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**AIR POLLUTION REGULATION IN CALIFORNIA
AND
THE ZERO-EMISSION VEHICLE MANDATE**

December 2002

Jeremy Ketchum

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The Mineta Transportation Institute

College of Business–BT550

San José State University

San Jose, CA. 95192-0219

Tel (408) 924-7560

Fax (408) 924-7565

E-mail: mti@mti.sjsu.edu

<http://transweb.sjsu.edu>

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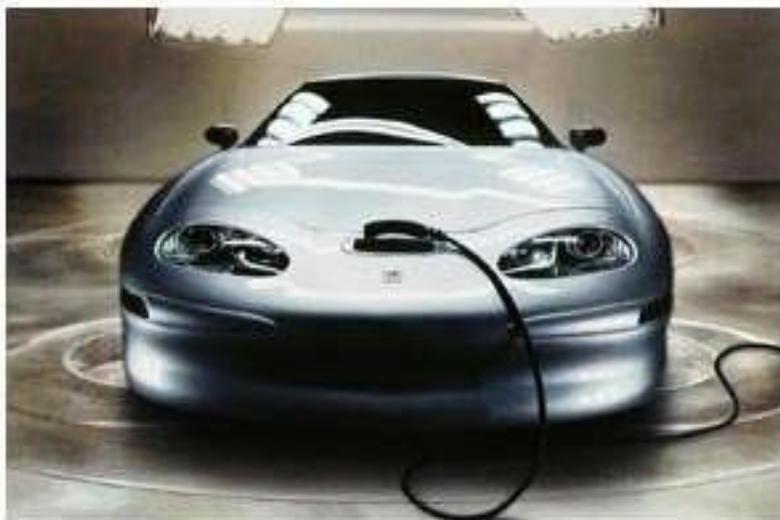
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EXECUTIVE SUMMARY

The California Air Resources Board approved the Zero-Emission Vehicle Mandate in 1990. The 1990 mandate required that two percent, five percent and 10 percent of new car sales be zero emitting by 1998, 2001 and 2003 respectively. Automobile manufacturers developed electric vehicles to meet the mandate. However, development of electric vehicles from 1990 to 2002 has failed to meet initial expectations of the Air Resources Board. Automobile manufacturers have been unable to produce an electric vehicle that can be sold for profit at the levels required by the mandate.

As a result, the Air Resources Board has reduced short-term Zero-Emission Vehicle requirements. However, the Air Resources Board continues to require increasing numbers of Zero-Emission Vehicles in future years. Zero emissions from all mobile sources would be the optimal situation from the perspective of the Board. The air quality benefit of achieving an entire zero-emission vehicle fleet would be substantial. Conversely, automobile manufacturers believe that the short-term air quality would benefit more from reducing emissions in other ways that would also be less costly to their companies than the Zero-Emission Vehicle Mandate.

As 2003 begins—the year that was to see 10 percent of the new vehicle market as zero emitting—the mandate is tied up in the courts. When the court injunction is lifted, as few as 4,650 zero emission vehicles will be required versus the approximately 100,000 that were envisioned in 1990. With many automobile manufacturers in opposition to the mandate it will be interesting to see whether or not the mandate is capable of creating substantial change in the vehicle market. If the past history of the mandate continues, then it is likely that the Zero-Emission Vehicle requirements will continue to be relaxed to provide manufacturers increased ability to be compliant with the mandate without suffering significant financial losses.



Above: General Motors EV1 Electric Vehicle charging

CHAPTER ONE: SUMMARY AND HISTORY OF AIR POLLUTION REGULATION IN CALIFORNIA

INTRODUCTION

Air pollution regulation has come a long way since the middle of the 20th century. Significant reductions in the level of pollutants from both stationary and mobile sources have occurred on both a per unit and overall level. Unfortunately, the air quality still has not reached healthy levels in many parts of the United States and especially in California. In the transportation field, population growth combined with the growing travel needs of the individual user has led to rapid growth in the aggregate number of vehicle miles traveled. As a result, even greater measures will be needed to reduce vehicle emissions and improve on the existing air quality levels.

The Zero-Emission Vehicle Mandate from the California Air Resources Board, created in 1990, was a proposal aimed at achieving greater reductions in vehicle emissions. Battery-powered electric vehicles (EVs) have been the vehicle designated as most likely to achieve the zero emission levels required by the mandate. However, vehicle manufacturers have stated that EVs are not competitive with the existing petroleum powered internal combustion engine vehicles prevalent in the current vehicle market. In fact, according to auto manufacturers, they lose money on each EV sold at market. Since EVs have not been ready for the market, adjustments to the 1990 ZEV Mandate have been required. These adjustments have provided the auto manufacturers more time and flexibility in meeting the ZEV requirements.

HISTORY OF AIR POLLUTION REGULATION

California has been a leader in establishing air pollution regulations in the United States. Air pollution regulation began in California in 1947 with the signature of the Air Pollution Control Act by Governor Earl Warren. The Act authorized the creation of an Air Pollution Control District in every county. That year the Los Angeles County Air Pollution Control District became the first of its kind in the nation. That same year California adopted the Ringelmann System, which measured the opacity of smoke arising from stacks and other sources. In 1950, Rule 50A, based on the Ringelmann System (a visual inspection method of air quality analysis), was passed in California, which limited the amount of smoke.

It was not until 1955 that the Federal government passed air pollution control regulations. The Air Pollution Control Act of 1955 defined the Federal role as being primarily confined to research. Actual pollution control was the responsibility of each state government, although the Surgeon General of the United States would conduct specific investigations of local pollution problems upon request.

Even at the time of these early air pollution regulations the impact of motor vehicles on pollutant levels was a primary concern. This concern continued to be addressed in subsequent legislation. In 1959, California enacted legislation requiring the state Department of Public Health to establish air quality standards and necessary controls for motor vehicle emissions. In 1960, California established the Motor Vehicle Pollution

Control Board (MVPCB). The primary function of the MVPCB was to test and certify devices for installation on cars for sale in California.

Also, in 1960 the Federal Motor Vehicle Act was enacted, which required federal research to address pollution from motor vehicles.

The California Motor Vehicle State Bureau of Air Sanitation mandated the first automotive emissions control technology in the nation when it required installation of the Positive Crankcase Ventilation (PCV) to control hydrocarbon crankcase emissions. The PCV withdraws blowby gases from the crankcase and re-burns them with the fresh air and fuel mixture in the cylinders.

In 1965, Federal Clean Air Act of 1963 was amended by the Motor Vehicle Air Pollution Control Act of 1965. The Act provided direct regulation of air pollution by the federal government, and directed the Federal Department of Health, Education, and Welfare to establish auto emission standards.

In 1966, the California Motor Vehicle Pollution Control Board took the national lead by adopting requirements for California vehicles to meet auto tailpipe emission standards for hydrocarbons and carbon monoxide. This was two years before similar federal requirements.

The California Air Resources Board (ARB) was created in 1967 when the California Motor Vehicle Pollution Control Board and the Bureau of Air Sanitation and its laboratory merged. The Air Resources Board continues to regulate air quality in California today. In that same year the California Highway Patrol began random roadside inspections of vehicle smog control devices. Also, the Federal Air Quality Act of 1967 was enacted. The act established a framework for defining “air quality control regions” based on meteorological and topographical factors of air pollution. The act also allowed the State of California a waiver to set and enforce its own emissions standards for new vehicles based on California’s unique need for more stringent controls.

In 1969, the first state Ambient Air Quality Standards (AAQS) were promulgated by California for total suspended particulates, photochemical oxidants, sulfur dioxide, nitrogen dioxide, and carbon monoxide.

It became clear that due to a lack of enforceability the Federal Air Quality Act of 1967 was an ineffective means of providing clean air. In 1970, the Federal Clean Air Act Amendments of 1970 were enacted. They established a basic U.S. program for controlling air pollution. In addition, they continue to serve as the principal source of statutory authority for controlling air pollution in the United States.

The 1970 standards were a more serious effort by the government to clean up the air. Under the Act, each state government was to set up a standard for each region and an implementation program to meet the standard. Sanctions are levied upon industry and states that do not meet the standards.

There are two primary mechanisms utilized by the Clean Air Act to maintain and achieve the state National Ambient Air Quality Standards (NAAQs). These include mandatory emissions limitations on all new stationary and mobile sources of regulated air pollutants. Secondly, each state must produce a State Implementation Plan (SIP), which prescribe

emission standards for pre-1970 stationary sources and places controls on the use of cars and trucks that are necessary to attain and maintain the NAAQs.

SIPs were required in the 1967 Clean Air Act, however the authority was left to the states. The 1970 Clean Air Act amendments mandated that the states develop a SIP. The SIPs were to attain the NAAQs no later than 1977.

The 1970 Clean Air Act used a technology forcing approach to combat the level of emissions from vehicles. Technology forcing because the current technology was not in place at the time of the regulations. The regulations required that a 90 percent reduction in emissions of hydrocarbon (HC), nitrogen oxide (NO_x) and Carbon Monoxide (CO), due to automobiles, occur in the next 5 or 6 years.

In 1971, the Federal EPA created the NAAQs that must be met across the nation for particulates, photochemical oxidants (including ozone), hydrocarbons, carbon monoxide, nitrogen dioxide and sulfur dioxide. However, California had already established even more stringent requirements. Also, in the same year the ARB adopted the first automobile nitrogen oxide standards in the nation.

From 1970 to 1977, most regions failed to meet the SIPs requirements. In addition, the 90 percent reduction in automobile emissions was not met. So, in 1977 the Federal Clean Air Act Amendments of 1977 were enacted. The amendments required a review of all National Ambient Air Quality Standards by 1980.

The 1977 amendments also extended the time period to meet the NAAQs to 1982 or 1987. Revisions to the SIPs were mandated for states not meeting the requirements. The legislation did force some technological innovations such as the catalytic converter. However, the amendments were still not able to achieve the 90% emissions reduction in vehicles as required.¹

In 1983, ARB began compliance testing on autos in use to determine whether they continue to comply with emission standards as they age. This became a strong incentive for manufacturers to develop more durable emission control equipment to avoid the risk of recall.

