CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS

2008 PROPOSED AMENDMENTS TO THE CALIFORNIA ZERO EMISSION VEHICLE PROGRAM REGULATIONS

This report has been reviewed by the staff of the California Air Resources Board and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Air Resources Board, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

Date of Release: February 8, 2008
Scheduled for Consideration: March 27, 2008

EXECUTIVE SUMMARY

In 1990, the California Air Resources Board (ARB or the Board) adopted an ambitious program to significantly reduce the environmental impact of light-duty vehicles through the commercial introduction of zero emission vehicles (ZEV) into the California fleet.

The ZEV program is vital in meeting California's environmental goals. Zero-emission technologies can greatly reduce or even eliminate some of the persistent environmental problems with motor vehicles. The ZEV program promotes the use of the cleanest gasoline technologies available, while still encouraging the development of pure zero emission technologies.

The ZEV program has been modified four times since its inception – in 1996, 1998, 2001, and most recently in 2003. While the program requirements have been changed to reflect the status of technology, the original objective has not changed. California continues to maintain a strong commitment to the commercialization of zero-emission passenger cars and light-duty trucks.

In response to the Board's actions, automakers have developed and demonstrated limited numbers of ZEVs to evaluate their technological and commercial feasibility. Parallel to these efforts, automakers have commercialized "near-zero" emission vehicles and hybrid electric vehicles (HEV) that have been supportive of the ZEV program goals and have significantly reduced vehicle emissions.

The ZEV program was last modified in 2003 to resolve legal challenges and to better address the state of technology. Given the uncertainty in the pace of technology development, the Board directed that an independent panel of experts (Panel) be convened to report on the status of ZEV technologies and their readiness for commercialization.

The Panel's findings were presented to the Board in May 2007. Subsequent to presentations by the ARB staff and Panel, and after taking public comment, the Board adopted Resolution 07-18 directing ARB staff to return to the Board with proposed changes that address the state of technologies needed to meet the regulation. In directing that changes were needed, the Board affirmed its support for the program and emphasized that any changes should strengthen the overall objectives of the program.

Proposed Amendments to the Regulations

In response to the Board's direction, ARB staff is now proposing amendments to the program that are designed to better reflect the state of technology and create incentives for new vehicle designs. Other proposed changes are intended to clarify and simplify specific program requirements pertaining to 2009 and subsequent model years (MY). The most significant proposed amendments pertain to Phase III and Phase IV (2012 – 2017), while Phase II (2009 – 2011) requirements remain largely unchanged. The

proposed amendments are expected to maintain pressure on the commercialization of pure ZEV technologies while recognizing the technological limitations and costs of current vehicles. The key elements of staff's proposal are the following:

A. Creation of the "New Path" for 2012. Combine the Base Path and Alternative Path requirements into a New Path where the ZEV obligation and the options to use other vehicle types are expressed as annual percentage requirements. The pure ZEV requirement may be offset by up to 90 percent "Enhanced" Advanced Technology Partial ZEVs (Enhanced AT PZEV), a new classification of vehicle in Phase III (2012 – 2014). In Phase IV (2015 – 2017), 50 percent of the ZEV target requirement could be met with Enhanced AT PZEVs. Enhanced AT PZEVs[1] are AT PZEVs with credit allowances[2] totaling more than 1.0 and which use fuels that can be used in a ZEV, like electricity or hydrogen. Examples of Enhanced AT PZEVs are plug-in hybrid electric vehicles (PHEVs) and hydrogen internal combustion engine vehicles. The proposed changes act to simplify the regulation while maintaining the overall outcome of the Alternative Path. Establish a new Type IV category to recognize longer range ZEVs and adjust ZEV credits such that Type III ZEVs earn 4 credits and Type IV ZEVs earn 5 credits through 2017.

B. Establish Carry-Forward and Carry-Back provisions for ZEV credits. Modify the credit provisions under the proposed "New Path" to be consistent with the existing provisions contained in the Alternative Path which allow compliance over a three year window. Additionally, modify the way credits may be used after a specified time to limit the possibility that amassed credits could cause a black out of ZEV production for an extended period of time and to make the regulatory requirements better reflect the expected outcome in terms of vehicles produced.

C. Provide More Equal Treatment of Battery Electric Vehicles. Eliminate the cap on the use of full-function and city battery electric vehicles (EV) within the Alternative Compliance Path. Change the ratio for substitution for each vehicle type to be consistent with the credits earned by the vehicle rather than a separate ratio established only for pure ZEV obligation compliance. Create a new Type I.5 to recognize opportunity for a marketable longer range city EV.

D. Adjust Credits for AT PZEVs. Modify the AT PZEV requirements, primarily to address PHEVs. The proposed amendments include addressing deployment of "blended" HEVs through an equivalent all electric range (EAER) credit, adjusting the credits for advanced componentry and fuel cycle emissions, and other conforming changes.

E. Increase Credit for Neighborhood Electric Vehicles. Double the existing credit for neighborhood electric vehicles (NEV) to 0.3 credits per vehicle to reflect the vehicle's

[1] In discussion papers and conversations with stakeholders, this classification of vehicles has been referred to as Silver Plus.
[2] Allowances are part of a vehicle's credit calculation and credits are the sum of the allowances given.

positive environmental benefits but limited functionality compared with full function battery or fuel cell EVs.

F. Extend "Travel" Provision. Extend the provision that allows Type III ZEVs placed in any state that has adopted California's ZEV program to count towards California's ZEV requirement through 2017, and include Type IV ZEVs. Include battery EVs within the provision but sunset the application of this provision for these vehicles in 2014.

G. Modify Transition for Intermediate Automakers. Create a ramp-up period of six years for intermediate volume manufacturers (IVM) who are transitioning to large volume status. During this time, an automaker would be allowed to meet its ZEV requirements with increasing numbers of partial ZEV allowance (PZEV) of which a percentage must be AT PZEVs.

H. Public Availability of ZEV Credit Data. Require that all production data be publicly available starting with the 2009 model year and release ZEV credit bank balance information for the 2010 model year and beyond.

Effect of Proposed Amendments

2009 – 2011: The staff proposal is not expected to change the number of pure ZEVs (e.g., fuel cell and battery EVs) in the near term. However, the changes made do allow additional flexibility for the use of battery EVs, should products be available in this timeframe. Since many automakers still retain sufficient banked credits to assist with their compliance plans for this time period, staff expects they will aggressively use banked credits to meet the requirements in this timeframe since ZEV technologies remain very expensive. Thus the actual number of new ZEVs produced is expected to be lower than the 2,500 commonly referred to for this time period. Additionally, the amendments provide a clearer path for the use of PHEVs which are under development.

2012 – 2017: The staff proposal is expected to decrease the number of pure ZEVs (e.g. fuel cell and battery EVs) introduced during this timeframe relative to the existing program. Where the existing program would call for 75,000 ZEVs between 2012 and 2017, the staff proposal could result in as few as 27,500 ZEVs if manufacturers comply using the highest credit earning ZEVs. A mix of ZEV types used for compliance in this time period, including fuel cell vehicles and a range of battery EVs, would result in a higher number of ZEVs. The overall number of advanced technology vehicles should increase as manufacturers are allowed to meet a part of the requirements with a new class of vehicle, referred to as Enhanced AT PZEVs. More than 150,000 Enhanced AT PZEVs could result in the 2012 – 2017 timeframe. The exact number of vehicles that will be placed is unknown; however use of banked credits will not be as significant in this timeframe, meaning that production of ZEVs should more closely match the stated requirements than in previous years of the program.

2018 and subsequent: No changes are proposed to the ZEV requirements for the long term. The current 16% requirement beginning in 2018 remains in place. It is expected that the program will be revisited prior to the implementation of this portion of the regulation to determine if the pace of vehicle introduction is correct or if it can be accelerated.

The proposal is expected to reduce the cost of compliance by reducing the number of vehicles incorporating the most expensive technologies (fuel cell and battery EVs) needed during the 2012 – 2017 timeframe. The estimated annual savings averages $1.3 billion in 2012 – 2014 and nearly $0.9 billion in 2015 – 2017.

The ZEV program continues to provide positive air quality impacts as compared to no program. The changes proposed by staff significantly reduce an automaker's cost of compliance, but still provide increased air quality benefits primarily because they rely upon the proven emissions benefits of commercially viable and increasingly available AT PZEVs. Staff believes that a reduction in the near term production volume of ZEVs is warranted because technological and cost hurdles remain that are best solved through continued lower volume demonstrations of the technologies. In making these changes, the program will reduce criteria pollutant emissions by 7,000 tons over the life of the affected vehicles. The proposed changes further encourage AT PZEV technologies as well as Enhanced AT PZEV technologies, both of which enable pure ZEV technology.

Staff Recommendation

The ARB staff recommends that the Board adopt the amendments as proposed in this Initial Statement of Reasons (ISOR). The proposed amendments respond to the current state of ZEV technology, and reduce the overall cost of compliance to industry, while maintaining the push toward ZEV commercialization.

TABLE OF CONTENTS

Table of Acronyms

AER ..... All Electric Range
ARB ..... California Air Resources Board
AT PZEV .... Advanced Technology Partial ZEV Allowance Vehicle
CNG ..... Compressed Natural Gas
EAER ..... Equivalent All Electric Range
EMFAC ..... ARB's mobile emissions inventory modeling program
EV ..... Electric Vehicle
HEV ..... Hybrid-Electric Vehicle
ISOR ..... Initial Statement of Reasons
IVM..... Intermediate Volume Manufacturers
LDT1 ..... Light Duty Truck with a loaded vehicle weight of 0-3750 pounds
LDT2 ..... Light Duty Truck with a loaded vehicle weight of 3751 pounds to a gross vehicle weight of 8500 pounds, or a "LEV I" light-duty truck with a loaded vehicle weight of 3751-5750 pounds
LEV I ..... First generation Low Emission Vehicle program, adopted in a 1990-1991 rulemaking, and generally applicable in the 1994-2003 model years
LEV II ..... Second generation Low Emission Vehicle program, adopted in a 1998-1999 rulemaking, and generally applicable in the 2004 and subsequent model years
LFCE..... Low Fuel Cycle Emissions
LVM..... Large Volume Manufacturers
MY ..... Model Year
NEV..... Neighborhood Electric Vehicle
NOx ..... Oxides of Nitrogen
PHEV ..... Plug-in Hybrid-Electric Vehicle
PZEV ..... Partial ZEV Allowance Vehicle
ROG ..... Reactive Organic Gases
Type 0 ..... Utility EV, less than 50 mile range
Type I ..... City EV, range of 50 to less than 75 miles
Type I.5 ..... City EV, range of 75 to less than 100 miles
Type II ..... Full Function EV, range of 100 or more miles
Type III ..... ZEV, range of 100 or more miles plus fast refueling
Type IV..... ZEV, range of 200 or more miles plus fast refueling
UDDS ..... Urban Dynamometer Driving Schedule
ULEV I ..... Ultra-Low Emission Vehicle, pre-1998 regulations
ULEV II ..... Ultra-Low Emission Vehicle, post-1998 regulations
VMT ..... Vehicle Miles Traveled
ZEV ..... Zero Emission Vehicle

1. INTRODUCTION

In 1990, the California Air Resources Board (ARB or the Board) adopted an ambitious program to dramatically reduce the environmental impact of light-duty vehicles through the gradual introduction of zero emission vehicles (ZEV) into the California fleet. The ZEV program, which affects passenger cars and light-duty trucks (LDT1 and LDT2), has been adjusted four times since its inception: in 1996, 1998, 2001 and 2003. The fundamental goal of the program, however, has not changed. California remains committed to the commercialization of ZEV technologies.

California's strong commitment to the ZEV program reflects the essential need for ZEV technology in order to achieve the State's public health protection goals. Health-based state and federal air quality standards continue to be exceeded in regions throughout California. California's growing population and increasing use of motor vehicles mean continued upward pressure on statewide emissions.

Zero-emission technologies can greatly reduce or even eliminate some of the persistent emissions related environmental problems with motor vehicles. Combustion-based engines are prone to deterioration over time and result in higher fuel cycle emissions. Catastrophic failures are also a concern. Older gasoline-powered vehicles, for example, become gross emitters if their emission control systems fail. Combustible fuels also have significant "upstream" impacts. Refining, fuel storage and delivery all have associated emissions. Apart from upset conditions that may occur during electric power generation or hydrogen fuel production and distribution, ZEVs have none of these vulnerabilities.

While ZEVs can provide significant environmental benefits, it is also necessary that they be economically viable. Since the program's inception, substantial technological improvements have occurred. These improvements have raised the level of vehicle performance and have resulted in attractive solutions to personal mobility. However, the cost goals necessary for such technologies to compete successfully in the marketplace have not been met, preventing widespread introduction of the technology.

