eight percent market share in 2020 with an increase expected for 2021.

The next three to five years are critical years for the EV market as industry is heavily investing in development and expansion of EV production and new government policies around the world are paving the way for the big shift from old polluting technologies to cleaner ones.<sup>1</sup> During this time, the California ZEV market will likely leap over the chasm between the early adopter market segment and reach the early majority market. This will lead to adjustments in price and technological features that better serve the needs of the mass market. We anticipate that at that point, we will reach a sustainable market where government incentives are no longer required for the mass market.

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<sup>1</sup> <https://www.iea.org/publications/reports/globalevoutlook2019/>

In this section of the Long-Term Plan, staff evaluates the CVRP funding need over the next three years as required by SB 1275. Staff also projects forward ZEV sales and CVRP funding need out to 2030 if the ZEV market growth continues on its current trajectory to make a preliminary assessment of how the market is doing compared to the State's ZEV deployment goals of:

- 1 million vehicles by 2023
- 1.5 million vehicles by 2025
- 5 million vehicles by 2030

The forecast out to 2030 is a requirement of the Supplemental Report to the 2018-19 Budget Act. While this report focuses on the ZEV deployment goals established in SB 1275, other CARB documents, such as the Mobile Source Strategy, provide an update on progress and strategies required to meet the State's other air quality targets and greenhouse gas reduction goals. The State's climate goals impacting the ZEV market include the target set by Executive Order S-03-05<sup>2</sup> to be carbon neutral by 2045 and Executive Order N-79-20<sup>3</sup> which calls for 100 percent of in-state sales of new passenger cars and trucks be zero-emission by 2035. An update to the Mobile Source Strategy is currently underway, and the Draft 2020 Mobile Source Strategy has called for an even more aggressive deployment of light-duty passenger vehicles.<sup>4</sup>

Staff first describes an update to its methodology for projecting CVRP funding needs given the health and economic crisis of 2020. Staff then presents a plan to update CVRP projections at the beginning of 2021 as part of the public process for the FY 2021-22 Funding Plan. Finally, staff presents an evaluation of effects of the CVRP changes proposed in this Funding Plan and the projections out to 2030.

### CVRP Projection Methodology

Previously, CVRP used historic sale and rebate data to project future participation in the CVRP program, with the assumption that future growth would resemble past growth. However, due to the current health and economic crisis and the subsequent "shelter-in-place" orders in California, staff has been prompted to reconsider how CVRP forecasts the EV market and program demand.

In an effort to supplement the current forecasting methodology and provide a more robust, secondary projection approach, the Center for Sustainable Energy (CSE) is developing a Monte-Carlo-based simulation model, which produces simulations based on a range of possible future conditions, then identifies the probability of different outcomes given those conditions. This method aims to address black swan events, or

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<sup>2</sup> [Executive Order S-3-05](#)

<sup>3</sup> [Executive Order N-79-20](#)

<sup>4</sup> [Workshop Discussion Draft 2020 Mobile Source Strategy](#)

low-likelihood events of significant magnitude, that typically increase the uncertainty in any modeling exercise. The parameters for the simulated conditions will be based on numerous sources, including review of opinions and analysis from industry stakeholders and researchers, new vehicle sales data from the Federal Reserve, and CVRP application data.

CARB staff in conjunction with CSE will finalize this updated projection methodology through a public process in early 2021 once additional data is available and will provide an in-depth update to long-term funding need in the FY 2021-22 Funding Plan.

### CVRP Funding Need for Next 3 Years

As stated before, the ongoing health and economic crisis has made it difficult to predict the CVRP funding need for this and subsequent years. As noted above, staff plans to update the projection methodology in early 2021 through the public process and provide an updated program funding need as part of the FY 2021-22 Funding Plan. Since program participation was much lower than initially projected for FY 2019-20, staff expects to carry over program funding into FY 2020-21, which should keep the program open until additional funding becomes available.

### Impact of Proposed CVRP Program Changes on Funding Need

For FY 2020-21, staff is proposing a handful of minor adjustments to CVRP to align with other programs and to improve implementation of CVRP. Staff expects these changes to have a negligible impact on CVRP funding need. These adjustments include:

- Changing from using urban dynamometer driving schedule (UDDS) to U.S. EPA all-electric ranges for PHEV eligibility
- Increasing the minimum all-electric range requirement for PHEVs to 30 miles EPA (45 miles UDDS)
- Increasing the maximum gross vehicle weight rating (GVWR) for vehicle eligibility from 8,500 to 10,000 pounds
- Increasing the income limit for CVRP increased rebates from 300% of the federal poverty level (FPL) to 400%
- Aligning household and Income definitions with other equity projects
- Adjusting the outreach requirement for CVRP administrator to focus more funding towards outreach targeting low- and moderate-income consumers
- Setting a framework for bifurcating vehicle eligibility requirements

A majority of these changes are administrative in nature and have no impact to CVRP funding need. Staff anticipates that increasing the income limit for CVRP increased rebates from 300% to 400% FPL will have a minor impact on funding need. Based on income data from 2019 rebate applications, about 7 percent of applications from individuals were from applicants in the 300% to 400% FPL household income range.

Given this information, staff anticipates a corresponding percentage increase for increased rebates after incorporating this change. Staff also anticipates that increasing the maximum GVWR for vehicle eligibility to 10,000 pounds will not have an immediate impact to CVRP funding need as there currently aren't any CVRP-eligible EVs in the 8,501-10,000 pound GVWR weight class. As larger EVs come to the market, staff will be able to better analyze how this change will impact funding need. Additionally, staff anticipates that an increased all-electric range requirement for PHEVs will decrease CVRP funding need since the number of eligible vehicles will decrease. Staff will evaluate the fiscal impact to the program as it reviews funding need projections in early 2021.

### Trajectory Analysis to 2030

The sales trajectories established in the three-year funding simulations are calculated to 2030 to help estimate progress toward State goals, as required by the Supplemental Report to the 2018–19 Budget Act. The State's ZEV deployment goals are:

- 1 million vehicles by 2023
- 1.5 million vehicles by 2025
- 5 million vehicles by 2030

The considerable uncertainty introduced by the global pandemic and apparent US recession is amplified when projecting farther into the future. Additional unforeseen circumstances that could have significant impact on future EV sales become more likely over time, and trajectory analyses smooth out those circumstances, as well as seasonal peaks and valleys. Despite these limitations, a trajectory analysis can be informative in indicating whether the market is "on-course" to achieving State goals.

