

**CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
AIR RESOURCES BOARD**

**REGULATIONS TO CONTROL GREENHOUSE GAS EMISSIONS
FROM MOTOR VEHICLES**

FINAL STATEMENT OF REASONS



August 4, 2005

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**California Environmental Protection Agency
AIR RESOURCES BOARD**

Final Statement of Reasons for Rulemaking,
Including Summary of Comments and Agency Responses

**ADOPTION OF REGULATIONS TO CONTROL GREENHOUSE GAS EMISSIONS
FROM MOTOR VEHICLES**

Public Hearing Date: September 23-24, 2004
Agenda Item Number: 04-8-2

I. GENERAL

In this rulemaking, the Air Resources Board (ARB or Board) is adopting regulations to control greenhouse gas emissions from motor vehicles. The Board is taking this action pursuant to Chapter 200, Statutes of 2002 (AB 1493, Pavley) which directed the Board to adopt regulations that achieve the maximum feasible and cost effective reduction in greenhouse gas emissions from motor vehicles. The regulations, which will take effect in 2006 following an opportunity for legislative review, apply to new passenger vehicles and light duty trucks beginning with the 2009 model year.

The rulemaking was formally initiated by the August 6, 2004 publication of a Notice of a September 23, 2004 public hearing to consider adoption of regulations to control greenhouse gas emissions from motor vehicles. A Staff Report: Initial Statement of Reasons (ISOR) was also made available for public review and comment starting August 6, 2004. The ISOR, which is incorporated by reference herein, contained an extensive description of the rationale for the proposed regulations. The text of the proposed regulations – adoption of section 1961.1, title 13, California Code of Regulations (CCR), and amendment of sections 1900, 1961 – was included as Appendix A to the ISOR. These documents were also posted on August 6, 2004 on the ARB's Internet site for this rulemaking at <http://www.arb.ca.gov/regact/grnhsgas/grnhsgas.htm>, as was the text of the proposed amendments to the "California Exhaust Emission Standards and Test Procedures for 2001 and Subsequent Model Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles," which is incorporated by reference in section 1961(d).

On September 23 and 24, 2004, the Board conducted the public hearing. The Board received written and oral comments at the hearing. At the conclusion of the hearing the Board adopted Resolution 04-28, which initiated steps towards final adoption of the originally proposed amendments with modifications in several areas. One modification incorporated a suggested modification staff had presented at the hearing ("Staff's Proposed Modifications to the Proposed Regulation Order, presented at the Board's September 23-24 hearing,") shown in Attachment C to the Resolution. Other modifications were initiated by the Board itself ("Additional Modifications Directed by the Board at its September 23-24, 2004 Hearing") also shown in Attachment C to the Resolution. The

Resolution directed the ARB's Executive Officer to incorporate the approved modifications into the proposed regulatory text, with such other conforming modifications as may be appropriate, and to make the modified text available for a supplemental comment period of at least 15 days.

In preparing the modified regulatory language, the staff made various additional revisions in an effort to best reflect the intent of the Board at the hearing. The staff also identified several additional modifications that are appropriate in order to make the amended regulation work as effectively as possible. These supplemental modifications were incorporated into the text of the proposed amendments, along with the modifications specifically identified in the Resolution.

The text of the proposed modifications to the amendments was made available for a supplemental 15-day comment period ending November 5, 2004 by issuance of a Notice of Public Availability of Modified Text (the first 15-day notice). This notice and its two attachments were posted on October 19, 2004 on the ARB's Internet site for the rulemaking. They were also mailed by October 20, 2004 to all parties identified in section 44(a), title 1, CCR, along with various other interested parties.¹

Attachment I to the first 15-day notice contained the Board-approved modifications to the originally proposed regulatory text for section 1961.1, title 13 of the California Code of Regulations and to the "California Exhaust Emission Standards and Test Procedures for 2001 and subsequent Model Passenger Cars, Light-Duty Trucks and Medium-duty Vehicles," along with commentaries identifying and explaining all of the substantive modifications. Attachment II listed for comment additional documents that the ARB was adding to the rulemaking record in accordance with Government Code section 11347.1. The first 15-day notice indicated that Resolution 04-28 and its attachments are available on the rulemaking's Internet site. Twenty-two written comments were received during the supplemental comment period ending November 5, 2004.

In Resolution 04-28 the Board also found that it was appropriate to reexamine the estimated number of lifetime vehicle miles traveled, used by staff in their analyses, to ascertain whether this number should be revised in response to testimony presented at the hearing. The first 15 day notice indicated that staff had revisited this issue and determined that there was no need to revise the lifetime VMT used in the analysis, and that additional explanation was available online at the ARB's Internet site for this rulemaking.

Additional supporting documents and information were made available for a second supplemental 15-day comment period ending May 26, 2005 by issuance of a Second Notice of Public Availability of Supporting Documents and Information (the second 15-day notice). This notice and its attachment were posted on May 11, 2005 on the ARB's

¹ Persons who had commented by email were transmitted by email links to the first 15-day notice and its attachments on the Internet for the rulemaking; they were not separately sent the notice by postal mail.

Internet site for the rulemaking. They were also mailed by May 11, 2005 to all parties identified in section 44(a), title 1, CCR, along with various other interested parties.²

Attachment I to the second 15-day notice listed for comment additional documents that the ARB was adding to the rulemaking record in accordance with Government Code section 11347.1. The additional supporting documents and information included additional staff analysis and calculation regarding EMFAC mileage accrual for pre-2008 vehicles and the calculation of consumer monthly savings, 122 additional references, and 77 emails and other correspondence. The second 15-day notice did not propose any modifications to the regulatory text. Four written comments were received during the supplemental comment period ending May 26, 2005.

After considering all of the comments received, the Executive Officer issued Executive Order G-05-061, adopting the amendments to title 13, CCR, and the incorporated Exhaust Emission Standards and Test Procedures reflecting the modifications that had been made available for supplemental comment.

Incorporated Documents

The Exhaust Emission Standards and Test Procedures are incorporated by reference in section 1961(d) and section 1961.1, title 13, CCR. The Exhaust Emission Standards and Test Procedures in turn incorporate certification test procedures adopted by the U.S. Environmental Protection Agency (U.S. EPA) and contained in title 40, Code of Federal Regulations (CFR) Part 86.

Section 1961(d), title 13, CCR identifies the incorporated Exhaust Emission Standards and Test Procedures by title and date. The ARB document is readily available from the ARB upon request and was made available in the context of this rulemaking in the manner specified in Government Code section 11346.5(b). The CFR is published by the Office of the Federal Registrar, National Archives and Records Administration, and is therefore reasonably available to the affected public from a commonly known source.

The Exhaust Emission Standards and Test Procedures are incorporated by reference because it would be impractical to print them in the CCR. Existing ARB administrative practice has been to have the motor vehicle emissions test procedures incorporated by reference rather than printed in the CCR as these procedures are highly technical and complex. They include the “nuts and bolts” engineering protocols required for certification of motor vehicles and have a very limited audience. Because the ARB has never printed complete test procedures in the CCR, the affected public is accustomed to the incorporation format. The ARB’s test procedures as a whole are extensive and it would be both cumbersome and expensive to print these lengthy, technically complex procedures with a limited audience in the CCR. Printing portions of the ARB’s test procedures that are incorporated by reference would be unnecessarily confusing to the affected public.

² Persons who had commented by email were transmitted by email links to the second 15-day notice and its attachments on the Internet for the rulemaking; they were not separately sent the notice by postal mail.

The Exhaust Emission Standards and Test Procedures incorporate portions of the CFR because some of the ARB requirements are substantially based on the federal emission regulations. Manufacturers typically certify vehicles and engines to a version of the federal emission standards and test procedures that have been modified by state requirements. Incorporation of the federal regulations by reference makes it easier for manufacturers to know when the two sets of requirements are identical and when they differ. Each of the incorporated CFR provisions is identified by date in the ARB test procedure documents.

Fiscal Impacts

The determinations of the Board's Executive Officer concerning the costs or savings necessarily incurred by public agencies and private persons and businesses in reasonable compliance with the proposed regulations are presented below.

Pursuant to Government Code sections 11346.5(a)(5) and 11346.5(a)(6), the Executive Officer has determined that the proposed regulatory action will create costs or savings to any state agency or in federal funding to the state, costs or mandate to any local agency or school district whether or not reimbursable by the state pursuant to part 7 (commencing with section 17500), division 4, title 2 of the Government Code, or other nondiscretionary savings to state or local agencies.

In general, the steps that manufacturers will need to take to comply with the regulatory standards are expected to lead to price increases for new light duty passenger vehicles. Many of the technological options that manufacturers will choose to comply with the regulation are also expected to reduce operating costs. The staff analysis concludes that over the lifecycle of the vehicle the reduction in operating costs will more than offset the increased initial cost, resulting in a net savings to vehicle owners.

There are about 420,000 State and local agency-owned vehicles in California. A typical agency-owned vehicle is driven an average of 12,500 miles each year. This usage rate is very similar to that of private consumers. The staff analysis indicates that for individual consumers, the increased initial cost is more than offset by operating cost savings over the life of the vehicle. Staff expects that the same would hold true for public agencies. Thus beginning in the 2009 model year state and local agencies would need to budget for increased initial vehicle costs, but savings from the lowered operating costs of the proposed regulation would outweigh the higher price over the lifecycle of the vehicles.

Vehicles built to comply with the regulation are likely to be more efficient, which, as a consequence, means that new vehicles sold in 2009 and beyond will use less fuel. This will result in the future in reduced state and local government revenue from the excise tax and sales tax on motor vehicle fuel. This reduction will be partially offset by increased sales tax due to the increased cost of new vehicles.

In developing this regulatory proposal, the ARB staff evaluated the potential economic impacts on representative private persons or businesses. The regulation directly affects automakers worldwide that manufacture California-certified light duty vehicles. Staff

estimates that for large manufacturers the regulation would result in average compliance costs in model year 2009 of about \$20 per vehicle for PC and LDT1 and about \$40 per vehicle for LDT2. Compliance costs would increase over time as the standards are phased in, rising to about \$1,060 per vehicle for PC and LDT1 and \$1,030 per vehicle for LDT2 in 2016. Compliance costs for intermediate and small manufacturers would vary depending on their specific circumstances.

The climate change regulation affects only light duty vehicles whose primary use is noncommercial personal transportation. Therefore, many vehicles that businesses use would not be covered under the proposed regulation. However, if the businesses purchase the same vehicles as consumers, they would be expected to pay higher prices for the vehicles but save on operating costs. As noted above, staff expects that reduced operating costs will more than outweigh the effect of the increase in price over the life cycle of the vehicle.

Due to higher initial vehicle costs and reduced demand for fuel, the proposed regulation may adversely affect some sectors of the economy. It is very likely, however, that savings from reduced vehicle operating costs would end up as expenditures for other goods and services. These expenditures would flow through the economy, causing expansion or creation of new businesses in several sectors. Staff's economic analysis shows that on balance the proposed regulation will have a positive impact on jobs and personal income in California.

Consideration of Alternatives

The regulations proposed in this rulemaking were the result of extensive discussions and meetings involving ARB staff and motor vehicle manufacturers, environmental groups, and others. The ISOR, released and made available to the public on August 6, 2004, identified and rejected three potential alternatives to the staff proposal: (1) adopt less stringent or no new vehicle standards, (2) adopt more stringent new vehicle standards, and (3) adopt standards that only regulate mobile air conditioner refrigerant emissions.

Staff rejected the first alternative because Chapter 200, Statutes of 2002 (AB 1493) requires the Board to adopt regulations that achieve the maximum feasible and cost effective reduction of greenhouse gas emissions from new motor vehicles. The staff analysis has demonstrated that the reductions achieved under the staff proposal are both feasible and cost effective. Therefore the alternative of no or less stringent standards was rejected because it would not achieve the maximum reductions and therefore would fail to meet the statutory requirement.

Staff also considered proposing more stringent vehicle standards. This could be accomplished by shortening the phase-in period, or by building into the standard some degree of early penetration of technologies that the staff technical analysis determined would not be available for widespread application in the near and/or mid term periods. Staff concluded that in either case, manufacturers would have a very difficult time incorporating the needed technologies across their fleet as rapidly as would be necessary.

Comments received from manufacturers and their consultants on the June 14, 2004 draft staff proposal, which used a three-year phase in schedule rather than the four-year phase in schedule recommended now, served to reinforce this point. Staff therefore rejected this alternative on the grounds that more stringent standards would not be technically feasible.

Finally, staff also considered proposing standards that only regulate mobile air conditioner refrigerant emissions. While the staff analysis has shown that regulation of mobile air conditioner refrigerant emissions can achieve significant greenhouse gas reductions, staff rejected this approach for two reasons. First, this would amount to a mandate to use specific technologies or equipment, rather than a performance standard. In general staff favors performance standards, which provide manufacturers flexibility to meet any given remission reduction target in the most cost-effective manner. Second, as noted above the staff analysis has identified a variety of other vehicle technology improvements that are feasible and cost effective, and would result in greater greenhouse gas emission reductions. Therefore the alternative of mobile air conditioner refrigerant regulation also failed to meet the statutory requirement to achieve the maximum feasible and cost effective reductions.

Staff has performed a thorough analysis of possible ways to reduce greenhouse gas emissions from motor vehicles, quantifying the emission reductions achieved and their cost. No alternatives or combination of alternatives considered by the Board or otherwise identified and brought to the Board's attention have been identified that would be equally effective in achieving the emission reductions projected under, and less burdensome to affected private persons than, the adopted regulation. This Final Statement of Reasons provides supporting information for this conclusion.

II. MODIFICATIONS TO THE ORIGINAL PROPOSAL

A. AN OVERVIEW OF THE ORIGINAL PROPOSAL

1. Background

Over the 20th century, we have observed a rapid change in climate that is attributable to human activities. The global mean temperature is warming at a rate that cannot be explained by natural causes alone. Human activities are directly altering the chemical composition of the atmosphere through the buildup of greenhouse gases. The past century has already seen changes in climate-related conditions in California such as average temperature (up 0.7°F), sea level (up 3 to 8 inches), spring run-off (decreased by 12 percent), and the timing of snowmelt and spring bloom (advanced by 1 to 3 weeks).

Projected future climate change may affect California in a variety of ways. Public health can suffer due to greater temperature extremes and more frequent extreme weather events, increases in transmission of infectious disease, and increases in air pollution. California's agriculture industry is especially vulnerable to altered temperature and rainfall patterns, and new pest problems. Climate change can adversely affect California's forest ecosystems and the Sierra snowpack that functions as the state's largest reservoir. Sea

level rise and storm surges could lead to flooding of low-lying property, loss of coastal wetlands, erosion of cliffs and beaches, saltwater contamination of drinking water, and damage to roads, causeways, and bridges.

In response to these threats, in 2002 the Legislature adopted and the Governor approved Chapter 200, Statutes of 2002 (AB 1493, Pavley), which directed the Air Resources Board to adopt the maximum feasible and cost-effective reduction of greenhouse gas emissions from motor vehicles.

In setting greenhouse gas emission standards, the staff performed a detailed evaluation of the technologies and fuels available to reduce vehicular greenhouse gas emissions, the reductions that could be achieved, and their cost. The evaluation of vehicle technology that formed the basis of the staff assessment was derived primarily from a comprehensive vehicle simulation modeling effort and a thorough cost analysis performed for the Northeast States Center for a Clean Air Future (NESCCAF) by consultants frequently used by the auto industry. ARB staff believes the NESCCAF study is the most advanced and accurate evaluation of vehicle greenhouse gas emission reduction technologies that has been conducted to date.