This rulemaking provides another opportunity for the Board to consider mid-course corrections that address the realities of the state of technologies while encouraging the introduction of new, innovative plug-in hybrid electric vehicle (HEV) designs to reduce the environmental impacts from light-duty vehicles and further support ZEV commercialization through deployment of enabling technologies.

2. BACKGROUND

2.1 ZEV Program Objectives

The ongoing adjustments to the ZEV program are the result of the continuing need to balance the pressure on vehicle manufacturers to develop ZEVs with the recognition of real-world status of the available technologies. Since its adoption, the ZEV program has pushed the boundaries of ZEV development, while taking into account the cost, performance, suitability for volume production and long-term prospects of the technologies. The following are the main objectives of the ZEV program and of staff's proposed changes:

- Maintain the pure ZEV requirement as a technology forcing-element of ARB's overall effort to achieve long term public health and air quality goals
- Take full advantage of technology options and accelerate ZEV development through deployment of advanced vehicles with ZEV enabling technology
- Maximize air quality benefits by allowing automakers the flexibility to meet portions of the regulation with conventional technologies substantially cleaner than required by other motor vehicle requirements
- Simplify the structure of the ZEV program

The program has not yet resulted in the commercial introduction of ZEVs. However, the tremendous progress that has been made in a variety of advanced technologies can, at least in part, be attributed to the existence of the ZEV requirement. Furthermore, ARB staff believes that continued regulatory requirements are needed to push the development of pure ZEVs.

2.2 Air Quality in California

Air quality in California has improved dramatically over the past 30 years, largely due to continued progress in controlling pollution from motor vehicles. Faced with ever more stringent regulations, vehicle manufacturers have made remarkable progress in advancing vehicle technology. Vehicles meeting ARB's most stringent emission certification standards achieve emission levels that seemed impossible when the ZEV program was adopted in 1990.

Despite this progress, air quality in many areas of the state still does not meet federal or state health-based ambient air quality standards. Mobile sources still are responsible for well over half of the ozone-forming emissions in California. The relative contribution of passenger cars and small trucks is expected to decline over time as new standards phase in, but in 2020 such vehicles will still be responsible for approximately 10 percent of total emissions based on the ARB emissions inventory.[1] State and federal law

[1] ARB 2007a, *2007 Almanac Data,* 2007.

requires the implementation of control strategies to attain ambient air quality standards as quickly as practicable and as mandated.

Other programs and legislation, including Assembly Bill 1007 (State Alternative Fuels Plan), require the state to prepare new plans to increase the use of alternative fuels in California. These other programs indicate the need for significant use of the electric drive train as well as other actions to meet California's air quality and emission reduction goals.

2.3 Zero Emission Vehicle Program History

Manufacturers originally pursued the development of battery electric vehicles (EV) to meet the ZEV requirements. In 1996, the ARB eliminated the requirements for the 1998 through 2002 model years (MY) due to cost and performance issues to allow additional time for battery research and development. To ensure a significant market for advanced battery manufacturers, ARB entered into agreements with manufacturers to place in California roughly 1,800 advanced-battery EVs between 1998 and 2000. The agreements were designed to provide battery developers with the necessary initial production volumes to meet the cost and performance goals needed for commercial production.

Contrary to expectations, advanced battery costs have remained too high for commercial viability. For example, research in 2000 showed that full-sized nickel metal-hydride battery packs would cost approximately $7,000 to $9,000 each at production levels exceeding 100,000 battery packs per year, and would cost twice as much at lower production levels. Notwithstanding these costs, several manufacturers continued to place a modest number of battery EVs after meeting their agreement volumes. These vehicles earned ZEV credits that have been used for compliance with the regulation.

Manufacturers began to look seriously at hydrogen fuel cell vehicles in the late 1990's as an alternative to battery EVs. This interest led to cooperative efforts among the ARB, industry and other governmental agencies to create the California Fuel Cell Partnership in 1999. The Partnership demonstrates fuel cell vehicle technology while exploring the paths to commercialization. Changes to the program in 2003 provided new incentives for fuel cell vehicles.

The most recent changes to the ZEV program in 2003 resolved legal challenges and addressed the state of various vehicle technologies. Given these changes and the uncertainty in technology development, the Board directed that an independent panel of experts (Panel) be convened to report on the status of ZEV technologies and their readiness for commercialization prior to 2009.

From the results of the Panel report[2], in May 2007, the Board found that some changes to the program were needed to align the requirements with the state of technology. However, the Board's overall direction was that any changes should be limited in scope to the greatest extent possible and that no "backsliding" of the program should result. The proposed amendments presented in this rulemaking respond to this direction and to the Board's findings contained within Board Resolution 07-18[3].

2.4 Current Program

Shown below in Table 2.1 is the structure of the current ZEV regulation for MY 2009.

Table 2.1: 2009 ZEV Program Requirements - Base Path

Certification Standards				
% Requirement	**% of Total Vehicle Sales[1]**	**Vehicle Type**	**Category**	**Technical Description**
2.5	< 1	Zero Emission Vehicle (ZEV)	Gold	Zero tailpipe emissions: battery electric vehicles and hydrogen fuel cells.
2.5	5	Advanced Technology PZEV (AT PZEV)	Silver	Vehicles certified to PZEV standards and employing ZEV-enabling technologies: e.g. hybrids or compressed natural gas vehicles.
6	30	Partial Zero Emission Vehicle (PZEV)	Bronze	Conventional vehicles certified to the most stringent tailpipe emission standards, zero evaporative emissions, and extended warranty.
11	35	Total ZEV Requirement		

[1] Percent of total California sales differs from percentage requirement because credits per vehicle type vary.

The three categories of vehicles used to meet the ZEV regulation are referred to as ZEV or "gold," advanced technology partial zero emission vehicles (AT PZEV) or "silver," and partial ZEV allowance vehicles (PZEV) or "bronze." To date, approximately 4,500 ZEVs have been demonstrated, while over 100,000 AT PZEVs and nearly 700,000 PZEVs have been commercially introduced, resulting in significant emissions reductions. An example of an AT PZEV is the Toyota Prius HEV while examples of a PZEV are the Ford Focus and BMW 325.

The Board's 2003 amendments increased the requirements for ZEVs to 11 percent starting in 2009 and ultimately increasing to 16 percent in 2018. Large volume manufacturers (LVM – those with annual California sales exceeding 60,000 vehicles) are allowed to comply using either the Base Compliance Path with the percentage ZEV requirements shown in Table 2.1 or the Alternative Path shown in Table 2.2 below. The

[2] Kalhammer, et al. *Status and Prospects for Zero Emission Vehicle Technology: Report of the ARB Independent Expert Panel 2007*, April 13, 2007
[3] ARB 2007b, *Board Resolution 07-18,* May 24, 2007

Alternative Compliance Path was included in the ZEV program in 2003 to promote the commercialization of fuel cell vehicles and to ensure that new ZEVs continued to be produced. The Alternative Compliance Path also allows AT PZEVs to fulfill a greater share of the top five percent of obligations (the gold and silver commitments), provided that the manufacturer meets the requirements specified below.

Table 2.2: Alternative Compliance Path Fuel Cell Requirements

Phase	During Model Years	Manufacturer's Market Share of:
I	2005 – 2008	250 fuel cell vehicles
II	2009 – 2011	2,500 fuel cell vehicles
III	2012 – 2014	25,000 fuel cell vehicles
IV	2015 – 2017	50,000 fuel cell vehicles

As illustrated in Table 2.2, the requirement for ZEVs, e.g., fuel cell vehicles, increases by factors of ten for Phases II and III and then doubles for Phase IV, as the technology was expected to make the transition from demonstration to full commercialization. Volumes in Phases I and II reflected the early development process, with further technological changes expected prior to ramp-up toward commercialization. Phases III and IV were designed to establish new commercial markets for the technology.

2.5 Manufacturer Compliance Status

Twenty-two auto manufacturers are subject to the ZEV regulation. Six are defined as LVMs: General Motors, Toyota, Ford, Honda, Chrysler LLC and Nissan. The remaining 16 are intermediate volume manufacturers (IVM). IVMs can meet the regulation entirely with PZEVs.

All manufacturers are currently in compliance with the ZEV regulation. The product plans and technology development strategies vary from manufacturer to manufacturer. Most manufacturers have enough banked credits from ZEVs already produced and placed to comply with the regulation through approximately 2009. It should be noted however, that while all of the large manufacturers have active fuel cell vehicle demonstrations, some of these manufacturers have chosen to comply using the Base Path and not need to produce any additional fuel cell vehicles between now and the end of 2008 to comply with the regulation.

To meet the AT PZEV portion of the regulation, manufacturers are either producing AT PZEVs (primarily HEVs) or using banked credits from previously produced neighborhood electric vehicles (NEVs). Four of the six large manufacturers have commercialized AT PZEVs; two of these manufacturers, Toyota and Honda, dominate the volumes produced to date. On aggregate, manufacturers have sufficient banked AT PZEV and NEV credits to meet the AT PZEV portion of the regulation for the next four to five years.

Regardless of the method with which manufacturers are meeting the AT PZEV portion of the program, the number of AT PZEVs produced to date is beyond what is required by the ZEV regulation. In 2005, twice as many AT PZEVs were produced as required to meet AT PZEV portion of the program due mostly from production from two manufacturers. Over-compliance will change within the next model year or so as the optional volume of AT PZEVs increases to 8 percent of the total fleet for those manufacturers on the Alternative Path.

Table 2.3 presents the approximate total number of gold, silver and bronze vehicles placed as of MY 2006. Manufacturers have been producing PZEVs at a rate greater than needed in aggregate (in 2005, manufacturers produced 40 percent more PZEVs than the industry-wide PZEV option).

Table 2.3: Vehicle Placements by Type

Vehicle Type		Quantity[1]
ZEV	Fuel cell	160
ZEV	Battery electric	4,400
ZEV	Neighborhood electric	26,000
AT PZEV	Hybrid/Compressed Natural Gas	109,000
PZEV	Conventional	672,000

[1] Estimates of total vehicle placements from 1994 through 2006.

Table 2.4 shows the current aggregate ZEV credit balances by vehicle type for the six LVMs. The balances reflect compliance with the AT PZEV and PZEV requirements in 2005 and 2006. However, for manufacturers on the Alternative Path, gold credits have not yet been spent since Phase I does not end until the end of the 2008 MY.

Table 2.4: Current Aggregated ZEV Bank Credits

Vehicle Type	Vehicle Credit
ZEV “Gold”	43,726
ZEV from NEVs[1]	123,271
AT PZEV “Silver”	110,839
PZEV “Bronze”	113,734

[1]NEV credits can only meet the PZEV or AT PZEV portion of the regulation

3. SUMMARY OF PROPOSED AMENDMENTS

In response to the Board's direction, and in consideration of the issues related to technology commercialization, staff is now proposing amendments to the program that are designed to reflect the state of technology and create an opportunity for new emerging vehicle technologies to count towards the pure ZEV requirement. Other proposed changes are intended to clarify and simplify specific program requirements. The areas identified in this section represent the most significant changes being proposed.

3.1 Creation of the "New Path" (2012 onward)

Staff Proposal: Merge the existing compliance paths into a single path beginning in 2012 and allow high-scoring AT PZEVs to meet up to 90 percent of the pure ZEV requirement in 2012 – 2014, and 50 percent in 2015 – 2017.

This set of changes is aimed at accomplishing a number of goals and includes a number of different elements. The goals include:

- Establish an appropriate volume of ZEVs given the state of the technologies
- Acknowledge new ZEV Types that hold promise for commercialization including mid-range battery EVs and longer range fuel cell vehicles
- Establish an appropriate relationship between ZEV types by adjusting the number of credits awarded
- Incentivize production of certain AT PZEV technologies that facilitate the commercialization of pure ZEVs
- Simplify the regulation

3.1.1 Adjustment of ZEV Volumes

Based on the projections of the Panel, production of thousands of fuel cell vehicles per year globally is achievable within the next five years given the pace of effort underway by manufacturers and suppliers. This projection is generally consistent with the existing requirements for Phase II (2,500 over a three year period). Maintaining Phase II is also important as manufacturers struggle to engage hydrogen fueling partners to seriously respond to the need for infrastructure, since greater use of stations is necessary for further investment by fuel providers. Staff, therefore, believes that the current Phase II requirements which represent a ten fold increase of Phase I requirements should remain unchanged.

However, the Panel found the Phase III and Phase IV requirements to be significantly higher than what is reasonable to expect in the 2012 – 2017 timeframe given the state of fuel cell technologies. According to the Panel, high costs and continuing challenges with durability and life expectancy of the technology could be prohibitive to manufacturers significantly growing the production volumes of vehicles. Similarly, the Panel found that battery technology, while making progress, has yet to reach a point

where significant ramp up of vehicle volumes could be mandated as costs remain high and some battery chemistries have yet to prove lifetime durability. The Board accepted these findings from the Panel at their May 2007 Board Hearing and directed that adjustments be made to address these issues while still embracing the overall objectives of the ZEV program to the greatest feasible extent.