In 1984, the California Smog Check Program went into effect to identify vehicles in need of maintenance and to assure the effectiveness of their emissions control systems on a biennial basis.

In 1988, California Clean Air Act was signed by Governor Deukmejian. This act sets forth the framework for how air quality will be managed in California for the next 20 years.

The Clean Air Act Amendments of 1990 were signed into law by President George Bush. They rely largely on elements of the California Clean Air Act, and require a number of new programs aimed at curbing urban ozone, rural acid rain, stratospheric ozone, toxic air pollutant emissions and vehicle emissions, and establishes a new, uniform national permit system.

For areas still not meeting the NAAQs the 1990 requirements require more stringent controls. In addition, the amendments took away a large amount of the remaining

discretion that the states had in determining regulation of existing sources and provided tough new source review and mobile source controls.

Furthermore, the emission standards for cars, trucks and heavy-duty trucks were changed with the 1990 Clean Air Act Amendments. The standards provided a different emission level allowable for passenger vehicles/light-duty trucks below 3,750 pounds, light-duty trucks between 3,750 and 6,000 pounds and heavy duty trucks over 6,000 pounds. In addition, a different standard was established for vehicles that are under 5yrs./50,000 miles and under the 10yr./100,000 mile limit.² Concurrent to these national changes, California established a set of standards which are even more stringent than the federal standard. In addition, in 1990, the ARB approved standards for cleaner burning fuels and low and zero-emission vehicles. The ARB also mandated that manufacturers produce 2 percent, 5 percent and 10 percent of new car sales to be zero emitting by 1998, 2001 and 2003 respectively.³

Smog Check II, signed into law by Governor Wilson following lengthy negotiations with the federal EPA, is designed to meet the requirements of the Federal Clean Air Act as amended in 1990. This program targets vehicles, which pollute at least 2 to 25 times more than the average vehicle and requires repairs and re-testing of offending vehicles.

In 1996, the big seven automakers signed a Memorandum of Agreement with the ARB committing to manufacture and sell zero-emission vehicles. In the same year California Phase II Cleaner Burning Gasoline (CBG) came to market. CBG reduces lung-damaging ozone and ozone precursors by 300 tons/day, as well as reduces airborne toxic chemicals like benzene that can cause cancer. This is equivalent to taking 3.5 million cars off the road.⁴

California's State Implementation Plan (SIP) for ozone was approved by the U.S. EPA on September 26, 1996.

In 1998, the ARB adopted its LEVII emission standards for most mini vans, pickup trucks and sport utility vehicles (SUVs) up to 8,500 pounds gross vehicle weight to reduce emissions to passenger car levels by 2007.⁵

AIR POLLUTION

The effect of the myriad of regulations, requirements and standards discussed above has been a general decrease in emissions since the 1970's levels. This has come about due to measures passed on stationary sources as well as the mobile source controls that are focused on in the discussion above. The overall change in emissions in California and across in the nation is represented in Table 1-1 below. As the table indicates, between 1981 and 2000 the emission levels of all pollutants have decreased except for Nitrous Oxides (NO_x) at the national level. California has been successful at significantly reducing the level of NO_x, but has seen increases in the levels of Particulate Matter (PM₁₀). In California, the reduction in NO_x is expected to continue through at least 2010 according to ARB forecasts. Particulate Matter (PM₁₀) is expected to continue to increase through 2010 primarily due to increases in the number of vehicle miles traveled (VMT)

on paved and unpaved roads. Road dust from vehicles traveling on unpaved roads is a primary contributor of PM₁₀.

Overall California has decreased emissions of each pollutant, except PM₁₀, at a faster rate than the national average. This is likely attributable to the stricter and oftentimes leading role that California has taken in terms of air quality measures.

Although, no figures for California were available for comparison lead (Pb) has been virtually eliminated except for hot spot locations from stationary sources. This is consistent with the national trend.

Table 1-1 Percent Change in Emissions 1981-2000

Pollutant	Nationally (1981-2000)	Nationally (1991-2000)	California (1980-2000)	California (1990-2000)
NO_x	+4	+3	-30	-28
VOC	-32	-16	NA	NA
SO₂/SO_x	-31	-24	-70	-41
PM₁₀	-47	-6	+17	+3
PM_{2.5}	NA	-5	NA	NA
CO	-18	-5	-51	-39
Pb	-94	-4	NA	NA

Source: California Air Resources Board 2002 Almanac of Emissions and Air Quality and the United States Environmental Protection Agency's Latest Findings on National Air Quality: 2000 Status and Trends

The table above includes information regarding pollutants from all sources in California and nationally. On-road mobile sources are the primary contributor of NO_x and Carbon Monoxide (CO) in California. On-road mobile sources are also a significant contributor to the level of Reactive and Total Organic Gases (ROGs and TOGs). Furthermore, as discussed above road dust is a significant contributor of PM₁₀ in California. Table 1-2 below demonstrates the pollutants and the percentage attributable to on-road mobile sources. More information regarding each pollutant and their sources is in Appendix A of this report.

**Table 1-2 Percent of Total Pollution per
Pollutant due to On-Road Mobile Sources**

Pollutant	On-Road Mobile Sources
NO_x	51
ROG	39
TOG	20
PM₁₀	2
SO_x	4
CO	67

Source: 2002 Almanac (page 49) Table 2-1 2001
Statewide Emission Inventory Summary

As noted above emissions rates from on-road mobile sources are of particular concern for NO_x, CO and organic gases. This is due to the fact that for each of these pollutants a substantial percentage of the emissions are due to on-road mobile sources. Therefore, in order to achieve additional emissions reductions, it is critical that on-road mobile sources reduce their emissions of each of these pollutants. Table 1-3 below shows the percentage reduction, in California, of NO_x, CO and ROG attributable to on-road vehicles versus the percentage reduction of each of these pollutants from all sources. Information on TOGs was not available for this comparison. As the table indicates, the percent reduction attributable to on-road mobile sources has been greater than the overall reduction in pollutants from all sources in California except for NO_x. However, the trend from 1990-2000 showed NO_x attributable to on-road mobile sources declining at a faster rate than from all sources.

**Table 1-3 Percent Change in California Mobile Source Emissions
Versus Change in Emissions from all Categories**

Pollutant	California (1980-2000)	On-Road Mobile Sources (1980-2000)	California (1990-2000)	On-Road Mobile Sources (1990-2000)
NO_x	-30	-24	-28	-33
ROG	-50	-64	-32	-46
CO	-51	-60	-39	-48

Source: California Air Resources Board 2002 Almanac of Emissions and Air Quality

Although pollution levels have improved, 95 percent of Californians live in areas that do not meet the Federal or State air quality standards.⁶

Table 1-4 Federal and California Pollutant Standards

California Standard	National Standard
State PM10 Standards: 50 µg/m ³ for 24 hours and 30 µg/m ³ annual geometric mean, neither to be exceeded.	National PM10 Standards: 150 µg/m ³ for 24 hours, not to be exceeded, more than once per year and 50 µg/m ³ annual arithmetic mean averaged over 3 years.
State Ozone Standard: 0.09 ppm for 1 hour, not to be exceeded.	National Ozone Standards: 0.12 ppm for 1 hour, not to be exceeded more than once per year and 0.08 ppm for 8 hours, not to be exceeded, based on the fourth highest concentration averaged over three years.
State CO Standards: 20 ppm for 1 hour and 9.0 ppm for 8 hours, neither to be exceeded. 6 ppm for 8 hours (Lake Tahoe Air Basin only), not to be equaled or exceeded.	National CO Standards: 35 ppm for 1 hour and 9 ppm for 8 hours, neither to be exceeded more than once per year.

Source: California Air Resources Board 2002 Almanac of Emissions and Air Quality

Additional measures must be taken to continue to improve upon the air quality in California. As shown above a significant percentage of this pollution is attributable to on-road mobile sources (primarily internal combustion engine vehicles powered by gasoline). Although, vehicles are 98 percent cleaner than those sold 30 years ago, the upward trends in population and driving habits make it increasingly difficult to improve further on emission levels.⁷ The increases in vehicle miles traveled (VMT) is a product of the increasing population and driving habits. Population is expected to grow by 18 percent and VMT are expected to increase by 27 percent in the next ten years.⁸ In addition, new infrastructure is not being added to the roadway networks at the same rate that the VTM are increasing. From 1960 to 1997, the VMT in the United States tripled, while the increase in roadways only increased by 10 percent.⁹ The Texas Transportation Institute estimates that the average metropolitan area would need to add 16 more highway miles and 37 more principal arterial lane miles than they currently do each year to keep pace with the increasing VMT. The result is increased congestion, which also leads to more pollution per mile traveled.

The further reductions in emissions while VMT increases will be difficult to accomplish. The answer to reducing emissions in SIPs are Transportation Control Measures (TCMs). TCMs fall mostly into two groups: 1) reducing the number of miles driven (VMT) and 2) reducing the emission level per mile driven. The remainder of this paper will focus on the latter of these two potential SIP measures. Specifically, it will look at another of California's leading efforts in air pollution regulation, the Zero-Emission Vehicle (ZEV) Mandate.

ZEV MANDATE

In order to continue to reduce emission levels California has enacted the ZEV Mandate. According to the original mandate in 1990, the first ZEVs were to be offered for sale in 1998. The initial mandate required that two, five and 10 percent of new vehicles offered for sale in the State of California would have zero emissions in 1998, 2001 and 2003 respectively. This mandate, like many of the measures before it, was a technology forcing one. In other words, the technology to produce this number of vehicles and be competitive on the open market did not exist in 1990. According to the vehicle manufacturers zero emitting vehicles are still not capable of being marketed versus gasoline powered vehicles today either. Current ZEV manufacturing is more expensive than gasoline powered vehicles and would require manufacturers to incur significant losses if built to the volumes required by the mandate. Due to the concerns of vehicle manufacturers and ARB staff reports the mandate has gone through some revisions.

