

State of California  
AIR RESOURCES BOARD

**STAFF REPORT: STANDARDIZED REGULATORY IMPACT ASSESSMENT**

**PROPOSED AMENDMENT TO THE ZERO EMISSION VEHICLE REGULATION  
FAST REFUELING CREDIT PROVISION**

# **Proposed Amendment to the ZEV Regulation Fast Refueling Credit Provision Standardized Regulatory Impact Assessment (SRIA)**

## **A. Summary**

The purpose of the Zero Emission Vehicle (ZEV) Regulation's fast refueling credit provision is to provide a technology-neutral, credit-earning mechanism for ZEVs that can refuel at a rate analogous to traditional gasoline- or diesel-fueled vehicles. The ZEV Regulation currently assigns credits to vehicles on the basis of ZEV-type categories (Type III, IV, or V), which are determined by a vehicle's zero emission range and fast refueling capability. Type III ZEVs achieve 100 miles or more of electric range and are capable of replacing 95 miles of a standard driving cycle range within 10 minutes. Type IV and V ZEVs achieve at least 200 and 300 miles, respectively, of electric range, and are capable of replacing 190 and 285 miles, respectively, of a standard driving cycle within 15 minutes.<sup>1</sup>

In October 2013, the Air Resources Board (ARB or Board) proposed to exclude battery exchange (or fast swap) from qualifying under the fast refueling provisions of the ZEV Regulation.<sup>2</sup> After considering input from stakeholders, the Board directed ARB to amend the regulation to ensure fast refueling credits are fuel neutral and are awarded only for demonstrated battery exchange events. ARB amended the regulation allowing manufacturers to document battery exchange events up to 12 months following vehicle placement and allowing one vehicle to earn fast refueling credits for up to 25 fast refueling events.<sup>3</sup> However, the number of fast refueling events for which a manufacturer can request credits cannot exceed the total number of eligible vehicles in that manufacturer's fleet.

At the October 2014 Board Meeting, the Board requested additional amendments to the ZEV Regulation to limit the fast refueling credits awarded to model year (MY) 2015-2017 vehicles. In response, ARB proposes the ZEV Regulation be amended to permit one vehicle to earn fast refueling credits for only one fast refueling event, rather than the 25 events currently allowed. The proposed amendment would be effective for MY 2017 vehicles.<sup>4</sup>

## **1. Statement of the Need for the Proposed Amendment**

### **a) Goal of ZEV Fast Refueling Credits**

The goal of the fast refueling credit provision in the ZEV Regulation is to encourage ZEV manufacturers to offer fast refueling capabilities such that ZEV drivers can obtain a similar level of utility as conventional gasoline- or diesel-powered vehicle users. The fast refueling credits are intended to reward manufacturers for providing the necessary

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<sup>1</sup> Model Year (MY) 2015 through 2017 Type III, IV, and V ZEVs currently earn 4, 5, and 9 ZEV credits, respectively.

<sup>2</sup> Battery exchange, battery swap, and fast swap are used interchangeably in this document.

<sup>3</sup> Fuel cell electric vehicles (FCEVs) are exempt from documentation requirements as all miles are attributed to fast refueling hydrogen fueling events.

<sup>4</sup> The amendment is proposed only for MY 2017 because MY 2015 and MY 2016 vehicles are on the road in California.

technology to enable ZEV fueling with electricity or hydrogen at approximately the same speed as conventional petroleum fuels.

#### **b) Statement of Need for ZEV Fast Refueling Credit Amendment**

The proposed amendment is developed to help meet the goals of the fast refueling credit provision in the ZEV Regulation and to prevent excessive credit generation (or gaming). The proposed amendment is required to ensure that fast refueling ZEV credits are only issued for range extension and not credit-earning schemes.

### **2. Major Regulation Determination**

The proposed amendment is determined to be a major regulation requiring a Standardized Regulatory Impact Assessment (SRIA) as the estimated direct cost impacts of the amendment exceed \$50 million in a 12-month period after full implementation. The proposed amendment could reduce the revenue generated from the sale of ZEV credits, which is defined as a direct cost to regulated parties. ARB has estimated that the proposed amendment could result in direct costs to regulated parties of up to \$252 million during 2017 and 2018, when the amendment would be fully implemented.

### **3. Baseline Information**

To estimate the economic impacts of the proposed regulatory amendment, a baseline or business-as-usual (BAU) characterization was developed. The economic impact of the proposed regulatory amendment is then evaluated against the BAU scenario.

Under the existing ZEV Regulation, fast refueling capable MY 2015 through 2017 vehicles qualify for a total of 5 and 9 credits as Type IV (200+ miles range) and Type V (300+ miles range) ZEVs, respectively. For a given model year, the current regulation also allows a manufacturer to report up to 25 fast refueling events per vehicle, with one fast refueling event counted for each demonstrated battery exchange event of the vehicle. However, the total number of credit-earning fast refueling events is capped by the manufacturer's fleet of that model year of vehicle and must take place within the 12-month period following the delivery of the model year's first vehicle.

The proposed amendment limits the number of battery exchange events that qualify for fast refueling credits to one per vehicle. Therefore, if one vehicle demonstrates 25 battery exchange events within a 12-month period (following the delivery of that model year's first vehicle), the manufacturer would be issued additional ZEV credits for only one event, and not 25 as under the current ZEV Regulation.

The assumptions ARB uses to characterize the BAU scenario for the proposed amendment are discussed in the Direct Costs section (C) of this document.