In response, staff is now proposing changes that are more in line with the findings of the Panel. The proposal creates a more feasible program by adjusting the number of pure ZEVs downward beginning in 2012. The existing ZEV production floor for Phase III and Phase IV are 25,000 and 50,000 ZEVs respectively. Staff proposes to reduce this floor to 2,500 ZEVs in Phase III and 25,000 ZEVs in Phase IV.

3.1.2 New ZEV Types and Adjustments to Existing ZEV Types

As staff assessed the types of ZEVs that may be used to meet the ZEV regulation in the coming years, two new types emerged. The first, described as a Type I.5 ZEV falls between a Type I ZEV (generally described as a City EV with minimum range of 50 miles) and a Type II ZEV (generally described as a full function battery EV with minimum range of 100 miles). The second, described as a Type IV ZEV is a ZEV with 200 miles range that is fast refuel capable.

The Type I.5 ZEV is proposed because staff learned that an optimal, cost effective, and marketable BEV may soon evolve, but that these might offer a driving range that is short of the 100 mile requirement for Type II but greatly exceeds the 50 mile requirement for Type I. Several manufacturers have indicated a strong interest in the creation of this new tier. To recognize this new BEV and provide appropriate incentives, staff proposes to award them with credit of 2.5.

The definition of the Type IV would be a ZEV that has a range of at least 200 miles and fast refueling capabilities. This would likely be an advanced fuel cell vehicle. It is proposed that the Type IV be given 5 credits per vehicle. This additional credit, compared to battery EVs and lower range fuel cell vehicles would be available in the near term to reflect the greater challenges for fuel cell vehicles to reach marketability and their higher development costs. Credit for these vehicles would become consistent with Type II and Type III vehicles beginning in 2018.

Type III ZEVs are defined as ZEVs with range greater than 100 miles and fast refueling capabilities. Staff is proposing to broaden that definition to allow ZEVs with range greater than 200 miles, but not fast refuel capable to be Type III ZEVs. This would mean that a battery EV with range greater than 200 miles would earn the same credit as a fuel cell vehicle with range less than 200 miles; the differentiation being the fast refueling capability.

3.1.3 Adjustment of Credits for ZEVs

With the addition of the two new ZEV types, and in consideration of the state of development of each vehicle type involved, staff has adjusted the credits for several ZEV types to establish distinction between them. As described above, Type I.5 ZEVs are assigned 2.5 credits and Type IV ZEVs are assigned 5 credits. Staff is also proposing that the 4 credits currently earned by a Type III ZEV (typically a fuel cell vehicle with less than 200 miles) in 2009 – 2011 be continued through 2012 – 2017 timeframe. This recognizes the state of development and continued high cost of fuel cell technology in this timeframe. Table 3.1 presents the credits for both existing and proposed ZEV categories. Expanding the vehicle types provides greater flexibility and opportunities for manufacturers to comply with the regulation.

Table 3.1: Credits for ZEVs 2009 to 2017

Tier	Expected Technology	Range	Existing	Proposed
Type I	Battery EV	50 – 74 miles	2	2
Type I.5 (new)	Battery EV	75 – 99 miles	NA	2.5
Type II	Battery EV	> 100 miles	3	3
Type III	Fuel Cell or Battery EV	Fuel Cell – 100 – 199 miles Battery EV > 200 miles	4	4
Type IV (new)	Fuel Cell	> 200 miles	NA	5

3.1.4 Incentives for Enhanced AT PZEVs

Staff proposes to create a new classification of vehicle called “Enhanced AT PZEVs” and to incentivize their production by allowing them to meet up to 90 percent of the ZEV target in 2012 – 2014, and 50 percent of the ZEV target in 2015 – 2017.

An Enhanced AT PZEV by definition would earn one or more credits per vehicle and use a “ZEV fuel.” Those that don’t are considered conventional AT PZEVs. Enhanced AT PZEVs, though not gold in terms of zero tailpipe emissions, are extremely clean in terms of both criteria pollutant and climate change fuel cycle emissions and, even more than conventional AT PZEVs make use of fuels and vehicle systems directly enabling further advancement of ZEVs. Examples of Enhanced AT PZEVs include plug-in hybrid electric vehicles (PHEVs) and hydrogen internal combustion engine vehicles.

Enhanced AT PZEVs would provide the option to lower the number of pure ZEVs required in Phase III and Phase IV. That is, manufacturers would be allowed to produce Enhanced AT PZEVs in sufficient quantities to replace the credits from the reduced number of pure ZEVs in each Phase, thereby providing a “backfill” as requested by the Board. Because the per vehicle credit for an Enhanced AT PZEV is less than the credit for a pure ZEV, use of the backfill option will result in a greater number of total vehicles produced.

3.1.5 Simplify the Program with the "New Path"

The staff also proposes to combine the existing Alternative and Base Paths into a single "New Path" beginning in 2012. The New Path would return the compliance calculation to an annual percentage requirement for ZEVs with options to comply with percentages of PZEVs, AT PZEVs and Enhanced AT PZEVs. Table 3.2 illustrates the New Path percentages and the expected numbers of vehicles for 2012 – 2014 and 2015 – 2017.

Table 3.2: Proposed "New Path" Requirement by Vehicle Category

	2012 – 2014 (12 % Total Requirement)[1]			2015 – 2017 (14 % Total Requirement)[1]		
	Percent	Vehicles Per Year[2]	Vehicles over period[2]	Percent	Vehicles Per Year*	Vehicles over period*
ZEV[3]	0.3%– 3%	840 – 8,353	2,500 – 25,000	3% – 6%	8,333-16,660	25,000 – 50,000
Enhanced AT PZEV	0 – 2.7%	Up to 25,000	Up to 75,000	Up to 3%	Up to 28,000	Up to 83,000
AT PZEV	3%	65,000	195,000	2%	51,000	153,000
PZEV	6.0%	420,000	1,260,000	6.0%	420,000	1,260,000

[1] Based on annual California vehicle sales of 1.4 million passenger cars, light-duty trucks (LDT 1 and LDT 2) by the six large volume auto manufacturers.
[2] Assumes that Enhanced AT PZEVs earn 1.5 credits, AT PZEVs earn 0.65 credits in 2012 – 2014, and 0.55 credits 2015 – 2017. Credits earned vary by vehicle technology, and thus the number of vehicles produced may vary from the volumes in this table.
[3] Assumes Type IV ZEV.

Approximately 75,000 Enhanced AT PZEVs could be placed to backfill ninety percent of the gold requirement in 2012 – 2014. This increases to roughly 83,000 vehicles in 2015 – 2017. The AT PZEV or "silver" percentage requirement is based on the existing Alternative Path and results in approximately 195,000 vehicles in 2012 – 2014. Concerning AT PZEVs, the existing program allows manufacturers to use AT PZEVs under the Alternative Path to meet a majority of the ZEV requirements. The number of standard AT PZEVs decreases in the 2015 – 2017 timeframe due to the creation of the new Enhanced AT PZEV category and due to the increasing requirement for the ZEV category. The PZEV option would remain unchanged during the six year period and stay consistent with the existing program.

The New Path is intended to increase flexibility and incentivize the introduction of innovative advanced vehicle technologies. Returning to a single path simplifies the regulatory structure and provides for a more easily described and understood regulation. The New Path results in more certainty and transparency about how many vehicles will be produced and what impacts the program will have on commercialization and air quality improvement.

3.2 ZEV Credits: Carry Forward/Carry Back

Staff Proposal: Modify the credit provisions under the proposed "New Path" to be consistent with the existing provisions contained in the Alternative Path which allow compliance over a three-year window. The proposal would also modify the way credits

may be used after a specified time to avoid excessive credit build up and help assure a smooth and continuous ramp up in production volume.

The ZEV regulation allows the banking and trading of credits earned from early introduction and/or over-compliance with the regulation. Because of the lag between early demonstrations and implementation of the regulation, automakers amassed substantial credit accounts with early actions, including production and placement of NEVs. This has caused delays in the introduction of increasing numbers of ZEVs into the market. In addition, the banked ZEV credits create uncertainty as to what actions automakers will take to comply with the ZEV requirement, which, in turn, impacts the Board's ability to accurately forecast the environmental impacts of the program. Staff is therefore proposing to change the long-term applicability of how banked credits can be used.

3.2.1 Carry Forward

Staff proposes that all ZEV credits earned thru 2008 MY retain their full flexibility thru 2011. Beginning in MY 2012, these credits would no longer be allowed to offset the ZEV requirement; instead they would only be allowed to meet portions of the regulation that could be met with PZEVs, AT PZEVs or Enhanced AT PZEVs. Credits earned in the 2009 MY and later would be allowed to be carried forward for two additional years for application to the gold requirement. For example, gold credits earned in 2010 would retain full flexibility until 2013, at which time "stale" credits could not be used to comply with the gold requirements. Existing provisions for banked AT PZEV and PZEV credit would remain unchanged. The proposed amendments will help alleviate the possibility of long black out periods during which pure ZEV production is curtailed, while, at the same time, allow automakers to build up short term reserves so that they may choose production phases that fit their product planning cycles.

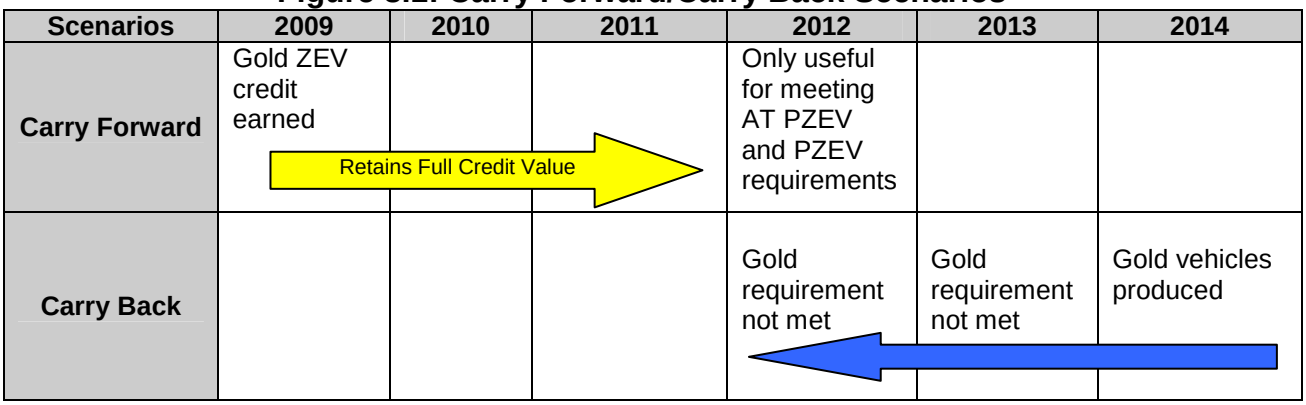
3.2.2 Carry Back

The ZEV regulation currently includes a one-year-carry-back provision for gold-category vehicles, meaning that if an automaker fails to meet its obligation in one year, the obligation may be made up in the next year, after fulfilling the past year's compliance obligation. Staff proposes to change the carry back provision to two years, meaning that an automaker may fulfill an obligation for year one and/or two after meeting the year-three compliance obligation. Like the carry-forward provision described above, this provides flexibility to automakers to match their production development schedules with technology demonstration phases. The stretch from one to two years coincides with the three-year windows originally established in the Alternative Path. The regulation already allows for a two-year carry back for silver and bronze vehicles and would also cover Enhanced AT PZEVs.

Figure 3.1 illustrates the proposed changes. As shown in the figure, a manufacturer producing in 2009 can use those credits to meet requirements in 2009, 2010 and 2011 without restriction. Beginning in 2012 the credits can only be used to meet a

manufacturer's PZEV or AT PZEV requirements. Regarding carry back, a manufacturer producing vehicles in 2014 can use those credits in MYs 2012 and 2013 to fulfill the requirements after fulfilling their full obligation for the 2014 MY.

Figure 3.1: Carry Forward/Carry Back Scenarios



In the worst case, using a combination of both carry forward and carry back an auto manufacturer could have a four-year "black out" in ZEV production. This is also possible under the existing Alternative Path compliance option as a manufacturer can front load Phase II and end load Phase III to achieve compliance. This gap is also consistent with product development cycles, which for demonstration volumes of vehicles is helpful for spacing out generations of technology. As the requirement grows, staff believes carry back will not be heavily relied upon because the risk of carrying such a significant debt is too great.

3.3 Provide for More Equal Treatment of Battery Electric Vehicles

Staff Proposal: Eliminate the cap on the use of full-function and city EVs within the Alternative Compliance Path. Change the ratio for substitution for each vehicle type to be consistent with the credit earned by the vehicle.