The staff technology assessment reviewed baseline vehicle attributes and their contribution to atmospheric climate change emissions, and evaluated technologies that have the potential to decrease these emissions. The technologies explored are currently used on some vehicle models, or have been demonstrated by auto companies and/or vehicle component suppliers in at least prototype form. Promising near-term technologies include cylinder deactivation, improved transmissions, variable valve timing and lift, turbocharging, gasoline direct injection, and more efficient, low-leak air conditioning.

2. The Originally-Proposed Greenhouse Gas Regulations

a. Climate Change Emission Reduction Standard

Based on the technology evaluation, the regulation approved by the Board imposes climate change emission standards that are incorporated into the current Low-Emission Vehicle (LEV) program, along with the other light and medium-duty automotive emission standards. This approach was taken to ensure that manufacturers can meet the standards while continuing to provide the full range of vehicles available today. The standards phase in during the 2009 through 2016 model years, allowing changes to be made as part of the normal product improvement cycle. When fully phased in, the near term (2009-2012) standards will result in about a 22 percent reduction in greenhouse gas emissions as compared to the 2002 fleet, and the mid-term (2013-2016) standards will result in about a 30 percent reduction.

Vehicle climate change emissions comprise four main elements: (1) CO₂, CH₄ and N₂O emissions resulting directly from operation of the vehicle, (2) CO₂ emissions resulting from operating the air conditioning system (indirect AC emissions), (3) refrigerant emissions from the air conditioning system due to either leakage, losses during recharging, sudden

releases due to accidents, or release from scrappage of the vehicle at end of life (direct AC emissions, and (4) upstream emissions associated with the production of the fuel used by the vehicle. The climate change emission standard incorporates all of these elements.

The regulation establishes one standard for passenger cars and the lightest trucks (PC and LDT1), and a separate standard for heavier trucks (LDT2). Staff proposed setting near-term standards, phased in from 2009 through 2012, and mid-term standards, phased in from 2013 through 2016. The proposed standards, expressed in terms of CO₂ equivalent grams per mile, are shown in Table II-1 below:

Table II-1. CO₂ Equivalent Emission Standards for Model Years 2009 through 2016

Tier	Year	CO ₂ -equivalent emission standard (g/mi)	
		PC/LDT1 (Passenger cars and small trucks/SUVs)	LDT2 (Large trucks/SUVs)
Near-term	2009	323	439
	2010	301	420
	2011	267	390
	2012	233	361
Mid-term	2013	227	355
	2014	222	350
	2015	213	341
	2016	205	332

To maintain simplicity, staff proposed to use the upstream emissions for vehicles that use conventional fuels as a “baseline” against which to compare the relative merits of alternative fuel vehicles. Therefore, the emissions standards as shown above do not directly reflect upstream emissions. Rather, when certifying gasoline or diesel-fuel vehicles, manufacturers would report only the “direct” or, “on vehicle” emissions. For alternative fuel vehicles, exhaust CO₂ emissions values will be adjusted in order to compensate for the differences in upstream emissions. This approach simplifies the regulatory treatment of gasoline vehicles, while at the same time allowing for appropriate treatment of alternative fuel vehicles.

Small Volume, Independent Low Volume, and Intermediate Volume manufacturers would not be required to comply with the climate change requirements until the final year of the phase-in (2016). Beginning in 2016, these smaller manufacturers would be required to meet the average CO₂ equivalent emissions of all 2012 comparable vehicles produced by the major vehicle manufacturers. A specialty low volume vehicle that utilizes a powertrain from a major manufacturer from the same model year would be considered compliant with the greenhouse gas emission standards if it adopted the package without modifications. Should a comparable vehicle not be available from a large manufacturer, the small volume manufacturer would be required to meet the 2012 emission standard for large volume manufacturers in 2016 and beyond.

b. Early Credits

AB 1493 directs that emission reduction credits be granted for any reductions in greenhouse gas emissions achieved prior to the operative date of the regulations. ARB staff proposed that (1) credit for early emission reductions should be available for model years 2000 through 2008, with manufacturers allowed to opt in to the program during any model year during this timeframe, and (2) the baseline against which manufacturer emissions are measured should be the fully phased in near term standard.

As noted in Table II-1 above, staff proposed that the fully phased in near term standard for passenger cars and T1 trucks should be 233 grams per mile CO₂ equivalent, and for T2 trucks should be 361 grams per mile. Thus under the staff early credit proposal a manufacturer's fleet average emissions, for model years beginning with their first year of participation through 2008, would be compared to these standards. If a manufacturer has fleet average emissions in a specific model year lower than these standards, the manufacturer would earn early compliance credits. Any emission reduction early credits earned could be used during model years 2009 through 2014, or traded to another manufacturer. To ensure that the regulation ultimately achieves the greatest possible climate change reductions, staff proposed that the credits generated by early compliance retain full value through the 2013 model year. These credits will then be worth 50 percent of their initial value in MY 2014, 25 percent of their initial value in MY 2015 and have no value thereafter.

c. Alternative Compliance

AB 1493 requires that the regulations "provide flexibility, to the maximum extent feasible consistent with this section, in the means by which a person subject to the regulations ... may comply with the regulations. That flexibility shall include, but is not limited to, authorization for a person to use alternative methods of compliance with the regulations." Thus the use of alternative compliance strategies must not undercut the primary purpose of the regulation, which is to achieve greenhouse gas reductions from motor vehicles. Accordingly, the ARB's alternative compliance program will be limited to the vehicles that are regulated through AB 1493, and their fuels. This is to ensure that the program does not dilute the technology-forcing nature of the regulation, since the goal is to improve the vehicles themselves. The major features of the staff proposal are:

- Projects must be located in California to be eligible as alternative methods of compliance.
- Only companies regulated by AB 1493 (automakers) will be permitted to apply for alternative compliance credits.
- Only those vehicles regulated under AB 1493 are eligible for alternative compliance credits. This includes model year 2009 and later passenger vehicles and light-duty trucks and other vehicles used for noncommercial personal transportation in California.
- Staff proposed that eligible projects be limited to those that achieve greenhouse gas reductions through documented increased use of alternative fuels in eligible vehicles.

B. MODIFICATIONS TO THE ORIGINAL PROPOSAL

At the conclusion of the September 2004 hearing, the Board adopted Resolution 04-28, in which it approved the original staff proposal described above, with modifications in four areas. The first modification, which specifies that the regulation may not take effect before January 1, 2006, was suggested by staff before the hearing to address the requirements of Health and Safety Code section 43018.5(b)(1). The text of this modification was contained in a document titled "Staff's Proposed Modifications to the Proposed Regulation Order, presented at the Board's September 23-24, 2004 hearing," which was distributed at the hearing and was Attachment C to the Resolution. Three additional modifications were suggested by staff at the hearing in response to public comments made to staff after issuance of the original proposal. The Resolution directed the Executive Officer to incorporate the approved modifications into the proposed regulatory text, with such other conforming modifications as may be appropriate, and to make the modified text available for a supplemental comment period.

The approved modifications include specifying that the regulation may not take effect before January 1, 2006; allowing the Executive Officer to approve the use of lower upstream adjustment factors for hydrogen vehicles and electric vehicles, based on the increased use of cleaner sources of hydrogen or electricity production; and providing credit for plug-in hybrid electric vehicles in the first year of production.

In addition, in response to comments, staff proposed additional modifications to extend the life of credits earned to five years and increase the number of years manufacturers are given to make up emission debits also to five years. These additional modifications will provide additional compliance flexibility to manufacturers while maintaining the overall stringency of the Board-approved proposal.

Also in response to comments, staff proposed two modifications to the calculation of indirect emissions allowances for air conditioning systems. First, an adjustment factor is proposed that will apply to systems equipped with CO₂ as the refrigerant. The adjustment factor offsets an inadvertent penalty that would have resulted when significant compressor downsizing occurs, which is only expected for CO₂-based air conditioning systems. Second, the inclusion of an adjustment factor magnifies the incentive to use a larger than necessary compressor in order to obtain a larger allowance. To minimize the incentive, an upper limit on the indirect emission allowances was proposed.

A minor correction is also proposed to an indirect emissions factor that is used for calculating the upstream greenhouse gas emission adjustment for alternative fuel vehicles. In reviewing the emissions factor, it was noted that an adjustment in the modeling exercise was not carried through. The proposed revision corrects this oversight.

Finally, a comment was made at the hearing that the lifetime vehicle miles traveled (VMT) used in staff's analysis was too high, thus overstating operating cost savings. Staff revisited this issue and determined that there is no need to revise the lifetime VMT used in

the analysis. Additional explanation was made available online at the ARB’s Internet site for this rulemaking –<http://www.arb.ca.gov/regact/grnhsgas/grnhsgas.htm>.

C. MANUFACTURER COSTS AND SAVINGS RESULTING FROM THE ADOPTED REGULATION

As part of its technology evaluation, staff estimated the average fleetwide incremental cost of control to meet the greenhouse gas emission standards. Table II-2 below shows the average cost of control by model year for each standard.

Table II-2: Average Cost of Control

Tier	Year	Average cost of control	
		PC/LDT1 (Passenger cars and small trucks/SUVs)	LDT2 (Large trucks/SUVs)
Near-term	2009	\$17	\$36
	2010	\$58	\$85
	2011	\$230	\$176
	2012	\$367	\$277
Mid-term	2013	\$504	\$434
	2014	\$609	\$581
	2015	\$836	\$804
	2016	\$1,064	\$1,029

As is shown in the table, when fully phased in the near-term standards will result in an estimated average cost increase of \$367 for passenger cars and small trucks/SUVs, and \$277 for large trucks/SUVs as compared to the 2009 baseline vehicle. The fully phased in mid-term standards will result in an estimated average cost increase of \$1,064 for passenger cars and small trucks/SUVs, and \$1,029 for large trucks/SUVs. The staff analysis concludes, however, that these increased costs will be more than offset by operating cost savings over the lifetime of the vehicle. Using the average increase in vehicle prices associated with the fully phased-in regulation (2016), and an assumed fuel price of \$1.74 per gallon, staff calculated that the increased vehicle payment minus the reduction in operating cost would result in a monthly savings of about \$3.50 to \$7.00. At higher fuel prices, the monthly savings increase.

D. COST-EFFECTIVENESS OF THE ADOPTED REGULATION

Typically, emission control regulations impose a cost. Cost effectiveness is a measure of the cost imposed per ton of reduction achieved, and thus is a useful tool to compare various possible approaches. In this instance, however, AB 1493 requires that the regulations be economical to the consumer over the life cycle of the vehicle. Consistent with this direction, the technology packages that provide the basis for the standard result in operating cost savings that exceed the capital cost, resulting in a net savings to the consumer over the lifecycle of the vehicle. This translates to a “negative” cost effectiveness value (there is a cost savings per ton reduced).

ARB staff estimated the net costs of this proposed regulation primarily by using cost data from the 2004 study “Reducing Greenhouse Gas Emissions from Light-Duty Motor Vehicles” done for the Northeast States Center for a Clean Air Future (NESCCAF). The initial costs are based on the expected increases in vehicle cost resulting from the technology improvements needed to meet the standards in the proposed regulation. The proposed regulation includes a phase-in schedule whereby earlier model year vehicles will meet a less stringent standard and, on average, will require less new technology than later model vehicles. ARB staff has estimated the average cost increases by model year, using data from the NESCCAF study and other sources. Staff has used these cost data, along with the assumption that average vehicle life is 16 years, to calculate the total annualized costs by calendar year. The total annualized costs are estimated to be roughly \$1,236 million for calendar year 2020 and \$2,595 million for 2030.

Staff also estimated annual savings in operating cost, again based on information provided in NESCCAF as well as other sources. The annual savings are estimated to be \$5,278 million in 2020 and \$9,394 million in 2030, well in excess of the annualized cost. This results in net annual savings of \$4,042 million in 2020 and \$6,799 million in 2030.

The cost effectiveness in dollars per ton for a given calendar year is calculated by dividing the total annualized costs for that year by the total CO₂ equivalent emission reductions for that year. The CO₂ equivalent emissions benefits of the proposed regulation are 87,700 tons per day in 2020 and 155,200 tons per day in 2030. Converting these figures to annual totals yields 32 million tons per year in 2020 and 56.7 million tons per year in 2030.

Table D-1 below provides the cost effectiveness in calendar years 2020 and 2030 based on the annualized vehicle costs and the estimated benefits.

Table D-1. Cost Effectiveness of Proposed Regulation

	2020	2030
Net Annualized Costs (Savings)	<i>\$4,042 million</i>	<i>\$6,799 million</i>
Emissions Reduction (tons/year)	<i>32.0 million</i>	<i>56.7 million</i>
Cost effectiveness (\$/ton)	-126	-120

E. ENVIRONMENTAL AND ECONOMIC IMPACTS

The climate change regulation may impact several sectors of the economy. The steps that manufacturers will need to take to comply with the regulatory standards are expected to lead to price increases for new vehicles. Many of the technological options that manufacturers choose to comply with the regulation are also expected to reduce operating costs. These two responses to the regulation have combined positive and negative impacts on California businesses and consumers.

Based on the staff analysis, the net effect of the regulation on the economy is expected to be small but positive. It is very likely that savings from reduced vehicle operating costs will end up as expenditures for other goods and services. These expenditures would flow through the economy, causing expansion or creation of new businesses in several sectors.

Staff's economic analysis shows that as these expenditures occur, jobs and personal income increase. Jobs increase by 3,000 in 2010, by 53,000 in 2020, and by 77,000 in 2030 as compared to the baseline economy without the proposed regulation. Similarly, income grows by \$170 million in 2010, by \$4.7 billion in 2020, and by \$7.3 billion 2030. There is no impact on the ability of California business to compete with businesses in other states. State and local agencies will not be adversely affected and are likely to realize a net reduction in their cost of fleet operations.

Staff estimates that the regulation will reduce climate change emissions from the light duty passenger vehicle fleet by an estimated 87,700 CO₂-equivalent tons per day statewide in 2020 and by 155,200 CO₂-equivalent tons per day in 2030. This equates to an 18 percent reduction in climate changes emissions from the light-duty fleet in 2020 and a 27 percent reduction in 2030. The regulation will also reduce emissions that occur during the fuel cycle (the marketing and distribution of gasoline). Such activities produce both climate change and criteria pollutant (smog-forming) emissions.

Analysis of fleet turnover effects using longstanding and accepted types of analyses indicated that there will be no significant adverse environmental impact associated with any potential delay in purchase of new vehicles.

To provide additional insight into the impact of the regulation, staff used newer exploratory tools to explore what would happen if consumers postpone the purchase of new vehicles due to their higher cost, or increase their driving due to the reduced cost of operating the vehicle. In both cases staff found that the effect on emissions is relatively small.

Staff has not identified any mechanisms by which the climate change regulation would result in a disproportionate negative environmental or economic impact on low income or minority communities. In fact, the reduced emissions from likely changes to the distribution and marketing of gasoline are likely to provide benefits to these communities. Staff also evaluated the broader impacts of the regulation on job and business creation in representative San Diego communities with environmental justice concerns. The evaluation concluded that the regulation would likely result in an increase in jobs and business creation.