In 1996, the auto-manufacturers and the ARB signed Memoranda of Agreements (MOAs) that altered the ZEV requirements. The MOA required manufacturers to:

- Offset the emission benefits lost due to the elimination of the ZEV requirements in model years 1998 to 2002 through participation in a national low-emission vehicle program or other program that would provide equivalent air quality benefits;
- Continue ZEV research and development through the placement of advanced battery-powered ZEVs in the marketplace;
- Participate in a market-based ZEV launch by offering ZEVs to consumers in accordance with market demand; and
- Annual and biennial reporting requirements.

The number of vehicles required in 1998 was significantly reduced, only 3,750 would be required, and this requirement was spread out over 1998, 1999 and 2000.¹⁰ Furthermore, manufacturers were allowed to receive additional credit for advanced batteries, so actually only 1,800 vehicles were needed.

Changes to the original agreement have not completely altered the requirement of manufacturers to offer 10 percent of their vehicles for sale in 2003 as ZEVs. However, substantial flexibility is now available for large and intermediate volume manufacturers in meeting the ZEV Mandate for 2003. Table 1-5 below explains some of the options that the manufacturers have in meeting the ZEV requirement.

**Table 1-5 ZEV Requirements for Large, Intermediate
and Small Volume Manufacturers**

Manufacturer Size	ZEV Requirement
Large Volume Manufacturers	In 2003 and subsequent model years, a large volume manufacturer must meet at least 40% of its ZEV requirement with ZEVs, full ZEV allowance vehicles, or ZEV credits generated by such vehicles. The remainder of the large volume manufacturer's ZEV requirement may be met using partial ZEV allowance vehicles or credits generated by such vehicles. Half of the pure ZEV requirement can be met with hybrids or fuel cell vehicles.
Intermediate Volume Manufacturers	In 2003 and subsequent model years, an intermediate volume manufacturer may meet its ZEV requirement with up to 100 percent partial ZEV allowance vehicles or credits generated by such vehicles. The PZEV requirement will be phased in, with only 25 percent required in 2003, and 50, 75 and 100 percent of the previous level in 2004, 2005, and 2006 respectively.
Small Volume Manufacturers	A small volume manufacturer is not required to meet the percentage ZEV requirements. However, a small volume manufacturer may earn and market credits for the ZEVs or ZEV allowance vehicles it produces and delivers for sale in California.

Source: California Air Resources Board's California Exhaust Emission Standards and Test Procedures for 2003 and Subsequent Model Zero-Emission Vehicles, and 2001 and Subsequent Model Hybrid Electric Vehicles, in the Passenger Car, Light-duty Truck and Medium-duty Vehicle Classes

In general, manufacturers have a number of ways to meet the 2003 requirements. Manufacturers receive credits toward ZEVs by introducing vehicles prior to 2003, using advanced batteries which enable the ZEV to achieve driving ranges over 100 miles and also may introduce partial ZEVs for a portion or all of their requirement.

The following sections look at the critical areas identified by the 2000 ARB Biennial Review for ZEV implementation.

ZEV Technology

There is no technological reason why battery-powered electric vehicles can not be created. However, the battery within the ZEV still needs to improve its range, so that the vehicles can be more competitive versus the internal combustion engine powered vehicles.

At the time of the 2000 ARB Biennial Report, only the Nissan Sentra met the Partial Zero-Emission Vehicle (PZEV) standard, which includes meeting the SULEV emission level, providing a 15year/150,000 mile warranty and having zero evaporative emissions.¹¹ Manufacturers only receive partial credit for the PZEVs. So, even if the technology level is achieved, the vehicles will need to be sold in large quantities to meet the ZEV Mandate.

Fuel cell vehicles are also an option at meeting the ZEV standard, however it does not appear that they will be offered by any leading manufacturer to meet the 2003 ZEV requirements.

Battery Technology

Battery technology must improve for the battery-powered ZEVs to be competitive with internal combustion engine powered vehicles. The range of a battery-powered ZEVs is limited versus a vehicle powered by an internal combustion engine. Also, the cost of the Battery for a ZEV leads to a substantial cost difference between the ZEV and internal combustion engine vehicle.

Infrastructure Assessment

A little over half of the chargers available are conductive and the rest are inductive. Current EVs use a 220 volt battery, however the Ford City Car will use a 110 volt battery.¹² It was determined that the lack of a standard platform for recharging may hurt consumer acceptance of ZEVs. So, a standard conductive charging platform will be required beginning in 2006.

Except for a few exceptions, such as Costco, most of the current charging infrastructure is publicly funded.

Fast charging is available with the DaimlerChrysler EPIC minivan. However, fast charging stations cost more and require special battery packs to prevent overheating.

Market Assessment

There is some disagreement between vehicle manufacturers and the EV advocates on the ability to sell the electric vehicles. Manufacturers state that they do not want to take the large financial hit that will come about with the initial release of EVs. They state that they can only absorb the losses of a few EVs each year. Conversely, EV advocates state that the existing waiting lists show that there is a demand.

There will be 4,000 to 15,000 electric vehicles necessary in 2003 to meet the ZEV Mandate. This is ten times as many vehicles that are currently operating. One must wonder why the manufacturers only met the quotas specified in the 1996 MOA rather than releasing additional vehicles early and get additional credit for early release.

Market success will depend on availability of the vehicles, vehicle platforms, public education (info on the products, subsidies, station locations and how to obtain a ZEV) and making all ZEV products available to retail customers.

Cost

The battery pack is the most expensive component of an EV. A high volume of production is needed to bring down this cost. When the cost of research and development is eliminated, city ZEVs cost \$7,500 to produce and freeway capable ZEVs are as much as \$20,000. The ARB estimates that with a production level of 100,000 the ZEVs would

be competitive in the market on a lifecycle basis. However, with the current cost of a ZEV subsidies are needed to bridge the gap between the market price (price consumers are willing to pay) and the cost.

Benefits

A number of benefits will occur if significant quantities of ZEVs are produced rather than internal combustion engine powered vehicles. A substitute to the conventional internal combustion engine (ICE) is desired because of declining petroleum reserves, increasing emissions leading to air pollution, and a national desire to be less dependent on foreign countries for energy needs. A significant shift from petroleum based vehicles to ZEVs would lead to a number of benefits including improved air quality, a reduced trade deficit and increased economic, political, and military security.

Petroleum is a non-renewable resource and is quickly becoming scarce. There are approximately 40 years of petroleum left if current consumption rates continue to deplete the identified reserves.¹³ In addition, the number of vehicles is steadily increasing, which means more energy will be required to run these additional vehicles. The world vehicle population has increased from 50 million in 1950 to 500 million in 1990.¹⁴ By 2030, this is expected to increase to 1.6 billion vehicles. All these new vehicles also add to the air pollution problems. By 2030, road vehicles will contribute 6.7 billion tons of CO₂ emissions.

Also, a major concern of the United States is declining petroleum reserves. Declining reserves mean a greater dependence on foreign oil and increasing trade deficits with foreign countries. Already the majority of oil used is foreign and most is needed for the transportation sector. In 1993, 40 percent of the United States trade deficit was due to petroleum imports.¹⁵ A transfer \$48 billion dollars of wealth from the United States to oil exporting countries occurred in 1995.¹⁶

CHAPTER TWO: PROGRESS OF THE ZEV MANDATE

INTRODUCTION

Methods to decrease air pollution from motor vehicles were discussed in Chapter 1. The two primary methods are efforts to reduce demand for motor vehicle use and reductions in emissions per mile driven. As indicated in the previous chapter this paper focuses on reduction of emissions per mile driven via the Zero-Emission Vehicle (ZEV) Mandate.

The ZEV mandate was a part of the Low-Emission Vehicle and Clean Fuels Program. Initially the mandate required that two percent of vehicles in 1998, five percent in 2001 and 10 percent in 2003 of all light and medium duty vehicles offered for sale be zero emitting. However, the mandate has gone through continuous revisions. In 1996, the ARB eliminated the 1998 and 2001 requirements. Also, in 1996 the ARB entered into a MOA with the large volume auto manufacturers (DaimlerChrysler, Ford, General Motors, Nissan, Mazda, Honda and Toyota). The MOA required that the manufacturers offset the emission benefits lost due to eliminating the 1998 and 2001 requirements, continue to invest in ZEV and battery research and offer ZEVs to consumers based on market demand. In 1998, the requirements were modified to allow partial ZEV credits to be earned for extremely clean vehicles that were not pure ZEVs. In September of 2000 the ARB voted to continue the ZEV mandate but also directed their staff to propose modifications that would “assure a successful and sustainable long-term ZEV market.”¹⁷

Staff recommendations were made and considered at a January 25, 2001 ARB board meeting. The most significant developments from these recommendations were:

- Reduce, by a little more than one half in the early years, the number of pure ZEVs, needed to comply;
- Allow a further reduction of up to 50 percent in the number of ZEVs if manufacturers produce other types of very clean advanced technology vehicles;
- Phase in PZEV introduction, with 25 percent of the previously required level in 2003, and 50, 75 and 100 percent of the previous level in 2004, 2005, and 2006, respectively; and
- Gradually increase the percentage requirement of ZEVs from 10 percent in 2003 up to 16 percent in 2018.

Prior to the January 25 amendment at least four percent of all vehicles were required to be pure ZEVs. As a result of the amendment only two percent of the vehicles will be pure ZEVs, another two percent will be hybrids or fuel cell and the final six percent will be extremely clean gas and other vehicles. The number of pure ZEVs will be between 4,450 and 15,450 depending on how each individual automaker decides to bring vehicles to the market. The 4,000-15,000 vehicles are much less than the 22,000 that was required prior to January 25 and far short of the 100,000 vehicles (10 percent of all vehicles) that were envisioned when the 1990 mandate was first introduced.

