ARB STAFF RESPONSE TO COMMENTS RAISING SIGNIFICANT ENVIRONMENTAL ISSUES REGARDING THE 2003 ZEV AMENDMENTS

December 19, 2003

Emissions Impact of Reducing the Number of ZEVs Required in the Earlier Years

1. Comment: A number of commenters asserted that the staff's proposed amendments will impair air quality due to reductions in the number of "gold" category zero-emission vehicles (ZEVs) required in the early years of the program.

For instance, the Mayor of Sacramento stated that "Proposed changes to the regulations that reduces the obligation of automakers to produce ZEVs, or changes allowing automakers to use early introduction credits to meet the proposed reduced requirements, is unhealthy and unsafe for California residents." Communities for a Better Environment and the City of Santa Monica stated that without an aggressive ZEV program, many California communities simply cannot and will not achieve health-based federal clean air standards, and that for the Air Resources Board (ARB) to roll back the ZEV program could be catastrophic for the health of many California citizens. The Building Industry Association of the San Joaquin Valley stated that the San Joaquin Valley was facing draconian federal sanctions because it cannot meet federal clean air standards, and "a relaxation of zero-emission vehicle requirements . . . could be disastrous for the San Joaquin Valley."

Agency Response: In the March 5, 2003 Supplemental Staff Report, staff estimated the 2010 and 2020 emissions impact in the South Coast Air Basin of the March 5, 2003 modified staff proposal, as compared to the current regulation and the "no-ZEV program" alternative. These estimates for reactive organic gases (ROG), oxides of nitrogen (NOx) and carbon monoxide (CO) are as follows:

Table 1

Summertime Direct Emissions, South Coast Air Basin in 2010 (Tons per day)

	ROG	NOx	CO
2001 Amendments	155.15	143.28	1571.28
Proposed January 2003 Amendments	155.14	143.26	1571.23
Proposed March 2003 Amendments	155.12	143.22	1571.05
No ZEV Program	155.50	144.24	1574.80

Table 2

Summertime Direct Emissions, South Coast Air Basin in 2020
(Tons per day)

	ROG	NOx	CO
2001 Amendments	87.62	65.75	791.04
Proposed January 2003 Amendments	87.81	65.74	791.07
Proposed March 2003 Amendments	87.58	65.58	787.50
No ZEV Program	90.86	67.81	807.38

These emissions reductions are attributable to the increased numbers of "silver" advanced technology PZEVs (AT PZEVs) that a manufacturer would have to produce in order to meet the ZEV requirements with reduced numbers of gold ZEVs. An example of the possible increase in AT PZEVs under one set of assumptions is shown on page 25 of the March 5, 2003 Supplemental Staff Report.

None of the commenters asserting that the 2003 amendments will increase emissions because of the reduced production of ZEVs have disputed the emissions analysis in the Supplemental Staff Report. The modifications to the supplemental proposal that are reflected in the Final Regulation Order will not appreciably change the March 2003 emissions analysis. The staff accordingly concludes that the 2003 ZEV amendments reflected in the Final Regulation Order will not result in adverse emissions impacts attributable to the anticipated reduced production of ZEVs resulting from the amendments.

2. Comment: The South Coast Air Quality Management District commented that a two-year delay in ZEV regulation requirements is too long. The District indicated that we do not have the luxury to pick from a menu of emission reduction strategies, and that all feasible options must be implemented as early as possible to achieve state and federal ambient air quality standards.

Agency Response: The preliminary injunction issued by the federal district court judge in the *Central Valley Chrysler-Plymouth* case, which is described in Appendix B of the January 10, 2003 *Staff Report: Initial Statement of Reasons* (the ISOR), prohibits the ARB's Executive Officer from enforcing the 2001 ZEV Amendments with respect to the sale of new motor vehicles in model years 2003 and 2004. Since the 2003 model year will be close to completion when the final 2003 ZEV amendments are adopted and the 2004 model year will be well underway, it is not appropriate to have the amended ZEV requirements start before the 2005 model year. This will not result in an adverse emissions impact because the preexisting ZEV requirements cannot be enforced for the 2003 and 2004 model years due to the preliminary injunction.