Battery EVs were the primary compliance strategy in the early years of the ZEV program. In 2003, findings on cost and durability pointed to an extremely limited commercial market (ARB 2003). In an effort to refocus the regulation towards a technology with mass market commercial potential, the Board shifted the regulation towards acceleration of fuel cell vehicle technology. Many stakeholders expressed a concern that these changes would hinder development of battery EVs. In response, in 2003, the Board provided limited incentives for battery EVs by allowing a portion of the Alternative Path to be met with the technology. However, battery EVs used as substitutes for fuel cell vehicles within the Alternative Path were required to substitute at a ratio between 5:1 and 20:1.

In response to continued public interest in battery EV technology, the ARB has been monitoring the state of battery technology and the prospects for battery EV commercialization. The Board directed that staff reassess the development of battery EV technology and cost in the Panel's technology assessment. The Panel found that

significant effort is going into development of improved batteries for use in vehicles. Lithium and nickel-metal-hydride technologies are receiving the greatest focus and are expected to meet the performance and life cycle demands of customers. However, while technological progress has been made and life cycle cost is starting to look more attractive as gasoline prices increase, cost remains high and at least for lithium, lifetime durability is not yet proven. The Panel concluded that a small market is possible for the technology.

Some automakers are now showing renewed interest in bringing battery EVs to market. Improvements in battery chemistry and announcements by battery companies and start-up automakers have raised new optimism that the technology may be viable in the mid-term. Given the progress made in battery technology and the possibility of automakers coming back into the battery EV market, staff is now proposing that the ZEV regulation be modified to provide for more even treatment of battery EVs (Type I and Type II ZEVs). The amendments would remove the cap for use of battery EVs to meet the gold requirement and would establish compliance ratios for their use based on the credits they earn rather than a secondary "substitution ratio" as was the case in the Alternative Path in the current regulation.

Tables 3.3 and 3.4 demonstrate the existing and proposed treatment of battery EVs under the New Path. Under the existing Alternative Path, manufacturers must meet at least 50 percent of the requirement with Type III vehicles, or fuel cell vehicles. This was included to ensure that fuel cell technology would have the necessary focus and attention. Type I and II vehicles (battery EVs) could be used to meet the remaining 50 percent, but at the credit ratios shown in Table 3.3. The large ratios between fuel cell and battery EVs meant that much larger numbers of battery EVs had to be produced if a manufacturer chose to meet the regulation with the technology. Additionally, a manufacturer had to produce two ZEV technologies to comply with the regulation – fuel cell vehicles and battery EVs.

Table 3.3: Existing Cap and Substitution Ratio for Type I and II ZEVs

ZEV Type	Cap (percent)	Ratio to Type III (2005-2011)	Ratio to Type III (2012-2017)
I (City EVs)	50	20:1	10:1
II (Full Function EVs)	50	10:1	5:1

The staff proposes to remove the cap and modify the ratios for substitution to be consistent with those in Table 3.2. Table 3.4 illustrates the proposed ratios as they relate to Type IV vehicles. For example, 5 full-function-battery EVs would be required in lieu of 3 Type IV fuel cell vehicles during the 2012 – 2014 timeframe.

Table 3.4: Proposed Ratio for Type I and II Vehicles

Type	Cap (percent)	Ratio to Type IV (2009-2017)
I (City EV)	0	2.5 : 1
I.5 (City EV)	0	2 : 1
II (Full Function EV)	0	5 : 3

By returning to technology neutrality and considering battery EVs and fuel cell vehicles similarly, ARB recognizes the equal air quality benefit of both technologies. The market has changed since the amendments to the program in 2003, with several manufacturers showing a renewed interest in battery technology. Current fuel cell development is strong and does not need as much regulatory advantage as is provided by the existing program. It is likely that some manufacturers will pursue more advanced battery EV development as a result of this proposal. Still, staff believes the strong interest and investment in fuel cell vehicle development will continue regardless of these changes.

3.4 Adjust Credit Determination Methods for AT PZEVs

The credit allowances provided to AT PZEVs are intended to accelerate the development and deployment of ZEV technologies in the marketplace. Examples of such technologies include electric drive systems, energy-storage systems, and gaseous fuel storage used in compressed natural gas (CNG) and hydrogen internal combustion engine vehicles. Staff believes that promoting the widespread adoption of ZEV technologies in AT PZEVs leads to component performance improvements and cost reductions that are necessary for ZEV commercialization. The Expert Panel agreed, even though sales of HEVs are steadily increasing, the critical components HEVs share with ZEVs, such as advanced technology batteries, are continuing to rapidly evolve.

Although automotive manufacturers are given a wide variety of AT PZEV options, staff is currently aware of near-term AT PZEV production plans only for CNG vehicles, HEV, and PHEVs.

Staff is proposing several modifications to the treatment of credits for HEV AT PZEVs, primarily to address PHEVs. They include addressing (1) treatment of "blended" PHEVs through an establishment of an equivalent all electric range (EAER), (2) adjusting the allowance for advanced componentry and Type C HEV credit, and (3), PHEV low fuel cycle emissions (LFCE).

3.4.1 Zero-Emission VMT PZEV Allowance

Staff Proposal: Replace the former "all electric range" (AER) calculation used in the zero-emission-vehicle-miles-traveled (VMT) allowance[4] determination with a newly defined EAER to enable blended PHEVs to be appropriately treated relative to non-blended PHEVs.

[4] Allowances are part of a vehicle's credit calculation and credits are the sum of the allowances given.

PHEVs[5] are HEVs which are capable of recharging from off-vehicle power sources in the same way battery EVs do. Since staff last examined the prospects for deployment of PHEVs, manufacturers have indicated an interest in deployment of "blended" PHEVs that have a more limited electric-only driving range. When PHEVs were last considered during 2003 ZEV regulation amendments, it was envisioned that all PHEVs would run off of the battery until it was depleted and then transition to combined engine and electric hybrid operation. Since 2003, the concept of a blended PHEV has emerged as an intermediate step between conventional hybrids and PHEVs. In some cases, it is anticipated that existing HEV models will evolve into blended PHEVs with the addition of extra battery capacity and an on-vehicle charger while their conventional HEV powertrain may remain much the same. A blended PHEV still plugs in and accumulates energy from an off-vehicle electrical power source. Blended PHEVs differ from an AER PHEV in electric range because the engine may start anytime during range testing, usually much before the off vehicle charge energy has been fully depleted. Proponents of blended PHEVs claim they provide the reductions in GHG emissions and petroleum dependency as AER PHEVs do, but through near-term, less-challenging transitional step between existing HEVs and higher-powered, more expensive AER PHEVs. Under the existing regulation, blended PHEVs would not earn the zero-emission-VMT allowance because they could not achieve 10 miles of Urban Dynamometer Driving Schedule (UDDS) range without their internal combustion engines starting.

Staff proposes to retain the existing 10 mile minimum AER requirement for this allowance, but would allow blended PHEVs to qualify with 10 or more miles of VMT EAER described below. Staff also proposes that the AER value used for credit determination be replaced with the EAER value. EAER will be defined as the UDDS miles driven by the PHEV until it has depleted its off-vehicle accumulated energy (charge depleting range or R_{cd}), but this range value is then multiplied by the fraction of those miles derived from off-vehicle electricity (electric range fraction or ERF) relative to electricity and gasoline.

$$\mathbf{EAER = (R_{cd} * ERF)}$$

For PHEVs with significant AER that can satisfy UDDS cycle(s) in electric mode, the ERF is 1.0 and the EAER is equal to the former AER. The allowance for the zero-emission, AER of PHEVs was formerly calculated using the following equation:

$$\mathbf{Allowance = (33.8 + [0.5 * AER])/25),}$$

where the AER is measured on city driving cycle test until the engine turned on.

Staff proposes to replace this allowance formula with the following:

[5] PHEVs are also described as Off-Vehicle Charge Capable HEVs.

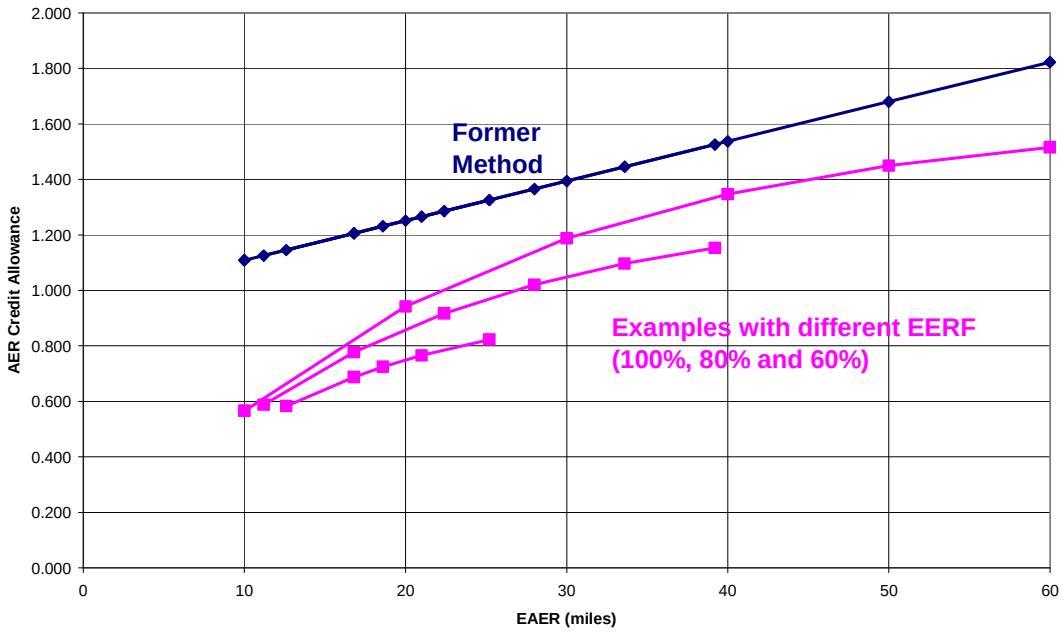
$$\text{Allowance} = \text{EAER} \times (1 - UF_{Rcd}) / 14.6$$

Where:

- R_{cd} is the UDDS range of the PHEV until the off-vehicle accumulated charge energy is depleted.
- ERF is the electric range fraction (electric energy/ total energy)
- UF_{Rcd} is the Utility Factor based on the charge depletion range according to *the 0-100 mile 4th order polynomial curve fit from SAE's J1711*[6]*, March 1999, page 52.,* which expresses the likelihood a vehicle will accumulate a daily range in miles.

The reason that the former linear equation is replaced by the utility-factor based function is to better reflect the likelihood that the range capability of a PHEV will be used by the general population. Under the proposed treatment, allowance per mile is very high near the 10-mile range because it is likely that these zero emission miles will be routinely driven, while the allowance per mile decrease to a lower value as range increases because of the decreased likelihood that these miles will be routinely driven. This new method results in the AER allowance (shown in blue as the "former method) compared to the EAER allowance (shown in pink for three different examples of electric-range-fraction values) as shown in Figure 3.2 below:

Figure 3.2: AER Credit Allowance VS EAER



[6] SAE. SAE International, *Recommended Practice for Measuring the Exhaust Emissions and Fuel Economy of Hybrid-Electric Vehicles*, March 1999

These proposed amendments will also result in low range AER PHEVs receiving less AER allowance under this proposal than they did formerly, but they will also receive additional advanced componentry allowance (see below) to offset this decrease. This combination of changes in allowances is necessary in order to appropriately reward the AER PHEVs relative to blended PHEVs.

3.4.2 PHEV Advanced Componentry Allowance

Staff Proposal: Extend the allowance sunset for Type C HEVs, and add a new higher-power Type F HEV category.

Advanced Componentry Allowance – Staff proposes to implement a phase-down schedule and eliminate the allowance sunset for Type C HEVs. The Type C modification is recommended in response to comments that post-2011 hybrids with significant (>10 kW) power capability can still make an important contribution to technology development even if sub-systems operate at lower-voltage levels that might not be suitable for full-function ZEVs. This is true because Type C HEVs must still make use of advanced energy storage systems that are expected to be used on ZEVs. Staff believes that Type C HEVs may be well suited for very high volume markets where tighter cost constraints may restrict other HEV technologies from being deployed. Staff recommends that the allowance for Type C hybrids be extended indefinitely, but at a reduced allowance level relative to other HEV designs.

Staff also proposes to add a new, higher battery capacity Type F HEV category for HEVs that demonstrate sufficient power capability to propel an HEV through the UDDS driving test cycle on electric power alone. Type F HEVs must also qualify for the zero-emission-VMT allowance, and must demonstrate at least 10 UDDS miles of AER, instead of EAER (i.e., blended PHEVs would not be Type F HEVs).