The mandate has been severely scaled down due to market uncertainties. When compared to an internal combustion engine powered vehicle the ZEV is still significantly higher in

cost to produce and can not achieve equal performance. Consumer preference is also not favorable to the ZEVs because the current infrastructure is not in place.

This chapter will identify some of the positive and negative developments that have occurred since the 1990 ZEV Mandate was first passed. Furthermore, the chapter will look at the approximate requirements of the manufacturers and the products that are currently being marketed.

CURRENT STATE OF EV TECHNOLOGY

The mandate was intended to be technically forcing in nature. Although, the capability to create a competitive ZEV did not exist in 1990, the mandate was expected to provide auto-manufacturers with the incentive to push the envelope on developing the technology capable of zero emissions.

ZEV technology has advanced due to the mandate. Improvements in battery technology, vehicle range, drive trains and power control electronics have occurred. In addition, key technical decisions are being made due to the research being conducted. A regulation was adopted on May 10, 2002 that requires all vehicles produced, beginning with the 2006 model year and capable of only Level 1 charging, to be equipped with a conductive charger inlet port that meets the specifications promulgated by the Society of Automotive Engineers (SAE).¹⁸

In addition, to electric vehicle (EV) research the major auto-manufacturers have come together to form the California Fuel Cell Partnership to advance fuel cell research.

However, despite the technological improvements the performance of the ZEV is not equivalent to that of a conventional vehicle. Furthermore, the production cost of each ZEV is still much higher than that of a conventional vehicle.

ARB: PROMISING FUTURE FOR ZEVS

The ARB believes that with proper marketing and incentive programs substantial numbers of ZEVs can be sold. For example, the Ford Ranger EV experienced quick sales due to competitive pricing.

Furthermore, the current level of marketing of EVs has not reached the majority of the public. A study conducted by PG&E found that in Northern and Central California only seven percent of those within the EV target market (25-54 years old with college education) were aware of even one of several EV products. In the San Francisco Bay Area only nine percent were aware of an EV product. Therefore, it is too early to make an assessment of EV market demand. Increased marketing is needed.

The ARB has also found that there are existing markets that have not been fully tapped for their EV potential. These markets are evidenced by waiting lists among fleet operators and favorable surveys of existing EV users and potential EV buyers.

All of the 1,800 ZEVs required by the 1996 MOA were sold, leased or assigned for use by consumers or other interested parties. There has been a high degree of customer satisfaction among the current EV users. Many EV users were satisfied that they had not contributed to pollution problems such as smog, climate change and fuel spillage. In addition, EV drivers have stated that they enjoy the convenience of home charging, the

smooth and quiet acceleration, the low maintenance, vehicle reliability and low operating cost.

The Mobile Source Air Pollution Reduction Review Committee (MSRC) and Air Districts conducted an EV owners survey. The survey found that owners drive their EVs more than they thought they would prior to acquisition. In fact, 74 percent of drivers drove their EV for 75 percent or more of the time. The majority (74 percent) of EV drivers were satisfied with the range of the vehicle. Seventy-seven percent of the drivers would lease another EV.¹⁹

Honda has begun to re-market vehicles after the expiration of the original three year lease, resulting in additional zero emission miles of service. Most of these vehicles are being re-leased by the original drivers, giving evidence of high customer satisfaction.

Surveys conducted have shown a strong level of interest in EVs and hybrid vehicles. A study by J.D. Power and Associates found that as many as 60 percent of new car buyers would consider buying a gasoline-electric hybrid vehicle if one were available in the same class of car or truck that they had just purchased. In addition, 33.4 percent of those polled said that they would buy an electric vehicle as their next car purchase if one were available at close to the same price as a gasoline vehicle.²⁰ Another study entitled "The Current and Future Market for Electric Vehicles," by the non-profit Green Car Institute and The Dohring Company automotive market research firm on behalf of the California Electric Transportation Coalition (CalETC), also found a strong market for EVs. The study found that the consumer market for EVs is 12 to 18 percent of the new light-duty vehicle market in California. This equates to approximately 151,200 to 226,800 electric vehicles per year, which would be enough to satisfy even the initial 1990 mandate of 10 percent of all vehicles.²¹

Rental facilities have also been identified as a potential market for EVs. Most major California airports currently have EVs or hybrids for rent as indicated in Table 2-1 below.

Table 2-1 Electric and Hybrid Vehicles for Rent at California Airports

Airport	Honda Insight	Toyota Prius	Honda Civic GX	Ford Crown Victoria	GM EV 1	Honda EV Plus	Nissan Sentra CA
Los Angeles	X	X	X	X	X	X	X
San Diego	X	X	X	X			X
Ontario	X	X	X	X	X		X
Burbank	X	X	X	X	X	X	X
Palm Springs	X	X	X	X			X
San Francisco	X	X	X				X
Sacramento	X	X	X			X	X
San Jose	X	X					X
Oakland	X	X					X

Source: <http://www.evrental.com/reservations.html>

EVs have been successful at marketing to fleets. However, this market could support even more EV purchases. The fleet market makes up 16 percent of the annual sales of vehicles in California. Government fleet purchases are around 15,000 per year. If one-quarter of these were sold as EVs, then that would equate to approximately 3,750 vehicles. Utility fleets are also a potential EV market. ARB estimated that utility companies could absorb as many as 1,000 vehicles per year.

Over 120 fleets and several utilities have been using EVs. For example, Southern California Edison operates a fleet of 320 EVs, which has logged more than 3.5 million miles of service.²² At the time of the 2000 Biennial Review by ARB, there were at least 14 additional public fleets that desired an EV but none were available. Most of the manufacturers participating in the MOA, other than Toyota and Ford, decided not to continue producing vehicles after meeting their MOA requirements. Evidently, the MOA and multiple credits that were offered for vehicle introduction prior to 2003 were not enough to encourage additional production.

Subsequent changes to the requirements have greatly reduced the ZEV requirement for 2003, so meeting this initial requirement will not be nearly as difficult or costly to industry. In fact, if ARB assumptions are even close to being accurate the majority of the ZEV requirement can now be met through fleet sales. Meeting the ZEV requirement in subsequent years will be increasingly difficult. Therefore, introduction into the retail market will be necessary. The ARB contends that on a life-cycle basis, assuming mass production, the EVs can be competitive to consumers with conventional vehicles. However, incentive programs may be necessary to bridge the gap in the initial price of a conventional vehicle versus that of an EV.

IS THE AUTO INDUSTRY DOING ALL THEY CAN TO MARKET ZEVS?

There have been some questions as to whether or not the auto industry has done all they could to market EVs. The official statement in the ARB 2000 Biennial Report was that “staff concludes that the manufacturers made good-faith efforts to meet their MOA demonstration vehicle placement obligations. The manufacturers strategies have, after all, been successful in accomplishing their intended purpose.”

However, many people commented at ARB workshops that they have been unable to obtain EVs. This was especially true among those who previously owned General Motors EV1s and had them recalled.

Also, individuals that would like to buy EVs found difficulties due to waiting lists, inexperienced sales staff and delays in getting vehicles they ordered.

During the MOA period, only GM and Honda offered their vehicles to the general public. The other major manufacturers focused their marketing efforts on fleets. Most of the vehicles available to the general public were only for lease with low mileage caps of 10,000 miles.²³ In the Green Car Institute survey most car buyers preferred to buy their next vehicle rather than lease. In fact, 40 percent of those who wanted to buy an EV would not be willing to lease one.

None of the major manufacturers released a five passenger four-door sedan, even though these are the most popular vehicles in the market.

Many felt that the auto industry did not price EVs appropriately. Prices of EVs were not competitive with equivalent conventional vehicles. “The high initial prices of EVs fail to take into account historic precedents of subsidizing the cost of vehicles deemed important to an automakers overall marketing program or corporate positioning.”²⁴ Subsidized pricing has been the case with the hybrid models that Honda and Toyota have introduced but not the case with EVs that have been released.

The Auto Manufacturers’ Perspective

The auto manufacturers have stated that the EVs are not competitive with gasoline-powered vehicles and mass production of them will result in significant losses to their companies. There are still technical questions that must be addressed such as getting the recharge time down, providing significant charging infrastructure and reducing battery cost. In addition, there is a lack of demand for the vehicles. Since these factors are not expected to change in the near future, the auto industry would prefer that other technologies be looked at in improving air quality. The auto industry has labeled EVs a costly stopgap that will soon be obsolete when fuel cell technology is perfected.²⁵

Battery-powered electric vehicles will cost significantly more to manufacturer than gasoline powered vehicles. According to Steven Douglas of the Alliance of Automobile Manufacturers, “We’re asking people to pay more for a vehicle that provides less,” and the “vehicles have been available, but the customers haven’t.”²⁶

The auto-manufacturers more than met the MOA requirement of placing 1,800 vehicles. There have already been 4,100 pure ZEVs, battery-powered, released into the California market.²⁷ Information from the release of these vehicles has led the industry to believe that a substantial EV market does not exist.

Honda was only able to lease 122 of their EV Plus vehicles from 1997 to 1999 before stopping production. This was far fewer than originally planned.

Vehicle inventory for GM also exceeded demand for their EV1. They had a backlog of over a year's supply on hand that needed to be sold. In the first two years of EV1 production there was an average of 200 days of supply on hand 80 percent of the time. This is three times the average, 60 days worth, of supply typically on hand for a vehicle.²⁸

The manufacturers also found that sales of EVs were very labor intensive, sales staff needed extensive training, additional time was needed to educate customers, sales to initial inquiries was low and there was a lot of time and effort needed to deal with infrastructure issues. The industry found that there may be a small niche EV market but in general the market could not be profitable for EV dealers despite considerable support from manufacturers.

The manufacturers also contend that although EV users are generally happy about their vehicles these results can not be applied to the general population. The EV users represent a small segment of the population that can accept the driving limitations of an EV and afford its high cost.