### **4. Public Outreach and Input**

Starting in May 2013, ARB held three public workshops on proposed changes to the ZEV regulation, including modifications to credits earned by battery exchange. These public workshops engaged representatives from manufacturers, Section 177 states, and

environmental advocates.<sup>5</sup> The public workshops were held in Sacramento on May 20, 2013, July 14, 2014, and June 5, 2015, and were webcast to encourage participation from stakeholders that could not attend in person. Following each workshop and throughout the regulatory development process, ARB received input from and worked with stakeholders on a variety of proposed changes to the ZEV Regulation. Announcements and materials related to the workshop were publically posted on the ARB website and distributed through a list serve to over 14,500 recipients.

After the October 2014 Board Hearing, ARB prepared a concept proposal for amending the battery exchange provision of the ZEV Regulation based on direction from the Board to provide additional ZEV credits for only one fast refuel per vehicle. In March 2015, ARB distributed the concept proposal through a listserv to solicit regulatory alternatives from stakeholders. However, ARB did not receive any alternative proposals by the requested deadline.

## **B. Benefits**

The proposed amendment is intended to prevent manipulation of the ZEV credit market, which is designed to incentivize the introduction and use of fast refueling technologies. The proposed amendment would ensure that fast refueling credits are awarded for extending vehicle range and not through artificial schemes or artifices, ensuring the integrity of the ZEV credit market.

### **1. Benefits to Individuals**

There are no benefits directly introduced to individuals by the proposed amendment.

### **2. Benefits to California Businesses**

There are no benefits directly introduced to California businesses by the proposed amendment.

## **C. Direct Costs**

This section begins with the identification of the entities that are affected by the proposed amendment. Next, the direct cost estimation methodology is outlined, including a discussion of the underlying assumptions and the rationales for these assumptions. The inputs and outputs of the indirect cost estimation are then discussed, followed by an interpretation of the results.

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<sup>5</sup> Section 177 states are states that administer California's ZEV requirements pursuant to Section 177 of the Clean Air Act (42 U.S.C. Sec. 7507).

## 1. Direct Costs on Individuals

The proposed amendment does not impose any direct costs on individuals.

## 2. Direct Costs on Typical Businesses

The primary entities affected by the proposed amendment are ZEV manufacturers that will sell MY 2017 automobiles in California with battery exchange capabilities that qualify for ZEV fast refueling credits.<sup>6</sup>

### Direct Cost Estimation

Under the current ZEV Regulation, manufacturers can sell excess credits to other manufacturers and create a significant revenue stream. Currently, ZEV-only manufacturers are using battery swapping as a fast refueling mechanism. These manufacturers sell credits to generate additional revenue.

The estimated direct cost imposed on manufacturers by the proposed amendment can be calculated through the change in revenue generated by ZEV fast refueling credits. Fast refueling credit revenue depends on the number of fast refueling events that are demonstrated by MY 2017 vehicles within the first year of their placement in the California market. The change in credit revenue between the BAU scenario  $i$  and the proposed amendment  $j$ , is denoted  $\Delta$ , and can be modeled as:

$$\Delta = P \left[ (Q_B + Q_{FR_i}) - (Q_B + Q_{FR_j}) \right], \quad \text{Eq. 1}$$

where  $P$  denotes the dollar value of a ZEV credit,  $Q_B$  represents the allotted amount of ZEV base credits, and  $Q_{FR}$  represents ZEV fast refueling credits. ZEV base credits represent the number of credits a qualifying ZEV would receive in the absence of a documented fast refueling event. Fast refueling credits are the number of credits a qualifying ZEV would receive (in addition to the base credits) for a documented fast refueling event.

Under the current ZEV Regulation, a MY 2017 manufacturer can earn 4 base credits for each Type V ZEV it places in the California market, and an additional 5 fast refueling credits for each demonstrated fast refueling event. However, the manufacturer can only report up to 25 fast refueling events within a 12-month period from delivery of each MY 2017 vehicle. The number of creditable fast refueling events also cannot exceed the total number of MY 2017 vehicles in the manufacturer's vehicle fleet.

Let  $V$  denote the projected sales volume for the model year that this amendment will affect (2017),  $SW$  the number of annual swaps, and  $TR$  the take rate of fast swap stations. Then Eq. 1 can also be represented as follows:

$$\Delta = P(4V + 5TR \cdot V \cdot SW_i) - P(4V + 5TR \cdot V \cdot SW_j), \quad \text{Eq. 2}$$

where  $P \geq 0$ ,  $V \geq 0$ ,  $0 \leq TR \leq 1$ , and  $0 \leq SW \leq 25$ .

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<sup>6</sup> As the ZEV Regulation's fast refueling credit provisions will be discontinued beginning with MY 2018 vehicles, the proposed amendment will only affect MY 2017 ZEV manufacturers with fast refueling capabilities. MY 2018 and beyond ZEVs will be awarded credits based on standard driving cycle range.

## Inputs

Estimating the direct costs of the proposed amendment, as outlined in Eq.2, requires assumptions related to the cost of ZEV credits over time, ZEV sales in California, and the number of battery swaps per vehicle. In this document, generous assumptions are made to avoid underestimating the true cost impact, including assumptions related to the inputs defined below.

**Credit Price:** The credit price is the dollar value of a single credit traded in the ZEV credit market. ARB estimates a ZEV credit price of \$3,500.

The ZEV credit price is calculated by dividing the credit revenues reported by ZEV manufacturers for fiscal year 2013 by the number of credits transferred or sold during the same time period. For this calculation, ARB used public filings of ZEV credit revenues reported to the U.S. Securities and Exchange Commission (SEC) and ZEV credit transfers between manufacturers and third parties reported to ARB.<sup>7,8</sup>

ARB assumes that the value of a ZEV credit, here estimated at \$3,500, will hold for credit transfers taking place during the period when the proposed amendment is expected to take effect, 2017 through 2018.<sup>9</sup>

**Sales Volume:** Sales volume is the total number of battery exchange capable MY 2017 ZEVs that will be produced and delivered for sale in California. ARB estimates there will be 20,000 MY 2017 Type IV and V ZEVs that qualify for fast refueling credits based on review of 2012, 2013, and 2014 ZEV sales in California.<sup>10</sup>

ARB assumes all battery exchange capable MY 2017 ZEVs will be Type V vehicles with electric ranges of at least 300 miles. These vehicles qualify for the largest number of combined ZEV base and fast refueling credits, a total of 9 credits for MY 2017.