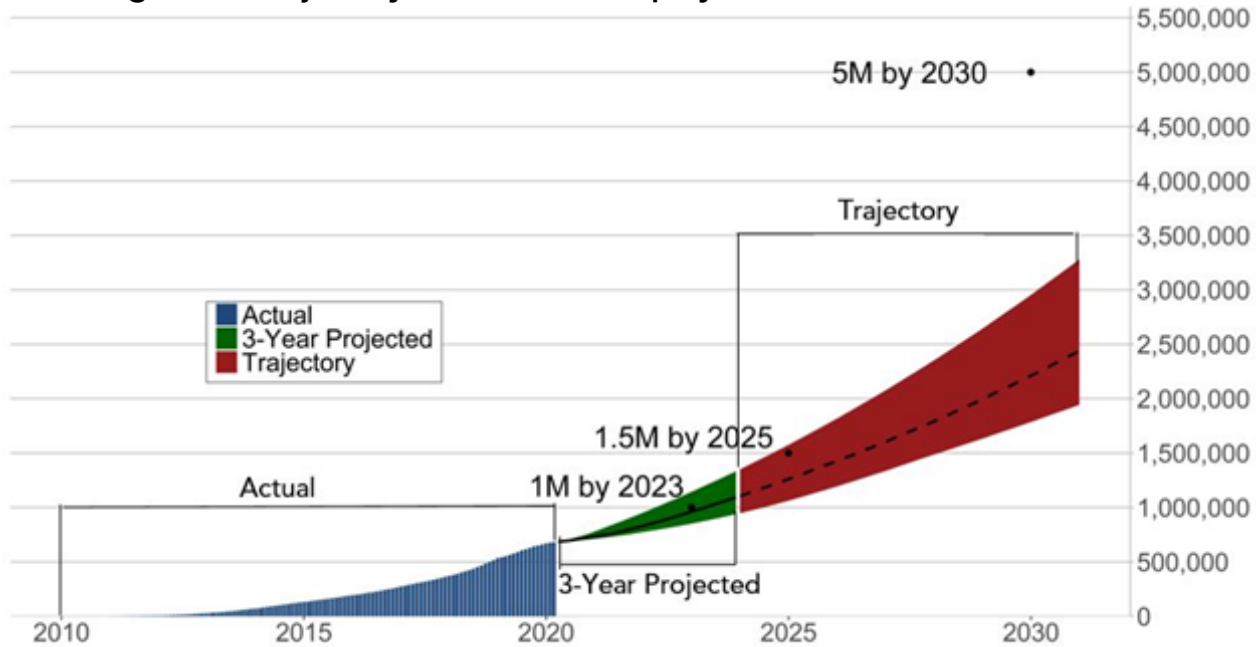
The drop in EV sales significantly impacts progress toward State goals. Figure 1 shows the trajectory toward State goals based on the three-year projections continuing to 2030. The blue bars indicate actual EV sales<sup>5</sup>, the green ribbon with line represents the three-year projected EV sales, and the grey ribbon with dashed line represents the trajectory established in the three-year projections.

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<sup>5</sup> Includes content from IHS Markit © 2020.



**Figure 1. Trajectory Toward ZEV Deployment Goals (Cumulative Sales)**



The State’s 2023 and 2025 goals are achieved in some simulations. The trajectory analysis shows cumulative EV sales are not on course to achieve the 2030 goal, indicating additional supportive policies may be needed to accelerate growth to meet the 2030 goal of 5 million EVs.

*Estimated Funding Need to Reach Five Million ZEVs*

Though the trajectory analysis shown in Figure 1 does not show cumulative EV sales meeting the 2030 goal, the trajectory analysis allows us to calculate the cost to reach State goals regardless of time. Table 1 shows the estimated number of rebates and funding needed to reach those goals, assuming the market and program continue along their trajectories until the goals are reached.

**Table 1. Estimated CVRP Funding Need to Reach ZEV Deployment Goals**

ZEV Deployment Goal	Additional Vehicles Rebated	Funding Need
1 million vehicles	141,000–161,000	\$235M–\$276M
1.5 million vehicles	386,000–408,000	\$694M–\$738M
5 million vehicles	~2.1M	\$4.2B–\$4.3B

The funds needed to reach State goals shown in Table 1 reflect only CVRP rebates, and do not include private investment in vehicles, infrastructure or other supportive resources. Total private investment for 2.1 million additional vehicles may be more than \$186 billion. A \$4.3 billion public investment would amount to approximately 2% of the total private investment.

## ZEV Market and Technology Assessment

In this section of the Long-Term Plan, staff updates the ZEV Market and Technology Assessment originally included in the FY 2016-17 Funding Plan as required by SB 1275. As part of this assessment, staff presents:

- An overview of recent ZEV market growth in California, the United States, and worldwide.
- An update on the state of ZEV technology, particularly battery costs and a comparison of the total cost of ownership of ZEVs compared to internal combustion engine vehicles.

Several of the topics covered here such as growth in ZEV sales, market share, and vehicle diversity are also indicators that staff uses to evaluate progress toward a sustainable ZEV market in California. As such, California-specific trends for each of these indicators are discussed in greater detail in the “Sustainable ZEV Market” section later in this Long-Term Plan.

### Trends in the ZEV Market

By the end of 2019, the number of electric passenger vehicles reached 7.2 million units worldwide, an increase of 2.1 million units from 2018. From 2014-2019, the global electric vehicle market expanded by an average of 60 percent. China had the world’s largest electric vehicle market with about 3.3 million total ZEV sales by the end of 2019, or 47% of the global ZEV market. Europe was the second largest EV market with a sales total of about 1.8 million vehicles by the end of 2019. The United States was a close third with a sales total of about 1.5 million EVs by the end of 2019.<sup>6</sup>

The health and economic crisis that affected the whole world in 2020 also had an impact on new EV sales. Various local and country-wide shutdowns severely impacted economies and many households saw a reduction in income. Shutdowns also affected EV production, delivery, and sale as factories closed, imports and exports were limited, and dealerships closed to in-person business. Although the new EV market took a hit in the first half of 2020, global sales numbers from July indicate the beginnings of a rebound largely due in part to the reopening of many countries. Additionally, a number of European countries introduced green stimulus incentives to help promote increased EV sales.<sup>7</sup>

Although many parts of the world have reopened, large portions of the United States only began taking steps towards reopening at the end of this summer. Due in large part to shutdowns, economic downturn, and a slower reopening, new light-duty vehicle sales in the United States decreased 23.5 percent in the first six months of 2020.<sup>8</sup> Over the same time period, new light-duty vehicle sales in California decreased

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<sup>6</sup> [Global EV Outlook 2020](#)

<sup>7</sup> [EV-Volumes.com](#)

<sup>8</sup> [CNCDA Auto Outlook: Q2 2020](#)

by 26.9 percent.<sup>9</sup> Prior to the current health and economic crisis, California EV market share was approaching 8 percent, or halfway to the market sustainability threshold of 16-20%. Although it would have been beneficial to see an increase in EV market share this year, sales of new light-duty EVs in California held relatively steady and maintained a 7.8 percent market share in the first, tumultuous half of 2020.<sup>10</sup>

Many industries have adapted and moved their businesses to an online model including new car dealerships. Additionally, vehicle inventory has increased over the last couple of months since many factories are ramping up production and deliveries. Based off current trends, new car sales in California are expected to increase in 2021 by 10 percent over 2020 numbers but these projections are subject to change if there are additional waves of shutdowns.<sup>11</sup>

The entire world continues to feel the impact of the ongoing health and economic crisis. Many industries, including new cars sales, took a direct hit during the first half of 2020. As new car sales begin to rebound, it is critical to continue support of the EV market. It is encouraging to see that the new EV market in California managed to maintain a nearly 8 percent market share during such trying times. This is a positive sign regarding the growth and sustainability of the ZEV market. However, significant additional market growth is needed to meet California's ZEV deployment goals. As discussed in the previous section, California remains behind the growth trajectory needed to meet the 2030 goal of 5 million ZEVs even with the impressive growth in recent years.

## ZEV Technology Assessment Update

Battery price is the major cost component in electric vehicle manufacturing. Monitoring the battery cost production and close analysis of cost reduction is critical for market projection. This section discusses current and future battery costs and its impact on ZEV market acceleration.

### *Battery/Battery pack system cost and projections*

Recent findings show that the trend of declining battery costs is continuing and the average cost of battery production is falling. A recent survey indicates that prices of automotive battery packs were around \$156/kWh by the end of 2019<sup>12</sup> which represents a 13 percent decline from 2018. This trend is expected to continue. As the production volume increases, the price will continue to decrease. BloombergNEF's 2019 Battery Price Survey indicates that as battery technology advances, the average price of battery packs decline. In this same report, they expect the price of an average battery pack to be around \$94/kWh by 2024 and \$61/kWh by 2030.<sup>13</sup>

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<sup>9</sup> Ibid.

<sup>10</sup> Ibid.

<sup>11</sup> Ibid.

<sup>12</sup> [BloombergNEF – 2019 Battery Price Survey](#)

<sup>13</sup> Ibid.