III. SUMMARY OF PUBLIC COMMENTS AND AGENCY RESPONSES

The ARB received numerous written and oral comments, in connection with the September 23-24, 2004 hearing and during the two subsequent 15-day comment periods. Set forth below are either the full text or a summary of each objection or recommendation specifically directed at the proposed regulation or to the procedures followed by the ARB in proposing or adopting the regulation, together with an agency response. The comments

have been grouped by topic whenever possible. Comments not involving objections or recommendations specifically directed towards the rulemaking are not summarized below.

A. COMMENTS PRESENTED PRIOR TO OR AT THE HEARING

1. Overview Comments on the Regulation as a Whole

1. Comment: Pollution from cars and light trucks causes global warming that threatens to worsen smog levels and increased health problems, including asthma attacks. To begin reducing the pollution that contributes to global warming we must begin by ensuring the maximum feasible and cost-effective reduction of polluting greenhouse gases emitted by passenger vehicles.

Recent reports show that California continues to have the worst air pollution in the country. Given the close link between smog-formation and hot weather, we must act to reduce global warming pollution. I urge you to ensure that the Air Resources Board sticks to its schedule and adopts the most protective cost-effective rule to reduce greenhouse gas emissions from cars this fall. (Rainey Aggerson; 110,000 similar postcards provided by Environment Now, as well as 256 handwritten letters restating the text of the postcard, in some cases with non-substantive modifications.)

Agency Response: ARB staff agrees with this comment, and the Board approved the regulations in a timely fashion. No further response needed.

2. Comment: The City of Santa Monica encourages the California Air Resources Board to support the maximum feasible and cost-effective vehicle emission reduction regulations under Assemblymember Fran Pavley's 2002 global warming bill. The bill gives us, as Californians, the opportunity to clean our own skies, reduce our contribution to global warming, and also to set a higher standard for the rest of the world to follow. California is a leader in environmental issues and this bill is an example of our leadership.

The California Air Resources Board has the opportunity to protect the quality of life of millions of Californians and set an example for the rest of the world to follow. We strongly urge you to ensure AB 1493 results in the maximum feasible and cost effective reduction of greenhouse gases from motor vehicles. (Richard Bloom, Mayor, City of Santa Monica. Similar letters received from Town of Yucca Valley; City of Monterey Park; City of Torrance; City of Burbank; City of Pacifica; City of Colton; City of Gardena; City of Grand Terrace; City of Rialto; City of Banning; City of Long Beach; City of Arcata; City of El Segundo; City of Los Angeles; Marin County; City of Lakeport; City of Cupertino; City of San Bernardino; City of Calabasas; Riverside County; City of Novato; City of Eureka; City of Santa Rosa; City of Napa; City of Montclair; Alameda County; City of Chula Vista; City of Hayward; City of Los Gatos; City of Pico Rivera; City of Santa Clara; City of Calistoga; City of Sonoma; City of Port Hueneme; City of Sacramento; Contra Costa County; City of San Leandro; City of Sunnyvale; City of Healdsburg; City of Clearlake; City of Cotati; Town of San Anselmo; City and County of San Francisco; Town of Fairfax; Sonoma County; Santa Clara County; City of Santa Cruz; City of West Hollywood; City of Agoura Hills; City

of Oxnard; City of Palo Alto; City of Redlands; City of Malibu; Town of Windsor; City of Hemet; City of Huntington Park; City of Oakland; City of Petaluma; San Mateo County; City of Sebastopol; City of San Buenaventura; City of San Diego; City of San Mateo; City of Riverside, City of San Jose, Marin Municipal Water District)

The City of El Segundo urges you to adopt new strong regulations to reduce greenhouse gas emissions from motor vehicles. The city supports the proposal that is before you for consideration today.

Local governments are likely to suffer severe consequences from the effects of global warming, as we are often the agencies of first recourse for constituents facing the burdens of poor environmental decisions.

Unfortunately, under California law, local governments have the least flexibility to generate the resources needed to respond effectively, a problem likely to be compounded by the expected adverse economic consequences of global warming on industries essential to the fiscal health of local governments such as real estate, tourism and agriculture.

In short, global warming threatens California's health, environment, economy, and quality of life; and greenhouse gas emissions from passenger vehicles and light trucks contribute vastly to the buildup of greenhouse gases in the atmosphere that results in global warming. The city believes it is imperative that California lead the way in addressing the problem of global warming. We must act now to avert even more severe impacts from global warming in the future. We must act now to cut greenhouse gas emissions from vehicles.

The city of El Segundo, along with 60 other cities throughout the State of California, supports strong measures to reduce vehicle greenhouse gas emissions and the proposed regulations that staff has prepared are a good start. They are a step in the right direction to ensure to the maximum extent feasible the cost-effective reduction of greenhouse gases emitted by passenger vehicles as mandated by AB 1493. (Councilmember Nancy Pfeiffer, City of El Segundo)

The City of Santa Monica is here today to applaud and support your efforts to reduce greenhouse gas emissions, and your leadership is welcome. The city has taken extraordinary steps to mitigate its own greenhouse gas emissions, and we will suffer extraordinary harmful consequences from the impacts of these emissions should they not be abated. (Brian Johnson, City of Santa Monica)

Mayor James Hahn and the City Council of the City of Los Angeles have adopted a resolution, which was forwarded by Council Members Perry and Carter, to "urge the California Air Resources Board to adopt the strongest possible regulations to reduce greenhouse gases emitted by passenger vehicles pursuant to AB 1493. "We endorse the staff proposal that is before you for consideration today." (Brian Williams, Deputy Mayor of Los Angeles)

Agency Response: ARB staff agrees with these comments, and the regulations approved by the Board will achieve the maximum feasible and cost effective reductions. No further response needed.

3. Comment: I urge you to adopt at your upcoming board meeting the recommendations contained in the June 14th staff proposal to reduce global warming from cars. California's actions are critical to controlling and reducing global warming pollution nationally, and can spur other states and nations to follow out lead.

Global warming threatens California's health, environment, way of life and economy, including a number of our key industries such as agriculture, recreation and tourism. Passenger cars and light trucks represent the largest source of global warming pollution in California, but experts estimate that we can reduce global warming pollution by 30 to 40 percent using cost-effective and readily available vehicle technology.

California's recently enacted law to limit global warming pollution from cars will improve our environment and our air, as long as strong regulations are adopted to implement the law. Again, I urge you to adopt the June 14th staff proposal so California can move forward with the steps necessary to achieve this goal. (Christine Hoekenga; about 4,500 other similar letters received.)

Agency Response: The regulations as approved by the Board substantially reflect the recommendations contained in the June 14 draft staff proposal. The only significant modification related to the phase-in of the standards. In the August 6 final staff proposal staff recommended phasing in the standards in two four-year increments, as opposed to the two three-year increments proposed in the June 14 draft. Staff believed that additional time was needed to allow manufacturers to implement the necessary technologies across their fleet. Staff believes that the regulations as approved by the Board achieve the maximum feasible and cost effective reductions.

4. Comment: I urge them to adopt the new rules to cut global warming pollution from California's cars. California passed the world's first law to curb global warming pollution from cars and trucks in 2002. Now the world is watching to see if we can make it work.

The proposed new auto pollution standards set a modest goal of reducing tailpipe emissions of carbon dioxide and other pollutants 30 percent by 2016. It's never been more important for California to keep its tradition of leading the U.S. and the world in cleaning up pollution. Again, please support the new rules and ask you the Board to do the same. (Wayne Williams; about 2,500 other similar letters received).

Agency Response: ARB staff agrees with this comment. No further response needed.

5. Comment: As you know, global warming threatens to disrupt California's economy, environment, water supplies, and quality of life. With this in mind, your board should adopt its June 14th proposed regulation. Cutting car pollution is one of the best ways we can slow climate change.

Eighty percent of Californians support the law to cut global warming pollution from cars. Moreover, Governor Schwarzenegger has promised to uphold the law and prevent any attempts to weaken it. Thank you for your right action. (Kevin James Gardner; about 3,000 other similar letters received.)

Agency Response: See response to comment number 3.

6. Comment: I am concerned about global warming and the threat that resulting climate change poses for California's health, economy, and environment. Consequently, I am writing to urge you to support the strongest possible regulations to reduce greenhouse gas emissions from new passenger cars and light trucks. Your determined and unwavering support is needed not only when the California Air Resources Board considers proposed regulations later this month, but for as long as automakers seek to undermine those regulations through misleading PR campaigns and threats of expensive litigation.

The Public Policy Institute of California found in July of this year that 81 percent of Californians support the law requiring automakers to reduce global warming emissions from new cars and light trucks. I am one of those who support the proposed regulations, which would reduce greenhouse gas emissions from new cars and light trucks by 30% by 2016. I hope you will defend these regulations vigorously and hope you will appeal to the major auto companies to support rather than undermine California's landmark campaign to build cleaner cars and a cleaner California. (Dr. Deborah Perlman Ph.D., about 2,500 other similar letters received.)

Agency Response. ARB staff agrees with this comment, and the regulations approved by the Board will achieve the maximum feasible and cost effective reductions. No further response needed.

7. Comment: I am concerned about the impact global warming has on the health, environment, and quality of life of everyone living in California.

I encourage you to uphold your promise to improve California's air quality. One way you can do this is by supporting the California Air Resources Board's groundbreaking regulations, pursuant to the California Clean Cars Law of 2002, that would for the first time require carmakers to reduce global warming emissions from new passenger cars and light trucks beginning in 2009. Adopting strong regulations will enable California to continue to be a world leader in solving air pollution problems and these regulations will go a long way to help to improve air quality and public health. (Holly Gardner; about 3,500 similar letters received).

Agency Response: It is reasonable to assume the cited law is AB 1493. With that assumption, ARB staff agrees with this comment, and the regulations approved by the Board will achieve the maximum feasible and cost effective reductions. No further response needed.

8. Comment: CARB has done an admirable job of designing a modest but meaningful proposal for reducing greenhouse gas emissions from new passenger vehicles.

It is critical that CARB approve the rule at its upcoming meeting. There is only one amendment that I would urge CARB to consider. To achieve maximum feasible emissions reductions, CARB should adopt 2015 as its final deadline. This gives automakers longer to adjust in the first stage, but recognizes that extending the time for compliance is not necessary in the second stage of implementation. (Keith Haumann; about 2,400 similar letters received).

Agency Response: See response to comment number 3.

9. Comment: I am a teacher working with middle school students in Santa Cruz. When I think about their future, the issue of global warming is the most crucial environmental catastrophe facing them. It deeply concerns me, as it does them. I am proud that our state has taken a national lead in efforts to reduce global warming, and I urge you to take every possible step to preserve a livable future for my students. One of those actions concerns the recommendations contained in the June 14th staff proposal to reduce global warming from cars.

I urge you to adopt at your upcoming board meeting those recommendations. California's actions are critical to controlling and reducing global warming pollution nationally, and can spur other states and nations to follow our lead. (George Merilatt; similar letters of general support received from 93 individuals and organizations)

Agency Response: ARB staff agrees with these comments. See also the response to comment number 3.

10. Comment: I am writing to you on behalf of the United Steelworkers of America District 12 to urge you to adopt the strongest possible regulations to reduce greenhouse gas emissions from motor vehicles. The draft plan developed by the Air Resources Board staff is a sound platform.

The CARB staff proposals are reasonable and we encourage CARB to approve them. We believe that California's Governor, Legislature, and other public officials should solidly support such regulations to protect the health of the state's economy and its people. The drive toward cleaner cars will continue to provide new opportunities for use of hybrid electric and advanced technologies that will have extremely low emissions of both traditional air pollutants and greenhouse gases. (Terry L. Bonds, United Steelworkers of America District 12; similar letters received from Pacific Coast Federation of Fishermen's Associations; International Association of Machinists and Aerospace Workers; International Association of Machinists and Aerospace Workers District Lodge 725; Operating Engineers Local Union Number 3; California State Council of the Service Employees International Union Local 660; Service Employees International Union Local 1000; Service Employees International Union; United Food and Commercial Workers International Local 324; United Food and Commercial Workers International Local 1179;

University Professional and Technical Employees CWA Local 9119; International Brotherhood of Electrical Workers Local Union 569; International Brotherhood of Electrical Workers Local Union 302, International Brotherhood of Electrical Workers Local Union 332, International Brotherhood of Electrical Workers 9th District; Contra Costa Building and Construction Trades Council.); American Federation of State, County and Municipal Employees; California Nurses Association; State Building and Construction Trades Council of California; International Brotherhood of Boilermakers; California Teachers Association.)

Over 23 unions in the state, including my union, the United Food and Commercial Workers; electrical workers; service employees; steel workers and machinists, have indicated their support for the strongest possible regulations to reduce greenhouse gas emissions from automobiles.

There's no doubt that the labor movement takes the threat of global warming and climate changes seriously. The draft plan before you is a sound platform for significant reductions and we urge your support. (John Perez, United Food and Commercial Workers Union and the United Food and Commercial Workers Western States Council)

Agency Response: ARB staff agrees with these comments, and the regulations approved by the Board will achieve the maximum feasible and cost effective reductions. No further response needed.

11. Comment: The Santa Clara County Medical Association supports California's efforts to address global warming through the implementation of a strong regulation to reduce greenhouse gas emissions from vehicles...The Santa Clara County Medical Association and the California Medical Association have already endorsed a resolution that supports a reduction in greenhouse gases. We recognize that this is the most important environmental problem facing us today.

We respectfully request that the California Air Resources Board adopt a strong and effective 1493 regulation that ensures the maximum feasible and cost-effective reduction of global warming pollution produced by passenger vehicles. (Stephen H. Jackson, MD; similar comments provided by Health Network for Clean Air petition signed by 165 medical and health care professionals, and by American Academy of Pediatrics, American Lung Association of California, Breast Cancer Action, Breast Cancer Fund).

Statewide health organizations supporting the proposed regulations include the American academy of Pediatrics, the California Academy of Family Physicians, the California Medical Association, the American Heart Association, the Western States, the Fresno-Madera Medical Society, the Health Officers Association of California, Medical Advocates for Healthy Air, the Regional Asthma Management Preventive initiative, and the American Lung Association. (Trisha Roth, Pediatrician)

I urge you to stand tall to it and support this measure. Denny Zane, American Lung Association volunteer)

I'd like to present to you in addition to the over 160 physicians and respiratory therapists and nurses over 3,000 letters of support from the public that's collected by the American Lung Association. And these letters urge you again to move forward today and adopt this resolution. Many of these are from health professionals or individuals suffering from lung illness.

I'd also like to present to you over 60 resolutions, letters of support from local governments around the state. We have a board here listing all of these cities and counties that have taken positions. You also have a folder with all of these resolutions and letters. So you actually have over 60 I think in your packet. There's fairly equal representation from northern and southern California. And all of these local governments have urged you to adopt the strongest possible regulations to reduce greenhouse gas emissions from motor vehicles and are urging you to take strong leadership on this issue.

Public health demands that you take action to control greenhouse gases. We are urging you today to demonstrate strong leadership for public health for California and the world by adopting the proposed regulations. (Bonnie Holmes-Gen, American Lung Association of California)

Agency Response: ARB staff agrees with these comments, and the regulations approved by the Board will achieve the maximum feasible and cost effective reductions. No further response needed.