**Take Rate:** The take rate is the proportion of projected MY 2017 Type V ZEV sales that are expected to receive fast refueling credits. ARB estimates that battery exchange facilities in California will serve 3 percent of the MY 2017 Type V ZEV fleet (600 unique vehicles) between 2017 and 2018.

Currently, there is one battery exchange facility operating in California.<sup>11</sup> The fastest, non-home based charging alternative to a battery swap is a charging facility that can

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<sup>7</sup> Manufacturers' ZEV credit revenues are reported to the U.S. SEC in Quarterly and Annual Reports (Forms 10-Q and 10-K), pursuant to section 13 or 15(d) of the Securities Exchange Act of 1934. ARB based credit price assumptions on ZEV credit revenues for fiscal year 2013 (October 1, 2012 – September 30, 2013), which are reported in nominal dollars. ARB was unable to estimate the credit price for other fiscal years due to data limitations.

<sup>8</sup> ZEV credit balances and transfers for fiscal year 2013 were obtained from the ZEV Credit Archive found on the ARB website, available at: <http://www.arb.ca.gov/msprog/zevprog/zevcredits/2012zevcredits.htm>.

<sup>9</sup> The price of a ZEV credit is not expected to exceed the \$5,000 penalty applied to manufacturers that do not comply with ARB's ZEV standards (California Health and Safety Code section 43211). ARB interprets the overall penalty for ZEV non-compliance to be \$5,000 per whole credit not produced.

<sup>10</sup> The 20,000 vehicle sales estimate includes likely increases in ZEV production volume and the introduction of new models (of both Type IV and Type V ZEVs) between model years 2015 and 2017.

<sup>11</sup> More information available at: <http://www.teslamotors.com/blog/battery-swap-pilot-program>.

offer more than 100kW of power output. There are currently 29 DC Quick Chargers in California that can output more than 100kW.<sup>12</sup> Assuming the ratio of battery exchange facilities to DC Quick Chargers persists through 2018 (1 battery exchange for every 29 DC Quick Charge facilities), ARB assumes 3 percent of all MY 2017 vehicles with fast charge capability will utilize the battery exchange facility. Thus, the fast swap station would accommodate up to 600 MY 2017 ZEVs with fast refueling capabilities (out of the projected 20,000), a take rate of 3 percent.

**Annual Swaps:** Annual swaps are the number of demonstrated battery exchange events expected in a year. An estimate of annual swaps is used in the BAU scenario for evaluating the impact of the proposed amendment. Since manufacturers are currently allowed to report up to 25 fast refueling events per battery swap of one vehicle, as an upper bound ARB assumes that each MY 2017 Type V ZEV would take 25 trips annually that are long enough to warrant battery exchange events or swaps. This assumption is made both in the BAU scenario and in the modeling of the proposed amendment.

### **Direct Cost Estimation Results**

From the inputs discussed above, the estimated change in ZEV credit revenue resulting from the proposed amendment is:

$$P = \$3,500, \quad TR = 0.03, \quad V = 20,000, \quad SW_i = 25, \quad SW_j = 1;$$

$$\Delta = \$262,500,000 - \$10,500,000 = \mathbf{\$252,000,000}.$$

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<sup>12</sup> Based on information obtained from the U.S. Department of Energy's Alternative Fueling Station Locator, available at: <http://www.afdc.energy.gov/locator/stations/>.

**Figure 1: ZEV Fast Refueling Credit Valuation or Revenues<sup>13</sup>**

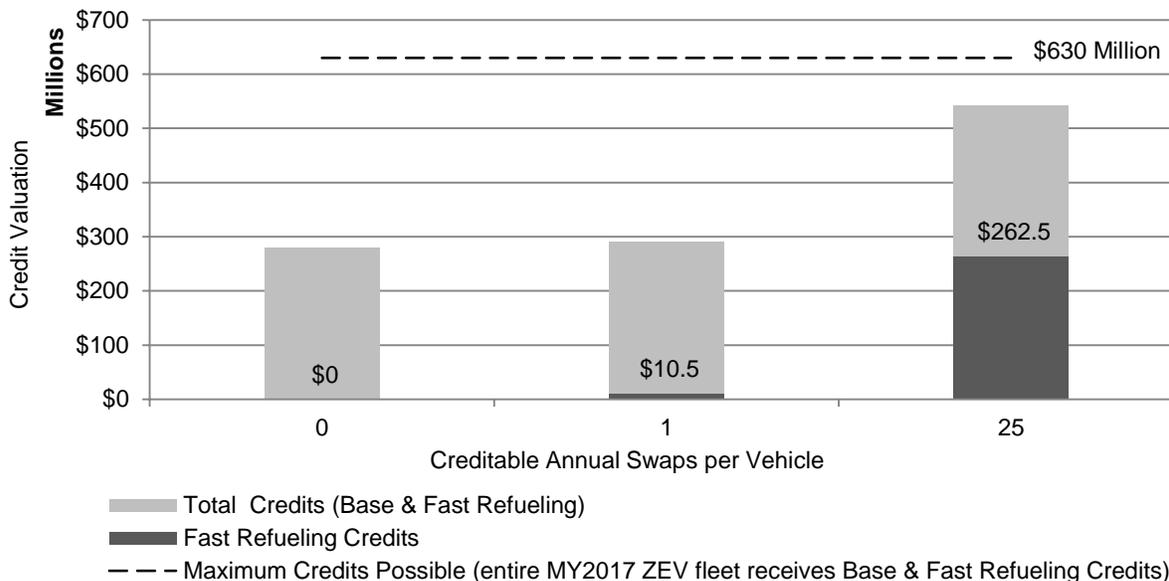


Figure 1 shows the estimated change in credit revenue between the BAU scenario, with an assumed 25 battery swaps per MY 2017 vehicle, and the proposed amendment, with one battery swap per MY 2017 vehicle. The proposed amendment is estimated to result in a \$252 million loss in credit revenues for California ZEV manufactures.