For a 200km (125 miles) range EV to be cost competitive with Internal Combustion Engines (ICEs), battery prices of \$100/kWh are necessary, at a fuel price of 80¢ per liter (\$3.20 per gallon) and 18,000 km/year (11,184 miles/year) mileage. The cost parity threshold falls to \$50/kWh for BEVs at a 400km (248 mile) range, in the same mileage and fuel price conditions.<sup>14</sup> If the battery cost reduction trend continues, cost parity would happen in 2024 for lower range EVs and 2030 for longer range EVs.<sup>15</sup>

### *Update on Incremental costs of PEVs*

The higher purchase price of EVs is considered one of the main barriers for consumers purchasing these vehicles. According to the International Renewable Energy Agency (IRENA), purchase price of a standard medium size EV is approximately 40 percent more than a conventional internal combustion engine (ICE) vehicle of similar size<sup>16</sup>. Although this higher purchase price is a critical element in consumer decision-making process, for a more accurate comparison, total cost of ownership is a more accurate measure to compare the cost of ICEs and PEVs. With battery prices to auto manufacturers of \$260 per kilowatt-hour (kWh) (comparable with battery production costs close to \$215/kWh, i.e. accounting for a 20 percent profit margin for battery suppliers), scaling up the consumer adoption of BEVs in cars continues to require policy support<sup>17</sup>.

EV purchase prices are not yet competitive with ICE vehicles. On a per mile basis, operating a BEV is cheaper than operating an ICE vehicle – the cost of electricity per mile is lower than the cost of gasoline per mile. However, assuming 3.5 years of ownership, even with higher than average fuel prices, the total cost of ownership for a BEV is higher than an ICE vehicle. Battery manufacturing costs are expected to decline, therefore shrinking the price gap between total cost of ownership of EVs and ICE vehicles and making EVs a more favorable choice to consumers.

While batteries are the most expensive component in the total cost of ownership calculation, there are opportunities for cost reductions in other areas. Redesigning EV manufacturing platforms and investing in fewer moving parts can help reduce the total manufacturing cost. There are indications that manufacturers are investing to develop more EV specific manufacturing platforms for larger scale production. Over the next 10 years, the top 29 OEMs have made plans to invest more than \$300 billion in EV productions<sup>18</sup>.

Overall, in 2018, the purchase price of a mid-size EV cost about 40 percent more than a comparable ICE<sup>19</sup>. The economic advantage of EVs are limited to specific cases. With battery cost reduction, vehicle redesigned manufacturing, and employing newer

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<sup>14</sup> Ibid.

<sup>15</sup> Ibid.

<sup>16</sup> The International Renewable Energy Agency

<sup>17</sup> <https://webstore.iea.org/global-ev-outlook-2019>

<sup>18</sup> [The Boston Consulting Group, "Who Will Drive Electric Cars to the Tipping Point"](#)

<sup>19</sup> Ibid.

digital technologies to match battery capacity and size to consumer needs, the cost parity of EVs and ICEs can potentially be achieved by 2025. In fact, globally, falling battery prices will lead to BEV total cost of ownership being lower than their ICE counterpart.<sup>20</sup>

In summary, findings of the technology assessment indicate that the overall trend of advancements towards lower cost and battery capacity improvements is continuing as expected. Therefore, manufacturers will benefit from these improvements and will be able to offer more ZEV choices with longer range in the next 5 to 10 years.

## **A Sustainable ZEV Market**

To address the SB 1275 requirement of assessing when a self-sustaining market is expected, CARB staff in consultation with academia and stakeholders, decided to use the *Diffusion of Innovation Theory* as the framework for this analysis when it did the first Long-Term Plan for CVRP and the ZEV market as part of the FY 2016-17 Funding Plan. Based on this approach, staff defined the self-sustainable ZEV market as a state of the market where broad incentives are not required to increase ZEV adoption. A self-sustaining market is expected once the California new ZEV market share reaches 16-20 percent, the market has reached the early majority segment, and there is enough demand to help market mechanisms take over and drive the market. The detailed description of the theory and staff's original work to establish this metric to define a sustainable ZEV market can be found in Part II of FY 2016-17 Funding Plan<sup>21</sup>.

In developing last year's update to the Long-Term Plan, staff asked stakeholders if it should consider alternative approaches to defining a sustainable ZEV market. There was no alternative offered, hence staff will continue using the metric of 16-20 percent ZEV market share based on the Diffusion of Innovation Theory as the indicator of a sustainable ZEV market. Staff recognizes, however, that this theory is predicated on a free-market, whereby the technologies originally included in the theory's development were not regulated in the same way that vehicles are regulated in California. Regardless, this theory serves as a reasonable guide given the nature of the vehicle market.

In the 2016-17 Long-Term Plan, staff identified metrics that can be used to track progress toward market sustainability. The most outstanding one was ZEV market share and staff chose this metric to define the sustainable market. Other indicators evaluated include annual ZEV sales numbers, diversity in available models, and consumer awareness. Progress on these metrics is described below. Staff also identified several technology-based metrics such as battery and vehicle cost as indicators of progress, which were described earlier in this Long-Term Plan in the ZEV Market and Technology Assessment section. Finally, staff also evaluated the importance and impact of the federal policies, including the federal tax credit, in the

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<sup>20</sup> [Ibid.](#)

<sup>21</sup> [Proposed Fiscal Year 2016-17 Funding Plan For Low Carbon Transportation And Fuels Investments And The Air Quality Improvement Program](#)

next section. This was done since federal policies may ultimately have a significant impact on the growth of the ZEV market toward sustainability and it is one of the elements CARB is required to evaluate per the Supplemental Report of the 2018-19 Budget Act.

### Annual New ZEV Sales and ZEV Market Share

Staff consider annual new ZEV sales in California as an indicator of market growth, and over the last few years monitored and analyzed the trend closely. California annual ZEV sales have grown continuously over the last three years even though general light duty vehicle sales have been declining since 2016. The new vehicle market in 2020 has been, and continues to be, impacted by the current health and economic crisis; new light vehicle registrations are expected to decline more than 26% from 2019. Table 2 shows details of new EVs sold over the last five years and California ZEV market share has held steady at about 8 percent of the new light-duty vehicle sales. The California ZEV market share is expected to increase as the new light-duty market continues to rebound following a down year in 2020.

**Table 2. Hybrid and Electric New Vehicle Registrations and Market Share<sup>22</sup>**

	2016	2017	2018	2019	YTD 2020*
<b>Plug in hybrid registration</b>	37,518	48,391	64,644	52,329	15,724
<b>Plug in hybrid share</b>	1.7%	2.2%	3.0%	2.5%	2.0%
<b>Electric registration</b>	41,932	59,388	99,121	106,752	45,601
<b>Electric share</b>	1.9%	2.7%	4.6%	5.1%	5.8%
<b>Total # of Vehicles</b>	79,450	107,779	163,765	159,081	61,325
<b>Total PEV Market Share</b>	3.6%	4.9%	7.6%	7.6%	7.8%
<b>Year-to-Year Growth Rate</b>	-	26%	34%	-3%	TBD

Data Source: IHS - California New Car Dealer Association

\*Data through June 2020

New PEV registrations in 2019 reached 159,081, which is a slight decline from 2018. This may be explained by the gradual decrease of the Federal Tax Credit for two manufacturers.