12. Comment: As California business leaders and members and supporters of Environmental Entrepreneurs (E2) we write to express our support for California's efforts to address global warming through the implementation of a strong regulation limiting greenhouse gas emissions from vehicles as set forth in AB 1493 (Pavley). E2 is a national community of businesspeople who believe in protecting the environment while building economic prosperity. Collectively, E2's over 500 members (70% of whom reside in California) have created more than 800 companies and 400,00 jobs, and manage \$20 billion of venture capital.

We believe that strong regulations for implementing AB 1493, as outlined in the staff proposal currently before the Air Resources Board, are key to accelerating the drive to put the latest pollution reduction technologies in California's fleet of cars. The vehicle global warming law is a win-win for the state's consumers and automotive technology companies. In addition, it will significantly improve the state's environment. Consumers will benefit from lower lifetime operating costs when new cleaner vehicle technologies are available. In fact, abundant off-the-shelf technology and available clean fuels can be readily applied to reduce global warming pollution from today's vehicles, cars and light trucks. Many of these technologies and innovations will depend on parts that Californian companies also produce. As California's economy is one of high-technology and innovation, it is likely once again to benefit (as it has in the past) from clean technology investments driven by this landmark law.

We encourage the California Air Resources Board to adopt strong regulations that ensure the maximum feasible and cost-effective reduction of greenhouse gases emitted by passenger vehicles, and urge California's Governor, Legislature, and other public officials to solidly support such regulations to protect the health of the state's economy and its people. (Bob Epstein and Nicole Lederer; letter co-signed by 193 members and supporters.)

Agency Response: ARB staff agrees with this comment. No further response needed.

13. Comment: The California Air Pollution Control Officers Association (CAPCOA) wishes to express its strong support for the strategies outlined in the Staff Report published on August 6, 2004 and amended on September 10, 2004. We commend your staff for the thoroughness of the technical evaluation conducted in developing this regulation and for their ability to incorporate the latest information in a timely fashion. The proposed regulation represents a positive first step in beginning to address one of the most significant environmental issues of our time.

AB 1493, enacted in 2002, directs the ARB to adopt regulations to achieve the maximum feasible and cost-effective reduction of greenhouse gas emissions from motor vehicles. The proposal before you today goes a long way toward achieving that goal. The recommended emissions-based control strategies involve primarily off-the-shelf existing technologies, and the phased schedule provides industry flexibility and adequate time to adjust to the new standards and requirements while making it highly feasible to earn emission reduction credits through early implementation.

In summary, CAPCOA believes that the strategies recommended by staff represent a cost-effective, feasible and critical first step in addressing greenhouse gas emissions from the light-duty motor vehicle fleet.....CAPCOA commends your Board and staff in moving forward on this front and stands ready as an organization to support your efforts. (Larry F. Greene, President; similar letters received from South Coast Air Quality Management District, Bay Area Air Quality Management District, Sacramento Metropolitan Air Quality Management District, San Luis Obispo County Air Pollution Control District)

CAPCOA believes that the strategies recommended by staff represent a cost-effective, feasible, and critical first step in addressing greenhouse gas emissions from the light-duty motor vehicle fleet. We believe that much more remains to be done in order to reduce the threat posed by global warming, not just in California but throughout the world. (Larry Allen, Air Pollution Control Officer for San Luis Obispo County, representing the California Air Pollution Control Officers Association)

The District urges you and your colleagues to adopt the staff proposal. It is critically needed and a reasonable step forward on our journey towards minimizing climate change. Please know that the Air District is both supportive of your efforts and will be doing what we can as well to address this issue. (Brian Bunger, Bay Area Air Quality Management District)

This regulation is very much supported by the residents in our region and that this idea of life cycle costs being actually a positive aspect for the consumers is an excellent aspect of the regulation.

We urge you to adopt the regulation as expeditiously as possible. And [we] support you -- we'll be there doing whatever we can to help along the way. (Larry Green, Sacramento Metropolitan Air Quality Management District)

Agency Response: ARB staff agrees with these comments. No further response needed.

14. Comment: We welcome this opportunity to comment on the proposal now before the Board pursuant to implementation of the State's AB 1493 legislation, requiring adoption of regulations that achieve the maximum feasible and cost-effective reduction of greenhouse gas emissions from motor vehicles. We commend CARB staff for its exemplary work developing this proposal, which will take a significant step forward in protecting the citizens of California from the threats of climate change.

We commend CARB staff for its thorough analysis and recommend without reservation that the Air Resources Board immediately adopt these proposed regulations, so that California can protect itself from the threats of global warming and California's citizens can reap the benefits of cost savings and a cleaner environment that will follow. (John M. DeCicco, Ph.D., and Kate M. Larsen, Environmental Defense; letters of support also received from Natural Resources Defense Council, Bluewater Network, Environment California, Communities for a Better Environment, Union of Concerned Scientists, Sierra Club, Coalition for Clean Air, Conservation Law Foundation, Alliance for a Clean Waterfront, As You Sow, The David Brower Fund, Clean Water Action, Coalition of Concerned National Park Retirees, Community Clean Water Institute, National Parks Conservation Council, Neighborhood Parks Council, Rainforest Action Network, San Francisco Bicycle Coalition, San Francisco Tomorrow, Santa Barbara Channelkeeper, Vote Solar Initiative, Community Action to Fight Asthma)

We believe the proposed regulation is really an excellent start, that it will result in the rules which are – which we believe are fair to manufacturers and in vehicles which are better for both the environment and consumers' wallets. (Dr. Russell Long, Executive Director, Bluewater Network)

This is what Californians want. In just I'd say about 12 short weeks we were able to mobilize 109,000 -- and let me just say that again -- 109,000 public comments from Californians of all stripes in support of the implementation of this measure. (Sujatha Jahagirdar, Environment California Research and Policy Center)

UCS supports the adoption of this regulation and look forward to California taking a leadership role once again in addressing air pollution. (Louise Bedsworth, Union of Concerned Scientists)

NRDC believes the proposal is technically and economically well justified. It's consistent with the intent and requirements of the law. And though the stringency in phase-in could be stronger, on balance we believe this is a good proposal, we believe the Board should adopt what is before you today. And I think this -- California has an opportunity here to repeat the success it has had over the last four decades fighting smog forming pollution from tailpipes and repeat their success of the catalytic converter during the 1970's.
(Roland Hwang, Natural Resources Defense Council)

Agency Response: ARB staff agrees with these comments, and the regulations approved by the Board will achieve the maximum feasible and cost effective reductions. No further response needed.

15. Comment: NRDC is pleased to submit the following comments regarding the California Air Resources Board staff's proposal to control greenhouse gas emission from motor vehicles. NRDC has spent years working in California and at the national level to reduce the environmental impact of our motor vehicle fleet and was one of the co-sponsors of AB 1493.

- California has the clear legal authority to regulate air pollution from motor vehicles including the air pollutants that cause global warming, under AB 1493 and the federal Clean Air Act. These are not fuel economy standards and are not affected by the federal fuel economy law.
- The staff's analysis of the technical feasibility and cost-effectiveness is scientifically sound. Its analytical thoroughness is comparable to the analysis performed for the highly successful LEV I (adopted 1990) and LEV II (adopted 1998) programs. The staff's conclusions are consistent with the findings of other independent analyses.
- As one of the sponsors of AB 1493, we believe the staff's proposed regulations are consistent with the legislative intent and requirements of AB 1493, including the requirements for: maximum technical feasible and cost-effective standards, maximum flexibility (including allowing for alternative compliance mechanisms) and early action credits.
- Due to California's vulnerabilities to the impacts of global warming, adoption of these standards is necessary to reduce the risks of global warming, including detrimental impacts on public health, sensitive ecosystems, water resources, and the economy.
- The history of air pollution control demonstrates that California's leadership actions play a vital role in leveraging pollution reductions by other states, nationwide, and even globally, as other jurisdictions learn from and follow California's leadership and as technologies pioneered in California are adopted elsewhere.
- Seven northeastern states have adopted the California LEV II program. These states will likely also adopt these new standards and, indeed, several have already stated their intentions to do so. Canada has also expressed interest in adopting California's program.
- The history of past motor vehicle pollution programs shows that the auto industry has consistently exaggerated the costs of proposed regulations. The history also shows that both California and the federal government have typically overestimated

compliance costs, though to a much lesser degree than the industry. (Roland Hwang, Natural Resources Defense Council)

Agency Response: ARB staff agrees with this comment. No further response needed.

16. Comment: Environmental Defense recommends immediate adoption of staff's changes. Our evaluation of the proposal is that it is scientifically and economically sound, meeting the requirements of AB 1493, as demonstrated by the careful analysis and assessment reflected in the Initial Statement of Reasons (ISOR) for Proposed Rulemaking prepared by CARB staff to justify the regulations. (Haxthausen, Environmental Defense, 11/05/04).

Agency Response: No response necessary.

17. Comment: I am writing to urge your support of the strongest possible regulation pursuant to AB 1493 (Pavley) to reduce greenhouse gas emissions from motor vehicles. As you are aware, global warming threatens California's health, economy, environment, and way of life. As a result, if global warming continues unchecked, the insurance industry could be significantly impacted. I believe it is extremely important for California to act now and be a leader in addressing the problem of global warming.

In addition to making good policy sense, reducing global warming related pollution will benefit the health and safety of Californians. Recent studies on the potential effects of further global warming predict an increase in the frequency and magnitude of flood events. Heat waves and wildfires are also predicted to increase. While it is difficult to quantify the actual and future impacts of climate change, the potential for greater loss of life and property are too serious to ignore. Because climate change has the potential to affect the number and severity of natural disasters resulting in significant impact on claims, this is a front line issue for the insurance industry.

On behalf of the California Department of Insurance, I strongly urge your office and the California Air Resources Board to adopt these proposed regulations for near-term and mid-term fleet average emission standards contained in the August 6th Proposed Regulation Order. Such action is critical to protect the health of the State's economy, its environment, and its people. (John Garamendi, Insurance Commissioner).

Agency Response: ARB staff agrees with this comment, and the regulations approved by the Board will achieve the maximum feasible and cost effective reductions. No further response needed.

18. Comment: On the basis of my experience with the control of other pollutants summarized above, I have no doubt that establishing emissions standards for pollutants that contribute to global warming would lead to investment in developing improved technologies to reduce those emissions from motor vehicles, and that successful technologies would gradually be mandated by other countries around the world.

In conclusion, based on my education, experience, and expertise, it is my strong opinion that California's regulatory requirements to reduce greenhouse gas emissions from motor vehicles would lead to investment and successful action to reduce those emissions by vehicle manufacturers that serve the California market. In turn, efforts to reduce emissions from California's motor vehicles would proliferate around the world as other countries again adopted similar regulatory requirements. Successfully reducing greenhouse gas emissions from vehicles in California and other countries would substantially and measurably slow and reduce the build-up of these pollutants in the atmosphere and would substantially and measurably mitigate the impacts of global warming. (Michael P. Walsh)

Agency Response: ARB staff agrees with this comment. No further response needed.

19. Comment: Reductions of greenhouse gases are very important to the New England regulators and policy makers. (Coralie Cooper, NESCAUM)

The New York State Department of Environmental Conservation and CARB have established a strong working relationship, particularly in the area of mobile source emissions assessment and control. We look forward to continuing that relationship as we move toward controls for emissions of greenhouse gases.

The leadership that California has established in emissions controls is of critical importance to New York and many other states in meeting our air quality objectives. The Clean Air Act specifically permits states to adopt California motor vehicle emissions standards. This is a right that we embrace, and fully expect to continue to exercise.

I am here today to support the proposal before the Board and reiterate New York's commitment to adopt the CO₂ emissions standards being considered today. (David Shaw, New York State Department of Environmental Conservation).

CA's standards have repeatedly leveraged much larger emission reductions by other jurisdictions, such as other states, the federal government and other countries. (David Doniger, Senior Attorney, NRDC)

Agency Response: ARB staff agrees with these comments. Under the Clean Air Act other states often adopt California's new motor vehicle regulations such as these, and doing so here would achieve further greenhouse gas emission reductions beneficial to California. No further response needed.

20. Comment: There are approximately 113,000 pieces of mail out in the hall in the mailbags from private citizens supporting staff's proposal. There are 65 cities, counties and local officials from Agoura Hills to Yucca Valley, a very broad range in terms of size and geographic location; 225 businesses, business organizations and business leaders, ranging from the California Restaurant Association to, our particular favorite, Spin & Margie's Desert Hideaway; health and medical organizations, including the California Medical Association and the Health Officers Association of California; 23 labor

organizations, including the California Nurses Association and the Pipe Trades Council; and nearly 40 environmental -- environmental justice, community and public interest groups all supporting staff's proposal.

The staff recommendation, while conservative, responds effectively to the directions set forth in the original legislation. ARB's adoption of the proposed vehicle emissions standards represents an important step forward in the state's efforts to protect public health and reduce harmful global warming pollution from cars. (Wendy James, California Clean Cars Campaign)

Agency Response: ARB staff agrees with this comment, and the regulations approved by the Board will achieve the maximum feasible and cost effective reductions. No further response needed.

21. Comment: The California Ski Industry was an early and ardent supporter of AB 1493. We take global warming very seriously. The viability of the winter sports industry and the economic benefit it provides California's mountain communities depend on sufficient precipitation and appropriate temperatures. We are California's canary in the mineshaft.

During the campaign for AB 1493 we were strongly criticized by our automotive marketing partners. SUVs bring a large percentage of skiers and snowboarders to our resorts. Our message then and now is that SUVs are great, let's just clean them up. We believe the technology exists to reduce the global warming pollution from SUVs 30-40%. We also know that our patrons are environmentally sensitive. The automotive industry owes us all a cleaner SUV.

As we worked with CARB on developing stronger standards for stationary diesel engines we are committed to supporting CARB in the quest to create feasible cost-effective regulation for passenger vehicles. Let us know what we can do to help. (Bob Roberts, California Ski Industry Association).

Agency Response: ARB agrees with this comment. No further response needed.

2. Comments on Specific Issues

a. ISOR Section 2--Climate Change Science

(1). Section 2.1—Climate Change Causes and Projections

22. Comment: Much of the basis for the statements and the inference in the Staff Report concerning scientific consensus in the Staff Report is based on the 2001 International Panel on Climate Change Third Assessment Report ("TAR") and a 2001 National Research Council ("NRC") report. The Intergovernmental Panel on Climate Change ("IPCC") was established by the United Nations Environment Program and World Meteorological Organization in 1988. About every five to six years, the IPCC produces an

assessment on all aspects of climate change. The most recent report was released in 2001 (the TAR), and the next one is due in 2007. Approximately 600 scientists from around the world contributed to the latest report on the scientific basis of climate change and additional scientists reviewed it. Some of the major conclusions include: 1) “There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities.” 2) it is likely the 1990s was the warmest decade in the past 1000 years, 3) by 2100, the global average temperature will have increased 1.4 to 5.8°C, and 4) by 2100, global mean sea level will have risen 0.09 to 0.88 m.