The direct cost impacts of the proposed amendment depend on the number of annual battery swaps that qualify for a fast refueling event:

$$\Delta = 5P \cdot TR \cdot V(SW_i - SW_j). \quad \text{Eq. 3}$$

As outlined in Eq. 3, the estimated change in ZEV credit revenue is based on the difference between  $SW_i$  and  $SW_j$ . All other estimated variables used to measure the direct cost impacts of the proposed amendment (credit price, in particular) are assumed to remain unchanged between the BAU scenario and the proposed amendment.

### Modified Annual Swaps Scenario

ARB also considered a second scenario in estimating the direct costs of the proposed amendment. The modified annual swaps scenario varies only in the assumed number of annual swaps per MY 2017 ZEV. Rather than assume the maximum of 25 annual battery swaps, this scenario relies on a calculation of the likely number of annual swaps that would be demonstrated by MY 2017 ZEVs. Assuming all MY 2017 ZEVs are Type V and capable of fast refueling and achieving 300 miles of electric range, ARB estimated the number of swaps needed to meet the average driver's daily driving needs in a year. While assumptions about credit price, sales volume, and take rate are

<sup>13</sup> Figure 1 relies on ARB's estimates of the ZEV credit price (\$3,500), sales volume of MY 2017 Type V ZEVs in California (20,000), annual take rate at battery swap facilities (3 percent), and the annual swaps per vehicle (0, 1, and 25).

unchanged, additional inputs were used to estimate the required number of swaps, as detailed below.

**Fleet Utility Factor:** The fleet utility factor characterizes the proportion of days and trips in a year that the average driver can meet his/her conventional driving needs by the Average Electric Range (AER) of a vehicle in a particular fleet. The fleet utility factor is calculated by dividing the charge-depleting miles of a specific fleet of vehicles by their total miles traveled.<sup>14</sup>

**Utility Factor Gap:** The utility factor gap measures the difference between full vehicle utility (100 percent) and the fleet utility factor. The fleet utility factor is calculated using average trips and miles driven per day, thus the utility factor gap can be multiplied by 365 to estimate the proportion of days in a year that a vehicle's AER does not satisfy conventional driving needs. ARB assumes that the maximum number of battery exchange events should not exceed the proportion of days where conventional driving needs are not met by a vehicle's usable AER.<sup>15</sup>

**Annual Swaps:** Based on the Society of Automotive Engineers' (SAE) calculations of fleet utility factor, ARB estimates that each MY 2017 Type V ZEV would take 10 trips annually that are long enough to warrant battery exchange events or swaps. Under this scenario, ARB estimates that the likely number of reported fast refueling events per MY 2017 vehicle would not exceed 10, on average, in both the BAU and under the proposed amendment.

Figure 2 illustrates varying ranges of a fleet's AER and the corresponding utility factor gap and number of annual battery exchange events or swaps:

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<sup>14</sup> For more information see the Society of Automotive Engineers (SAE) J2841 (Sept. 2010 revision) International Surface Information Report, "Utility Factor Definitions for Plug-In Hybrid Electric Vehicles Using Travel Survey".

<sup>15</sup> Since, on average, ZEVs do not completely deplete their battery charge before recharging, a reserve range of 40 miles is used to approximate an electric vehicle's usable AER.

**Figure 2: Annual Swaps based on Utility Factor Gap<sup>16</sup>**

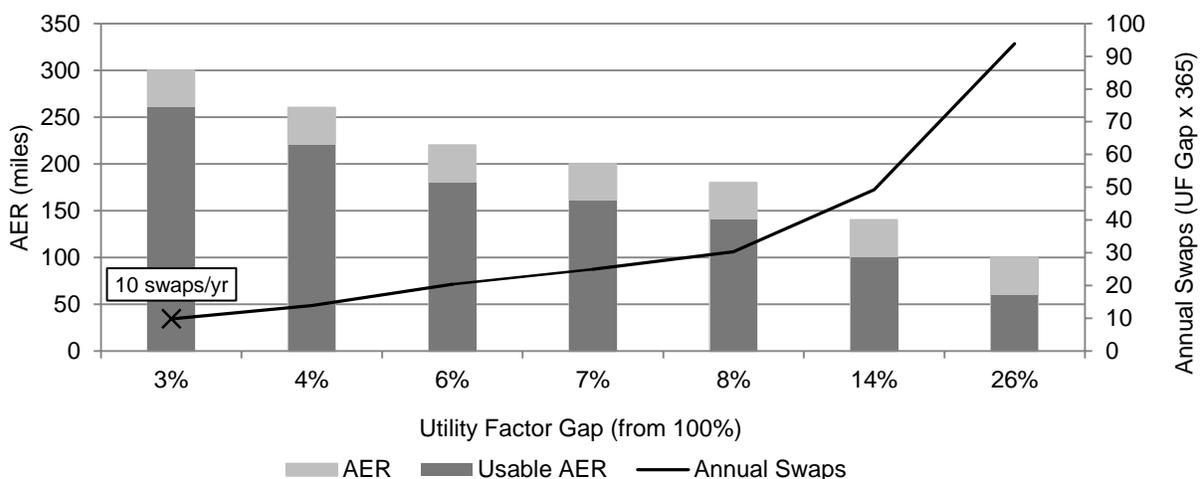


Figure 2 shows that the annual number of fast refueling events increases significantly for vehicles that have a lower AER. Since all MY 2017 ZEVs are assumed to be capable of achieving 300 miles, the corresponding usable AER, utility factor, and utility factor gap for these vehicles are: 260 miles, 97 percent, and 3 percent, respectively. Therefore, in the first 12 months after a vehicle has been placed, ARB estimates that the likely number of reported fast refueling events per vehicle would not exceed 10 for MY 2017 ZEVs.