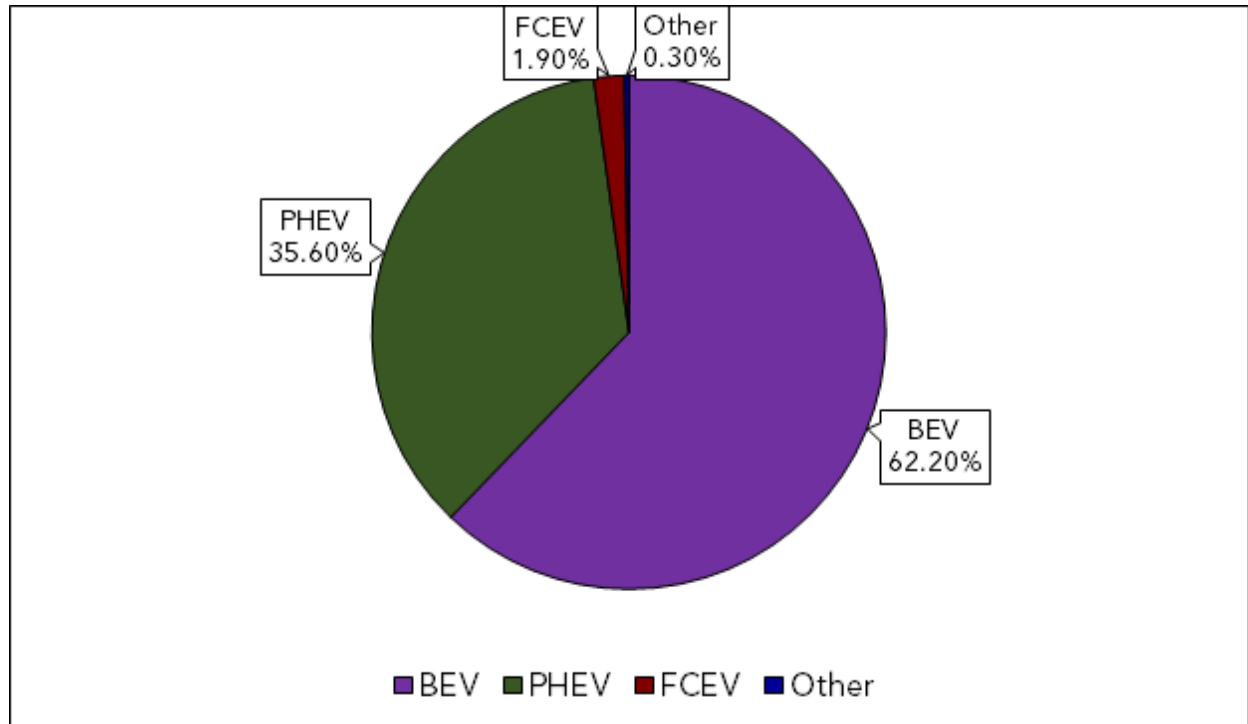
Despite the overall decline of total new light-duty vehicle sales in California, ZEV sales are increasing or holding steady each year, and the ZEV market share has grown about 20 percent over the past five years on average. The spike seen in 2018 was due in large part to the Tesla Model 3 debut. As more ZEV models are introduced, it is likely that their market share will increase.

In recent years, the same technology split trend under CVRP has been observed and as Figure 2 shows, CVRP recipients chose BEVs 1.5 times more than PHEVs. This

<sup>22</sup> [CNCDA California Auto Outlook: Q2 2020](#)

indicates that with more diverse and higher-range BEVs with higher incentive amounts available, consumers are more willing to choose cleaner technologies.

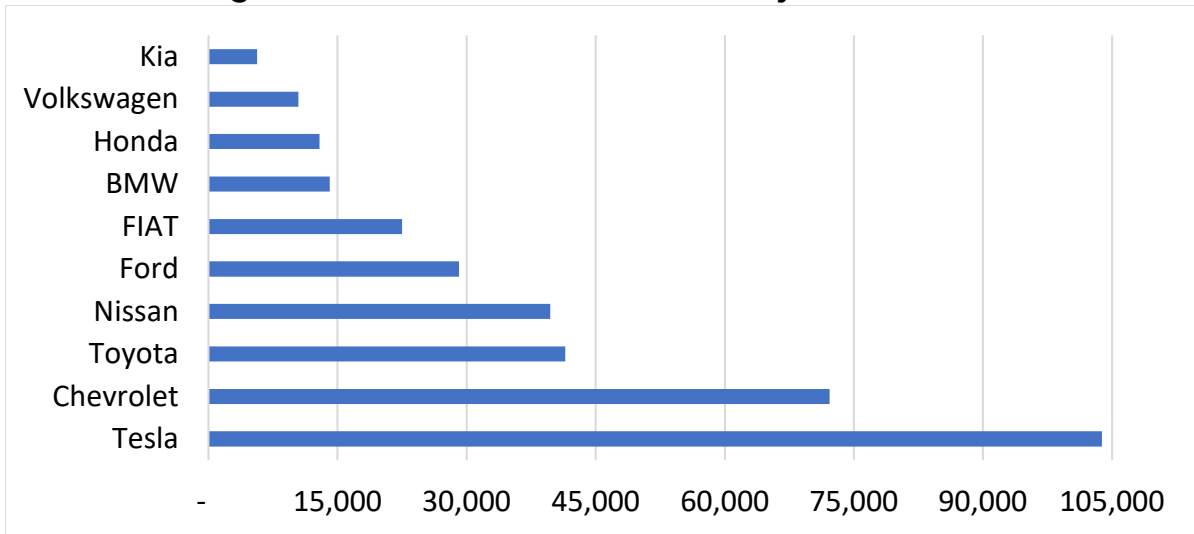
**Figure 2. CVRP Cumulative Rebates by Technology Type**



Tesla, Chevrolet, Nissan, Toyota, and Ford are the top five manufacturers whose vehicles have received rebates under CVRP, which is similar to the makeup of the top-selling EV manufacturers in California.<sup>23</sup> Figure 3 illustrates the amount of rebates received under CVRP by Vehicle Make since the inception of the program.

<sup>23</sup> ["California Green Vehicle Report", California New Car Dealers Association, Released August 2019](#)

**Figure 3. Cumulative CVRP Rebates by Vehicle Make**



In summary, ZEV car sales have grown to about 8 percent of new car sales in California through the end of 2019 and maintained this market share through the first half of 2020. This is about half way to staff’s defined indicator of a sustainable ZEV market of 16-20 percent market share. According to the Veloz sales dashboard, a total of 726,145 EVs have been sold in California through Q2 of 2020<sup>24</sup> – over 70 percent of the way to the 2023 goal of 1 million ZEVs deployed.

### Vehicle Choice Diversity

Consumers have different needs and expectations, especially when it comes to vehicles. Vehicle choice and model availability across market segments is a critical decision making factor for new car shoppers and a diverse selection of makes and models is an indicator for market growth. For Model Year 2020, 84 different models of electric-drive vehicles across 11 EPA vehicle classes are available in the US market<sup>25</sup>, and 34 of them are CVRP-eligible in California.

As staff has noted, vehicle diversity is an indicator of the health of the ZEV market, which is supported by research. For example, a recent publication by the International Council on Clean Transportation (ICCT) shows that cities with more models available to consumers had higher EV registrations in 2018.<sup>26</sup> More choices in larger vehicle categories like SUV, minivan, pick-up truck, and light-duty trucks in the PEV market are needed for the emerging EV market to be more attractive to consumers and become competitive with the ICE market.

As a number of electric trucks and SUVs are expected to hit the U.S. market in the next few years, it is important that eligibility requirements for CVRP are crafted in a

<sup>24</sup> [Veloz Sales Dashboard](#)

<sup>25</sup> [Transportation Energy Data Book Edition 38, U.S. Department of Energy](#)

<sup>26</sup> [https://theicct.org/sites/default/files/publications/ICCT\\_EV\\_surge\\_US\\_cities\\_20190610.pdf](https://theicct.org/sites/default/files/publications/ICCT_EV_surge_US_cities_20190610.pdf)



way that supports these emerging larger vehicle categories. Bifurcating eligibility requirements for smaller vs. larger plug-in hybrid and battery electric vehicles is one way to do so. As larger plug-in hybrid and battery electric vehicles come to the market, staff recognize that these vehicles may have a higher MSRP with ranges that may be shorter than smaller vehicle classes that have been part of the ZEV market for some time. This change could help CVRP continue to be supportive of electric vehicle deployment across the various vehicle classes in the light-duty market while prioritizing funding for the cleanest vehicles.