In any event we note that the amendments provide incentives for early PZEV production in the 2003 and 2004 model years by allowing such vehicles to be used as AT PZEVs in

model years 2005 and 2006. It is hoped that this incentive will encourage the production of as many as 150,000 PZEVs per year.

The "Fleet Turnover Effect"

3. Comment: In the 2001 ZEV rulemaking, General Motors (GM) submitted extensive comments asserting that the ZEV regulation reflecting the proposed 2001 amendments would ultimately increase rather than decrease emissions. GM claimed that this would happen because assumed increases in the prices of new California cars and light trucks resulting from the ZEV regulation would depress sales of new vehicles, to the extent that emission increases from the greater number of higher-emitting older vehicles on the road due to reduced "fleet turnover" will more than offset the emission decreases attributable to the presence of ZEVs in the new vehicle fleet. To support this position, GM relied on a report dated January 2001 by National Economic Research Associates, Inc. and Sierra Research, Inc. entitled *Impacts of Alternative ZEV Sales Mandates on California Motor Vehicle Emissions: A Comprehensive Study* (the January 2001 NERA/Sierra Report).

The January 10, 2003 ISOR referred to GM's earlier comments regarding the fleet turnover effect and to the January 2001 NERA/Sierra Report. The ISOR stated that the ARB staff analysis of these arguments was outlined in the *ARB Staff Review of Report Entitled "Impacts of Alternative Sales Mandates on California Motor Vehicle Emissions: A Comprehensive Study"* (October 31, 2001) (the 2001 ARB Staff Review) prepared during the prior rulemaking. In this document the staff concluded that the January 2001 NERA/Sierra Report significantly overstated the effect of the ZEV program on fleet turnover, and that the fleet turnover effect would not cause the ZEV regulation to result in an overall emissions increase. The ISOR also described a 2002 RAND report entitled *Driving Emissions to Zero – Are the Benefits of California's Zero Emission Vehicle Program Worth the Costs?*, in which the authors chose not to include any fleet turnover effect in their quantitative emission and cost-effectiveness analyses of the ZEV regulation.

In comments submitted on March 26, 2003 in this rulemaking, NERA/Sierra provided an update to their previous analysis. Submitted along with the written comments was an updated model that addressed the fleet turnover impact of the staff's March 5, 2003 modified proposal. The updated NERA/Sierra model was used to analyze a range of scenarios concerning future costs and regulatory requirements related primarily to the March 2003 Proposal, but also to the January 2003 Proposal. Under the various scenarios considered, the ZEV Mandate would result in emissions disbenefits in the South Coast Air Basin. The analysis indicated that without major cost reductions in excess of what is currently foreseen, overall emissions would increase in the South Coast Air Basin under the ZEV mandate at least through 2020 relative to what they would be in the absence of the mandate – with the exception of the single year 2020 for one scenario – even though emissions from new vehicles subject to the mandate would decrease.

The March 26, 2003 NERA/Sierra comments also addressed the conclusions of the RAND report referenced by ARB staff, and asserted that the authors' reasons for excluding fleet turnover were not valid. They noted that a previous 1996 RAND report had come to a different conclusion.

Agency Response: As indicated, the NERA/Sierra assertions that the ZEV regulation will actually increase emissions due to the fleet turnover effect were previously raised in the 2001 ZEV rulemaking.

The staff's analysis of these arguments was outlined in the 2001 ARB Staff Review, which concluded that the NERA/Sierra report significantly overstated the purported effect of the ZEV program on fleet turnover and resulting fleet-wide emissions. The 2001 ARB Staff Review is incorporated by reference. Major considerations leading to its conclusions included:

- The cost increases assumed by NERA/Sierra were overstated.
- Manufacturers will not necessarily be able to pass along all increased costs.
- Small price increases can be addressed by a variety of manufacturer marketing practices and will not necessarily reduce sales.
- The NERA/Sierra emission modeling failed to take into account recent changes to the LEV II program.