### Direct Cost Estimation Results of the Modified Annual Swaps Scenario

From the inputs discussed above, the estimated change in ZEV credit revenue resulting from the proposed amendment is:

$$P = \$3,500, \quad TR = 0.03, \quad V = 20,000, \quad SW_i = 10, \quad SW_j = 1;$$

$$\Delta = \$105,000,000 - \$10,500,000 = \mathbf{\$94,500,000}.$$

<sup>16</sup> Figure 2 uses Fleet Utility Factor data from the SAE's J2841 (Sept. 2010 revision) International Surface Information Report, "Utility Factor Definitions for Plug-In Hybrid Electric Vehicles Using Travel Survey".

**Figure 3: ZEV Fast Refueling Credit Valuation or Revenues<sup>17</sup>**

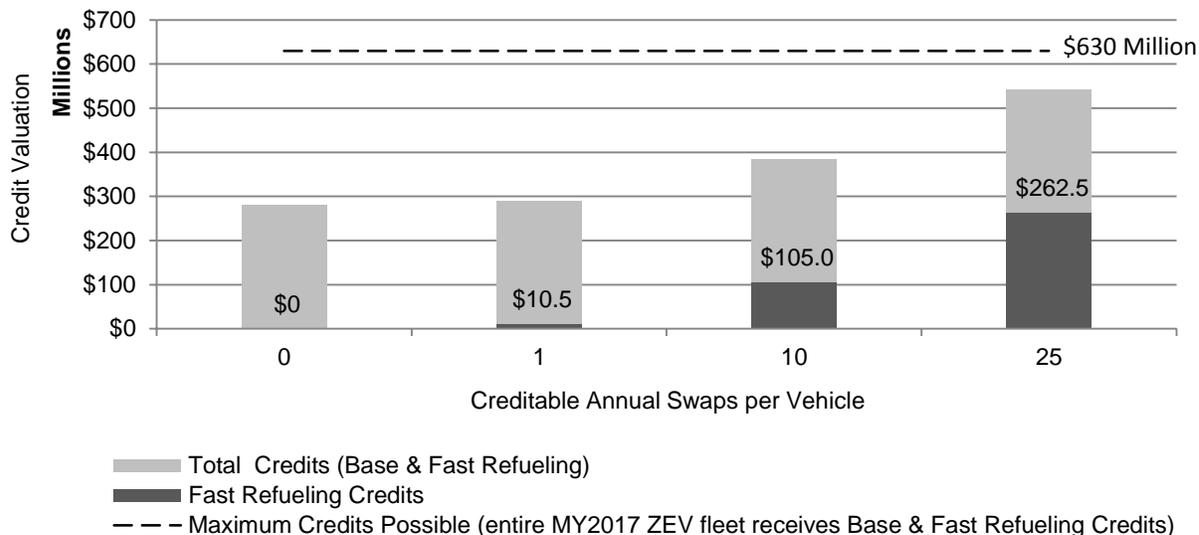


Figure 3 shows the estimated change in credit revenue between the current ZEV Regulation (assuming 10 and 25 battery swaps per vehicle) and the proposed amendment with one battery swap per vehicle. Under the modified annual swaps scenario (assuming 10 battery swaps), the proposed amendment could result in an estimated \$94.5 million loss in credit revenues for California ZEV manufactures.

While it is plausible, and even likely, that MY 2017 ZEVs will demonstrate at most 10 annual battery swaps, the current regulation allows for 25 battery swaps per vehicle to qualify for credits. Therefore, to estimate the upper bound of the economic impacts of the proposed amendment, ARB assumes that MY 2017 ZEVs will take 25 trips annually that are long enough to warrant battery swaps under the current regulation. The direct cost impact derived from this assumption, \$252 million, is used in the remainder of the document to estimate the impacts of the proposed amendment on California’s economy, and should be considered an upper bound of the potential cost impact of the proposed regulation.

## D. Macroeconomic Impacts

### 1. Methodology for Determining Economic Impacts

Regional Economic Models, Inc. (REMI), a computational general equilibrium model, is used to estimate the macroeconomic impacts of the proposed amendment on the California economy. The direct cost of the proposed amendment, outlined in the previous section, is an input into the REMI model and used to estimate the indirect, and induced economic impacts of the proposed amendment. REMI Policy Insights Plus (PI+) is utilized to provide year-by-year estimates of the total impacts of the proposed amendment, pursuant to the requirements of SB 617 and the California Department of

<sup>17</sup> Figure 3 relies on ARB’s estimates of the ZEV credit price (\$3,500), sales volume of MY 2017 Type V ZEVs in California (20,000), annual take rate at battery swap facilities (3 percent), and the annual swaps per vehicle (0, 1, 10, and 25).

Finance (DoF).<sup>18</sup> ARB uses the REMI PI+ one-region, 160-sector model that has been customized by DoF to include California-specific data on population, demographics, and employment.

Under the current ZEV Regulation, a MY 2017 Type V ZEV can receive 5 additional fast refueling credits for up to 25 fast swaps (capped by the manufacturer's model year vehicle fleet size). The proposed amendment would limit each MY 2017 vehicle to one fast charge, effectively reducing the potential number of ZEV credits that would be supplied to the market.