The TAR was a detailed analysis of the latest scientific information on climate science and had widespread participation by scientific experts in most relevant subject areas. However, most of the authors wrote only small sections of the voluminous report and only had a say in the content of their small sections. The Summary for Policymakers, which is what is most often cited, was written by a small number of government-appointed scientists, some of whom were responsible to political management. Authors of the technical reports had no say in the content of the Summary for Policymakers. Consequently, the TAR and the IPCC’s previous reports do not represent a consensus of all the scientists involved in the process. (Declaration of Jon M. Heuss)

Agency Response: Staff disagrees with the comment. The Summary for Policymakers (SPM) in the IPCC Third Assessment Report (TAR) was not written by a “small number of government-appointed scientists”. A total of 59 authors of the IPCC TAR are listed as SPM signatories. The TAR SPM notes that additional contributions to the SPM were made by many TAR authors and reviewers. The majority of SPM authors were not “government-appointed scientists”. While each scientist could only author a section of the entire report, all of the TAR authors and many additional external reviewers were allowed to critique and suggest revisions – both of the SPM and the underlying scientific chapters on which it was based – during the multiple stages of review. Many authors of the underlying chapters and technical summary were directly involved in the SPM, and all TAR lead authors were encouraged to review it. Consequently the SPM does represent the view of TAR authors and reviewers.

23. Comment: The 2001 NRC report, “Climate Change Science - An Analysis of Some Key Questions” was commissioned by President Bush in 2001 to address 14 key questions. Normally a NRC review takes a few years to complete. This review was completed in about three weeks. The composition of the NRC committee was balanced with experts in most of the climate-related disciplines and the committee produced an objective assessment that highlights the uncertainties of the science. The body of the report does not state unequivocally that man-made emissions are causing the surface temperature to rise. Such a statement only appears in the four-page summary. It is obvious that the full committee did not review the summary. Consequently, the summary does not represent a consensus of the full committee who wrote the body of the report. (Declaration of Jon M. Heuss)

Agency Response: The comment suggests that the summary of the 2001 NRC “Climate Change Science” report was not reviewed by the full NRC committee. This is incorrect.

The NRC requires that all committee members sign off on the publication of the entire report, including the summary.

24. Comment: The first IPCC assessment (IPCC, 1990) contained two schematic diagrams (Figure 7.1 b & c) depicting global temperature variations derived from proxy temperature measures for the last 10,000 years. This is reproduced in my Declaration as Figure 1. What this shows is that there was a period called the Holocene maximum 5,000 to 6,000 years ago that was the warmest in the last 10,000 years. In addition, it shows another period warmer than today called the Medieval warm period about 1200 AD. That was followed by a colder period, the Little Ice Age, that lasted until the 1800s. The temperatures then recovered from the Little Ice Age throughout the 20th century. Subsequent studies, such as Keigwin (1996) (Figure 2), Huang and Pollack (1997) and Tyson et al. (2000), reinforced this view of the temperature at many locations around the globe.

The foregoing assessment was taken as the prevailing view of the past global temperature history, until a paper was published in 1999 by Mann et al. (1999) that received the attention of the TAR authors who reproduced it in the TAR as Figure 2.20, and reproduced here as Figure 3. Absent from this study was any evidence for the warmer Medieval warm period or the Little Ice Age. In this reconstruction, which became known as the "hockey stick," the present temperatures are the warmest of the record. The TAR authors dismissed the Medieval warm period and the Little Ice Age as local European events and adopted Mann's reconstruction as representative of the globe as a whole. Figure 2-2 in the ARB Staff Report is derived from Figure 2.20 and is the basis of the ARB'S claim that the present is the warmest in the last 1,000 years. (Declaration of Jon M. Heuss)

Agency Response: Staff disagrees with the comment. For context, the staff report provides a primer on climate change science. It is not intended to be a comprehensive treatment of the issue. Science is an inherently dynamic endeavor. We obtain new information, learn from that new data, and sometimes modify previously-held theories. The "schematic diagrams" referred to by the commenter were estimates of global-scale temperature changes over the past 10,000 years. In 1990, at the time of publication of the first IPCC scientific assessment, the scientific community did not have rigorous quantitative estimates of how the average temperature of the Earth's surface might have changed over the preceding 10 millennia. Professor Mike Mann and his colleagues provided such rigorous quantitative estimates in the late 1990s. They attempted to reconstruct hemispheric-scale changes in temperature from a variety of natural archives or 'climate proxy' indicators, such as tree rings, corals, ice cores and lake sediments. While previous work had focused on individual indicators, Mann's research used rigorous statistical methods to synthesize the information from many different types of proxy record, at dozens of different locations. Due to the paucity of data in the Southern Hemisphere, recent studies have emphasized the reconstruction of Northern Hemisphere (NH) mean, rather than global mean temperatures over roughly the past 1000 years.

The term "Hockey Stick" was coined by the former head of NOAA's Geophysical Fluid Dynamics Laboratory, Jerry Mahlman, to describe the pattern common to numerous proxy

and model-based estimates of Northern Hemisphere mean temperature changes over the past millennium. This pattern includes a long-term cooling trend from the so-called “Medieval Warm Period” (broadly speaking, the 10th-mid 14th centuries) through the “Little Ice Age” (broadly speaking, the mid 15th-19th centuries), followed by a rapid warming during the 20th century that culminates in anomalous late 20th century warmth.

Estimates of Northern Hemisphere average temperature changes from climate model simulations employing estimates of long-term natural (e.g., volcanic and solar) and modern anthropogenic (greenhouse gas and sulphate aerosol) radiative forcings of climate agree well, in large part, with the empirical, proxy-based reconstructions. One notable exception is a study by von Storch *et al.* (2004) that makes use of a dramatically larger estimate of past natural (solar and volcanic) radiative forcing than is accepted in most studies, and exhibits greater variability than other models. Yet even this simulation points towards unprecedented warmth of the late 20th century. The general message from such modeling work is that the anomalous late 20th century warmth cannot be explained without including major contributions from anthropogenic forcing factors, and, in particular, modern greenhouse gas concentration increases.

Despite current uncertainties in empirical and model-based estimates of climate changes in past centuries, it nonetheless remains a widespread view among paleoclimate researchers that late 20th century hemispheric-scale warmth is anomalous in a long-term (at least millennial) context, and that anthropogenic factors likely play an important role in explaining the anomalous recent warmth.

25. Comment: Since the TAR was published in 2001, there have been numerous papers that have appeared in the scientific literature showing evidence that the Medieval Warm Period and the Little Ice Age were indeed global events. These new studies, as well as some older ones have recently been summarized in two papers by Soon and Baliunias (2003) and Soon *et al.*, (2003). They compiled all of the data from over 130 proxy measurement studies and asked three questions: 1) Is there an objectively discernable climatic anomaly during the Medieval Warm Period (800-1300)? 2) Is there an objectively discernable climatic anomaly during the Little Ice Age (1300-1900)? 3) Is there an objectively discernable climatic anomaly during the 20th century that is the warmest on record? The authors define anomaly as a period of more than 50 years of sustained warmth/cold or wet/dry during the interval. The answers to these three questions are displayed in Figures 4-6. The overwhelming majority of the studies indicate that the Medieval Warm Period and the Little Ice Age were global events and that the Medieval Warm Period was warmer than present day. (Declaration of Jon M. Heuss).

Agency Response: Staff disagrees with the comment. In support of his contention that “the Medieval Warm Period and the Little Ice Age were global events and that the Medieval Warm Period was warmer than present day,” the commenter cites papers by astronomer Willie Soon and coauthors (Soon and Baliunas, 2003). These papers have been soundly rejected in the peer-reviewed scientific literature, most recently by a dozen leading climate scientists (Mann *et al.*, 2003). The research of Soon and colleagues fails to recognize the important distinction between regional temperature changes and changes

in global- or hemispheric-mean temperature. Specific periods of cold and warmth differ from region-to-region over the globe (Jones and Mann, 2004). Changes in atmospheric circulation over time often exhibit a wave-like character, ensuring that certain regions tend to warm while other regions cool. To obtain truly representative estimates of global or hemispheric-mean temperature, it is necessary to calculate average temperature changes over a sufficiently large number of distinct regions. The temperature changes in a single small region are not a useful “yardstick” for judging whether the warmth of the late 20th Century is unusual. Thus, the identification of a period of true global or hemispheric warmth requires that warm anomalies in different regions should be synchronous, and not merely occur within a very broad interval in time, such as AD 800-1300 (as in Soon and Baliunas, 2003).

As noted in the response to comment 24, the general finding of many different reconstructions of global- and hemispheric-scale temperature changes (not simply those of Prof. Mann and colleagues) is that the warmth during the second half of the 20th Century is indeed unusual, even in the context of the Medieval Warm Period. The temperature “reconstructions” of Soon and colleagues are the scientific outliers – not the reconstructions of Mann *et al.*³

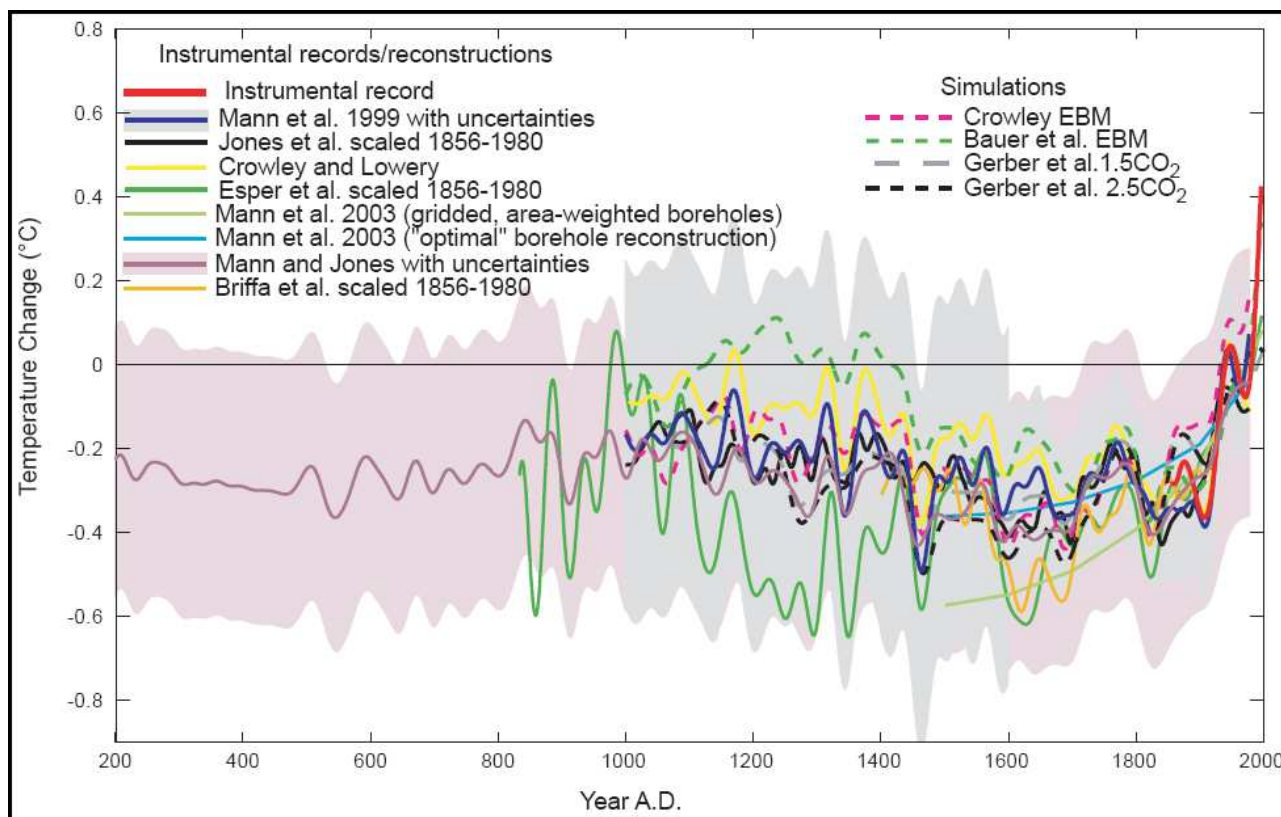
The figure reproduced below (Mann *et al.*, 2003) shows eight different reconstructions of Northern Hemisphere temperature variations over the past 1-2 millennia. These reconstructions have been produced by at least four different research groups. The purple and grey “envelopes” are an attempt to place uncertainty bars on two of these eight reconstructions. The instrumental record of surface air temperature changes over 1856 to 2000 is also shown (the red curve), as are results from four climate model simulations, in which different computer models are driven by estimated changes in natural and human-caused climate forcings.

The clear message from this picture is that the Mann *et al.* reconstruction is not fundamentally different from other reconstructions. All eight reconstructions illustrate that the Northern Hemisphere warmth of the second half of the 20th century is unusual in the context of our best current understanding of temperature changes over the past 1-2 millennia. The model simulations substantiate this result.

The Mann *et al.* temperature reconstruction has been rigorously scrutinized by the scientific community. A number of research groups around the world have independently produced millennial-timescale temperature reconstructions. These groups have used different input data and different statistical methods to generate their reconstructions. While there are differences in the details of these reconstructions (such as the size of their temperature variability), all concur in showing that the warmth of the Northern Hemisphere

³Another problem with the work of Soon and collaborators is their focus on the average warmth of the 20th Century. It is not the average 20th Century warmth, but the magnitude of warming during the 20th Century, and the level of warmth observed during the past few decades, which appear to be anomalous in a long-term context. Studies such as those of Soon and Baliunas (2003) which consider only average ‘20th Century’ conditions, are incapable of resolving trends in recent decades, and cannot meaningfully address the question of whether late 20th Century warmth is anomalous in a long-term and large-scale context.

in the second half of the 20th century is indeed unusual, and was not rivaled by the warmth of the Medieval Warm Period.



26. Comment: In an earlier paper, Mann et al. (1998) presented a temperature reconstruction from 1400 to 1980. The Mann et al. (1999), which was reproduced in the TAR, simply extended the record back to 1000 AD. Recently, McIntyre and McKittrick (2003) obtained the data used by Mann et al. (1998) and attempted to reproduce the Mann et al. (1998) temperature reconstruction. Instead they found the following: collation errors, unjustifiable truncation of data, unjustifiable extrapolations, obsolete data, geographical location errors, incorrect calculation of principal components, and other quality control defects. After they made the appropriate corrections, they recalculated the proxy temperature record and plotted it along with Mann et al.'s (1998) original line. This is shown in Figure 7. The corrected line indicates that there were periods in the 11th century that were warmer than the present. Details of the McIntyre and McKittrick reanalysis are documented at: <http://www.uoguelph.ca/~rmckitri/research/trc.html>. (Declaration of Jon M. Heuss).

Agency Response: Staff disagrees with the comment. The comment, citing work by McIntyre and McKittrick (2003), suggests that there are errors in the Mann *et al.* (1998, 1999) analyses, and that these putative errors compromise the “hockey stick” shape of hemispheric surface temperature reconstructions. The claims of McIntyre and McKittrick do not hold up under scientific scrutiny, and are now in the process of being rebutted in the peer-reviewed scientific literature (see, e.g., Rutherford *et al.*, 2005). A key aspect of

McIntyre and McKittrick's criticism relates to a statistical technique known as Principal Components Analysis (PCA). This technique is commonly used in studies of modeled and observed climate data. McIntyre and McKittrick claim that Mann *et al.* made a very basic error in their PCA, and allege that this mistake fundamentally biases the results that Mann *et al.* obtained. In fact, the "mistake" that McIntyre and McKittrick identify (failure to remove the time-mean of the entire dataset prior to performing PCA) is not a mistake at all, but a specific and scientifically-justifiable choice.