The 2001 ARB Staff Review went on to demonstrate that when using more reasonable ARB staff assumptions rather than the assumptions used in the NERA/Sierra analysis, the NERA/Sierra model projected an average per vehicle increased cost of roughly $25 to $40 rather than the $250 to $400 estimated in the January 2001 NERA/Sierra Report. Staff believed that at these modest levels, such increases would have an insignificant effect on vehicle sales. Even if one accepts the NERA/Sierra premise that any cost increase, no matter how small, will reduce vehicle sales, staff concluded that the ZEV regulation as amended in 2001 would still result in an emission decrease, rather than the emission increase alleged in the NERA/Sierra report. Further staff analysis was provided on pages 80-108 of the December 2001 *Final Statement of Reasons*.

In the January 2003 ISOR (pp. 46-49) for the current rulemaking, staff updated its assessment of the fleet turnover issue. First, staff noted that the proposed changes put forth in the January 2003 staff proposal served to reduce the number of pure ZEVs that will be needed in model years 2005-2011 as compared to the 2001 amendments. The estimated savings from this change ranged from $375 million to almost $3.7 billion over the model-year 2005-2011 period, depending on the types of vehicles manufacturers choose to build.

In addition, staff noted that its estimate of the incremental cost of a PZEV has been further reduced from the level assumed in the 2001 rulemaking. Based on analysis of recently certified PZEVs, staff concluded that the incremental cost to build a PZEV is $100 per vehicle rather than the $200 per vehicle assumed in the *2001 ARB Staff*

Review. Although the cost difference per vehicle is small, it has a large effect on the total cost of the program given the large number of PZEVs that will be built as compared to the other vehicle types. The reduction in estimated total incremental cost to manufacturers over the model-year 2005-2011 period due to this reduced PZEV cost is roughly $350 million.

Moreover, staff noted that the analyses conducted during the 2001 ZEV rulemaking did not take into account the use of banked credits. The use of banked credits could allow several manufacturers to significantly reduce or eliminate the production of pure ZEVs and other ZEV program vehicles during the early years of the program. This would serve to dramatically reduce manufacturer compliance cost from the levels assumed in the 2001 NERA/Sierra Report.

Based on the above considerations, staff concluded in the January 2003 *ISOR* that the originally proposed amendments would have a smaller effect on fleet turnover than the ZEV regulation as amended in 2001. Given that the effect of the 2001 version of the regulation was demonstrated to be minimal, staff concluded that fleet turnover would likewise play a minimal role under the January 2003 staff proposal.

Turning to the updated 2003 NERA/Sierra model, there are some respects in which it addresses points raised in the 2001 ARB Staff Review. Specifically:

- The model now takes into account the value of fuel savings achieved by hybrid electric vehicles
- The model no longer assumes that ZEV technology remains constant over time (that is, it now includes scenarios under which there is technical improvement over time, leading to cost reduction)
- The model appears to correctly model the credit values for different types of AT PZEVs.

Meanwhile, the ARB staff has concluded that AT PZEVs for which the value of fuel saved exceeds the assumed incremental cost should be treated as having a zero incremental cost – consistent with the NERA/Sierra approach – rather than having imputed net manufacturer cost savings as had been the case in previous staff analyses.

As a result of these changes, the areas of difference between the ARB approach and the NERA/Sierra approach have narrowed as compared to the 2001 analysis. Nevertheless, significant differences remain as described below.

With that background, the staff has performed an analysis in which the amendments covered by the April 2003 Board Resolution and the ARB cost assumptions are incorporated into the updated 2003 NERA/Sierra model. This analysis again indicates that the effect of the amended ZEV regulation on vehicle prices and sales will be insignificant and the regulation accordingly will not increase emissions.