The proposed amendment could directly impact the revenue stream of manufacturers whose vehicles generate fast swap credits – with the change in the number of credits awarded for fast refueling impacting the net earnings of the manufacturer. To estimate the macroeconomic impacts of the proposed amendment, ARB assumes all direct cost impacts imposed on ZEV manufacturers are passed to California vehicle owners through an increase in the purchase price of all new vehicles.

## **2. Inputs of the Assessment**

Under the proposed amendment, vehicle manufacturers are expected to adjust the consumer price of all vehicles they produce (including conventional petroleum vehicles and ZEVs) to fully offset losses in credit revenue. Thus, as modeled, the estimated \$252 million direct cost to manufacturers is entirely passed through to consumers through an increase in the consumer price of new motor vehicles. The increase in the price of new motor vehicles reduces the purchasing power of consumers as they reduce their spending in other categories to offset the higher vehicle purchase price.

As the placement of a vehicle model year can span more than one calendar year, ARB evenly applies the estimated direct cost impact of the proposed amendment over two calendar years. MY 2017 ZEVs can be placed in the California market as early as January 2, 2016, thus ARB assumes that ZEV credits for fast refueling will be awarded in the 2017 and 2018 calendar years.<sup>19,20</sup> The potential increase in new motor vehicle prices is also assumed to occur within the 2017 and 2018 calendar years. The estimated direct cost of the proposed amendment results in a small percentage increase in the price of new motor vehicles, as shown in Table 1.

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<sup>18</sup> More information is available on the California Department of Finance website at: [http://www.dof.ca.gov/research/economic\\_research\\_unit/SB617\\_regulation/view.php](http://www.dof.ca.gov/research/economic_research_unit/SB617_regulation/view.php).

<sup>19</sup> Given that manufacturers have up to 12 months after delivery of a vehicle to report fast refueling events, ARB assumes that these reports will take place over a 24-month period after placement of the first MY 2017 vehicle. This assumption accounts for vehicles sold at the beginning of the model year that report fast refueling events shortly after delivery, and extends to events reported 12 months after the final delivery of vehicles in the model year.

<sup>20</sup> ZEV credit balances and trades published on the ARB website suggest that credits are actively traded in the market. ZEV credit balances and transfers for 2010-2014 are available on the ARB website's ZEV Credit Archive at: <http://www.arb.ca.gov/msprog/zevprog/zevcredits/archive/archive.htm>.

**Table 1: Changes in Consumer Price for New Motor Vehicles<sup>21</sup>**

	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
<b>Change (percent of BAU price)</b>	0.15%	0.14%	0.00%	0.00%
<b>Aggregate Change (2014 M\$)</b>	\$126.00	\$126.00	\$0.00	0.00

### **3. Assumptions and Limitations of the Model**

The estimated economic impacts of the proposed amendment are sensitive to assumptions made by ARB in the modeling of the regulatory change. The list below outlines the key assumptions made in estimating the economic impacts of the proposed amendment.

**Credit Price:** ARB assumes a ZEV credit price of \$3,500 based on credit revenues reported by ZEV manufacturers for fiscal year 2013.

**Sales Volume:** ARB assumes 20,000 MY 2017 ZEVs with fast refueling capabilities will be placed in the California market. This assumption is based on the review of 2012, 2013, and 2014 ZEV sales in California (Type IV and V vehicles).

**Sales Timing:** ARB assumes that MY 2017 vehicles will be sold in equal proportions in calendar year 2017 and calendar year 2018, resulting in a concurrent increase in the consumer price of new motor vehicles.

**Take Rate:** ARB assumes that 3 percent of the MY 2017 Type V ZEVs (600 vehicles) can be accommodated by battery exchange facilities in the state, as outlined in section C, Direct Costs.

**Annual Swaps:** ARB assumes 25 refueling events are reported for each fast refueling capable MY 2017 ZEV based on the current ZEV Regulation.

### **4. Results of the Assessment**

#### **a) California Employment Impacts**

As modeled, the proposed amendment would have a small impact on employment growth relative to the current ZEV Regulation (BAU). Table 2 shows a slowing in the growth of employment equivalent to 1,200 and 1,300 jobs in 2017 and 2018, respectively. In the following two years as the proposed amendment is phased out, employment growth begins to increase but is still slightly slower than under the BAU scenario.

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<sup>21</sup> The SRIA requires a 12-month analysis after full implementation of a major regulation. Thus, the tables in this section present the economic impacts of the proposed amendment for the implementation years (2017 through 2018) as well as the following 12-month period (2019). 2020 was included in the tables to show that the economic impacts imposed by the proposed amendment are attenuated after 2019.

The slowing of job growth is primarily due to the increase in consumer price for new motor vehicles, and subsequent budget reallocation. As modeled, consumers would spend more on new vehicle purchases and reduce all other expenditures, slowing employment growth throughout California. However, the slowing of employment growth is negligible to California’s economy with 16 million industrial jobs in 2014.<sup>22</sup>

**Table 2: Changes in Employment Growth**

	2017	2018	2019	2020
<b>Change (percent)</b>	0.01%	0.01%	0.00%	0.00%
<b>Change in Jobs</b>	-1,200	-1,300	-175	-75

The value in each year is interpreted as the reference year value less the BAU value in that same year. The change in jobs is rounded to the nearest 25.

**b) California Business Impacts**

Table 3 shows that the proposed amendment slows output growth for the California motor vehicle manufacturing industry in 2017 and 2018. The change in output growth can be attributed to the potential reduction in fast refueling credit generation. The total change in output includes all California vehicle manufacturers, and represents a minor percentage change from the output levels estimated under the BAU scenario.