Mike Mann and colleagues have noted that the main features of their temperature reconstruction are robust to a variety of different processing options, including:

- (1) The elimination of any proxy data which were "infilled" in the original analysis,
- (2) Whether the reconstruction is produced with PCA, or an entirely different statistical technique.⁴

The putative 'correction' to the Mann *et al.* "hockey stick" by McIntyre and McKittrick, which argues for anomalous 15th century warmth (in contradiction to all other known reconstructions; see response to First Declaration of Jon M. Heuss, comment 24) is an artifact of the censoring by the authors of key proxy data in the original Mann *et al.* (1998) dataset. Unlike the original Mann *et al.* (1998) reconstruction, the so-called 'correction' by McIntyre and McKittrick fails statistical verification exercises, rendering it statistically meaningless.

27. Comment: As indicated in Figure 2-1 of the Staff Report, CO₂ emissions are rising in response to man-made emissions. The data and references in the Staff Report do not, however, establish with certainty whether those increased concentrations are producing a measurable increase in global temperatures. A few years ago, Figure 8 (Figure 2.22 in the TAR), which depicts the temperatures and the CO₂, and methane concentrations for the last 400,000 years obtained from ice cores from Antarctica, was used to demonstrate the cause and effect relationship between increased carbon dioxide and methane gases and temperature. However, more recent studies that had better temporal resolution showed that the temperature changes preceded the changes in the concentrations of CO₂ by several hundred to a thousand years (Fisher *et al.*, 1999, Caillon *et al.*, 2003). There is now some consideration of the possibility that the increased temperatures caused marine and terrestrial sinks to outgas CO₂. Consequently, Figure 8 can no longer be used to demonstrate that temperature responds to changes in CO₂ concentrations. (Declaration of Jon M. Heuss)

Agency Response: Staff disagrees with the comment. The comment refers to the famous Vostok ice core data from Antarctica, showing that CO₂ and temperature have varied hand-in-hand over the past 400,000 years. The commenter claims that these data were

⁴Rutherford *et al.* (2004) demonstrate nearly identical results to those of Mann *et al.* (1998), using the same proxy dataset as Mann *et al.*, but addressing the issues of infilled/missing data raised by McIntyre and McKittrick, and using an alternative climate field reconstruction (CFR) methodology that does not use PCA to represent proxy data networks.

used in the TAR to demonstrate a “cause and effect relationship,” and that this no longer holds in the light of new data showing CO₂ lagging behind Antarctic temperature.

Both claims are incorrect. The TAR specifically discusses this time lag, and cites the Fischer *et al.* (1999) reference mentioned by the commenter right next to its Figure 2.22. The TAR concludes the relevant paragraph with the following statement: “This is consistent with a significant contribution of these greenhouse gases to the glacial-interglacial changes by amplifying the initial orbital forcing (Petit *et al.*, 1999).”

In other words, climatologists have never considered CO₂ as the *cause* of the glacial-interglacial temperature variations, but rather as an *amplifying feedback*. In this feedback loop, temperature affects CO₂ and CO₂ in turn affects temperature. This role as a feedback is not called into question by the time lag – to the contrary, such a time lag is entirely consistent with theory, and was expected before it could be measured. The authors of the new, more accurate measurement of this time have emphasized that their result in no way argues against the role of CO₂ as a greenhouse gas.

Data from glacial times are by no means the only or most important evidence demonstrating an effect of CO₂ on temperature (which was first established by Arrhenius in 1896), but they do provide additional evidence for it. Computer models are now able to simulate a realistic ice age climate, but only if they take the effect of CO₂ on temperature into account. A number of studies have explicitly estimated the “climate sensitivity” using data from the last glacial including the researchers who drilled the Vostok ice core. The results are consistent with the accepted IPCC range of 1.5-4.5 °C, and thus provide independent support for this range.

28. Comment: Nevertheless, it is clear that global surface temperatures and CO₂ concentrations are currently rising together. Figure 9 indicates that the average global surface temperature has risen about 0.6°C (1.1°F) over the past 100 years. This is close to the rise of 0.7°F that has been estimated by the Staff Report. This rise cannot be unequivocally attributed to increased concentrations of greenhouse gases for a number of reasons. About half of the global surface temperature increase occurred prior to 1940, before the increased CO₂ concentrations would have been a factor. Consequently, it is widely accepted that this increase was due to natural variability. From 1940 to about 1970, the temperatures actually decreased about 0.4°F. There is no consensus as to the cause of this decrease, especially in light of the fact that CO₂ concentrations were rising. After 1970, the increasing temperature trend resumed, and between 1970 and 2000 exhibited an increase of roughly the same magnitude as was observed from 1900 to 1940. Since the increase in both of these periods is similar, natural variability cannot be ruled out. In addition, since the earth has been warmer than now during at least two to three other times in the past 10,000 years, natural variability cannot be dismissed. (Declaration of Jon M. Heuss)

Agency Response: As correctly noted by the commenter, the curve describing the estimated changes in Earth’s global-scale surface temperature over the 20th century is complex. It is not simply a monotonic trend. The commenter has accurately summarized the salient features of this curve: an initial warming (from roughly 1900 to 1940), a period

of little net change (from 1940 to 1970), and strong recent warming (from roughly 1970 to present). The commenter then compares this complex time series of surface temperature changes with the famous “Keeling curve” of gradually increasing atmospheric CO₂ concentrations over the 20th century. Finally, the commenter incorrectly assumes that since there is not a direct one-to-one correspondence between the CO₂ changes and the temperature changes (*e.g.*, the cessation of warming between 1940 and 1970 is occurring while atmospheric CO₂ levels are increasing), CO₂ is unlikely to be the primary driver of these temperature changes. The implication of the comment is that natural climate variability provides a more plausible explanation of the historical surface temperature record.

The problem with this simplistic interpretation is the implicit assumption that CO₂ is the only human factor influencing climate. This assumption is clearly wrong. It has conclusively been demonstrated that other anthropogenic factors have also influenced the surface temperature record. Over the last 100 years, there have been important changes in sulfate and soot aerosol particles, tropospheric and stratospheric ozone, land surface properties, *etc.* (Ramaswamy *et al.*, 2001). These are all examples of human-caused “climate forcings”. Not all of these forcings are expected to yield warming. Additionally, there have been changes in purely natural climate forcings, such as the Sun’s energy output, and the amount of volcanic dust in the atmosphere. Each of these human and natural forcings shows complex changes over space and time, and thus we expect climate to change in a complex way, and not in a neat, linear fashion.

So-called “detection and attribution” (D&A) studies seek to disentangle these complex human and natural influences on climate. This is a challenging statistical problem. D&A research relies on the fact that different forcings have different characteristic “fingerprints” of climate change. For example, increasing the Sun’s energy output tends to warm the entire atmosphere, while increasing CO₂ warms the troposphere, but cools the stratosphere (Hansen *et al.*, 1997, 2002). Many different D&A studies have attempted to quantify how much each climate forcing has contributed to observed surface temperature change, and how these contributions have evolved over time (see, *e.g.*, Hegerl *et al.*, 1997; Tett *et al.*, 1999; Stott *et al.*, 2000; Mitchell *et al.*, 2001, and references therein).

There are several “red threads” running through this large body of D&A research: 1) Natural factors alone cannot explain the rapid increase in Earth’s surface temperature since 1970, or over the second half of the 20th century; 2) Increasing greenhouse gases are the main contributor to this late-20th century temperature increase; 3) The greenhouse gas climate-change “signal” is robustly identifiable in virtually all D&A studies; 4) A sulfate aerosol cooling signal, which has partly offset the greenhouse gas warming, is also identifiable in observed temperature change records, and may well have contributed to the cessation of warming between 1940 and 1970; 5) The causes of the warming between 1900 and 1940 are more ambiguous.

The final issue raised by the comment relates to the role played by “unforced” variability of the climate system (also referred to as “climate noise”). This variability is unrelated to changes in external forcings, such as the concentration of greenhouse gases, or the Sun’s

energy output. It encompasses variability “internal” to the climate system, such as that caused by El Niño, or the North Atlantic Oscillation. We rely on both models and observations for estimates of this variability. D&A studies rigorously test whether such natural “noise” could explain observed temperature changes in surface temperature. The bottom-line conclusion of this work is that natural variability cannot explain the late-20th century warming.

29. Comment: There are also several other reasons to question whether the global surface temperature record is an indicator of global climate change. Some of the reasons to question the surface temperature trends include the following: 1) there are a different number of stations each year, 2) stations have moved during record period, 3) stations are not distributed homogeneously, 4) equipment has changed over time, 5) local environments have changed over time, and 6) temperatures must be corrected for the urban heat island effect. The TAR estimates that the urban heat island effect only accounts for an increase of 0.06°C per century, which would only account for a negligible part of the observed global trend. (Declaration of Jon M. Heuss)

Agency Response: The global surface temperature record is considered to be a reliable indicator of global climate change for several reasons including:

- As the comment notes, the number of stations making surface temperature measurements varies from year-to-year and from decade-to-decade. The effect of such changes has been investigated in many different studies. These studies use spatial interpolation and area-averaging schemes that were designed to work well with networks of unevenly-distributed stations. Such interpolation and area-averaging approaches yield estimates of global-scale temperature that are relatively insensitive to changes in station numbers over time (Smith and Reynolds, 2005).
- A wide variety of homogeneity adjustment techniques have been developed. These techniques are successful in identifying changes in station location, determining the artificial change in temperature caused by such moves, and adjusting the time series to account for them (Peterson *et al.*, 1998; Aguilar *et al.*, 2003).
- A wide variety of homogeneity adjustment techniques have been developed to identify changes in temperature sensors, determine the artificial change in temperature caused by a change in equipment, and adjust the time series to account for such effects (Peterson *et al.*, 1998; Aguilar *et al.*, 2003).
- Local changes in the station environment can create very subtle artificial changes in observed temperature records. Homogeneity adjustment techniques may identify some of these as step function changes, and thus account for the largest impact. But if station environment changes are widespread and systematic, they may indeed have an impact on the temperature record. There are two competing types of change occurring near observing sites. One can be thought of as “urbanization”. This may involve the building of new structures, or the paving of driveways (the latter may occur even at quite rural sites). The other type of change can be thought of as “ruralization,” of which

tree growth is an example. Trees not only provide some shade to the station environment, but also increase evapotranspiration, which likely cools temperatures, particularly during daytime. The approach currently used to minimize these influences is to use a subset of only the highest quality stations for analysis. This is routinely done in the U.S. with the U.S. Historical Climatology Network (Easterling *et al.*, 1996).

- Recent investigations have confirmed earlier research findings that the urban heat island impact on global temperature values is very small (Jones *et al.*, 1990; Peterson *et al.*, 1999; Peterson, 2003; Parker, 2004).
- Global temperature values are heavily weighted to Sea Surface Temperatures (SST), since 70% of the world is ocean and SSTs are not impacted by urbanization.
- Strong independent support for warming of the Earth's surface is provided by observations of widespread glacial retreat, later lake and river freeze up dates, earlier lake and river thaw dates, earlier blooming dates for plants, changing distributions of some bird species, etc.
- There is close agreement between overall trends in independent analyses of land surface air temperature, sea surface temperature (SST) and night marine air temperature (NMAT).
- The agreement between island and coastal land air temperature trends and those at the surface of the nearby ocean.

30. Comment: The U.S. temperature record (Figure 10) is probably the most scrutinized and analyzed data set in the world. The trend for the U.S. is much less than for the globe, and since the 1930's there is no trend at all (Hanson *et al.*, 1989; Plantico *et al.*, 1990; Hansen *et al.*, 2001, LeLinson and Waple, 2004). There have also been a number of papers published recently that indicate that the urban effect is much larger. These include: Houston observing a +0.8°C increase from 1986 - 2000 (Streutker, 2003), a +0.05°C/decade in southeast China cities (Zhou, 2004), three South Korean cities with a +0.35-0.50°C trend since 1980 (Choi *et al.*, 2003), and in U.S. cities a +0.35°/century trend (Kalnay and Cal, 2003) has been observed. In addition two recent papers have found a positive correlation between the slope of an area's temperature trend and local economic activity (de Laar and Maurellis, 2004; McKittrick and Michaels, 2004). Taken collectively, these studies suggest a degree of contamination due to this urban influence in the global temperature records that has not been accounted for. (Declaration of Jon M. Heuss).

Agency Response: The U.S. national temperature was quite warm during the dustbowl era of the 1930s. Therefore, time series that start at a very warm time show less warming. Over 1930 to 2004, U.S. temperatures⁵ show a small trend of 0.04 °F/decade. By comparison, starting at the earliest year available (1895), the trend is 0.10°F/decade. If

⁵See U.S. Climate at a Glance: <http://www.ncdc.noaa.gov/oa/climate/research/cag3/cag3.html>.

one instead starts at the end of a cool era, the temperature trend can appear very large, such as the 1976 to 2004 trend of 0.56°F/decade.

Urban heat island analysis is very difficult to do well because one has to separate out all the other potentially confounding effects such as changes (through time) or differences (in space) in instrumentation, latitude, coastal influences, elevation effects, *etc.* Also, when one looks at only one city, one has a basic problem that has been recognized since the 1940s: some locations would naturally be warmer than other locations, even if they were all pristine rural area. Therefore, the best research is done not on a few stations in one or two cities, but on data from hundreds or thousands of stations that have undergone homogeneity testing and adjusting. Kalnay and Cai's work, which is mentioned by the commenter, has already been formally rebutted in *Nature* (Vose *et al.*, 2004), and did not use homogeneity-adjusted data. Recent results using data from large numbers of stations (Jones *et al.* 1990; Peterson *et al.* 1999; Peterson 2003; Parker 2004) indicate that globally and in the U.S., urban heat island contamination in the surface temperature signal is small. The reason for this is likely to be that the local- and micro-scale influences around an urban station which is more likely to be located over cool grass in a park-like area rather than in the hot industrial section of town are stronger than the meso-scale urban heat island.

The cited work of de Laar and Maurellis (2004) and McKittrick and Michaels (2004) is irrelevant to the issue of urban heat island effects. Temperatures are warming more in high latitudes than in the tropics. The economies of middle latitude countries are doing far better than the economies in the tropics. So one would expect economic progress to be correlated with temperature change, simply because of this latitudinal effect. The simplistic arguments of de Laar and Maurellis (2004) and McKittrick and Michaels (2004) ignore the evidence of temperature increases over the ocean which constitutes 70 percent of the Earth's surface. These increases cannot be due to changes in local economic activity.

31. Comment: There is another reason to question the ramifications of the global surface temperature record. Since 1979 to present there exist two other temperature data sets that show no significant trends. The first is the satellite measurements (Figure 11) in the troposphere from the Microwave Sounding Units (MSU) first reported by Spencer and Christy (1990). The second are the data obtained around the world from weather balloons (Hurrell *et al.*, 2000 and Pielke *et al.*, 1998). These data are highly correlated and suggest a lower troposphere (0 to 8 km) temperature trend of only 0.08°C per decade (Christy and Norris, 2004). In addition the MSU trend for the troposphere from 0 to 18 km is reduced to 0.03 +/- 0.05°C per decade. This contrasts with the surface record that shows a slope of about 0.17°C per decade. (Declaration of Jon M. Heuss)

Agency Response: The comment raises several points. First, it notes that surface and tropospheric temperatures have apparently warmed at different rates since 1979, with muted warming of the troposphere (as inferred from satellites) and strong warming of the surface (as inferred from the surface thermometer network). The commenter implies that this differential warming casts doubt on the reliability of the global surface temperature record, and therefore on the reality of surface warming. This is incorrect. The reality of

large-scale warming of the Earth's surface has been confirmed in numerous studies, most recently by a U.S. National Academy Panel (NRC, 2000) and by the Intergovernmental Panel on Climate Change. Independent corroboration of recent surface warming is provided by increases in ocean heat content, by widespread glacial retreat, and by increases in tropospheric water vapor. It is difficult to understand how such pervasive changes could be occurring in the absence of surface warming.