The Type F HEV category is intended to encourage the deployment of higher battery capacity HEV drive systems interchangeable with those deployed in Type III ZEVs. In this way, design, development, tooling, and other costs can be shared with the systems destined for ZEVs in order to further drive down costs and deploy ZEVs sooner. The allowance schedule proposed is shown in Table 3.5 below:

Table 3.5: Proposed HEV Componentry Allowance Schedule

Year	Type C 10 kW	Type D 10 kW	Type E 50 kW	Type F (NEW) >= 10 mile UDDS Capable
2005-2011	0.2	0.4	0.5	0.85
2012-2014	0.15	0.35	0.45	0.8
2015+	0.1	0.25	0.35	0.7

3.4.3 PZEV Low-Fuel-Cycle-Emissions-Allowance

Staff Proposal: Eliminate the LFCE allowance for vehicles that do not make exclusive use of LFCE fuels. PHEVs receive additional allowance under AER and Advanced Componentry to make up for this loss of LFCE allowance. As a result, only dedicated LFCE fueled vehicles will now be eligible for AT PZEV LFCE allowance. Examples of AT PZEVs still eligible include CNG and hydrogen internal combustion vehicles.

3.4.4 Overall Effect of Changes to PHEV Allowances

The proposed changes would result in PHEVs receiving overall pre-multiplier allowances as shown in examples listed in the Table 3.6 below, where B20, B30 and B40 are blended PHEV examples and P20, P40 and P60 are AER examples.

Table 3.6: PHEV Allowances

PHEV	Type	Rcd	ERF (%)	2011 Allowance	
				Existing	Proposed
B12.5	Blended PHEV	12.5	80	0.7	1.24
B20	Blended PHEV	20	80	0.7	1.45
B30	Blended PHEV	30	80	0.7	1.65
B40	Blended PHEV	40	80	0.7	1.78
P10	AER PHEV	10	100	1.9	1.62
P20	AER PHEV	20	100	2.1	1.99
P40	AER PHEV	40	100	2.4	2.4
P60	AER PHEV	60	100	2.7	2.57

Table 3.5 shows that for AER PHEVs, the allowances awarded are not significantly changed from the existing regulation. Blended PHEVs which under the existing regulation could earn no more than 0.7 credits as a conventional hybrid, can now earn more than double. However, the table also shows that blended PHEVs also do not earn as much as AER PHEVs even if their “range” is similar.

3.4.5 AT PZEV Credit Cap

Staff proposes to implement a pre-multiplier credit cap of 3.0 for all AT PZEVs. While AT PZEV attributes may be attractive features that advance deployment of ZEVs, earning pre-multiplier credit that is greater than that earned by a full function Type II ZEV is not justified.

Table 3.7: AT PZEV Post-Multiplier Credit

AT-PZEV Type	Description	2009-2011		2012 and beyond
		Pre-Multiplier	Final Credit	Final Credit
Type E	HEV	0.70	0.70	0.65
CNG	Compressed Natural Gas Engine	0.70	0.70	0.70
HICE	Hydrogen Internal Combustion Engine	2.30	6.90	2.30
B12.5/ 80% ERF	Blended PHEV	1.24	3.72	3.57
B40/ 80% ERF	Blended PHEV	1.78	5.34	5.18
P10	AER PHEV	1.62	4.86	4.85
P40	AER PHEV	2.40	7.20	7.19

3.5 Increase Credit for Neighborhood Electric Vehicles

Staff Proposal: Double the credit earned by NEVs to 0.3 credits per vehicle to reflect the vehicle's positive environmental benefits but limited functionality compared with full function ZEVs.

During the 2003 ZEV amendments, ARB committed to reviewing the credit value for NEVs. NEVs are low speed vehicles that have a maximum speed of 25 miles per hour and are only allowed to be driven on roads with a maximum speed limit of 35 miles per hour. The positive benefits of NEVs include reducing emissions from cold starts, providing zero tailpipe emissions, providing high consumer usage for short trips and providing a future market and demand for more robust ZEVs. However, NEVs are limited to a niche market due to the small number of areas in California where speed limits are low and due to a limited driving range, currently 30 miles per charge.

According to research to done by DiamlerChrysler and GEM[7], approximately 2 cold starts on average per day are reduced due to the use of NEVs. Cold starts represent a large portion of a conventional gasoline vehicle's environmental impacts. Consequently NEVs can eliminate up to one third of an owner's yearly ozone precursor emissions due to the reduction in cold starts.

[7]GEM. *Surveys of NEV Owner Behavior in California*. December, 2005 Prepared for GEM by Mightycomm and Access Research Group.

In analyzing the credit value of NEVs, staff is mindful that higher credit values in the past encouraged mass production of low quality NEVs many of which remained in California for only a short period of time. Staff proposes an increase in the NEV credit value from 0.15 to 0.3 reflecting the positive benefits listed above balanced with the limited use of the vehicle.

3.6 Extend Travel Provision

Staff Proposal: Extend the provision that allows Type III ZEVs placed in any state that has adopted California's ZEV program to count towards California's ZEV requirement through 2017. Also, allow Type IVs placed in any state to count towards the California requirements. Include Type I and Type II ZEVs but sunset the application of the provision for these vehicles in 2014.

Section 177 of the federal Clean Air Act allows other states to adopt California motor vehicle emission standards, including the ZEV regulation. The current ZEV regulation allows Type III vehicles placed in service in section 177 states to be counted towards compliance with the California percentage ZEV requirements as if they are placed in service in California. Similarly, a vehicle placed in California counts towards compliance in a section 177 state. This "travel" provision was added in 2003 to encourage the initial development of higher cost Type III vehicles by starting with a lower volume production nationwide until the technology is ready to become commercially viable. The travel provision is set to sunset in 2011 under the current regulation. (ARB 2003)

Ten section 177 states have adopted the ZEV regulations: Connecticut, Maine, Maryland, Massachusetts, New Jersey, New Mexico, New York, Oregon, Rhode Island, and Vermont. If manufacturers were to meet the ZEV requirements in each state, the number of ZEVs required nationally more than double and hinder the ability of auto manufacturers to bring these vehicles to market. Therefore, staff proposes that the travel provision for Type III and Type IV vehicles be extended through MY 2017.

Stakeholders also proposed that Type I and Type II vehicles be eligible for the travel provision. Similar to Type III vehicles, the cost to produce and introduce Type I and Type II vehicles into the market is high. In examining this proposal staff believes that technology neutrality is necessary to encourage all advanced technologies to come to market as soon as possible. Staff notes that the successful introduction of AT PZEV hybrids began with low volumes in select states and still represents a small percentage of the overall market and that ZEV technologies must start with low production volumes until the vehicles are commercially viable. Staff proposes that Type I, Type I.5 and Type II vehicles be eligible for the section 177 travel provision through MY 2014 when they are estimated to be commercially viable. Table 3.8 shows the existing and proposed schedule for sun-setting the travel provision.

Table 3.8: Travel Provision Sunset Schedule

Vehicle Type	Type I	Type I.5	Type II	Type III	Type IV
Current:	N/A	N/A	N/A	2011	N/A
Extended to:	2014	2014	2014	2017	2017

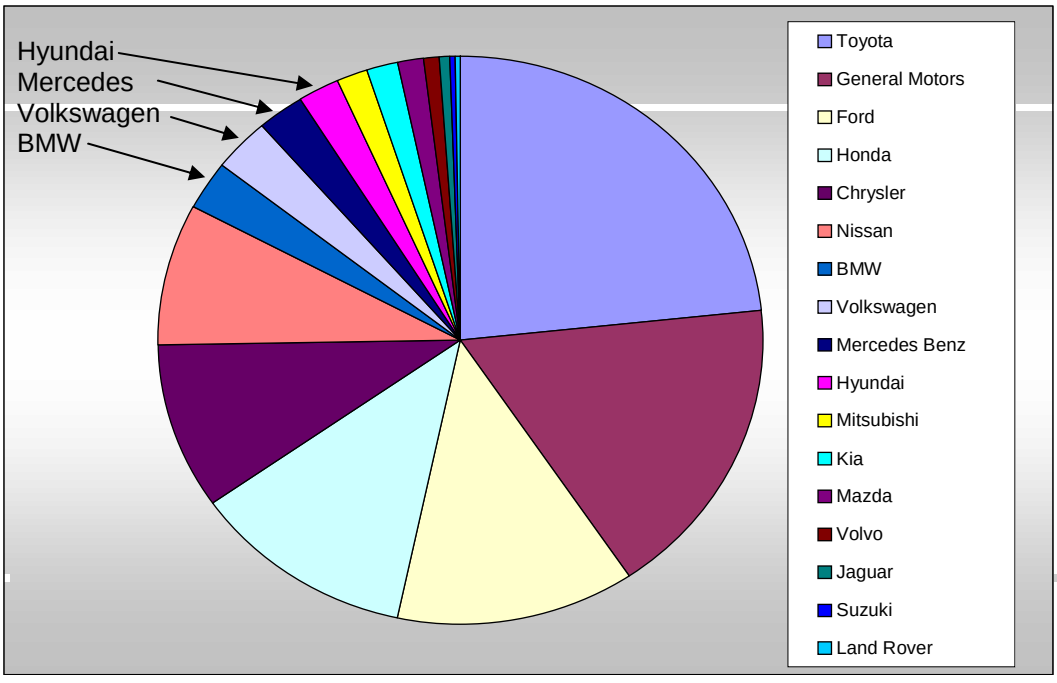
3.7 Modify Transition for Intermediate Volume Manufacturers

Staff Proposal: Extend the transition period by six years for IVMs. During this time, an automaker would be allowed to meet their ZEV obligations with PZEVs and AT PZEVs, where a minimum percentage would have to be AT PZEVs.

ARB's regulations define LVMs as automakers with annual California sales in excess of 60,000 passenger cars and light-duty trucks (LDT 1, LDT 2, and MDVs). They define IVMs as automakers with annual California sales between 3,001 and 60,000 passenger cars, LDT 1s, LDT 2s, and MDVs.

The 60,000 vehicle sales volume threshold was established to acknowledge the significant gap between intermediate volume and large volume automakers. While BMW, Mercedes, Hyundai, and VW, all IVMs, are nearing the 60,000 vehicle threshold, their relative size has not changed in relation to the six largest automakers – Toyota, General Motors, Ford, Honda, Chrysler, and Nissan because the volume of vehicles sold in California has been increasing across the board. This gap is illustrated in figure 3.3 below.

Figure 3.3: Market Share by Manufacturer



Once an automaker exceeds the threshold for three consecutive years, they are defined as a LVM. That automaker then has six years before having to meet the requirements for LVMs. Under the existing regulation, that means they must begin to produce pure ZEVs vehicles or acquire the appropriate credits.

During the May 2007 technology report to the Board, the ARB suggested the threshold for LVMs transitioning to LVMs be changed upward to reflect changes in the overall automobile market. After taking comment, the Board directed that the threshold remain unchanged. However, the Board also directed staff to identify ways to ease the transition for intermediate volume automakers.

Staff is now proposing to provide an additional transition period of six years. During this time, transitioning automakers would be required to produce a growing percentage of AT PZEVs if they do not comply with gold vehicles as described in Table 3.9. In the first three years of the extend transition, newly defined LVMs would have the option to meet the ZEV requirements with a combination of PZEVs and AT PZEVs, of which at least a quarter would have to be AT PZEVs. In the second three years of the ramp-up phase, these manufacturers would continue to meet the ZEV regulation requirements with a combination of PZEVs and AT PZEVs, of which at least a third would have to be AT PZEVs.

Table 3.9: Intermediate to Large Volume Transition

	Current Regulation		**Proposed Amendment**		
Years	**3 years of volume in excess of 60,000**	**1-6 Lead Time**	**7-9 AT PZEV Transition 1**	**10-12 AT PZEV Transition 2**	**13 and beyond Full ZEV Requirement**
Status	**IVM**	**LVM**	**LVM**	**LVM**	**LVM**
PZEVs	100 % of ZEV Obligation	100% of ZEV Obligation	75% of ZEV Obligation	67% of ZEV Obligation	Full LVM Obligations as dictated by regulation

These changes act as a way to bridge IVMs into ZEV production and provide additional time to develop full ZEV technologies while bringing them into the AT PZEV market with ZEV enabling technologies.

3.8 Additional Modifications

3.8.1 ZEV Credits for Advanced Technology Demonstration Programs

Staff Proposal: Establish new restrictions on the placement of advanced technology demonstration vehicles.

Under the current program, vehicles that are placed in a California advanced technology demonstration program may earn ZEV credits even if they are not “delivered for sale.”

In addition, vehicles in these programs are only required to be in California for six months. Staff believes that the nature of demonstrations for these vehicles has changed and that vehicles receiving credit should be demonstrated in California for a longer period of time.

Staff also wants to encourage manufacturers to lease these advanced vehicles to the public or to fleet operators. Thus, staff is proposing that vehicles in an advanced technology demonstration program remain in California for the first year of a two year placement requirement and that the number of vehicles eligible for this provision per manufacturer is six. Beyond six vehicles, manufacturers would then need to certify vehicles through the regular certification process. Additionally, staff is proposing that the advanced technology demonstration program provision be phased out at the end of 2014 when it is anticipated that small scale demonstration programs will no longer be needed.