A study, sponsored by Toyota and General Motors, conducted by the National Economic Research Associates found a low level of demand for EVs. The study found that for 50 percent of customers to select a RAV4 EV over the conventional RAV4 the price would need to be \$28,000 less. Since, the RAV4 is \$28,000 the study concluded that the average consumer would not accept a free RAV4 EV. Ford also found that to lease its Ranger EV it would need to set a price at less than \$200 a month. A \$200 a month lease price corresponds to a MSRP below \$10,000, which is substantially less than the \$14,000 conventional Ranger price. However, production costs to the manufacturer would be substantially higher for the EVs versus the conventional models.

Some auto-manufacturers representatives believe that the ZEV Mandate is about California's desire to lead the way on environmental regulation rather than sound technical reasoning. According to Chris Preuss, a General Motors spokesperson, "This is all about making a statement that California is the center of the universe in the environmental debate. This is the limit in terms of the pain they can inflict."²⁹

ENVIRONMENTAL BENEFITS

According to the Alliance of Automobile Manufacturers, the cost of a ZEV will be \$24,000 more than a similar gasoline-powered vehicle. The difference in price will lead to an increase in the price of all cars and lead would-be new car buyers to retain their old car for a longer period of time. The result will be worse air quality in California.³⁰

The statement above is in contrast to the ARB position that EVs will provide emissions benefits, while diversifying vehicle demand for energy resources.

The majority of electric vehicle charging is expected to occur overnight during off-peak hours. Therefore it makes efficient use of the existing utilities for energy. Due to the fact that the power is used during off-peak hours, no additional power generation or transmission systems would be needed due to EVs in the next 15 years.

Even when emissions from the power plant that creates electric vehicle power are included, the electric vehicle pollutes 90 percent fewer emissions than an internal

combustion engine. In addition, there is a 71.2 percent reduction in greenhouse gases over the life of the vehicle by using an EV instead of an internal combustion vehicle. According to a study entitled “Driving Out Pollution, The Benefits of Electric Vehicles,” the Union of Concern Scientists calculated that each EV would displace \$17,000 of air pollution control costs in the South Coast Air Basin over the life of the vehicle. In Sacramento, each EV would save approximately \$8,000 in air pollution costs.³¹

LEGAL ACTION BY GENERAL MOTORS

General Motors filed suit in Contra Costa County Superior Court alleging that the sales quota for battery-powered vehicles violates the California Environmental Quality Act and other state and federal laws. The GM website provides a number of reasons for their opposition to the ZEV Mandate:

- The goal of real air quality improvement will be best met by something better than a mandate: fewer emissions from all vehicles on the road and continued market-driven development of advanced vehicles.
- California’s air is the cleanest it has been in years—and continues to get cleaner. The ZEV mandate will have no significant impact on the continuing trend of cleaner air in California; replacing older vehicles with today’s clean vehicles, which are currently 99 percent cleaner than uncontrolled vehicles from the 1960s, will.
- Further air quality improvements will be made as diverse technologies, such as hybrids and fuel cells, enter the marketplace. A mandate focused on a single technology would preclude development of these and other technologies.
- Consumer acceptance will determine which products succeed in the marketplace. In spite of substantial marketing efforts, very few EVs have been sold in California to date. What’s more, these sales have not resulted in breakthroughs in battery technology, have not stimulated infrastructure development, nor generated sustainable retail and commercial fleet sales.
- California’s ZEV Mandate will be 100 times more expensive than any other emissions controls adopted by the Air Resource Board and there’s no evidence to suggest that the public is willing to pay the hundreds of millions of dollars a year extra imposed by the mandate.³²

GM also stated that the ARB did not take into consideration safety impacts resulting from the release of thousands of low-speed neighborhood electric vehicles that can not travel faster than 35 mph.

GM felt that the mandate places an undue economic burden on their company. In addition, the mandate also effects the sales of vehicles in New York, Massachusetts and Vermont because each of these states automatically adopt California emission standards. Even though New York and Massachusetts voted to delay implementation in their states until 2007, the future impact to GM could be substantial. The four states make up 18 percent of the U.S. auto market.³³

In response to the allegations, Jerry Martin, chief spokesman for the ARB, stated that the speed that the lawsuit was filed “shows that they were planning on suing all along.”³⁴

MANUFACTURER STATUS

Requirements for ZEVs apply differently to large, intermediate and small volume manufacturers. Large volume manufacturers are those that sell more than 60,000 light and medium duty vehicles per year. Included in this group are DaimlerChrysler, Ford, General Motors, Honda, Nissan and Toyota. Beginning in 2003 large volume manufacturers must sell at least 10 percent of their passenger cars and light duty trucks below 3,750 pounds gross vehicle weight produced and delivered for sale in California as ZEVs.

Large volume manufacturers must meet at least 40 percent of their ZEV requirement with pure ZEVs. Pure ZEVs include City EVs, “full function” electric vehicles, neighborhood electric vehicles (NEVs) and hydrogen fuel cell vehicles. In addition, up to half of the pure ZEV requirement may be met with Advanced Technology Partial Zero-Emission Vehicles (AT-PZEVs). Types of AT-PZEVs include hybrid-electric, natural gas and methanol fuel cell vehicles that meet the SULEV tailpipe emissions, have zero evaporative emissions and include a 150,000 mile warranty on emission control equipment.

Large volume manufacturers may, at their option, meet the remaining 60 percent of their ZEV requirement with partial allowance vehicles or credits generated by such vehicles. In 2003 only 25 percent of the PZEV requirement must be met, followed by 50 percent in 2004 and 75 percent in 2005. Beginning in 2006, 100 percent of the PZEV requirement must be met if this option is chosen.³⁵

Intermediate volume manufacturers are those that sell between 4,501 and 35,000 light and medium duty vehicles per year. The intermediate vehicle classification includes BMW, Subaru, Hyundai, Isuzu, Jaguar, Kia, Mazda, Mitsubishi, Rover, Volkswagen and Volvo. Intermediate volume manufacturers may meet their entire ZEV requirement with partial allowance vehicles or credits generated by such vehicles.

Isuzu and rover produce medium-duty vehicles only, and therefore will not be required to meet the Zero-Emission mandate.

Small volume manufacturers are those selling 4,500 vehicles or less per year. The small vehicle classification includes Daewoo, Ferrari, GFI, Lamborghini, Lotus, Porsche, Rolls Royce, Saab and Suzuki. Small volume manufacturers are not required to meet the 10 percent requirement. However, they may produce ZEVs and market the credits that they earn.

The large manufacturers sell approximately 1 million vehicles (light-duty cars and trucks) per year. The initial ZEV mandate required approximately 100,000 vehicles. Each percentage point would be equivalent to approximately 10,000 vehicles. Subsequent changes have reduced the number of ZEVs that will be required to between 4,650 and 15,450.

Table 2-2 below indicates the light-duty and medium-duty production levels of each of the major vehicle manufacturers in California. Table 2-3 indicates the projected number of vehicles that all major manufacturers combined would need to produce in 2003. The numbers below provide a range of possible production levels, however the actual number of EVs introduced will depend on the production strategy of each manufacturer. Table 2

4 assumes that each manufacturer elects to produce full function EVs rather than NEVs or city EVs and that the producers elect to produce the maximum AT-PZEVs allowable. Under this scenario there would be 4,650 EVs on the market in 2003. The share of the overall market, as represented in Table 2-2, was then multiplied by the total number of EVs (4,650) to calculate a projected minimum number of EVs for each manufacturer in 2003.

Table 2-2 Production Levels of Major Manufacturers

Manufacturer	1998 Production	% of Total
GM	210,265	21.8%
Toyota	201,473	20.9%
Ford	186,977	19.4%
Honda	172,768	17.9%
Nissan	88,455	9.2%
DaimlerChrysler	105,691	10.9%
TOTAL	965,630	100%

Source: California Air Resources Board's 2000 Zero-Emission Vehicle Program Biennial Review

Table 2-3 Estimated Number of Vehicles in 2003

		New Regulation without AT Option	New Regulation with AT Option
ZEVs	If 100% full function EVs	9,300	4,650
	If 100% City EV	23,500	11,750
	If 100% NEV	30,900	15,450
PZEVs		94,500	94,500
AT PZEVs			10,700

Source: California Air Resources Board's Zero-Emission Vehicle Program Changes

Table 2-4 Estimated Number of Vehicles in 2003 per Manufacturer

Manufacturer	% of Total	Minimum Number of Pure ZEV
GM	21.8%	1,013
Toyota	20.9%	970
Ford	19.4%	900
Honda	17.9%	832
Nissan	9.2%	426
DaimlerChrysler	10.9%	509
TOTAL	100%	4,650

The auto-manufacturers are all expected to comply with the mandate. This is despite the fact that the fine for non-compliance, \$5,000 per ZEV not produced, may be less than their loss per vehicle. Non-compliance would likely lead to public relations problems and possibly difficulty from stockholders.³⁶

Several of the manufacturers are producing low cost city and neighborhood EVs to meet their requirement. DaimlerChrysler has introduced the GEM, which costs only \$6,000 to \$7,000 to build. Even if the GEMs are not sold, DaimlerChrysler will not lose much more than they would have by not complying with the mandate, while avoiding the public relations fallout.³⁷

Fleets also continue to be an attractive early market for placement of EVs. Ford is shipping 480 postal trucks based on the Ranger EV platform to help meet its ZEV requirement.

Full commercialization of the battery-powered EVs will be dependent upon regulatory stability and competition from other technologies capable of equivalent emissions benefits. If regulatory factors remain stable, then full commercialization of EVs could occur as early as 2010. However, if superior performance can be achieved at a lower cost, then fuel cells or other technologies may replace EVs.