The commenter also suggests that the surface and troposphere should be warming at the same rates, and that if they are not, it must point towards an error in the surface data. This, too, is incorrect. There are good physical reasons why we do not expect surface and tropospheric temperatures to change at exactly the same rate, at all places and on all timescales. We know, for example, that during an El Niño event, there is large-scale warming of sea-surface temperatures in the eastern equatorial Pacific. This surface warming stimulates convection, which leads to latent heat releases in the troposphere. The net effect is larger warming in the troposphere than at the surface. Similarly, large volcanic eruptions cause greater cooling in the troposphere than at the Earth's surface (Santer *et al.*, 2001).

Finally, although the commenter mentions the muted warming in satellite- and weather balloon-based estimates of lower tropospheric temperature change, the comment fails to note that there are very large uncertainties associated with these estimates (NRC, 2000). In-homogeneities in the weather balloon data have been well documented by Lanzante *et al.* (2003) and Seidel *et al.* (2004), and are related to such factors as changes in temperature sensors, observing times and locations, *etc.* Adjusting the weather balloon data to account for such "non-climatic" changes is a difficult technical problem. Estimated temperature trends are sensitive to the assumptions that different groups make in adjusting for in-homogeneities (Seidel *et al.*, 2004). The same applies to tropospheric temperature trends derived from the MSU instruments flown on Earth-orbiting satellites (see response to comment 32 below). The commenter also neglects to mention that over the entire period of weather balloon measurements (roughly the last 45 years), tropospheric temperature increases are larger than temperature increases at the surface.

32. Comment: In order to generate temperature data from the MSU, algorithms for orbital decay and other adjustments need to be applied to the raw data. Christy *et al.* developed these and have refined them over time, but these refinements have not altered the observed trend in any significant way. In the past two years, three groups (Mears *et al.*, 2003, Vinnikov and Grody, 2003 and Fu *et al.*, 2004) have suggested alternative algorithms that resulted in a positive MSU temperature trend on the order of the surface temperature trends. In each case Christy has responded to point out the shortcomings of the alternative algorithms and show that only his algorithm produces a data set that agrees with the independent weather balloon data set (Christy and Norris, 2004). (Declaration of Jon M. Heuss)

Agency Response: Satellite-based estimates of tropospheric temperature changes (from 1979 to present) are obtained from MSU instruments that have flown on over a dozen satellites. These satellites have orbital drifts that affect the time of day at which they sample Earth's daily temperature cycle, and the portion of the Earth's atmosphere that

they “see” from space. In theory, MSU instruments are engineered to be identical. In practice, however, each MSU instrument behaves somewhat differently in the hostile environment of space. It is a difficult and challenging technical problem to adjust “raw” MSU data for the complex effects of orbital drifts, instrument calibration drifts, and the biases between MSU instruments flown on different satellites. There are a large number of possible adjustment choices that an analyst can make in trying to splice together a homogenous temperature record from 12+ drifting satellites. These adjustment choices can influence the estimated temperature changes, as is clearly illustrated by the work of Mears *et al.* (2003) and Vinnikov and Grody (2003).

It is incorrect to suggest that Christy *et al.* identified all of the adjustments that have been applied to MSU data. In fact, a significant problem with the MSU lower tropospheric temperature record (the so-called “falling satellite” effect, which relates to changes in the altitude of a satellite relative to Earth’s surface) was first identified by Wentz and Schabel (1998), and not by Christy and co-workers. The fact that major adjustments to the Christy *et al.* MSU records have failed to alter Christy *et al.*’s estimates of tropospheric temperature changes is viewed as a strength by the commenter, but would give many scientists pause for thought.

John Christy and his colleagues have not identified “shortcomings” of the approach used by Mears *et al.* (2003). The differences between the tropospheric temperature-change estimates of Christy *et al.* (2003) and Mears *et al.* (2003) are primarily related to the two groups’ different estimates of a single uncertain number related to the calibration of one specific MSU instrument. If anything, Mears *et al.* have shown that the number estimated by Christy *et al.* is unrealistically large.

Finally, the commenter believes that we should place more confidence in the Christy *et al.* (2003) MSU-based estimate of tropospheric temperature changes, since this is the only “data set that agrees with the independent weather balloon data set”. The commenter implies that the weather balloon data are an unambiguous ‘gold standard’ that the scientific community can use for evaluating the reliability of different satellite data sets. This is incorrect. Data on long-term atmospheric temperature changes gleaned from weather balloons are (like the satellite-estimated temperature changes) very sensitive to the specific processing choices that an analyst makes in adjusting for data in-homogeneities. There is no weather balloon ‘gold standard’.

Furthermore, it is worth pointing out that there have been at least five different versions of the Christy *et al.* MSU temperature data sets. These versions have evolved over time, as John Christy and colleagues, or other investigators (Wentz and Schabel, 1998) have identified specific problems with the satellite data. These different MSU versions have been compared with different subsets of weather balloon data – the same ‘gold standard’ has not been applied to all versions of the Christy *et al.* MSU data. Many of the weather balloon records used by Christy *et al.* in their most recent work are highly limited in their spatial coverage, making them less than ideal for evaluating the relative reliability of the Mears *et al.* and Christy *et al.* versions of the MSU temperature data.

33. Comment: Very recently, two different groups (Chase et al., 2004 and Douglass et al., 2004) ran six different general circulation models (GCM) to study the dependence of predicted temperature trends on altitude in the troposphere. All six of the models gave similar results. They predicted a positive temperature trend that is larger for the troposphere than for the surface. As a result of this discrepancy, Chase et al. conclude that the models contain errors in tropospheric water-vapor content and therefore in total greenhouse-gas forcing, precipitable water and convectively forced large-scale circulations. They further state that such errors argue for extreme caution in applying results to future climate change assessment activities and to attribution studies, and the errors call into question the predictive ability of recent generation model simulations. (Declaration of Jon M. Heuss).

Agency Response: Staff disagrees with the comment. Neither Chase *et al.* nor Douglass *et al.* “ran different general circulation models”. Both studies simply used results from existing GCM experiments. The Chase *et al.* study relied on model experiments that were performed over five years ago. These runs included estimated historical changes in well-mixed greenhouse gases and sulfate aerosol particles. They neglected climate forcings that are now known to have had important effects on recent atmospheric temperature changes, such as stratospheric ozone depletion and volcanic aerosols (see Ramaswamy *et al.*, 2001; Hansen *et al.*, 2002). There is considerable evidence that these neglected forcings may have cooled the troposphere by more than the surface over the last several decades (Santer *et al.*, 2001; Free and Angell, 2002). Thus, Chase *et al.* did not make use of model simulations that incorporate the current understanding of the major “forcings” that have influenced observed tropospheric temperature changes. This is a serious deficiency. When such newer model runs are compared with observations, and uncertainties in the observations are properly accounted for, it is found that levels of model-data agreement are critically sensitive to the choice of observational dataset (Santer *et al.*, 2003). The Chase *et al.* and Douglass *et al.* papers cited by the commenter did not account for observational uncertainty, nor did they rigorously assess the statistical significance of model-data differences. In contrast, a number of rigorous statistical studies have identified model-predicted “fingerprints” of human-induced tropospheric temperature change in observed satellite data (Santer *et al.*, 2003) and in observed weather balloon records (Tett *et al.*, 1996; Thorne *et al.*, 2002, 2003; Jones *et al.*, 2003).

34. Comment: In summary, there are legitimate questions regarding the reasons for the observed temperature trends. If it is due to global greenhouse gas emissions, then there should be an even faster warming of the troposphere. The fact that warming is not observed in the troposphere calls into question the ability of the present generation of GCMs to predict future climate scenarios. (Declaration of Jon M. Heuss)

Agency Response: Staff disagrees with the comment. Observational uncertainty is large, both in weather balloon (Lanzante *et al.*, 2003) and in satellite-based estimates of tropospheric temperature change (Mears *et al.*, 2003; Vinnikov and Grody, 2003). While the Christy *et al.* analysis of MSU data shows limited warming of the troposphere since 1979, the Mears *et al.* and Vinnikov and Grody analyses of the same raw MSU data both indicate pronounced warming of the troposphere over the past two and a half decades.

This observational uncertainty has important implications for our ability to evaluate climate models. Model simulations of the expected tropospheric temperature changes due to combined anthropogenic and natural effects are consistent with the Mears *et al.* MSU data, but not with the Christy *et al.* results (see Santer *et al.*, 2003). The commenter ignores uncertainties in the satellite observations. Furthermore, the commenter implies that human-caused changes in greenhouse gas are the only influence on climate. This is incorrect. It is inarguable that other climate forcings (*e.g.*, stratospheric ozone depletion, explosive volcanic eruptions) have also operated over the satellite era, and have had important effects on tropospheric temperatures (NRC, 2000; Hansen *et al.*, 1997; 2002).

The additional heat that the planet has acquired as a result of greenhouse warming is partitioned between various 'storage cells': *e.g.*, ice sheets, glaciers, ice melting, and the oceans. About 90% of the additional heat has appeared in the oceans, the hub of the planetary climate system, due to their high heat capacity. That is where the greenhouse warming signal should be most apparent - not in the atmosphere, which has 1,000 times less heat capacity. In this regard, it is remarkable that the warming signal has been rigorously detected in the atmosphere (Santer *et al.*, 1996; Tett *et al.*, 1996; Santer *et al.*, 2003; Thorne *et al.*, 2003).

Previous (Barnett *et al.*, 2001) and current studies have investigated the net warming of the oceans over the last 40 years. The observed increase in heat content in all ocean basins is almost exactly what is predicted by anthropogenically-forced climate models from both the US and Europe. It has been clearly shown that the observed ocean signal cannot be due to natural variability, nor can it be due to external forcing (solar and volcanic). The detection of this model-predicted signal has a huge statistical significance, *e.g.*, it is in the range of 5-10 standard deviations. By the same token, the noise levels of natural variability produced by the models are approximately the same as observed, again lending support to the models' accuracy. There is no doubt that the model-predicted warming signal has been observed from the oceans' surface to a depth of at least 700m. This fact, plus the earlier detection in the atmosphere (Santer *et al.*, 1996; Tett *et al.*, 1996; Santer *et al.*, 2003; Thorne *et al.*, 2003) leaves little doubt as to the current existence of the greenhouse signal in the environment. The proof of the models' ability to produce the observed signal in both ocean and atmosphere means that their predicted changes over the next 20-30 years are apt to be accurate.

35. Comment: As noted in the previous section of this Declaration, GCMs are unable to reproduce the observed vertical temperature structure and this raises fundamental questions about their predictive ability. However, even those who believe that the model predictions have some value, caution against using them to make regional predictions. To its credit, the ARB does not rely on regional modeling predictions to make their case for possible future warming. However, a recent paper by Hayhoe *et al.* (2004) does look at regional and local results for not only temperatures, but for incidence of heat waves, precipitation, snowpack, and runoff as well. They use two GCMs, the Parallel Climate Model (PCM) and the U.K. Hadley Centre Climate Model (HadCM3), and run them out to 2100. (Declaration of Jon M. Heuss)

Agency Response: Staff disagrees with the comment. The commenter incorrectly claims that “GCMs are unable to reproduce the observed vertical temperature structure”. In fact, GCMs have successfully reproduced observed changes in atmospheric temperature profiles (see, e.g., Santer *et al.*, 1996; Tett *et al.*, 1996; Thorne *et al.*, 2002, 2003; Jones *et al.*, 2003). Such model-data comparisons rely on weather balloon data for information about observed changes in atmospheric temperature. For example, weather balloons show tropospheric warming and stratospheric cooling over the past 45 years, in accord with climate model predictions. The apparent discrepancy between modeled and observed temperature changes is over the satellite era only. This ‘discrepancy’ is restricted to the troposphere, and is highly sensitive to uncertainties in observed satellite data. If the Mears *et al.* version of the MSU tropospheric temperature data is used, model and observational estimates of atmospheric temperature change are reconciled.

The commenter suggests that climate models have little or no predictive power at regional scales. This is incorrect in that climate models are continually being improved; simulation of regional features (regional being defined as areas the size of several states) of climate in recent models is better than in previous versions. For example, the PCM mentioned by the commenter has been shown to accurately simulate regional aspects of heat waves and frost days in the latter part of the 20th century (Meehl *et al.*, 2004; Meehl and Tebaldi, 2004). Evaluating a GCM’s ability to simulate such second order aspects of climate, such as extremes associated with heat waves and frost days, is relatively new in the climate science field. The results show that the models do a surprisingly good job of simulating such phenomena on regional scales. This builds confidence that these models can provide useful and relevant information regarding changes of these phenomena in the future.

Furthermore, several recent “fingerprint” detection studies have compared modeled and observed surface temperature changes at continental and sub-continental scales (Stott, 2003; Zwiers and Zhang, 2003). This work finds convincing statistical evidence of a human “fingerprint” (primarily due to human-caused changes in greenhouse-gases and sulfate aerosols) in observed surface temperature records. This illustrates that models have some skill in simulation of regional-scale temperature changes.

The Hayhoe *et al.* study cited by the commenter started with low-resolution, global GCMs, and then derived local information from these models using a standard technique called statistical downscaling. Numerous studies have shown this technique to be effective in deriving such small-scale information from the global models. However, this information is only as good as the global model simulations, and this is why it is important to note that recent studies (such as the above-mentioned investigations of heat waves and frost days) show the current generation of global models is doing a credible job in simulating such regional-scale features.

36. Comment: One of the main reasons one should not consider using a GCM for regional and local planning purposes is their poor spatial resolution. In a GCM, the world is divided up into grid boxes and the meteorological variables as well as topographical and hydrogeological features are averages within the box. In the PCM, the grid boxes are approximately 200 miles by 150 miles (latitude x longitude) in size while the HadCM3 has 175 by 200 miles grid boxes (IPCC, 2001). Since California is approximately 700 miles

long and 250 miles wide, the minimum number of grid boxes in the state would be 1.25 by 4.7 (PCM) and 1.4 by 3.5 (HadCM3). In practice, however, the number of grid boxes would be larger since California does not run directly north to south, and it is unlikely the side of the grid boxes would adhere to the state boundaries. Nevertheless, there would only be a handful of grid boxes representing all of California, and this creates a serious problem because of California's rugged terrain. It is clearly possible that one grid box could contain parts of the Sierra Nevada's and part of the Pacific Ocean. The significance of the mean elevation that would be calculated as input for that box, the significance of the average temperature computed for that box, and the significance of the average precipitation level in that box have not been frilly (sic) considered or explained in the Staff Report or in the references included in the Staff Report. As a result, extrapolations that provide detailed estimates of future temperatures, precipitation, and snow-pack and river runoff have unknown credibility. (Declaration of Jon M. Heuss).