3.8.2 ZEV Credits for Transportation Systems

Staff Proposal: Clarify minimum participation requirements for transportation system credit.

Under the current ZEV regulation, vehicles that are placed as part of a transportation system, such as a car-share program, can earn additional ZEV credits. Originally the vision for vehicles in these programs was that they would remain in the program for at least two years; however, this was never explicitly stated in the regulatory language. Staff proposes that vehicles in transportation systems remain in these programs for two years. At the same time, staff proposes the level of credits that these vehicles earn be reduced, and would sunset for PZEV and AT PZEV in 2011. ZEVs would continue to receive transportation system credits beyond this sunset.

3.8.3 Fast Refueling

Staff Proposal: Modify the description of fast refueling capability for Type III ZEVs.

Since the 2003 ZEV regulation amendments were adopted, there have been several inquiries regarding the specific details on how the fast refueling capability requirement for Type III ZEVs will be applied. Unfortunately, ARB staff cannot yet cite industry definitions, standards, or test procedures because these are still under development. The fast refueling criterion is important because this distinction between Type II and Type III & IV is crucial to manufacturers who wish to take advantage of the additional incentives ARB is providing for Type III & IV ZEVs through 2017.

The majority of hydrogen fuel cell vehicle prototypes made to date are equipped with compressed hydrogen storage. Since 2003, compressed hydrogen storage systems have become available at an alternative 10,000 pounds per square inch (psi) pressure rating in order to further improve the range of hydrogen vehicles. This increase in pressure results in a hydrogen vehicle range increase of approximately 67 percent for

the same external tank volume. At the time of the 2003 amendments, the feasibility of refilling 5,000 psi tanks in less than 10 minutes seemed certain, and ARB received very little comment regarding challenges involved in meeting the proposed Type III fast refueling criterion of 10 minutes. (ARB 2003)

However, most demonstration vehicles outside of the manufacturer's test facilities currently refuel under conservative default or "non-communication" procedures that were developed at the California Fuel Cell Partnership. Fast refueling is not yet achievable using 10,000 psi storage systems with some of these preliminary fill procedures. The longer refueling times for these systems will eventually decrease as refueling standards and dispensing equipment technology mature and the industry settles on solutions to accelerate the refueling process. Furthermore, ARB staff believes that existing fuel cell vehicles with 10,000 psi hydrogen storage tanks will ultimately be capable of sub-10-minute refueling when used with refueling apparatus that will be deployed for public use. Staff does not intend to require that this fast refueling requirement be met at any currently-existing refueling or charging station. Even at today's refueling stations, 10,000 psi capable vehicles are refueling in nearly 10-minute times; the impact of this technology change is not burdensomely long refuelings.

Staff proposes to clarify the regulation to require a Type III ZEV to have the capability to accumulate at least 95 miles of UDDS range in 10 minutes or less. This change is to align standards with those suggested in ARB's Manufacturers' Advisory Correspondence 2006-02: Policy Regarding the "Fast Refueling Capability" Criterion For 2003 and Subsequent Model-Year Type III Zero-Emission Vehicles (ZEV)[8]. It is expected that the "maximum rated energy capacity" value that a manufacturer declares will be the same value used to determine vehicle range and that this "maximum-rated-energy-capacity" value has already compensated for unusable fuel and fast-fill limitations. Since the requirement is that 95 percent of this capacity be delivered to the vehicle fuel system in 10 minutes or less and since Type III ZEVs must achieve a minimum 100 mile UDDS range, it is, therefore, equivalent to the current ZEV regulation requirement, but would be clarified by staff's proposed amendments.

3.8.4 Release of Production Data and Credit Bank Balances

Staff Proposal: Require that all production data be publicly available beginning in 2009 and release specified ZEV credit bank balance information in MY 2010.

To provide greater transparency to interested stakeholders, staff is proposing that all production credits earned and submitted by automakers in the 2009 MY and beyond be public information. The ZEV bank credit balances of automakers in specified categories would be considered public information beginning in the 2010 MY. This change is

[8] ARB 2006b. California Air Resources Board, *Manufacturers' Advisory Correspondence 2006-02: Policy Regarding the "Fast Refueling Capability" Criterion For 2003 and Subsequent Model-Year Type III Zero-Emission Vehicles (ZEV).* May 10, 2006.

proposed to allow stakeholders and the public to better understand how manufacturers are complying with this regulation, and to assure they can more fully participate in future regulatory hearings on this subject.

3.8.5 Revise the Definition of Independent Low Volume Manufacturer

Staff Proposal: Revise the existing definition of independent low volume manufacturer.

In response to the industry consolidation that was occurring in the late 1990s, ARB adopted percentage ownership criteria and set the value at 50 percent for aggregation of production volume for determination of manufacturer size. Doing so created a fair method to determine aggregation that was objective and equitable for all manufacturers involved in partial ownership scenarios. Adopting this provision also recognized the challenging technical nature of the program and the fact that the requirements to develop and market ZEV technologies place a greater than normal risk and burden on smaller companies. For independent low volume manufacturers, a different aggregation value of 10 percent was adopted.

The inconsistency in aggregation percentages used to determine ZEV requirements could create a situation in which aggregation between two firms with a qualified ownership scenario is asymmetrical. An independent low volume manufacturer that accumulates a capital investment in another firm with ownership totaling greater than 10 percent would be forced to aggregate its sales with the other firm to determine its ZEV obligation. However should the other firm be either an intermediate or small volume manufacturer, this company would not aggregate with the independent low volume manufacturer until ownership exceeded 50 percent. To address this issue, staff is proposing to amend the definition to include a clause in which the Executive Officer can allow an exemption if it is determined that 10% or greater ownership by one of the firms does not result in responsibility for overall direction of both firms.

3.8.6 Revise Phase II Vehicle Requirement Methodology

The existing regulation calculates the Alternative Compliance Path requirements based on a LVM's market share of the target ZEV volume. Using this method creates uncertainty due to shift in market between LVMs. Staff is therefore proposing to use production data from MYs 2003 – 2006 to provide certainty for the requirements during this timeframe for each manufacturer.

4. EFFECT OF PROPOSED CHANGES

This section provides an assessment of the number of vehicles that may be produced due to the proposed changes. Sections 6 and 7 then use these estimates to project the economic and environmental impacts of the proposed changes.

The ZEV program has by far the largest impact on the LVMs as IVMs are able to meet the requirements with PZEVs. Consequently, the analysis focuses on the impact on the six LVMs. Due to the small number of automakers affected and to the resulting confidentiality concerns, staff's analysis of the proposed changes reflects the overall impact to the industry.

Creating further uncertainty in the assessment is the fact that each automaker is in a unique situation. Some have smaller numbers of banked credits, while others have credits sufficient to cover their compliance obligations for a number of years. In addition, manufacturers differ in the status of fuel cell development, the availability of PZEV or AT PZEV products in the near term, and the technologies to be emphasized in their corporate strategy. All of these factors affect a manufacturer's compliance status, and, therefore, the compliance pathways it pursues. Because of these factors, predicting the impacts for the proposed changes with certainty is not possible. Rather the estimates represent plausible outcomes from the proposed amendments based on current ZEV credit accounts, numerous discussions with industry and other information gathered.

The most significant proposed changes are presented below along with their expected impacts to the number and types of vehicles produced.

4.1 Creation of the "New Path" (2012 onward) and Changes to Treatment of Battery EVs

As a result of this proposal, the minimum number of Type IV ZEVs required in Phase III (2012 – 2014) would be reduced from 25,000 to 2,500 vehicles. This pure ZEV requirement could be met with either fuel cell vehicles or battery EVs. If manufacturers choose to produce city EVs, the total production required would increase due the differences in credit value.

Table 4.1 shows the impact from removing the cap and modifying the credit ratios for ZEV Types. The proposed changes are expected to make this approach less costly than producing fuel cell vehicles. However, the amount of interest in battery EV production will depend largely on improvements in battery technology in the near future and their marketability.

Table 4.1: Production Requirements for Zero Emission Vehicles

Vehicle Type	2009 – 2011	2012 – 2014	2015 – 2017
Type I (City EV)	5,000	6,250	62,500
Type I.5 (City EV)	4,000	5,000	50,000
Type II (Full Function)	3,333	4,167	41,667
Type III (Fuel Cell)	2,500	3,125	31,250
Type IV (Fuel Cell)	2,000	2,500	25,000

By comparison, the existing program requires 2,500 Type III vehicles in 2009 to 2011 and 25,000 in 2012 – 2014. The existing program limits the substitution of battery EVs to 50 percent of the requirement with significantly higher credit ratios resulting in much higher production requirements.

The proposal would allow Enhanced AT PZEVs to make up the "shortfall" or difference with the existing requirements. Table 4.2 shows the incremental production of Enhanced AT PZEVs over the three-year period that would be required. To give a sense of the increase in total vehicles required, two Enhanced AT PZEVs are considered, a PHEV with a 40 mile AER, and a blended Enhanced AT PZEV with 12.5 miles of AER. The number of "offset" vehicles varies due to the differences in credit earned for each vehicle type but will exceed the existing 25,000 requirement for Type III vehicles. For purposes of estimating cost and emissions later in Section 6 and 7, a value of 1.5 was used to represent a weighted average Enhanced AT PZEV credit.

Table 4.2: Incremental Production Using Enhanced AT PZEVs as Gold Backfill 2012 – 2014

Vehicle Type	Proposed Credit	Incremental Production
AT PZEV		
HEV: 40 mile AER	2.4	46,875
Blended HEV: 22 mile electric range	1.5	75,000
Blended HEV: 12.5 mile electric range	1.24	90,725

4.2 Increase Credit for Neighborhood Electric Vehicles

Doubling the level of credit for NEVs increases the incentives for manufacturers to produce them. This increase will not necessarily result in overwhelming the market with new NEVs, but will provide a modest incentive for those already in production. Since the 2001 to 2005 timeframe, the number of NEVs placed in California has dropped dramatically. Thus, the impact from this proposed change is expected to be extremely small. Because of the limitations on the use of NEVs for compliance, they are typically used to offset PZEV or AT PZEV requirements. Therefore, the increase in credits for NEVs will reduce the number of AT PZEVs that are produced. The resulting impact is approximately one less AT PZEV for every four NEVs placed.

4.3 Extend "Travel" Provision

Extending the "travel" provision can reduce the industry obligation in states that have adopted the California program. California sales are nearly equal to the sales from all states that have adopted the ZEV requirements. Consequently, this change is anticipated to reduce the number of ZEVs needed in other states by approximately 2,500 vehicles in the 2012 – 2014 timeframe. The proposal would extend the provision for Type III and IV ZEVs through 2017. To the extent that fuel cell vehicles are produced to meet the requirements in that timeframe, this proposal will reduce the number of vehicles by the amount placed in states that have adopted the ZEV program. Similarly, since battery EVs are also included in the travel provision, battery EVs could be reduced by half nationwide.

4.4 Modify Transition for Automakers

Several automakers with a collective market share of roughly 10 percent are projected to be affected by this aspect of staff's proposal. When compared to the existing transition where gold ZEVs are required, the net effect would be a reduction of several hundred pure ZEVs and a corresponding "backfill" or increase of approximately 3,000 to 4,000 PZEVs and AT PZEVs in the 2012 timeframe. Due to the large numbers of PZEVs and AT PZEVs, the overall impact would be a net reduction in cost and emissions.

4.5 Overall Anticipated Impacts

Staff has also looked at the existing ZEV bank on an industry wide basis, as shown in Table 2.4. Using the industry wide aggregate totals for the ZEV bank, staff examined the possible numbers of vehicles to be placed between 2009 and 2017. Presented below are two scenarios of the number of vehicles manufacturers will place, dependent on their use of banked ZEV credits. Staff took into account limited applicability of NEV credits for use in gold and silver categories. Scenario 1, presented in Table 4.3, shows the approximate number of vehicles that would be placed if the manufacturers used no banked ZEV credits.

Table 4.3: Scenario 1 – No Credit Use

Vehicle Type	2009-2011	2012-2014	2015-2017
ZEVs			
Fuel Cell Vehicle Type IV, or	2,000	2,500	25,000
Fuel Cell Vehicle Type III, or	2,500	3,125	31,250
Battery Vehicle Type II, or	3,333	4,167	41,667
City EV Type I.5, or	4,000	5,000	50,000
City EV Type I	5,000	6,250	62,500
Enhanced AT PZEVs	0	75,000	83,333
AT PZEV	207,000	195,000	153,000
PZEV	1,260,000	1,260,000	1,260,000

Assumes Enhanced AT PZEVs earn 1.5 credits, silver vehicles earn 0.65 credits in 2012 – 2014, and 0.55 credits 2015 – 2017. Based on annual California vehicle sales of 1.4 million passenger cars, light-duty trucks (LDT 1 and LDT 2) by the six large volume auto manufacturers.