Updating the Model. The first step in this process was to update the model to reflect the April 2003 Resolution. (The model as submitted was based on the March 2003 version, under which the ZEV requirement for the alternative path for 2009 and beyond was "to be determined." To account for this uncertainty, NERA/Sierra prepared two scenarios, neither of which fully corresponded to the ultimate Board action). To accomplish this change, staff started with the NERA/Sierra scenario that most closely resembled the Board action, and then adjusted the percentage of AT PZEVs allowed in each model year to correspond to the allowable percentages given the April 2003 modifications.

The results of this adjustment are shown in Table 1 below. Note that the "ZEV tax" (the NERA/Sierra measure of the per-vehicle price increase due to the regulation) is somewhat higher under the April 2003 version than under the model as submitted. This is due to the fact that the number of ZEVs required under the April 2003 modifications was higher than was assumed in the NERA/Sierra scenario.

Substituting the ARB Assumptions. The second step was to substitute the ARB assumptions in several key areas, as follows:

- The incremental cost for a PZEV was reduced to $100
- The incremental cost for an AT PZEV was reduced to $2,350 in the near term and $700 in the long term
- The credit level earned by an AT PZEV was increased to reflect "high voltage high power" technology
- The incremental long term cost for a ZEV was reduced to $9,300
- The assumed demand for ZEVs was increased by a factor of two over the level used in the model.

The results of these changes are also shown in Table 1 below. The combined effect of these changes is to dramatically reduce the "ZEV tax" to $42 in model-year 2005 and $70 in model-year 2010.

The model-year 2015 and 2020 results are somewhat higher, but staff believes that these figures require careful interpretation. In the NERA/Sierra model, the incremental cost of the ZEV program in a given year is driven by the regulatory requirements that will be in place six years later. (This is due to the fact that under the ZEV regulation the compliance obligation faced by a manufacturer in a given year is based on its previous sales, with a six year lag.) In the regulation reflecting the April 2003 Resolution, there is a significant jump in the pure ZEV obligation in model-year 2018 – the year that the requirement returns to the "red line" as defined in 2001. This 2018 jump in the regulatory requirement shows up in the NERA/Sierra model as a 2012 jump in the incremental cost of the program. Thus the increase in estimated program cost in the 2012 timeframe is driven by requirements and estimated vehicle costs for 2018, which are subject to considerable uncertainty. For example, by that time the Independent Expert Review Panel will have conducted its review and the Board will have made adjustments as necessary to reflect the state of the technology.

Table 3
Per Vehicle Estimated Increased Cost

	2005	*2010*	*2015*	*2020*
Model as submitted	$198	$281	$322	$321
Modified to reflect April 2003	$195	$291	$337	$328
Modified to use ARB assumptions	$42	$70	$117	$110

Factors Not Considered. Finally, staff notes that there are a number of factors that serve to reduce the cost of the program, but are not taken into account in the modeling results. For example:

- Manufacturers have accrued significant quantities of banked ZEV credits, which serve to reduce the cost of compliance. Staff estimates that several manufacturers have banked credits sufficient to allow them to postpone building any new pure ZEV vehicles until model-year 2008 or beyond. The availability of banked credits clearly will reduce the incremental cost of the ZEV program in its early years.
- The estimated incremental costs used in the model do not take into account the value of any financial incentives, which could be significant. For example, the conference version of the energy bill currently before the U.S. Congress would provide incentives of $5,000 to $8,000 for fuel cell vehicles placed in service prior to 2013, and would provide incentives of $650 to $3,400 for the first 80,000 hybrid electric vehicles sold by each manufacturer.
- The 2003 amendments provide increased flexibility for manufacturers. Relevant amendments include:
  - The imposition of the “NEV cap” in the silver category is delayed until 2009. This further increases manufacturers’ ability to use banked credits to achieve compliance.
  - Fuel cell vehicles placed in any ZEV program state are allowed to count towards compliance in all ZEV program states through model-year 2011. This reduces the number of such vehicles that will be required nationwide and will result in a reduction in manufacturer costs.
  - Excess PZEVs placed in model-years 2003 and 2004 are allowed to count towards the silver category through model-year 2006. This will make it easier for some manufacturers to take full advantage of the silver option and allow for cost reduction.