**Table 3: Changes in Output Growth**

Industry Name		2017	2018	2019	2020
<b>Motor Vehicle Manufacturing</b>	<b>Change (percent)</b>	-0.21%	-0.21%	0.00%	0.00%
	<b>Change (2014 M\$)</b>	-\$11.26	-\$11.19	\$0.00	\$0.00

The value in each year is interpreted as the reference year value less the BAU value in that same year. The values presented above are rounded to the nearest \$10,000.

**c) Impacts on Investments in California**

As modeled, the proposed amendment would produce very small impacts on California private business investment from 2017 through 2020. Table 4 shows a small slowing in the annual growth of investments in California from 2017 through 2020. The change in private investment can be linked to decreased cash flow of ZEV manufacturers resulting from reduced ZEV credit revenue, restricting potential investment in capital equipment. The slowed growth in private investment is indiscernible from BAU given the size of California’s \$2.2 trillion economy.<sup>23</sup>

<sup>22</sup> Source: Employment Development Department of the State of California website: <http://www.labormarketinfo.edd.ca.gov/>.

<sup>23</sup> Source: California Department of Finance website: [http://www.dof.ca.gov/HTML/FS\\_DATA/LatestEconData/documents/BBStateGDP.XLS](http://www.dof.ca.gov/HTML/FS_DATA/LatestEconData/documents/BBStateGDP.XLS).

**Table 4: Change in Gross Domestic Private Investment Growth**

		2017	2018	2019	2020
<b>Private Investment</b>	<b>Change (percent)</b>	0.01%	0.01%	0.00%	0.00%
	<b>Change (2014 M\$)</b>	-\$23.38	-\$34.75	-\$16.44	-\$6.44

The value in each year is interpreted as the reference year value less the BAU value in that same year. The values presented above are rounded to the nearest \$10,000.

#### **d) Impacts on Individuals in California**

The proposed amendment would produce a negligible change in personal income for all years analyzed. Table 5 shows that the annual change in the growth of personal income in California does not represent a discernable change from the BAU scenario. The results can be described as an increase in spending by consumers on new motor vehicles due to the slight increase in price, and a decrease in consumption of other goods. The growth in personal income follows in the same pattern as employment – the greatest impacts on personal income growth are in 2017 and 2018, when the proposed amendment would take effect. ARB interprets the impact of the proposed amendment as being indiscernible in California’s \$2.2 trillion economy.

**Table 5: Changes in Personal Income Growth**

		2017	2018	2019	2020
<b>Personal Income</b>	<b>Change (percent)</b>	0.01%	0.01%	0.00%	0.00%
	<b>Change (2014 M\$)</b>	-\$78.75	-\$98.00	-\$25.50	-\$16.00

The value in each year is interpreted as the reference year value less the BAU value in that same year. The values presented above are rounded to the nearest \$10,000.

#### **e) Impacts on Gross State Product (GSP)**

As presented in Table 6, the proposed amendment is estimated to slightly slow the growth of California GSP from 2017 through 2020. The reduction in growth does not represent a discernable change from GSP growth under the current ZEV Regulation.

The estimated slowing of GSP results from the increased price of new motor vehicles in 2017 and 2018, which decreases GSP through reductions in the growth of personal investment and employment. However, as the proposed amendment is phased out in 2019, the estimated impact on GSP decreases through to 2020. ARB interprets these results as small relative to the size of California’s \$2.2 trillion economy.

**Table 6: Changes in Gross State Product Growth**

		2017	2018	2019	2020
<b>GSP</b>	<b>Change (percent)</b>	0.00%	0.01%	0.00%	0.00%
	<b>Change (2014 M\$)</b>	-\$105.75	-\$119.00	-\$17.50	-\$8.00

The value in each year is interpreted as the reference year value less the BAU value in that same year. The values presented above are rounded to the nearest \$10,000.

#### **f) Creation or Elimination of Businesses**

It is not anticipated that there will be the creation or elimination of businesses as a direct result of the proposed amendment. Vehicle manufacturers in California exhibit strong growth in terms of employment and vehicle sales (statewide, national, and international). Therefore, the estimated economic impact of the proposed amendment is not expected to result in the creation or elimination of any businesses in California.

#### **g) Incentives For Innovation**

The proposed amendment would not eliminate the incentive for innovation in California. The proposed amendment does not change the opportunity to generate ZEV credits for manufacturing zero emission vehicles, nor would it eliminate the opportunity to generate fast refueling credits through a battery exchange program. ZEV manufacturers are still encouraged and awarded credits for innovative technologies and methods that allow for fast refueling. Implementation of the proposed amendment would only serve to ensure the integrity of the ZEV credit market.

#### **h) Competitive Advantage or Disadvantage**

Based on the direct cost estimation, the proposed amendment would not change the competitiveness of directly regulated entities. The underlying purpose of the fast refueling provision of the ZEV Regulation is to level the playing field between gas-powered and zero emission vehicles and is unaffected by the proposed amendment. Thus, ZEV manufacturers are not expected to face competitive disadvantages as a result of the proposed amendment.

### **5. Summary and Interpretation of the Results of the Economic Impact Assessment**

The proposed amendment supports the goals of the ZEV Regulation and ensures the integrity of credits awarded for fast refueling. Limiting ZEV credit-generating opportunities to one fast refueling event per vehicle encourages innovation for fast refueling technology, while ensuring the integrity of the ZEV credit market.

As modeled, the proposed amendment is unlikely to have significant impacts on California's economy, including the growth of employment, investment, personal income, and production. All of these economic indicators do not exhibit a significant change when comparing the impact of the proposed amendment to the ZEV Regulation currently being implemented. The estimated cost impacts of the proposed amendment represent the upper bound of anticipated impacts, providing additional confirmation that the likely economic impact would be negligible given the size of the California economy.