For Scenario 2, as presented in Table 4.4, staff projected the total number of vehicles to be placed by manufacturers using a combination of banked credits and new production. As shown, existing banked credits are largely spent in the 2009 – 2011 timeframe with minimal impact in 2012. The number of fuel cell vehicles estimated for 2009 – 2011 reflect staff's understanding of industry wide plans for the technology. For both scenarios the number of pure ZEVs is not added together, but rather reflects the number of vehicles that would be needed to meet the requirements for each technology type. Given the current state of battery technology, staff does not anticipate that manufacturers will produce any battery EVs prior to 2012.

Table 4.4: Scenario 2 – Probable Credit Use

Vehicle Type	2009-2011	2012-2014	2015-2017
ZEVs			
Fuel Cell Vehicle Type IV or	250	2,500	25,000
Fuel Cell Vehicle Type III or	200	3,125	31,250
Battery Vehicle Type II or	0	4,167	41,667
City EV Type I.5 or	0	5,000	50,000
City EV Type I	0	6,250	62,500
Enhanced AT PZEVs	30,000	75,000	83,333
AT PZEV	107,000	95,000	153,000
PZEV	700,000	1,260,000	1,260,000

Assumes Enhanced AT PZEVs earn 1.5 credits, silver vehicles earn 0.65 credits in 2012 – 2014, and 0.55 credits 2015 – 2017. Based on annual California vehicle sales of 1.4 million passenger cars, light-duty trucks (LDT 1 and LDT 2) by the six large volume auto manufacturers.

5. REGULATORY ALTERNATIVES

5.1 Do Not Amend Program

ARB staff considered not recommending any amendments to the ZEV regulations. In this case, large volume manufacturers would need to produce and place 25,000 advanced technology vehicles between 2012 and 2014. Based on the data obtained, the technology needed will not be ready for such large volumes and will result in the imposition of a large cost burden on the manufacturers.

The vehicles would need to be priced aggressively to meet the sales targets, and this would reduce the revenue available to the manufacturers to offset their costs. To the extent that the state provides subsidies in order to assist with vehicle marketing, such a large number of vehicles needing subsidies would result in large state expenditures. Under the current program, manufacturers would most likely use their entire amount of banked credits before needing to produce costly additional ZEVs to meet their program requirements.

5.2 Adopt Substantial Revisions to the ZEV Regulation

As part of the regulatory development process, ARB staff considered three options regarding the number of vehicles required under the Alternative Compliance Path, as shown in Table 5.1. The options were evaluated in the context of strengthening the program by deploying advanced technology vehicles to further advance ZEV commercialization and manufacturing capacity while considering balancing the overall costs and compliance feasibility.

Table 5.1: Possible Options

Phase		II	III	IV
Years		2009-2011	2012-2014	2015-2017
***Option 1**	Staff Proposal	2,500	2,500/ Enhanced AT PZEV offset	25,000/ Enhanced AT PZEV offset
***Option 2**	Combined Phase	5,000		10,000 to 15,000
***Option 3**	No Change	2,500	25,000	50,000

* Each LVM would be required to produce their sales-weighted share.

Option 1 would maintain the pressure to continue the development of emerging ZEV technologies. At the same time, the proposal would take greater advantage of the recent interest in new technology options and provide manufacturers with greater flexibility in meeting the ZEV program requirements.

Option 2, suggested by some automakers, provides flexibility around product plans and allows greater time for technology advancement before introducing larger numbers of vehicles. However, staff rejected this option because of the significant risk that it would create a gap in vehicle production as automakers back-load their obligation.

Option 3, suggested by several environmental organizations, delays any action in proposing amendments to Phase III. However, staff rejected this approach as automakers have indicated that product planning and development schedules for the 2012-2014 MYs are now in place and a feasible regulation is needed for this timeframe.

Staff's proposed amendments to ZEV program maintain the on going goals of pure ZEV commercialization while taking into consideration the current cost and associated technological barriers. The changes proposed by staff significantly reduce an automaker's cost of compliance, but still provide increased air quality benefits primarily because they rely upon the proven emission benefits of commercially viable and increasingly available AT PZEVs. Staff believes that relinquishing a portion of the research and development production volume in exchange for reduced costs to automobile manufacturers and increased near term emission benefits is a compromise that benefits almost all stakeholders. The proposed amendments are the most feasible and cost effective option.

6. ECONOMIC IMPACTS

The proposed amendments to the ZEV program are projected by ARB staff to reduce the costs of compliance for automobile manufacturers. Staff believes, therefore, that the proposed amendments would cause no noticeable adverse impact on California employment, business status, and competitiveness when compared to the existing program. Because the ZEV regulations provide considerable flexibility to manufacturers, the magnitude of these savings is difficult to estimate with certainty.

6.1 Legal Requirement

Sections 11346.3 and 11346.5 of the Government Code require state agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include consideration of the impact of the proposed regulation on California jobs, business expansion, elimination, or creation, and the ability of California businesses to compete.

State agencies are also required to estimate the cost or savings to any state or local agency and school districts in accordance with instruction adopted by the Department of Finance. This estimate is to include any nondiscretionary costs or savings to local agencies and the costs or savings in federal funding to the state.

6.2 Directly Affected Businesses

LVMs that produce passenger cars and light-duty trucks in California would be directly affected by the proposed amendments. Also affected are businesses that supply parts for these vehicles. California accounts for only a small share of total nationwide motor vehicle and parts manufacturing. There are about 40 companies worldwide that manufacture California-certified light- and medium-duty vehicles and heavy-duty gasoline engines. All but the largest six would not be affected by the amendments with the exception of those IVMs that transition to LVMs due to increasing production volume. Current projections show that one to four IVMs will transition to LVMs. Only one motor vehicle manufacturing plant is located in California, the NUMMI facility, which is a joint venture between GM and Toyota. Since NUMMI does not produce vehicles affected by the amendments to the ZEV regulation, staff expects there to be no California based impacts.

6.3 Potential Impact on Manufacturers

The proposed amendments are expected to reduce costs to motor vehicle manufacturers. The key factors that determine the cost of compliance with the ZEV program are the number and types of vehicles that are required, and the incremental cost per vehicle. The changes that would result from the proposed amendments are

estimated below and are subject to considerable uncertainty because of the flexibility allowed by the regulation.

6.4 Incremental Per-Vehicle Cost Estimates

ARB staff used the incremental costs per vehicle from the 2003 regulatory amendment process as the starting point for the staff estimates. Where appropriate, staff modified the projected costs based on gathered estimates of technology costs and to reflect changes in volume and timing.

Fuel cell Vehicles

The 2003 rulemaking estimated the incremental cost of fuel cell vehicles for development Phase III at $120,000 per vehicle (ARB 2003). However, this assumed a vehicle production of tens of thousands of vehicles. Because the proposal would repeat the volumes required in Phase II with 2,500 vehicles, this analysis uses the cost estimates from 2003 for development required for Phase II. Consequently, the incremental cost is estimated to be $250,000 per vehicle in the 2012 – 2014 timeframe. Fuel cell vehicles with greater range are typically more expensive due to efficiency improvements, and/or greater on-board fuel storage. Staff therefore assumes an average additional incremental cost of $50,000 for these vehicles in the near term, and $25,000 in the mid-term.

Battery Electric Vehicles

Recent announcements have increased optimism in new battery chemistries, namely lithium-based batteries. However, price fluctuations and lithium-ion battery availability make recent cost numbers uncertain, so staff will continue to use the estimates from 2003 until these batteries become available in large pack quantities. The 2003 rulemaking estimated the incremental costs for Type II battery EVs at $17,000 and Type I city EVs at $8,000 (ARB 2003). These estimates, however, were based on larger volume production than would be needed to meet the requirements in 2012 – 2014 and would underestimate the cost to industry. Since the cost of the vehicles will depend on several factors including the battery chemistry used, a sizable cost range is used for Type I and Type II vehicles. Increased range for Type I.5 is largely dependent on greater battery size. In small volumes this increased range is expected to raise the cost of the vehicle by $15,000 over the 2012-2014 timeframe. In much high production quantities over all costs for both are expected to be reduced significantly.

Plug-in Hybrid Electric Vehicle

Staff has relied on a report by EPRI entitled “Comparing the Benefits and Impacts of Hybrid Electric Vehicle Options for Compact Sedan and Sport Utility Vehicles”[9] to

[9] “Comparing the Benefits and Impacts of Hybrid Electric Vehicle Options for Compact Sedan and Sport Utility Vehicles”, EPRI, Palo Alto, CA: 2002. 1006892.

estimate the average incremental cost for Enhanced AT PZEVs vehicles produced in low volumes.

Table 6.1 presents the incremental cost estimates for each vehicle technology.

Table 6.1: Incremental Vehicle Cost Estimates

Vehicle Type	2012 to 2014	2015 to 2017
ZEVs		
Fuel Cell Vehicle: Type IV	$300,000	$150,000
Fuel Cell Vehicle: Type III	$250,000	$125,000
Battery Vehicle: Type II	$80,000 to $120,000	$40,000 to $60,000
Battery Vehicle: Type I.5	$40,000 to $80,000	$20,000 to $40,000
Battery Vehicle: Type I	$35,000 to $65,000	$15,000 to $35,000
AT PZEVs		
Plug-in Hybrid Electric Vehicle	$25,000	$12,500

The estimates for the various vehicle types are subject to great uncertainty associated with projecting future costs for evolving technology. As such, though the direction of the cost impact of the proposed amendments is clear, the magnitude of the savings is much more difficult to assess.[10]

6.5 Cost Savings

The incremental vehicle costs from Table 6.1 were used to estimate the costs from the proposed changes to the Phase III and Phase IV requirements. The incremental costs were combined with the projected changes in Table 4.1 to estimate the costs for complying with the proposed amendments through each of the ZEV technologies allowed. Scenarios 1 through 5 present compliance costs assuming the minimum required numbers of ZEVs ("floor" requirement) combined with the maximum use of Enhanced AT PZEVs for backfill. The proposed amendments allow varying amounts of different ZEV technologies to be used to meet the floor requirement. The five scenarios reflect these proposed changes.

Though the number of required vehicles decreases for higher scoring vehicles (e.g., Type III and Type IV), overall costs are higher due to greater incremental cost per vehicle. As compared to the existing regulation, the overall cost of compliance strategies using the combination of vehicle types is lower. These estimates are summarized below in Table 6.2, where the annual cost of each scenario is subtracted from the projected annual cost of the existing regulation ($2,083 million)

[10] ARB 2008. California Air Resources Board, Excel Spreadsheet: Vehicle Estimates and Costs, February 2008

Table 6.2: Estimated Annual Costs and Savings from Proposal (In millions)

Scenarios	Vehicle Types	2012-2017 Annual Cost	2012-2017 Annual Savings
Existing Regulation	**Type III**	**$2,083**	**N/A**
1	Type IV + Enhanced AT PZEV	$1,236	$847
2	Type III[1] + Enhanced AT PZEV	$1,267	$816
3	Type II + Enhanced AT PZEV	$903	$1,180
4	Type I.5 + Enhanced AT PZEV	$786	$1,297
5	Type I + Enhanced AT PZEV	$799	$1,284

[1] Assumes fuel cell vehicle, not battery EV.

Table 6.2 also presents the savings from the proposed amendments when compared to the existing program. As shown, the proposed amendments greatly decrease overall cost due to the reduction in vehicle numbers of the most expensive technologies.

6.6 Potential Impact on Dealerships

The extent to which motor vehicle dealerships are affected by the current ZEV regulation, or the amended regulation, depends on the specifics of the interaction between the dealership and the manufacturer. The proposed changes are expected to have limited impact on dealers as many of the vehicle technologies affected are not expected to be sold commercially and those that will be are placed in relatively small numbers.

6.7 Potential Impacts on Vehicle Operators

The proposed changes would reduce the number of fuel cell and battery EVs demonstrated. These vehicles are not expected to be sold or leased in the timeframe under consideration as a commercial product. As is the case with dealerships, the impact of the current regulation or the amended regulation on vehicle purchasers will depend on the extent to which manufacturers choose, and are able, to pass along any increased costs. Once again, staff cannot estimate the extent to which this would occur, but it is clear that the proposed amendments would serve to reduce any possible cost increases for vehicle purchasers as compared to the current regulation.

6.8 Potential Impact on Business Competitiveness

Because the proposed amendments are anticipated to reduce costs faced by California businesses, they would have no adverse impact on the ability of California businesses to compete with businesses in other states.

6.9 Potential Impact on Employment

The proposed amendments are not expected to cause a noticeable change in California employment because California accounts for only a small share of motor vehicle and parts manufacturing employment, which is not expected to be affected by the regulation.

6.10 Potential Impact on Business Creation, Elimination or Expansion

Staff sees a potential benefit to start up companies specializing in advanced battery technology and ZEVs. The proposed amendments are not expected to affect business creation, elimination or expansion.

6.11 Potential Costs to Local and State Agencies

The proposed amendments are not expected to result in an increase in costs for state and local agencies.