Table 3 lists each of the 84 models available by type across 11 different vehicle classes in the US market. Models with an asterisk (\*) are eligible for CVRP.

**Table 3. Electric-Drive Vehicles Available by Manufacturer, Model Year 2020<sup>27</sup>**

Model	Drive Type	EPA Size Class
Audi e-tron Sportback	BEV	Standard SUV 4WD
BMW I3 BEV (120 Ah battery)*	BEV	Subcompact Cars
BMW I3 with Range Extender*	BEV	Subcompact Cars
BMW I3s with Range Extender*	BEV	Subcompact Cars
BYD e6	BEV	Small SUV 2WD
BYD e6	BEV	Subcompact Cars
Chevy Bolt (BEV)*	BEV	Small Station Wagons
Hundai Kona EV*	BEV	Small SUV 2WD
Hyundai Ioniq Electric*	BEV	Midsize Cars
Jaguar I-Pace (BEV)	BEV	Small SUV 4WD
Kia Niro Electric*	BEV	Small Station Wagons
Mini Cooper SE Hardtop 2 Door*	BEV	Subcompact Cars
Nissan Leaf (40 kW-hr battery pack)*	BEV	Midsize Cars
Nissan Leaf (62 kW-hr battery pack)*	BEV	Midsize Cars
Nissan Leaf SV/SL (62 kW-hr battery pack)*	BEV	Midsize Cars
Porsche Taycan Turbo	BEV	Large Cars
Porsche Taycan Turbo S	BEV	Large Cars
Porche Taycan 4S Perf Battery Plus	BEV	Large Cars
Tesla Model 3 Long Range*	BEV	Midsize Cars
Tesla Model 3 Long Range AWD*	BEV	Midsize Cars
Tesla Model 3 Long Range AWD P18*	BEV	Midsize Cars
Tesla Model 3 Long Range AWD P19*	BEV	Midsize Cars
Tesla Model 3 Long Range AWD P20*	BEV	Midsize Cars
Tesla Model 3 Mid Range*	BEV	Midsize Cars
Tesla Model 3 Standard Range*	BEV	Midsize Cars
Tesla Model 3 Standard Range Plus*	BEV	Midsize Cars
Tesla Model S Long Range	BEV	Large Cars
Tesla Model S Long Range Plus	BEV	Large Cars
Tesla Model S P19	BEV	Large Cars
Tesla Model S P21	BEV	Large Cars
Tesla Model S Standard Range	BEV	Large Cars
Tesla Model X Long Range	BEV	Standard SUV 4WD
Tesla Model X P20	BEV	Standard SUV 4WD
Tesla Model X P22	BEV	Standard SUV 4WD
Tesla Model X Standard Range	BEV	Standard SUV 4WD
Tesla Model Y Performance AWD*	BEV	Small SUV 4WD
Tesla Model Y Performance AWD (21" Wheels)*	BEV	Small SUV 4WD
Honda Clarity (Fuel Cell Vehicle)*	FCEV	Midsize Cars
Hyundai Nexo (Fuel Cell Vehicle)*	FCEV	Small SUV 2WD

<sup>27</sup> [Transportation Energy Data Book Edition 38, U.S. Department of Energy](#)

Hyundai Nexo Blue (Fuel Cell Vehicle)*	FCEV	Small SUV 2WD
Toyota Mirai (Fuel Cell Vehicle)*	FCEV	Subcompact Cars
Audi A8L	PHEV	Large Cars
Audi Q5	PHEV	Small SUV 4WD
Bentley Bentayga	PHEV	Standard SUV 4WD
BMW 530e	PHEV	Compact Cars
BMW 530e xDrive	PHEV	Compact Cars
BMW 745e xDrive	PHEV	Large Cars
BMW i8 Coupe	PHEV	Subcompact Cars
BMW i8 Roadster	PHEV	Two Seaters
BMW Mini Cooper SE Countryman ALL4	PHEV	Midsize Cars
BMW X3 xDrive30e	PHEV	Small SUV 4WD
Chrysler Pacifica Hybrid*	PHEV	Minivan 2WD
Ford Escape FWD PHEV*	PHEV	Small SUV 2WD
Ford Fusion Energi Plug-in Hybrid FWD*	PHEV	Midsize Cars
Ford Fusion Special Service Vehicle PHEV*	PHEV	Midsize Cars
Honda Clarity PHEV*	PHEV	Midsize Cars
Hyundai Ioniq Plug-in Hybrid*	PHEV	Midsize Cars
Karma Revero GT PHEV (21-inch wheels)	PHEV	Subcompact Cars
Kia Niro Plug-in Hybrid*	PHEV	Small Station Wagons
Kia Optima Plug-in Hybrid*	PHEV	Midsize Cars
Land Rover Range Rover	PHEV	Standard SUV 4WD
Land Rover Range Rover Sport	PHEV	Standard SUV 4WD
Lincoln Aviator AWD	PHEV	Standard SUV 4WD
Mercedes GLC 350e 4Matic	PHEV	Small SUV 4WD
Mercedes S 560e	PHEV	Large Cars
Mitsubishi Outlander PHEV	PHEV	Small SUV 4WD
Polestar Automotive Polestar-1	PHEV	Minicompact Cars
Porsche Cayenne e-Hybrid	PHEV	Standard SUV 4WD
Porsche Cayenne e-Hybrid Coupe	PHEV	Standard SUV 4WD
Porsche Cayenne Turbo S e-Hybrid	PHEV	Standard SUV 4WD
Porsche Cayenne Turbo S e-Hybrid Coupe	PHEV	Standard SUV 4WD
Porsche Panamera 4 e-Hybrid	PHEV	Large Cars
Porsche Panamera 4 e-Hybrid Executive	PHEV	Large Cars
Porsche Panamera 4 e-Hybrid Sport Turismo	PHEV	Large Cars
Porsche Panamera Turbo S e-Hybrid	PHEV	Large Cars
Porsche Panamera Turbo S e-Hybrid Executive	PHEV	Large Cars
Porsche Panamera Turbo S e-Hybrid Sport Turismo	PHEV	Large Cars
Subaru Crosstrek Hybrid AWD	PHEV	Small SUV 4WD
Toyota Prius Prime*	PHEV	Midsize Cars
Volvo S60 AWD	PHEV	Compact Cars
Volvo S90 AWD	PHEV	Midsize Cars
Volvo V60 AWD	PHEV	Small Station Wagons
Volvo XC60 AWD	PHEV	Small SUV 4WD
Volvo XC90 AWD	PHEV	Standard SUV 4WD

In summary, there are currently 34 EV models eligible for CVRP and available to Californians, and there has been a significant increase in the number of EV models over recent years. In 2011, there were about 5 EVs available for sale which has expanded to more than 80 in 2020. Looking forward, manufacturers have announced many additional vehicle introductions anticipated over the next several years specifically in larger vehicle classes. However, vehicle diversity remains far more limited than the fully diversified ICE market. Because of this, the ZEV market still does not meet the needs of a wide range of consumers for various vehicle choices in different categories.

## Consumer Awareness and Assessment of ZEV Marketing Efforts by Automobile Manufacturers

The Supplemental Report to the 2018-19 Budget Act directs CARB to assess the marketing efforts of EV manufacturers. CARB is coordinating with stakeholders including OEMs, Alliance for Automotive Innovation (Auto Innovators), California New Car Dealers Association (CNCDA), and VELOZ to evaluate current marketing efforts and determine how to enhance these efforts.