## **E. Alternatives**

In addition to the proposed amendment, ARB also evaluated alternative modifications to the ZEV Regulation as required by California Code of Regulations (CCR), Title 1, §2003(e). To solicit alternatives from stakeholders, ARB distributed a proposal of the proposed amendment on March 27, 2015. No alternative regulatory proposals were received. Therefore, ARB generated and evaluated the following two alternatives to the proposed amendment:

1. No action. The ZEV Regulation is not amended.
2. Disqualify the battery exchange program from earning fast refueling credits.

Alternative 1 assumes that there are no changes to the ZEV Regulation, which results in no additional costs to producers or consumers. Meanwhile, Alternative 2 explores a scenario under which battery exchanges would not receive fast refueling credits.

### **1. Alternative 1: No Action. The ZEV Regulation's Fast Refueling Credit Provision is Not Amended.**

#### **a. Costs and Benefits**

Alternative 1 would impose no additional costs on consumers or ZEV manufacturers relative to the BAU. This scenario would allow the ZEV Regulation to continue as it was written in CCR, Title 13, § 1962.1.

#### **b. Economic Impacts**

Since Alternative 1 does not impose any additional costs to industries or consumers, there would be no economic impacts relative to the BAU scenario. The current ZEV Regulation is included in the BAU scenario, and would continue to be implemented through the period in which the proposed amendment would be implemented.

Compared to the BAU scenario, there would be no changes in GSP, personal income, private investment, or other economic indicators.

#### **c. Cost-Effectiveness**

Alternative 1 may be a less-costly alternative compared to the proposed amendment as it does not impose any fiscal costs or regulatory costs that may be associated with the development and enforcement of the proposed amendment.

#### **d. Reason for Rejection**

Alternative 1 does not sufficiently meet the goals of the proposed amendment, which is to eliminate the potential for excess generation of fast refueling ZEV credits. Therefore, it is not a viable alternative to the proposed amendment.

### **2. Alternative 2: Remove the Battery Exchange Program from Qualifying as Fast Refueling**

Alternative 2 would effectively disallow credit generation from the battery exchange program and additional ZEV credits for battery fast swaps would not be generated.

### **a. Costs and Benefits**

Alternative 2 would have a direct cost to ZEV manufacturers, as ZEV credit revenue would decline relative to the current ZEV Regulation. As modeled (analogous to the analysis of the proposed amendment), this would result in higher consumer prices for new vehicles. Compared to the existing ZEV Regulation, this alternative would entirely eliminate revenue generated from battery exchange demonstrations. Based on projections for MY 2017, the direct cost imposed on manufactures from this alternative would be \$262.5 million (see Figure 1), spread over calendar years 2017 and 2018.

Based on the modeling assumption made by ARB, the direct cost can be estimated using Eq. 3, where  $\Delta = 5P \cdot TR \cdot V(SW_i - SW_j)$ .

Using the same inputs used to estimate the direct cost of the proposed amendment, this alternative would require that  $SW_j = 0$  (i.e., no fast swaps are awarded ZEV credits):

$$\Delta = 5(\$3,500) \cdot 0.03 \cdot 20,000(25 - 0) = \$262,500,000.$$

### **b. Economic Impacts**

As modeled, Alternative 2 would have a very small impact on GSP, personal income, and private investment. The greatest impacts are during the first two years as the proposed amendment is implemented. In the following years, the effects of the economic impacts are attenuated. Through 2020, there are negligible declines in the growth of GSP, personal income, and private investment. These results are not considerably different from the estimated impacts under the proposed amendment and are presented in Table 7.

**Table 7: Alternative 2 (Compared to BAU)**

		<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
<b>Employment Growth</b>	<b>Change (percent)</b>	0.01%	0.01%	0.00%	0.00%
	<b>Change (2014 M\$)</b>	-1,250	-1,350	-175	-75
<b>Motor Vehicle Manufacturing Output</b>	<b>Change (percent)</b>	-0.26%	-0.25%	0.00%	0.00%
	<b>Change (2014 M\$)</b>	-\$11.73	-\$11.65	\$0.00	\$0.00
<b>Private Investment</b>	<b>Change (percent)</b>	0.01%	0.01%	0.00%	0.00%
	<b>Change (2014 M\$)</b>	-\$23.35	-\$34.30	-\$15.29	-\$5.16
<b>Personal Income</b>	<b>Change (percent)</b>	0.00%	0.00%	0.00%	0.00%
	<b>Change (2014 M\$)</b>	-\$76.90	-\$93.26	-\$24.90	-\$15.63
<b>GSP</b>	<b>Change (percent)</b>	0.00%	0.01%	0.00%	0.00%
	<b>Change (2014 M\$)</b>	-\$104.98	-\$115.72	-\$16.60	-\$7.08

**c. Cost-Effectiveness**

Alternative 2 would have significantly lower regulatory and enforcement costs, when compared to the proposed amendment, as no enforcement and regulation-maintenance efforts would be required.

**d. Reason for Rejection**

While Alternative 2 may provide a lower cost solution, it does not provide the desired encouragement for development of innovative methods to refuel ZEVs at speeds equivalent to those of gasoline- or diesel-powered cars. Therefore, Alternative 2 does not meet the goals of the ZEV Regulation and is not a viable alternative to the proposed amendment.

**F. Fiscal Impacts**

**1. Local Government**

The proposed amendment does not affect local government costs, either in terms of tax revenue or personnel requirements.

## **2. ARB**

The proposed amendment would have minimal impact on staffing resources, which could be accommodated through a redistribution of existing staff. The fiscal impact of the proposed amendment for ARB is expected to be negligible.

## **3. Other State Agencies**

The proposed amendment does not impose an impact on other state agencies. The fiscal impact of the proposed amendment on other state agencies is expected to be negligible.