VEHICLE COMPARISONS

Currently, there are only three fully functional EVs available, the Nissan Altra EV, the Ford Ranger EV and the Toyota RAV4 EV. The Altra EV is only available to fleets, while the RAV4 and Ranger are available to the public and fleets. In addition there is one City EV, the Ford Th!nk City EV. Neighborhood Electric Vehicles include the DaimlerChrysler GEM and the Ford Th!nk Neighbor. Other small companies are also marketing neighborhood EVs.

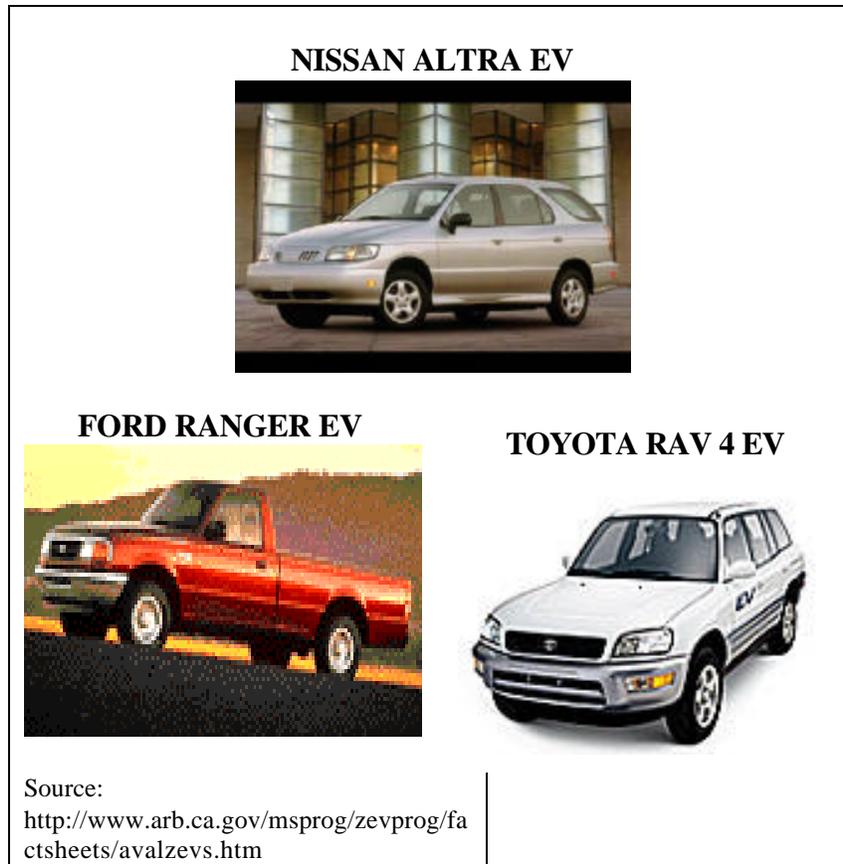


Figure 2-1 Electric Vehicles Available in California

Table 2-5 compares the EVs currently on the market with their conventional vehicle equivalents. Information not readily available via the ZEV website was obtained from local car dealers. Therefore, prices may vary depending on location. The RAV4 price is the Manufacturers Suggested Retail Price of a manual transmission front wheel drive vehicle. The local dealer quoted a price of \$21,000 to \$22,000 over the phone for the RAV4 manual transmission front wheel drive vehicle and stated that the RAV4 EV would be approximately \$43,000. The Ford Ranger price below was quoted from a dealer assuming the base front-wheel drive 5-speed manual transmission model.

Table 2-5 Comparison of EVs and Comparable Conventional Vehicles

Vehicle	Price (\$)	Range (miles)	Top Speed	Recharge/ Refuel Time
RAV4 EV	42,500	80-100	78	6.5 hours
RAV4	17,035	Over 300	NA	Minutes
Altra EV	NA	80	75	NA
Ranger EV	214/ month lease	40-50	75	6 hours
Ranger	200/ month lease	Over 300	NA	Minutes

Source: <http://www.arb.ca.gov/msprog/zevprog/factsheets/avalzevs.htm>

The EV purchase price could be reduced by as much as \$12,000 if the owner applies for grants from the state and federal governments. Local grants may also apply. There is a total of \$18 million available in state grants, as a result of Assembly Bill 2061, which could be applied to up to 2,000 vehicles prior to 2003. Additional funds are expected to be allocated by the governor for grants in future years.

An additional fee for home installation of the battery charger is not included in the price of the EV. Installation of charging device also requires an initial site inspection, contractor inspection and local agency inspection to ensure safety and code compliance.

Although some enjoy the convenience of home recharging, the lack of a recharging infrastructure detracts potential buyers away from purchasing the EVs. There are three levels of charging for EVs. Levels 1 and 2 both take several hours. A Level 3 charge is done in a matter of minutes but is not available with any of the models available to the public at this time. Beginning in 2006, all vehicles capable of only level 1 charging must be equipped with a conductive charger inlet port that meets the specifications promulgated by the Society of Automotive Engineers (SAE). Prior to this regulation there were multiple inductive and conductive charging platforms that were being utilized, which further limited the number of locations that could charge a particular vehicle.

The total number of charging stations is very limited. On their website Toyota estimates that there are 100 public charging locations.³⁸ The California Electric Transportation Coalition estimates a higher number of locations (3,291). However many of these are for fleets, are inductive rather than conductive or are located at personal residences.³⁹ Table 2-6 provides the California Electric Transportation Coalition estimates of electric rechargers in California by charging station type.

Table 2-6 Electric Vehicle Recharging Infrastructure in California

Charger/Station Type	Inductive	Conductive	Total
Public Access Charging Locations	617	378	995
Public and Private Fleet and Business Chargers	710	860	1570
Residential Chargers	600	126	726
Total Chargers	1927	1364	3291

Source: California Electric Transportation Coalition, in consultation with Clean Fuel Connection Inc., and the Sacramento Municipal Utility District, Electric Transportation Infrastructure

Another limitation is that there are few charging locations outside of the Bay Area, Sacramento, Los Angeles and San Diego. Therefore, long trips may not be possible in an EV at this time.

On the positive side, as of July 1, 2000, electric vehicles that have secured the appropriate permit sticker from the California Department of Motor Vehicles to travel in High Occupancy Vehicle lanes regardless of the number of occupants. An additional benefit of electric vehicle ownership is that when a public charging station can be utilized, there is no charge to the user to recharge.

CHAPTER 3: FUTURE OF THE ZEV MANDATE

The Zero-Emission Vehicle (ZEV) Mandate was aimed at forcing manufacturers to develop a technology that could further reduce the emissions of automobiles. However, despite gains in the technology, the auto industry still can not deliver a zero emitting vehicle that is competitive with the conventional vehicles in use. As a result, the ZEV Mandate has continued to be scaled back in scope and pushed back in time. Currently, the lawsuit by General Motors has led to an injunction on the ZEV mandate due to wording by the Air Resources Board (ARB) that had to do with fuel efficiency. The Air Resources Board, as a state agency, is not allowed to regulate fuel efficiency. The United States government regulates fuel efficiency pursuant to the Clean Air Act.

As a result of the reduced scope of the ZEV mandate less ZEVs will be available for sale in the next few years. However, the mandate still requires increasing numbers of ZEVs over the next twenty years.

Despite the fact that ZEVs are still mandated in future years it is still unclear whether vehicles will actually be produced at these levels. As long as the auto industry can demonstrate that the mandate will lead to an uncompetitive product and significant financial losses the ZEV Mandate will continually be at risk of further scale downs and push backs. In addition, manufacturers are unlikely to produce more zero-emitting vehicles than what is required by law.

With the current injunction on the ZEV mandate manufacturers are pulling out of some of their current electric vehicle ventures. In late August 2002 Ford announced plans to stop selling electric vehicles in the United States. Think City electric cars were being produced at a plant in Norway. Ford had asked the Norwegian government to purchase a number of vehicles and set aside money for the plant. The Norwegians declined and now it appears that the plant will be closed altogether.

While Ford is pulling the plug on the Think City, DaimlerChrysler is practically giving away Global Electric Motors (GEMs). GEMs are currently being sold for between \$6995 and \$8995.⁴⁰ GM currently does not have a ZEV on the market.

How the ZEV mandate will be scaled down and pushed back will be dependent on the ARBs willingness to continue to review the mandate. According to the ARB, biennial reviews have been discontinued due to the controversy that they brought about rather cooperation between EV advocates and the automobile industry. The biennial reviews became an exercise of the industry making a case for how the ZEV mandate could not be met versus EV advocates presenting evidence in support of the demand for the vehicles. Past reviews were done with a large degree of public and industry input regarding the status of the electric vehicles and its readiness to be marketed at the rates prescribed by the mandate. Each biennial review resulted in a reduction in the requirements of the mandate by the ARB. Although, the biennial reviews have been discontinued the ARB will continue to review the mandate internally. If ARB takes a firmer stance with the ZEV mandate, then the auto industry may continue to look to the courts for relief.

As is evidenced above, there is no clear future for the ZEV mandate. There are only potential scenarios that may occur. These scenarios run the full spectrum from complete repeal of the mandate to a continuance of the current policies that would lead to a situation where between 10 and 20 percent of vehicles are ZEVs 20 years from now.

SCENARIOS

The following scenarios are based upon potential outcomes for the ZEV mandate. The scenarios do not represent a full range of potential outcomes but give a general idea of what may occur based on the information gathered during this research project.

ZEV Mandate is Unchanged

The first potential scenario is that ARB will not significantly alter the ZEV mandate. Under this scenario, ZEVs are produced by manufacturers at levels in Table 3-1 below.