CNCDA's Green Vehicle Report is released twice a year and provides comprehensive information on the State's green vehicle market. The report includes a segment watch, including the top 20 best-selling alternative powertrain vehicles; best sellers in market segments including hybrid, plug-in hybrid, electric, and fuel cell vehicles; and market trends by powertrain type and brand shares in alternative powertrain market. In coordination with CNCDA, CVRP will host a special webinar to highlight the efforts that dealers are taking to be green leaders.

VELOZ aims to engage electric car stakeholders with three annual forums that include interesting panels and speakers on current electric car topics, as well as webinars designed to share and discuss the latest updates in the electric car industry. In coordination with its contractor, Charge Across Town, VELOZ also coordinated a statewide ride-and-drive campaign (Best.Drive.EVer) to increase electric car awareness and adoption across the State. Best.Drive.EVer also reached low-income and disadvantaged communities that are typically underserved with electric car events. VELOZ also launched a multi-million dollar electric car public awareness campaign called Electric For All, focused on reaching Californians. CSE and CARB are founding members of Veloz.

Multiple OEMs took advantage of the national spotlight and aired commercials advertising new EV models during Super Bowl LIV in February 2020. This was the first time that multiple EV commercials were shown during the nation's biggest game of the year. About 45%, or 4 out of 9, of the auto ads aired during the game were for plug-in vehicles. General Motors (GMC Hummer Truck), Audi (e-Tron Sportback), Porsche (Taycan), and Ford (Mach-E) used star power and flashy commercials to promote EVs and persuade those still unsure about the technology.<sup>28</sup> Tesla, known for not spending on advertisements, received public nods from athletes on both teams when they were interviewed about the hottest car right now. Many of the athletes either owned a Tesla or had orders in for the upcoming Tesla Cybertruck.<sup>29</sup> All of

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<sup>28</sup> Business Insider, "[Electric-vehicle ads made up nearly half of this year's Super Bowl car commercials, but account for less than 2% of US car sales](#)", February 4, 2020.

<sup>29</sup> Electrek, "[New electric car ads at the Super Bowl, Tesla gets publicity for free](#)", February 3, 2020

which are steps in the right direction as we look to encourage consumers from the early core and main market to transition to electric.

Auto Innovators continues to promote dialogue with industry, federal, and state governments around public policy and incentives, as well as providing analysis around market data. OEMs are also helping to provide the public with more information about EVs by educating dealer staff through trainings. CVRP continues to educate and foster relationships with eligible OEMs and dealers about the CVRP rebate and the clean vehicle market.

It should be noted that CSE, as the CVRP administrator, undertakes extensive outreach and education activities to increase new car purchasers' awareness of EVs. In addition, a dedicated outreach and education team focuses on lower-income consumers in disadvantaged communities to make sure these priority populations receive proper education and information regarding EVs and incentives. Since 2014, CSE's outreach and education teams have participated in more than 800 events across the State and conducted more than 68,000 EV and incentive related conversations with consumers.

Furthermore, CSE's Dealer Outreach team focuses on providing training, tools, and tips to dealers for EVs and incentives. Table 4 shows the increases of outreach in recent years under the CVRP grant.

**Table 4. CVRP Dealer Outreach Team Activities**

<b>Dealership Outreach by Year</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020*</b>	<b>Total</b>
<b>In Person Visits</b>	-	-	222	990	1,777	336	3,325
<b>Information Sessions</b>	-	-	2	48	67	14	131
<b>Materials Distributed</b>	48	1,081	1,640	6,694	12,080	3,262	24,805

\*As of 8/1/2020

Under the CVRP grant, CSE administers surveys to individual CVRP participants and covers topics such demographics, housing characteristics, interest in and research on PHEVs, sources of information used, decision-making process, dealership experience, vehicle details, and charging.

Other consumer surveys are being conducted under various research grants and contracts and CARB will coordinate to streamline the survey methodologies and questions to collect similar information across surveys to help inform long-term analyses.

## *Historical Consumer Awareness*

Underscoring the importance of the efforts described above, consumers have historically demonstrated poor awareness and acceptance of battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). For example, in two surveys undertaken by Kurani<sup>30</sup> that gauged the California public's knowledge, awareness and preferences towards EVs, findings suggest that many consumers still struggle with even the basics of EVs. For example, when asked if they could name a BEV that is being sold in the US, the majority (56%) of respondents were unable to identify a single BEV for sale (as indicated by "No" responses in June 2017).<sup>31</sup> Despite the surging popularity of Tesla vehicles and Nissan Leafs, overall recognition remains low as less than about a quarter of respondents were even aware of these models existing,

Likewise, Kurani (2018)<sup>32</sup> found that less than 1 in 8 respondents could correctly distinguish the differences between hybrid electric vehicles (HEVs), PHEVs and BEVs in terms of which uses what type of fuel, and respondents commonly (and mistakenly) believed BEVs used gasoline and HEVs used some electricity. This research indicates that consumers remain largely unengaged and uninformed on the basic attributes and existence of EVs. These findings also indicate that increased outreach efforts are not only needed but can be a key way to increase understanding of and familiarity with EVs..

Kurani (2018) also summarized the most common reasons for which respondents imagined they would buy an EV. The question posed all answers and allowed respondents to select all that would apply. According to the survey results, a significant portion of California consumers are unaware that an EV provides them any benefits, and of those who do believe there are benefits, they tend not to be connected to climate change. A majority of respondents lack knowledge of EVs and/or have misconceptions about the technology. Better education (e.g. understanding BEVs do not use any gasoline) could improve the perceptions of EVs in the eyes of consumers.<sup>33</sup>

With all this in mind, it is perhaps unsurprising that overall intention to seriously consider an EV is still very low among California consumers. More than 80% of consumers did not take any serious action towards considering an EV, and did not seek any information regarding EVs (as indicated by all responses except "Already

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<sup>30</sup> Kurani, Kenneth. (2018). "State of the Plug-In Electric Vehicle Market: Report II". UC Davis Research Reports, National Center for Sustainable Transportation. Available at <https://escholarship.org/uc/item/8rp9h6fb>

<sup>31</sup> Ibid.

<sup>32</sup> Ibid.

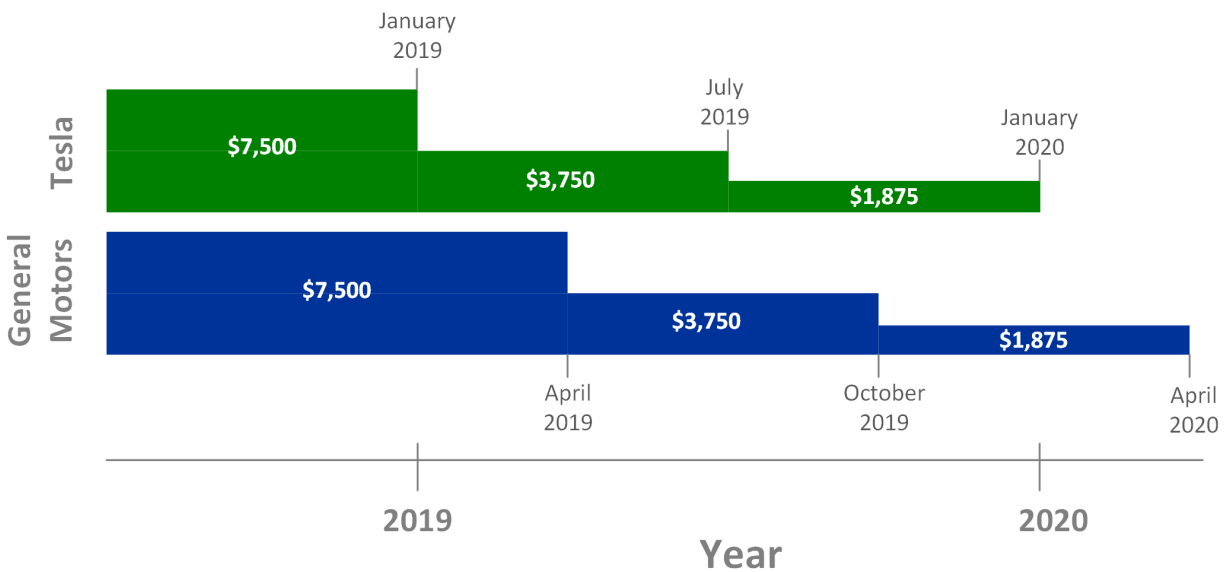
<sup>33</sup> Ibid.