Staff expects that when these factors play out in program implementation, the real world cost impact of the ZEV program and its impact on sales will be further reduced from the levels calculated by the updated NERA/Sierra model.

To summarize, staff concludes – based on its past and updated analyses – that there is minimal risk that the ZEV regulation as amended in 2003 will increase emissions in California or in the South Coast Air Basin.

With regard to the 2002 RAND Report, staff has not reviewed in detail the arguments and counter-arguments advanced by the report authors and the commenters, but rather emphasizes two points. First, as staff noted in the January *ISOR*, the RAND report found that "there are good arguments on both sides of this debate." Staff's purpose in quoting the RAND findings was to emphasize that the inclusion of fleet turnover effects is not a completely settled issue – as implied by NERA/Sierra – but rather is subject to debate. Second, and more important, it is agreed by all parties that consideration of the fleet turnover effect is not relevant for small price increases. In the words of the commenter, "NERA/Sierra modeling acknowledges that relatively modest cost increases may not be reflected in increased California costs." Thus the issue, as always, turns on the magnitude of any purported price increase.

Emissions Impacts Associated With the Production and Distribution of Hydrogen Fuel for Fuel Cell Vehicles

4. Comment: Tom Austin of Sierra Research commented that excess emissions associated with the production and marketing of hydrogen fuel have not been accounted for in the analysis of environmental impacts of the proposed regulatory changes. He indicates that hydrogen derived from natural gas will be the predominant production technique, and such hydrogen, whether produced in centralized or decentralized facilities would result in increased emissions. In the case of centralized production he asserts that higher emissions result from the increased need for tanker truck deliveries compared to gasoline. In the case of decentralized production (on-site production and refueling capable facilities), higher emissions would result from the reformation of natural gas and that these emissions would not be captured by stationary source emission controls because the fall under the threshold for control or mitigation.

Agency Response: The clearly articulated goal regarding establishment of hydrogen as the future energy carrier for transportation is use of renewable fuels for production of hydrogen. Just as with the vehicle technology, the fuel infrastructure technology is in the developmental stages. Until commercialization of fuel cell vehicles is reached, fleets will be the primary users of fuel cell vehicles. It is likely that a combination of centralized and decentralized hydrogen production facilities will be utilized. Demonstration of a variety of generation methods will most likely be pursued in order to gain critical experience with production of hydrogen fuel. If a decentralized station can serve 80 fuel cell vehicles, as many as 34 stations could create the early hydrogen infrastructure network.

The ZEV regulation promotes both near-term and long-term vehicle technologies that yield emissions reduction benefits in different time frames. Hydrogen fuel cell vehicles and other ZEVs are expected to yield significant emission reduction benefits beyond

2015 from both direct and upstream sources. One could argue that simply mandating PZEVs would achieve greater emissions benefits in the near-term than requiring relatively small numbers of ZEVs. However, for long-term achievement of California's air quality goals, the ZEV program accepts near term sacrifices in potential air quality improvements in order to drive vehicle emissions to zero. The infrastructure to support such vehicles may follow the same path.

While it makes sense to assess the near-term emissions reduction benefits of incremental technological improvements on existing combustion engine technology, ZEV technologies are much more fundamental and challenging to implement on a large scale. Near term hydrogen generation techniques may not be optimized for emissions performance at this time, however, as the market for hydrogen matures, increasingly efficient and environmentally benign processes of generation are expected to dominate the market. Assessing fuel cell vehicle benefits solely on near-term upstream emissions reductions is inappropriate.

Calculating the total emissions impact using the data provided in Mr. Austin's comments (12,000 mile per year, 0.03 grams per mile) results in up to 0.003 tons per day NOx from the maximum 2,750 fuel cell vehicles that could result from the regulation by 2011. This compares to the 1.02 tons per day of NOx benefit of the ZEV program in 2010; a 0.3 percent loss in benefits from the program.