Table 3-1 ZEVs Required in Future Model Years

Model Years	Minimum ZEV Requirement
2003 through 2008	10 percent
2009 through 2011	11 percent
2012 through 2014	12 percent
2015 through 2017	14 percent
2018 through subsequent	16 percent

Source: California Air Resources Board's Zero-Emission Vehicle Program Changes

As the table indicates, manufacturers would be responsible for producing an increasing number of ZEVs with time. By 2018, 16 percent of the new vehicles in the fleet would need to be zero-emitting. In addition, the mandate will not be as easy to meet in future years. Currently, Neighborhood Electric Vehicles (NEVs), vehicles with limited range and speed, can receive four credits. By 2006, no credits could be earned for an NEV. Also starting in 2007, sport utility vehicles, pickup trucks and vans would be added to the sales figures used to calculate the ZEV requirement of each automaker. Using current sales volumes, by adding in sport utility vehicles, pickup trucks and vans the total number of vehicles subject to the ZEV requirement would increase from 1 million to 1.7 million. Furthermore, the number of vehicles that are needed to meet the PZEV requirement will increase from 25 percent now to 100 percent in 2006.⁴¹

If the ZEV mandate is unchanged, then it is likely that sales of the vehicles would reach or exceed the numbers specified above. The logic being that the ARB would be compelled to scale back the mandate if substantial numbers of ZEVs went unsold.

Substantial numbers of unsold ZEVs would result in less air quality benefits and substantial financial losses to the auto-manufacturers. So, an unchanged ZEV mandate depends in part on the auto-manufacturers ability to sell the vehicles for profit over the long term.

For substantial ZEV sales to occur, the projections by the Green Car Institute Study would need to be accurate. As stated in Chapter 2, the study found an EV market that could be as large as 12-18 percent of the total vehicle market, if offered for a price similar to conventional vehicles.

Even with mass production, the initial vehicle price for ZEVs will be higher than for conventional vehicles. However, government incentive programs could bring the purchase price within a competitive range compared to conventional vehicles. Current government programs would need to be expanded to allow provide rebates for up to 16 percent of the market.

The ZEV Mandate Continues But is Delayed

This scenario is likely if the auto-manufacturers can continue to show the ARB that they will suffer large financial losses in the near term due to implementation of the ZEV mandate. The ARB may still continue to require a small number of ZEVs be produced to ramp up for future years.

Electric Vehicles and other ZEVs, such as fuel cells, may not be competitive in the near future. However, as fuel prices increase with the anticipated reduction in oil supplies the demand for alternative fuel vehicles will increase. Potential breakthroughs in EV and fuel cell technology also may significantly reduce the price for these technologies making them more competitive in the future.

A delayed ZEV mandate may benefit fuel cell vehicles more than EVs. Fuel cells have a number of benefits versus both electric and conventional vehicles. A Fuel cell vehicle has equivalent driving range and refueling time to that of a conventional vehicle. In addition, it has superior environmental benefits because a hydrogen powered fuel cell vehicle emits only water vapor. Even EVs produce some emissions from the generation of energy to run the batteries. Furthermore, fuel cell vehicles have the highest fuel efficiency and economy of any vehicle propulsion system. So, a delay in implementation may allow time for the production costs of fuel cell vehicles to be reduced enough to make them a more competitive option than EVs.⁴²

The ZEV Mandate Continues But is Substantially Altered

Another potential scenario would occur if due to legal action or through policy changes by the ARB the ZEV mandate becomes substantially altered. This scenario would be likely in the event that the industry is unable to sell vehicles at the levels required by the mandate. In this situation the mandate, would be altered in scope by allowing fewer pure ZEVs. The ZEV requirement could be reduced by allowing more credits for other clean fuel vehicles, increasing credits for vehicle performance or altering the number of vehicles used to determine production volumes (i.e. in 2007 do not count sport utility vehicles, pickup trucks and vans toward the total number of vehicles subject to the ZEV requirement).

If this scenario becomes a reality, then it is expected that the number of ZEVs produced per year would be relatively small. The ZEVs produced would mainly cater to fleets and a small niche market. Although credits for city and neighborhood EVs are expected to be phased out by 2006, changes to the regulations may allow manufacturers to meet most or all of their quotas with these vehicle types.

As with the delayed ZEV mandate scenario above, EVs under this scenario would never be produced in large quantities. Therefore, the EV production cost would remain high. Fuel cell vehicles may become the vehicle of choice in later years of the mandate.

The ZEV Mandate is Repealed

A complete repeal of the ZEV mandate does not appear likely at this time. However, as the political climate and players change the Mandate may be in jeopardy. If the State and ARB determine that the benefits of the program do not warrant the cost of implementation to the State and manufacturers, then a phasing out or complete repeal of the mandate could occur.

If the ZEV mandate was repealed, then EVs would likely be produced by a few companies but the majority would discontinue their EV programs.

From speaking with ARB staff and from the history of how ARB has dealt with the mandate in the past, it does not appear that a complete repeal of the mandate is under serious consideration. ARB has delayed and reduced the scope of the mandate in the past but they have also always taken measures to strengthen it for future years. The ARB appears committed to the mandate as a long term strategy for reducing vehicle emissions.

STAKEHOLDERS

Attempts to contact the Alliance of Automobile Manufacturers, Western States Petroleum Association, ARB, California Energy Commission, Ford, DaimlerChrysler, General Motors, Honda, Nissan, Toyota and Electric Vehicle Association of the Americas were made to determine their viewpoints and future plans as they relate to the ZEV Mandate. The majority of these efforts were unsuccessful at gaining information that was not already included in ARB reports or available in articles related to the ZEV Mandate.

Appendix B does include the results of questions posed to the Electric Vehicle Association of the Americas (EVAA) and to the Alliance of Automobile Manufacturers. In general, the EVAA responses were supportive of any incentive program that would increase consumer demand for electric vehicles. Once demand was sufficiently increased, then with mass production the EVAA believes that electric vehicles will be able to compete effectively with conventional vehicles. The Automobile Association responses are consistent with quoted statements earlier in this report from the automotive industry. The Automobile Association feels that the ZEV Mandate does not provide any benefits whatsoever and “does so at an extraordinary cost.”

Based on the research conducted the views of the major stakeholders of the ZEV Mandate are expressed in general below:

Automobile manufacturers

The automobile manufacturers have goals of long-term and short-term market share and profitability for their corporations. Achieving these goals is, in part, dependent on meeting legal requirements and keeping a positive public image. In addition, the people that work for these corporations also must live in the same environment as everyone and therefore have a stake in cleaner vehicles. However, the position of the major manufacturers is that ZEVs are not currently viable products. In addition, if ZEVs are produced at the levels prescribed by the ZEV Mandate, then many vehicles may go

unsold. Therefore, the vehicles will not substantially improve the environment and other measures to reduce emissions should be looked at. Also, since the vehicles will go unsold or will be sold for a loss, the manufacturers feel that an undue financial hardship will be placed on their corporations in order to meet the ZEV Mandate.

Automobile Dealers

Auto-dealers also have little incentive to push for ZEVs. ZEVs require additional training of staff and are also more difficult to sell thereby taking up space on their lots.

Environmental Groups and EV Advocates

These groups are supporters of incentives for electric vehicles. In general, they would like to see that the policies like the ZEV mandate continue to be in effect and that the industry be required to support the vehicles that they have already produced. These groups also support anything that the government can do not erase the barriers to full implementation of ZEVs. Potential barriers include technological, infrastructure and the need to achieve mass production to achieve reduced production prices. These groups would like to see continued and increased financial and regulatory support for the ZEV Mandate.

Government

There are many levels of government involved with the ZEV mandate.

The ARB implements and evaluates the effectiveness of the ZEV mandate as a part of the overall goal of improved air quality. An ultimate goal of the ARB would be zero emissions of pollutants attributable to all sources both stationary and mobile. The mandate is a step in this direction, in that it requires elimination of emissions from a percentage of vehicles. Automobile manufacturers have not been able to create a competitive ZEV, so the ARB has continued to relax the requirement and allow increased numbers of other low-emission vehicles to achieve the desired short-term goal of reduced emissions. However, in keeping with their overall goal of long-term goal of no emissions of pollutants, the ARB has continued to require that a significant number of vehicles be zero-emitting in future years.

In addition to the ARB, the Energy Commission supports the mandate because it promotes uses of alternatives to vehicles powered by petroleum a finite resource, which must be imported at an increasing rate as U.S. supplies decrease.

The mandate is subject to legal challenges in the courts. The courts are involved with the mandate due to legal challenges that have been filed. Decisions by the courts on these challenges will determine ARBs ability to enforce the mandate. Without the backing of the courts the mandate loses its power and will not be able to create the change in technology desired by the ARB.

Local governments, federal agencies and the state legislature all have created grants for those who purchase the vehicles required by the mandate. The continued support by all levels of government is necessary for the ZEV mandate to be effective.

Petroleum Industry

The ARB, in its reports, does not analyze the impact to the oil industry that would occur if the ZEV mandate were fully implemented. However, it is apparent that full implementation of the ZEV mandate would have a substantial impact on the corporations associated with the petroleum industry. Full implementation of the ZEV mandate would lead to a situation where as many as 10 to 20 percent of vehicles were battery-powered. While, the industry can switch to other fuels such as methanol, ethanol and hydrogen at their service stations, battery-powered vehicles are not conducive to recharging at such locations. Therefore, the petroleum industry is likely to push for technologies that allow for vehicle refueling rather than battery-powered vehicle technologies.

CONCLUSION

Due to the opposing perspectives of the various stakeholders on the necessity of the ZEV Mandate, there are a multitude of potential scenarios.

Success of the mandate will be dependent upon government support for programs to reduce the price paid by the consumer for ZEVs, the ARB sticking to its requirements and the courts upholding them. Effectively dealing with the concerns of the various stakeholders also will ensure long-term success of the mandate. ARB must look at all stakeholders, not just the auto industry. One concern brought up the 2000 Biennial Review was the lack of desire by dealers to sell the EVs. Although according to the ARB incentives for dealers have been looked at it, it was not apparent in the biennial review. Also, the petroleum industry and individual service stations and the effect on them did not appear to be a major consideration of the ARB. Service stations could be utilized as part of the solution to electric vehicle infrastructure. By emphasizing EVs capable of fast charging and placing these fast-chargers at service stations these businesses could be part of the solution and maintain their profitability. In addition consumers would have increased awareness of EVs and comfort with potential EV purchases, if charging stations were available at the gas station that they frequently visit.