have one” and “Shopped for one”).<sup>34</sup> At the same time, less than 8% of consumers took substantive action towards considering a PEV. It appears that information and awareness of EVs and their benefits continues to be one of the main obstacles towards EV adoption. As such, key policies that aim to increase EV adoption must address consumer EV awareness, knowledge and perceptions. This action needs to come not only from a government level but from EV manufacturers who have a vested interest in educating consumers about their vehicles and who have more resources to do so.<sup>35</sup>

### Impacts of Federal Policies – Federal Tax Credit

The Supplemental Report of the 2019-20 Budget requires CARB to evaluate the impacts of federal policy, such as the federal tax credit, on the adoption of ZEVs. The Internal Revenue Code Section 30D allows a tax credit up to \$7,500 for the purchase of a qualifying plug-in electric vehicle. The tax credit amount begins to phase out once a vehicle manufacturer has sold 200,000 qualified vehicles, halving two quarters after the milestone is reached, and again two quarters after that, before being eliminated entirely after six quarters. Tax credits began to phase out in January 2019 and April 2019 for Tesla Motors and General Motors, respectively. (Figure 4).

**Figure 4. Tax incentive levels for Tesla Motors and General Motors<sup>36</sup> during the phase out period**



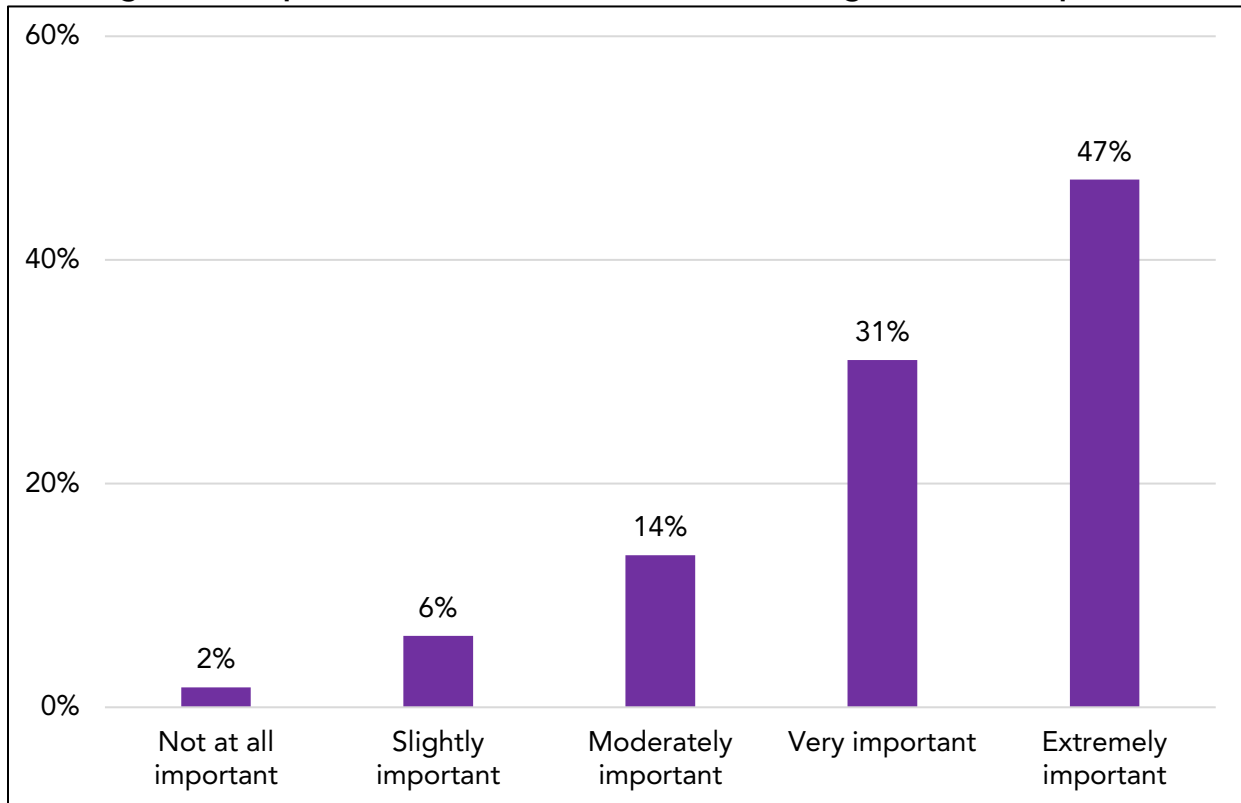
<sup>34</sup> Ibid.

<sup>35</sup> Ibid.

<sup>36</sup> Fueleconomy.gov (2020 August 21). Federal Tax Credits for New All-Electric and Plug-in Hybrid Vehicles. Retrieved 26 June 2020 from <https://www.fueleconomy.gov/feg/taxevb.shtml>.

The CVRP Consumer Survey asks respondents to rate the importance of the federal tax credit in making it possible to acquire an electric vehicle. Those who answered “extremely important” are most influenced by the incentive and can be used as a proxy for those who might not have purchased/leased their vehicle without the tax credit. For applicants between March 2017 through December 2019, 47 percent of respondents said the tax credit was extremely important, as shown in Figure 5. This level of importance indicated by respondents has remained relatively constant throughout this period.