7. ENVIRONMENTAL IMPACTS

This section includes a discussion of the emission impacts of the ZEV program, and, separately the proposed regulatory amendments. The first analysis calculates the projected benefits of the total ZEV program. The analysis includes both criteria pollutant and climate change emissions.

7.1 Program Benefits

The Mobile Source Emission Inventory, EMFAC2007[11], was used to assess the overall emission benefits of the ZEV program. Using EMFAC, staff modeled the ZEV program and compared these results to a vehicle program with no ZEV component. This comparison is applicable to the South Coast Air Basin and represents the emissions from vehicles subject to this regulation. It includes passenger cars and light-duty trucks weighing less than 3,751 pounds gross vehicle weight, plus light duty trucks weighing less than 8,500 pounds gross vehicle weight phased in beginning in 2008.

Table 7.1 presents the difference in emissions for the South Coast Air Basin in 2020 and 2030 for the current ZEV program compared to not having a ZEV program. As shown in Table 7.1 staff estimates that the proposed changes will result in a net decrease of about 13.83 tons per day of direct emissions of reactive organic gases (ROG) and oxides of nitrogen (NOx) in 2020. For 2030, Table 7.1 shows a net decrease of about 15.52 tons per day of direct emissions of ROG and NOx from the proposed amendments when compared to the current program.

Table 7.1: Summertime Emissions, South Coast Air Basin in 2020 and 2030 (Tons per day)

2020	ROGexh.	ROGevap.	NOx	Total
No ZEV Program	36	63	66	164
Current Program	26	60	64	151
Benefit of Current Program v. No Program	**10**	**3**	**2**	**13**
2030	ROGexh.	ROGevap.	NOx	Total
No ZEV Program	22	55	38	115
Current Program	14	49	36	100
Benefit of Current Program v. No Program	**8**	**6**	**2**	**16**

As illustrated, the ZEV requirements provide benefits beyond that achieved by using a fleet emissions average. As important, the program continues to push new technology that will reduce emissions in the future.

7.2 Benefits of Proposed Amendments

The Greenhouse gases, Regulated Emissions, and Energy use in Transportation (GREET)[12] model was used to directly compare the emission impacts from the changes

[11] ARB 2007c, EMFAC2007. Version 2.3, Updated November 2006

being proposed by staff. The most significant element of the proposal affects the requirements for pure ZEVs beginning in 2012.

Using the GREET model, staff analyzed the five scenarios presented in Section 6.5 to show the lifetime emissions benefit of the proposed changes. The analysis considers the impacts from reducing the floor number of gold vehicles and backfilling with Enhanced AT PZEVs. All scenarios were run on a well-to-wheel basis with an assumed 150,000 mile vehicle life. Presented below in Table 7.2 and Table 7.3 are the average lifetime emissions for criteria pollutants and climate change emissions for Phase III and Phase IV respectively.

Table 7.2: Total Lifetime Emissions of Proposed Changes for 2012 – 2014[1] (Tons in thousands)

Scenarios	Lifetime Emissions	
	ROG + NOx	Climate Change (CO2)
Existing Regulation	11	13,200
Average of Five Scenarios	6	9,750
Average Emission Benefit	5	3,450

[1] In all scenarios, the emissions from conventional vehicles were included as necessary to make the total number of vehicles, 145,833, consistent for each scenario.

Table 7.3: Total Lifetime Emissions of Proposed Changes for 2015 – 2017[1] (Tons in thousands)

Scenarios	Lifetime Emissions	
	ROG + NOx	Climate Change (CO2)
Existing Regulation	6	7,800
Average of Five Scenarios	4	5,700
Average Emission Benefit	2	2,100

[1] In all scenarios, the emissions from conventional vehicles were included as necessary to make the total number of vehicles, 145,833, consistent for each scenario.

As shown in Table 7.2 and 7.3, the flexibility provided by the proposed amendments will reduce emissions during the 2012 – 2017 timeframe. In terms of climate change emissions, all alternatives analyzed reduce overall emissions.

7.3 Energy Diversity and Energy Demand

The vehicle technologies expected to be used to comply with the ZEV program typically use fuel more efficiently, and thus when fully commercialized will reduce demand for petroleum fuels. These technologies also use non-petroleum fuels, such as electricity and hydrogen, which helps diversify the transportation fuel market. The ZEV program

[12] ARB et al 2007d, Modified California GREET model "greet1.7ROW_US_CA_v92" _ftp://ftp.arb.ca.gov/carbis/fuels/ab1007/CA_Greet_june07_ June, 2007

and the proposed amendments are consistent with recent reports that recommend increased vehicle efficiency and increased use of alternative fuels.

7.4 Environmental Justice

The proposed regulation is consistent with the ARB's Environmental Justice Policy to reduce health risks from criteria pollutants in all communities, including low-income and minority communities. Many communities are located near heavily traveled freeways. By reducing emissions of air pollutants from light duty vehicles, the proposed regulation will provide air quality benefits by reducing exposure to and associated health risk from these pollutants.

7.5 California Environmental Quality Act

The California Environmental Quality Act (CEQA) and ARB policy require an analysis to determine the potential environmental impacts of proposed regulations. Because the ARB's program involving the adoption of regulations has been certified by the Secretary of Resources pursuant to Public Resources Code section 21080.5, the CEQA environmental analysis requirements may be included in the Initial Statement of Reasons (ISOR) for this rulemaking. In the ISOR, ARB must include a "functionally equivalent" document, rather than adhering to the format described in CEQA of an Initial Study, a Negative Declaration, and an Environmental Impact Report. In addition, staff will respond, in the Final Statement of Reasons for the regulation, to all significant environmental issues raised by the public during the public review period or at the Board public hearing.

Public Resources Code section 21159 requires that the environmental impact analysis conducted by ARB include the following: an analysis of reasonably foreseeable environmental impacts of the methods of compliance; an analysis of reasonably foreseeable feasible mitigation measures; and an analysis of reasonably foreseeable alternative means of compliance with the regulation.

Compliance with the proposed regulation is expected to directly affect air quality and potentially affect other environmental media as well. Our analysis of the reasonable foreseeable environmental impacts of the methods of compliance is presented below. Regarding mitigation measures, CEQA requires an agency to identify and adopt feasible mitigation measures that would minimize any significant adverse environmental impacts described in the environmental analysis.

Because this regulatory proposal identifies no new potentially significant environmental effects, it would not have any significant or potentially significant effects on the environment. Therefore no alternatives or mitigation measures are proposed to avoid or reduce any significant effects on the environment.

8. COST-EFFECTIVENESS

This section discusses the cost-effectiveness of the proposed amendments. Determining the cost-effectiveness of the ZEV program has always been more difficult and uncertain than for other regulatory measures due to the far-reaching nature and longer lead times of the program. Predicting the future cost of technologies that are still in the demonstration stage is difficult at best. In addition, the ZEV program has always combined two distinct objectives – first, achieving emission reductions today through expanded introduction of commercially available near-zero emission technology, and second, accelerating the development of pure ZEV technologies that have the potential to provide significant air quality benefits over the long term, but have minimal immediate air quality impact given their pre-commercial status and limited production.

Cost-effectiveness is a measure of the cost incurred to achieve a specific outcome, as compared to other ways to reach that same end. Under the proposed amendments, the primary impact would be to reduce the number of fuel cell and battery EVs required in the 2012 – 2017 timeframe. As noted in Section 6.5, the estimated annual savings to industry from these changes would be $1.3 billion in 2012 – 2014 and $0.9 billion in 2015 – 2017 depending upon the compliance strategy chosen, though some compliance options would increase a manufacturer's costs if chosen. Consequently, when compared to the existing program, the proposed amendments produce positive cost-effectiveness. That is, the overall impact to the environment is improved at less cost due to the expected commercialization of larger numbers of AT PZEVs.

9. SUMMARY AND STAFF RECOMMENDATION

9.1 Summary of Staff Proposal

Staff's proposed modifications would recognize the state of development for the leading ZEV technologies, provide greater flexibility in manufacturer compliance and increase the near-term air quality benefits through the commercialization of larger numbers of AT PZEVs. In addition, the proposed amendments maintain pressure toward the commercialization of ZEV technologies while at the same time reflecting the current state and cost of ZEV technology. The staff proposal contains the following specific amendments:

Table 9.1: Summary of Proposed Modifications

Goal	Solution
Address technology challenges of fuel cell vehicles	Lower required numbers of fuel cells during Phase III and IV (2012 – 2014 & 2015 – 2017) and create Type IV ZEV.
Incentivize PHEVs with zero emission mile capability	Allow Enhanced AT PZEVs in Phase III to count for 90% of gold requirement. Establish new calculations for AT PZEV credits to account for new plug in hybrid configurations.
Simplify regulation	Create "New Path" to replace two path system.
Remove barriers to using Battery EVs for compliance	Remove caps on Type I and II battery EVs; change ratio for use and create Type I.5 ZEV, however maintain higher credits for fuel cell vehicles compared to battery EVs to reflect relative state of development.
Fulfill commitment to revisit role of NEVs	Up credit to 0.3 to recognize environmental benefits.
Smooth transition for IVMs going to LVM	Create transition period emphasizing AT PZEVs.
Program compliance transparency	Release of ZEV production data beginning in 2009 and ZEV credit balances in 2010.
Conforming changes	Extend travel provision.

9.2 Staff Recommendation

ARB staff recommends that the Board amend section 1962, Title 13, California Code of Regulations, and the incorporated test procedures and related regulations, and adopt section 1962.1. The proposed amendments and adoptions are set forth in the Proposed Regulation Order in Appendix A.

10. REFERENCES

ARB 2000. California Air Resources Board, *Staff Report, 2000 Zero Emission Vehicle Program Biennial Review*, August 7, 2000.

ARB 2001. California Air Resources Board, *Final Statement of Reasons, Amendments to the California Zero Emission Vehicle Program Regulations*, December 2001.

ARB 2003. California Air Resources Board, *Staff Report, 2003 Proposed Amendments to the California Zero Emission Vehicle Program Regulations*, January 10, 2003.

ARB 2004. California Air Resources Board, *Initial Statement of Reasons for Proposed Rulemaking, Public Hearing to Consider Adoption of Regulations to Control Greenhouse Gas Emissions from Motor Vehicles,* August 2004.

ARB 2006a. California Air Resources Board, *California Hydrogen Highway Network: Year End Progress Report to the Legislature,* December 2006.

ARB 2006b. California Air Resources Board, *Manufacturers' Advisory Correspondence 2006-02: Policy Regarding the "Fast Refueling Capability" Criterion For 2003 and Subsequent Model-Year Type III Zero-Emission Vehicles (ZEV).* May 10, 2006.

ARB 2007a. California Air Resources Board, *2007 Almanac Data,* 2007.

ARB 2007b. California Air Resources Board, *Board Resolution 07-18,* May 24, 2007.

ARB 2007c. California Air Resources Board, EMFAC2007. Version 2.3, Updated, http://www.arb.ca.gov/msei/onroad/latest_version.htm November 2006.

ARB 2007d. ARB, Tiax, CEC, Argonne National Labs, Modified California GREET Model: "greet1.7ROW_US_CA_v92" ftp://ftp.arb.ca.gov/carbis/fuels/ab1007/CA_Greet_june07_ June, 2007

ARB 2007e. California Air Resources Board, *Status Report on the California Air Resources Board's Zero Emission Vehicle Program*, April 20, 2007

ARB 2007f. California Air Resources Board, *Concept Paper: Staff's Suggested Modifications to the Zero Emission Vehicle (ZEV) Program*, November 9, 2007

ARB 2008. California Air Resources Board, Excel Spreadsheet: Vehicle Estimates and Costs, February 2008

EPRI. Duvall, et al. *Comparing the Benefits and Impacts of Hybrid Electric Vehicle Options. Palo Alto*, CA: 2001 1000349.

GEM. *Surveys of NEV Owner Behavior in California*. December, 2005 Prepared for GEM by Mightycomm and Access Research Group.

Kalhammer, F., Kopf, B., Swan, D., Roan, V., Walsh, M., *Status and Prospects for Zero Emissions Vehicle Technology: Report of the ARB Independent Expert Panel 2007*, April 13, 2007.

SAE. SAE International, *Recommended Practice for Measuring the Exhaust Emissions and Fuel Economy of Hybrid-Electric Vehicles*, March 1999

APPENDIX A: PROPOSED AMENDMENTS

1. Proposed Regulation Order: Amendments and Adoption to the Zero-Emission Vehicle Program

   Attached

2. Proposed Amendments to the test procedures incorporated by reference in sections 1962 and 1962.1, title 13, California Code of Regulations.

   Copies of the Test Procedures are available on the ARB's Internet site at http://www.arb.ca.gov/msprog/zevprog/2007rule/2007rule.htm, or may also be obtained by contacting the agency contact person for this rulemaking, Mark Williams, at (916) 327-5610 or via email at mwilliam@arb.ca.gov.