Although the overall goal of zero emissions is the long-term goal, ARB must continue to be flexible enough to ensure that the short-term goal of reduced emissions each year is met.

The overall goal must be viewed against other alternatives. Since a large government expenditure is likely needed for the ZEV program to be effective, it should be viewed in comparison with other potential strategies at meeting our short-term and long-term emissions reductions goals, as well as our needs to diversify our energy resources.

APPENDIX A: POLLUTANT SOURCES

Sources of Pollutants (tons per day, annual average)

Major Category	TOG	ROG	CO	NO _x	SO _x	PM ₁₀
Stationary Sources	2568	588	362	587	137	139
Fuel Combustion	203	43	304	478	53	42
Waste Disposal	1422	22	3	3	0	1
Cleaning And Surface Coatings	401	285	0	0	0	0
Petroleum Production And Marketing	458	168	9	14	55	3
Industrial Processes	85	69	45	92	28	94
Area-Wide Sources	2032	749	2309	96	5	2076
Solvent Evaporation	561	504	0	0	0	0
Miscellaneous Processes	1471	244	2309	96	5	2076
Mobile Sources	1816	1672	14394	2741	161	123
On-Road Motor Vehicles	1296	1197	11636	1767	12	53
Other Mobile Sources	519	474	2759	974	149	70
Natural Sources*	106	38	409	18	0	80
Total California	6522	3046	17474	3441	302	2418

Detail of Pollutant Sources from Mobile Sources (tons per day, annual average)

Major Category	TOG	ROG	CO	NO _x	SO _x	PM ₁₀
Stationary Sources	2568	588	362	587	137	139
Mobile Sources (division total)	1816	1672	14394	2741	161	123
On-Road Motor Vehicles (major category total)	1296	1197	11636	1767	12	53
Light Duty Passenger (sub-category total)	682	632	5733	528	3	18
- Non-Evaporative	409	359	5731	524	3	17
- Evaporative	272	272	0	0	0	0
- Diesel	1	1	2	4	0	1
Light Duty Trucks(<3750 lbs.) (sub-category total)	152	141	1593	139	1	3
- Non-Evaporative	94	83	1592	138	1	3
- Evaporative	58	58	0	0	0	0
- Diesel	0	0	0	1	0	0
Light Duty Trucks (>3750 lbs.) (sub-category total)	144	132	1519	217	1	10
- Non-Evaporative	95	83	1518	216	1	10
- Evaporative	49	49	0	0	0	0
- Diesel	0	0	1	1	0	0
Medium Duty Trucks (sub-category total)	119	109	1320	139	1	4
- Non-Evaporative	85	75	1317	132	1	4

Major Category	TOG	ROG	CO	NOx	SOx	PM10
Medium Duty Trucks (sub-category total continued)						
- Evaporative	33	33	0	0	0	0
- Diesel	1	1	3	7	0	0
Light Heavy Duty Gas Trucks (<10000 lbs.) (sub-category total)	78	72	509	33	0	0
- Non-Evaporative	48	42	509	33	0	0
- Evaporative	30	30	0	0	0	0
Light Heavy Duty Gas Trucks (>10000 lbs.) (sub-category total)	7	6	56	7	0	0
- Non-Evaporative	4	4	56	7	0	0
- Evaporative	2	2	0	0	0	0
Medium Heavy Duty Gas Trucks (sub-category total)	42	40	335	27	0	0
- Non-Evaporative	30	27	335	27	0	0
- Evaporative	12	12	0	0	0	0
Heavy Heavy-Duty Gas Trucks (sub-category total)	16	14	234	13	0	0
- Non-Evaporative	13	11	234	13	0	0
- Evaporative	3	3	0	0	0	0
Light Heavy Duty Gas Trucks (<10000 lbs.)	1	1	2	10	0	0
Light Heavy Duty Gas Trucks (>10000 lbs.)	1	1	3	13	0	0
Medium Heavy Duty Diesel Trucks	4	4	25	143	1	4
Heavy Heavy-Duty Diesel Trucks	23	20	90	448	4	12
Motorcycles (Mcy) (sub-category total)	20	19	126	3	0	0
- Non-Evaporative	12	11	126	3	0	0
- Evaporative	8	8	0	0	0	0
Heavy Duty Diesel Urban Buses	2	1	6	31	0	1
Heavy Duty Gas Urban Buses (sub-category total)	2	2	23	3	0	0
- Non-Evaporative	2	2	23	3	0	0
- Evaporative	0	0	0	0	0	0
School Buses (sub-category total)	1	1	12	5	0	0
- Non-Evaporative	1	1	11	1	0	0
- Evaporative	0	0	0	0	0	0
- Diesel	0	0	1	4	0	0
Motor Homes (sub-category total)	2	2	51	8	0	0
- Non-Evaporative	2	2	51	6	0	0
- Evaporative	0	0	0	0	0	0
- Diesel	0	0	0	2	0	0

2002 Almanac (page 49) Table 2-1 2001 Statewide Emission Inventory Summary

Appendix B: Interview Questions and Answers

The following questions were provided to Steve Douglas of the Alliance of Automobile Manufacturers and to the Electric Vehicle Association of the Americas (EVAA). Responses by Mr. Douglas and the EVAA are provided below in bold. The EVAA responses follow those provided by Mr. Douglas.

1. We should focus on meeting goals of reduced emissions for all vehicles rather than mandating that a specific number of vehicles be zero emitting.

Douglas: Strongly Agree

EVAA: EVAA does not support mandates; rather, we encourage government — at all levels—to enact policies and programs that can encourage and assist industry in the development and deployment of clean, efficient and consumer-attractive electric drive technologies.

The EVAA was asked that because they do not support mandates in general, then do they not support the ZEV Mandate as well? Their response was:

A much better way to state the position of EVAA is: EVAA takes NO POSITION on mandates. We have never stated public opposition, or support for the CA ZEV or for any other state or federal mandates. Rather, we advocate the enactment of government policies and programs that help to advance the technology through collaboration with industry and through the provision of incentives. Our members believe that favorable government policies are the best means of assisting industry in the establishment of widespread and sustainable markets for electric drive technologies.

2. Electric Vehicles, priced at levels relative to their cost to produce, will not be competitive with conventional vehicles.

Douglas: Strongly Agree

EVAA: The initial prices for electric drive technologies will be high due to both low volumes and immature technology. EVAA supports government purchase incentives, targeted to consumers for a limited period of time to allow the technologies to mature, volume production to become established, and consumers to become aware of the advantages of the technologies. Without such support, these important new technologies will have trouble establishing market share against conventional technologies that have 100+ years of refinement; massive volumes and an established infrastructure.

3. Government incentive programs are currently inadequate at bridging the price difference between electric and conventional vehicles, which would allow the electric vehicles to be competitive at the levels necessary to meet the ZEV Mandate in California.

Douglas: Strongly Agree

EVAA: A combination of incentives made available at the federal, state and local levels can be sufficient to attract consumers in some instances. An example would be the AQMD rebates, coupled with State of California monies, coupled with federal income tax incentives that allowed for the purchase and/or lease of all full-function electric vehicles that were provided to that market by Ford, General Motors, Honda and Toyota through 2001. In addition, the price of available hybrid electric vehicles does not appear to have dampened consumer acceptance of these vehicles, particularly as a federal government income tax deduction of \$2,000.00 is available to purchasers. And, I would note that non-financial incentives, such as access to HOV lanes for single occupant drivers of HEVs has served as a very good purchase incentive as well.

4. Significant losses to the manufacturer would occur if electric vehicles were priced at levels equivalent to conventional vehicles.

Douglas: Strongly Agree

EVAA: This has been addressed/discussed above. I would note that Toyota has stated publicly that it DOES NOT lose money on the sales of its hybrid electric PRIUS.

5. A significant segment of the population is willing to pay a premium for the life-cycle and environmental benefits that they would enjoy with the purchase of a ZEV.

Douglas: Strongly Disagree

EVAA: There are many studies that dispute this claim. While consumers are interested in products that have environmental and/or another societal benefits, the price that they are willing to pay for such products does not have a lot of elasticity. In most instances, a consumer must see personal value in the purchase of a vehicle, i.e. significant fuel/operation savings; higher performance; etc. in order to make the decision to buy.

6. Manufacturers will need to take a loss in the early years of the ZEV Mandate, however as mass production occurs, combined with the continuance of the current government incentive programs to help bridge initial price gap, a profit can be made on the sale of ZEVs.

Douglas: Strongly Disagree

EVAA: As stated above, EVAA believes that government incentives are necessary during the initial, early years of electric drive entry into the market place. Eventually, such subsidies should become unnecessary as volume production is established and the technologies are matured. However, as also stated above, EVAA does not believe that the imposition of mandates isn't the way to initiate products in the market.

7. The Air Resources Board will need to reduce its requirement for ZEVs for future years or manufacturers will incur significant losses.

Douglas: Strongly Agree

EVAA: EVAA has no comment beyond what has been made in response to the questions above.

8. If the Air Resources Board does not reduce the ZEV Mandate, then future legal action by the manufacturers is likely.

Douglas: Unknown

EVAA: EVAA has no information on manufacturers plans with respect to court proceedings related to the CARB mandates.

9. Do you feel that the ZEV Mandate will be repealed, scaled back or kept as is in the upcoming years? Why?

Douglas: Unknown. It should be eliminated since it provides no benefits and diverts resources from areas that might provide benefits.

EVAA: The Chairman of the ARB, Alan Lloyd, has announced publicly that the Board will consider further revisions to the ZEV Mandates beginning in January of 2003.

10. How effective will it be at meeting Air Quality Goals?

Douglas: The ZEV Mandate provides no benefit (none, nada, zilch) but does so at an extraordinary cost!

EVAA: EVAA has no comment.

ENDNOTES

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