**Figure 5. Importance of Federal Tax Credit Among CVRP Participants<sup>37</sup>**

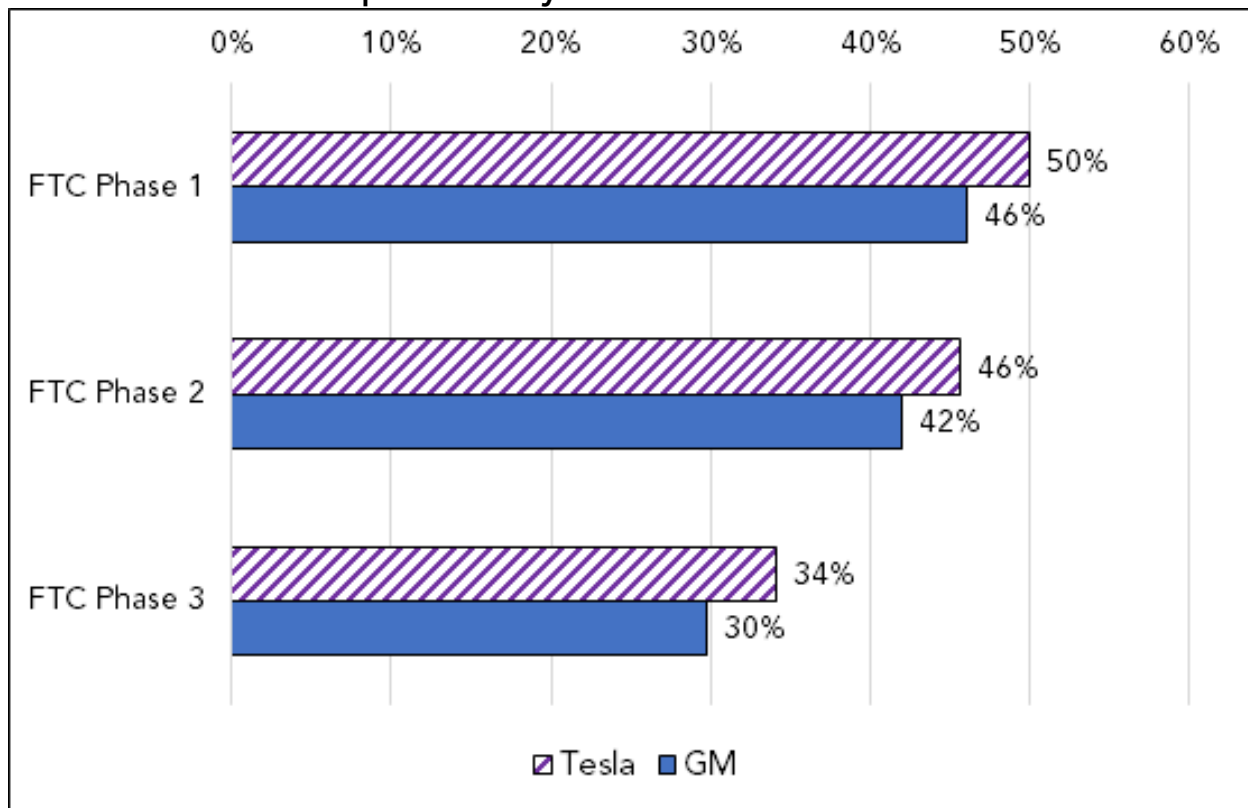


The phase out of tax credits for Tesla Motors and General Motors provides an opportunity to evaluate the importance of the tax credit and its impact on the importance of the CVRP rebate. Figure 6 shows that the percent of consumers indicating that the federal tax credit was extremely important decreased by approximately a third as the tax credit decreased from \$7,500 to \$1,875 for both Tesla Motors and General Motors. Interestingly, there was no increase in the importance of the CVRP rebate despite the decrease in the tax credit level for both manufacturers (Figure 7).

<sup>37</sup> CVRP Rebate Data. Applications received March 2017 – December 2019. N = 160,272.

The CVRP survey responses indicate that tax credits remain important to consumers despite the phase out of tax credits for the best-selling manufacturers. The phase out of tax credits for Tesla and GM showed that decreasing incentive levels are associated with a decrease in the importance of the tax credit. The data does not indicate that the CVRP rebate has increased in importance as tax credits have decreased for Tesla and GM as the tax credits have phased out. It is not clear from this analysis how the phase out of tax credits impacts EV adoption, but it is feasible that it will reduce the rate of adoption or shift consumers to makes that have available tax credits. Research aimed at specifying the impact of the tax credit on the market is ongoing.

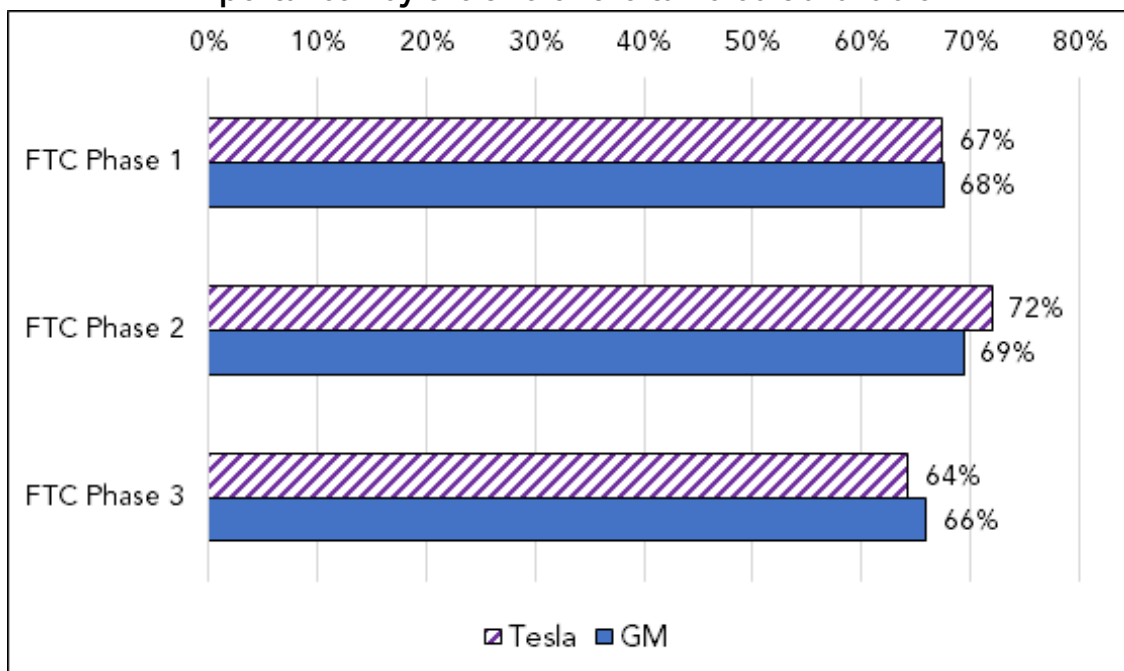
**Figure 6. Percent of consumers indicating that the federal tax credit was of "Extreme Importance" by the size of the tax credit available<sup>38</sup>**



<sup>38</sup> CVRP Rebate Data. Applications received March 2017 – December 2019. N = 95,907.



**Figure 7. Percent of consumers indicating that the CVRP rebate was of “Extreme Importance” by the size of the tax credit available<sup>39</sup>**



### Summary of a Sustainable ZEV Market Section

Staff has defined the ZEV market reaching 16-20 percent market share of the new light-duty car market as the point at which it would be considered sustainable, and no longer need financial incentives for the broader market. ZEV car sales grew to about 8 percent of new car sales in California by mid- 2019 and maintained this market share during the health and economic crisis of 2020. Increases in ZEV sales and vehicle diversity and reductions in battery costs are all strong indicators of continued market growth. However, consumer awareness remains an issue where additional work is needed, and the elimination of the federal tax credit may negatively impact growth.

### **CVRP and ZEV Market Long-Term Plan Conclusions**

Considering the current state of EV technology, the EV market, the economy, and fuel prices, the market is moving towards the path to achieve the State’s ZEV deployment goals. If ZEV sales growth increases and continues on the current trajectory and there are no additional major disruptions in the economy, California could meet the 2023 and 2025 ZEV deployment goals in some simulations, but would not meet the goal of 5 million EVs deployed by 2030.

ZEVs have yet to become the mainstream option for vehicle purchasers and there are still barriers that consumers must overcome before choosing this new technology over ICEs. Availability of less expensive EVs and a more diverse selection in different

<sup>39</sup> CVRP Rebate Data. Applications received March 2017 – December 2019. N = 96,490.

vehicle classes with higher range is needed to make ZEVs more favorable than ICE vehicles.

As the market is approaching the early majority segment, or mainstream consumers, who are sensitive to pricing and vehicle utility, incentives are more essential than ever before. Incentives will continue to encourage mainstream consumers to purchase cleaner vehicles and help maintain the current momentum of the ZEV market. Since technology has advanced and more models with higher ranges are available to consumers compared to three years ago, All Electric Range (AER) requirement for PHEVs should be increased and eventually phased out for the broad consumer market in few years. This policy change would direct the limited funding towards cleaner technologies, mainly BEVs and FCEVs. Staff recommends that incentives for PHEVs should continue to be available for low-income consumers for at least few more years.

Additionally, an MSRP cap could be adjusted over time. As more models become available, reducing the MSRP cap could help drive the supply side of the market to produce more economical choices, supporting the needs of the mass market and lower-income consumers. Although, staff recommends that in each vehicle class there should be at least two model choices available to consumers. Ramping down incentives and making adjustments as the market progresses may allow us to be more responsive to market changes and thus better direct limited incentives funding towards those who need it the most, in particular to priority populations.