Agency Response: The commenter would have a point if low-resolution GCMs were the only tools used to understand future climate change. However, this is not the case. In the case of California, studies seeking to assess the potential impacts of climate change have used either high resolution regional models or statistical "downscaling" techniques. This enables researchers to bring the low-resolution global model results down to highly local scales (e.g., to "grid boxes" of 12 x 12 km, rather than the 200 x 150 mile grid boxes mentioned by the commenter). At the smaller spatial scales of the downscaled data, the major orographic features in California (the Sierra Nevada) are much better resolved, and their impacts on weather and climate are more reliably represented. The results of the most comprehensive study to date, performed for the western U.S., shows the region with insufficient water to meet today's mandates, let alone those of a region with higher population than present. (Pennell and Barnett, 2004). It is these high resolution studies that give the necessary detail about temperature, snow pack, etc. required to estimate future changes in future stream flow and water availability.

37. Comment: The IPCC and ARB promote a particular reconstruction of climate history, popularly known as the "hockey stick,"¹ as their chief exhibit in support of regulatory climate policy. When plotted as a graph, the data in this reconstruction form a relatively flat line from 1000 A.D. to 1900 A.D. (the handle of the hockey stick) and a sharply upward curving line during the past 100 years (the blade of the hockey stick). The reconstruction allegedly proves that the 20th Century was the warmest century of the past millennium and the 1990s the warmest decade on record.

However, the most comprehensive review of the climate reconstruction literature found 79 studies that show "periods of at least 50 years which were warmer than any 50 year period in the 20th century." Another study finds that the hockey stick "contains collation errors, unjustifiable truncation or extrapolation of source data, obsolete data, geographical location errors, incorrect calculation of principal components and other quality control defects." Temperature data going back 420,000 years, derived from the Vostok ice core in East Antarctica, indicate that all four interglacial periods prior to the one in which we now live were warmer than the present one by 2^oC or more.⁵ Claims that the late 20th Century warming was unprecedented, outside the range of natural variability, and therefore cause

for alarm, are controversial, not “settled” science. (Competitive Enterprise Institute, 9/21/04)

Agency Response: Staff disagrees with the comment. Please see the response to comments 24 and 25.

38. Comment: A satellite study of the Houston, Texas, urban heat island (UHI) finds that in just 12 years, a 30 percent increase in population added 0.82°C to Houston’s UHI⁶ – more than the IPCC calculates global temperatures rose over the entire past century, when the earth’s population grew by some 280 percent. Another study estimates that urbanization and land-use changes account for 0.27°C or about one-third or average U.S. surface warming during the past century – at least twice as high as previous estimates. Still another finds “strong observational evidence that the degree of industrialization is correlated with surface temperature,” leading the authors to conclude that “the observed surface temperature changes might be a result of local surface heating processes and not related to radiative greenhouse gas forcing.” The heat effects from urbanization and land-use changes are larger than the IPCC assumed, and have not been adequately corrected in 20th Century surface temperature records. (Competitive Enterprise Institute, 9/21/04)

Agency Response: When trees or grass are replaced by asphalt or buildings, the temperature of the surface will increase due to changes in albedo, transport of heat from the surface layer to subsurface layers, and especially latent heat released by evapotranspiration. Satellites see the skin temperature. It is quite likely that areas in Houston that went from grass to paved roads or building roofs warmed over the past 12 years. But *in situ* weather observing stations in the U.S. are not sited on roofs or on highway intersections. Examining the UHI using a radiosonde mounted to a car, Klysiak and Fortuniak (1999) found the permanent existence of heat cells during the night, with housing estates on the outskirts of the city distinguishing themselves very sharply from the surroundings in terms of thermal structure. Open areas (gardens, parks, railway yards, etc.) were sharply separated regions of cold air. The thermal contrast (in other words, the horizontal gradient of temperature) at the border between the housing estates and the fields covered with snow reached several degrees centigrade per 100 meters. So it is entirely consistent to have satellite observations of a city as a whole warm considerably, while little or no impact is observed at *in situ* weather stations located in park cool islands.

Examination of temperature trends for global rural stations versus the full data set found no difference (Peterson *et al.*, 1999). Comparison of hundreds of U.S. rural and urban stations found that the urban heat island effect on U.S. temperatures was miniscule (Peterson, 2003). Comparison of trends at urban stations on both windy days (when urban heat islands should be minimized) and calm days (when urban heat islands should be enhanced) showed no significant difference (Parker, 2004). This is compelling evidence that increased urbanization is not significantly impacting *in situ* climate observations. Regarding the claimed links between the degree of industrialization and surface temperature, see response to comment 30.

39. Comment: The ARB *Staff Report* acknowledges that “In California the less populated and rural areas have shown the lowest average rate of temperature increase.” ARB should also have noted that several weather stations in less populated and rural areas show a *cooling trend* in the 1990s, allegedly the warmest decade of the past millennium. Stations where cooling occurred include Berkeley, Chico, Colfax, Death Valley, Fort Bragg, Fresno, Lake Spalding, Lemon Cove, Lodi, Mount Shasta, Ojai, Orland, Paso Robles, Quincy, Redding, Redlands, San Luis Obispo, Santa Cruz, Tahoe City, Ukiah, Wasco, and Yosemite Park. (Competitive Enterprise Institute, 9/21/04).

Agency Response: The decade of the 1990s was in fact the warmest on record for California, and only one year during that period (1998) was cooler than the 20th century average. In general, temperature trend analyses are susceptible to extremely warm or cool events at the start or end of the series, particularly for very short analysis periods. Because 1998 was much cooler than normal and because the period 1990-99 is very short for a trend analysis, many stations in California could very well have a cooling trend for the 1990s. However, this does not mean that California has been cooling on a long-term basis; in fact, for California as a whole there have been only two years since 1980 that experienced temperatures below the 20th century average.

40. Comment: As much as half the surface warming of the past 50 years may be due to the Pacific Decadal Oscillation, a natural event that alternately warms and cools the Pacific Ocean at 20- to 30-year intervals. In just two years (1976-1977), global average surface air temperatures increased by 0.2^oC, and remained elevated through the end of the 20th century. No current climate model can explain the step-like increase. If greenhouse warming were the driving force, the 1976 shift in atmospheric temperatures should have preceded any corresponding change in ocean temperatures. Instead, increases in tropical sea surface and subsurface temperatures preceded the atmospheric warming by 4 years and 11 years, respectively. (Competitive Enterprise Institute, 9/21/04).

Agency Response: Staff disagrees with the comment. The comment incorrectly asserts that over half of the surface warming of the past 50 years may be due to the effects of the Pacific Decadal Oscillation, a natural mode of climate variability. The commenter provides no scientific evidence to support this assertion. The comment ignores the pervasive and compelling scientific evidence of a large and identifiable human effect on climate.

Furthermore, the commenter implies that all of the recent increase in global-mean surface air temperature is associated with a step-like change between 1976 and 1977. This, too, is incorrect, as is easily verifiable by examining a time series of global-mean surface air temperature changes. Pronounced surface warming of 0.15 to 0.20^oC/decade occurs even after the step-like change in the late 1970s. Climate model simulations are capable of reproducing the key features of observed surface temperature changes over the 20th century, as has been extensively documented in a wide range of scientific studies (e.g., Mitchell *et al.*, 2001).

41. Comment: The sun was the significant source of 20th Century warming. There were two distinct warming periods during the past 100 years: from 1910 to 1945 (+0.50°C, +0.90°F), and from 1976 to the present (+0.46°C, +0.82°F). The sun probably caused most of 1910-1945 warming, because more than two-thirds of the buildup in greenhouse gas emissions over pre-industrial levels occurred after 1945. The sun also contributed to the later warming. A reconstruction of solar magnetic field fluctuations from beryllium 10 isotope concentrations in ice cores drilled in Greenland and Antarctica shows that the last 60 years were a “period of high solar activity ... unique throughout the past 1150 years.” (Competitive Enterprise Institute, 9/21/04)

Agency Response: The commenter erroneously asserts that changes in solar irradiance are the main driver of 20th century warming. Once again, the commenter provides no credible scientific evidence to support this assertion.

We do, however, have information on how the Sun’s energy output has varied over the past century, and can rigorously test the hypothesis that the Sun is the major cause of 20th century warming. Such tests have been performed many times. They reveal that changes in the Sun’s energy output simply cannot explain the large increase in global-mean surface temperatures over the 20th century (Hegerl *et al.*, 1997, 2003; Wigley *et al.*, 1998; Crowley, 2000; Mitchell *et al.*, 2001). A substantial human influence (arising primarily from increases in the atmospheric concentrations of greenhouse gases) is required in order to best explain the observations.

Regarding the final sentence of the comment, it should be noted that “since climate itself can affect the deposition of cosmogenic isotopes in ice and trees, the ¹⁴C and ¹⁰Be records may also indicate terrestrial variability rather than solar”. The implication is that isotopes like beryllium-10 respond to more than solar irradiance changes alone. Interpretation of ¹⁰Be records is not as straightforward as the commenter erroneously suggests. Furthermore, recent scientific analyses of long (8,000 year) radiocarbon records indicate that the cosmogenic isotopes like ¹⁴C do not have unusually high values in recent decades.

42. Comment: The information I have read seems to indicate that the production of CO₂ by natural means is far more prevalent than manmade sources. The fact that global warming is a figment of computer models, and can be explained through history as having to do with solar phases, rather than anything that people can do, cause me to believe that all you are really after is more of our hard-earned money. The fact that you are a state agency that has no direct accountability to the taxpayers just means that you can pretty much say or do whatever you want. I, as an informed citizen will be doing what I can to make sure that you and your money-grabbing scheme is stopped. (Larry Rosner, similar letters received from Scott Fulrath, Ron Kilmartin).

Agency Response: Staff disagrees with the comment. See response to comment 41.

43. Comment: No real scientist will claim the ability to quantify the relative contributions of greenhouse gases, the Pacific Decadal Oscillation, solar radiation, and urban heat islands to the warming trend of recent decades. (Competitive Enterprise Institute, 9/21/04).

Agency Response: Staff disagrees with the comment. Numerous well-published scientists have spent the past decade attempting to quantify the relative contributions of human and natural forcings. The best available scientific information indicates that human-caused increases in greenhouse gases have made a substantial contribution to the warming of the Earth's surface over the 20th century, and that natural factors alone cannot explain the observed changes (Mitchell *et al.*, 2001).

44. Comment: The models on which climate alarmists rely project 50-100 percent more warming in the troposphere, the layer of air from roughly two to eight kilometers up, than at the surface. Observations show the opposite is occurring. The surface appears to be warming at a rate of 0.17^oC per decade since 1976. However, the troposphere is warming at less than half that rate – by 0.08^oC per decade since 1979 according to both satellite and weather balloon measurements. Either the climate models get the basic physics wrong, or something other than the greenhouse effect is driving much of the surface warming – or both. (Competitive Enterprise Institute, 9/21/04).

Agency Response: This issue has been dealt with comprehensively in response to comments 29 through 32. The best available scientific information suggests that climate models do not “get the basic physics wrong,” as the commenter erroneously contends. In fact, recent studies have identified serious problems with the satellite and radiosonde datasets that the commenter mentions. New satellite-based temperature retrievals (Mears *et al.*, 2003) yield tropospheric temperature changes that are entirely consistent with climate model projections.

45. Comment: Most models also assume significant net cooling effects from aerosol emissions. For example, the IPCC produced larger warming projections in its 2001 (Third Assessment) report than in its 1995 (Second Assessment) report chiefly because IPCC modelers assumed more aggressive efforts worldwide to reduce aerosol emissions. However, subsequent research finds that one type of aerosol – black carbon (“soot”) – is a strong warming agent and may “nearly balance” the cooling effect of other aerosols. Indeed, NASA researchers James Hansen and Larissa Nazarenko find that black soot may be responsible for “20 percent of observed global warming over the past century.” Future reductions in aerosols will likely cause less warming than the IPCC projects. (Competitive Enterprise Institute, 9/21/04)

Agency Response: Climate forcing over the 20th century has included a significant cooling from sulfate aerosols. This cooling has partly offset the warming caused by greenhouse gas increases. Models do not “assume” this cooling, as the Competitive Enterprise Institute incorrectly states: the effects of sulfate aerosols on climate are calculated from first principles. The IPCC Special Report on Emission Scenarios (a group of independent researchers) generated new scenarios which were approved by all the governments, including the U.S. government. These scenarios recognized that mounting regional air

quality concerns would reduce sulfate emissions as the GDP/person increased. This resulted in large cuts in projected sulfate emissions by the middle of the 21st century. As noted by the Competitive Enterprise Institute, soot is an aerosol that warms. Hansen's estimate for warming by soot is possible, but at the extreme upper end of all models (read the IPCC 2001 chapters on aerosols and radiative forcing). Thus, reductions in soot would not necessarily accomplish that much. More important, the reductions in sulfate are achieved locally for very different purposes and with different technologies than needed for soot. Thus, sulfate and soot reductions are not coupled.

46. Comment: The theory of catastrophic warming assumes the existence of strong positive water vapor feedback effects. In most models, the direct warming from a doubling of CO₂ concentrations over pre-industrial levels is 1.24°C (2.2°F). Greater warming supposedly occurs when the initial CO₂-induced warming accelerates evaporation and, thus, increases concentrations of water vapor, the atmosphere's main greenhouse gas.

However, a NASA satellite study found that “some climate models might be overestimating the amount of water vapor entering the atmosphere as the Earth warms.” Another satellite study discovered a negative water vapor feedback effect in the tropical troposphere – a thermostatic mechanism strong enough to cancel out most positive feedbacks in most models. As temperatures rise at the ocean's surface, infrared-absorbing cirrus cloud cover diminishes relative to sunlight-reflecting cumulous cloud cover. Those changes allow more heat to escape into space, cooling the surface back down. (Competitive Enterprise Institute, 9/21/04)

Agency Response: The comment relates to water feedbacks in climate models. Several recent papers have attempted to evaluate whether this feedback mechanism is reliably represented. For example, the eruption of Mt. Pinatubo was used to test one particular model's water vapor feedback. The surface and tropospheric cooling caused by Pinatubo led to a global-scale reduction in total column water vapor. Since water vapor is a strong greenhouse gas, the reduction in water vapor led to less trapping of outgoing thermal radiation by Earth's atmosphere, thus *amplifying* the volcanic cooling. This is referred to as a “positive feedback.” The researchers disabled this feedback in a climate model experiment, and found that the “no water vapor feedback” model was incapable of simulating the observed tropospheric cooling after Pinatubo. Inclusion of the water vapor feedback yielded close agreement between the simulated and observed temperature responses to Pinatubo. This suggests that the model used by the researchers captures important aspects of the physics linking the real world's temperature and moisture changes. In contrast, there is no compelling observational evidence for the type of negative water vapor feedback mentioned by the commenter.

47. Comment: The CARB report in response to AB 1493 is biased and incomplete to achieve a predetermined response that will result in a reduction of vehicle emissions regardless of the validity or truth of the “science” behind it.

By ignoring the water vapor that comes out of the vehicle tailpipe along with the CO₂, the CARB is ignoring the major greenhouse gas and as a result, any reduction in CO₂ is trivial

compared to the water vapor, and there is NO impact on the greenhouse effect or on global warming. (John Dodds)

Agency Response: Staff disagrees with the comment. See response to comment 46.

48. Comment: The entire Climate Change paragraph is misleading in that you first indicate that the industrial revolution etc. has increased the levels of greenhouse gases. Yes CO₂ has increased from ~300 ppm to 376 ppm, but water vapor is essentially constant at 30,000 ppm, so the total has increased from 30,300 ppm to 30,376 ppm – some of it probably due to natural warming, not manmade. Is this SUBSTANTIAL? Also, you have not established that the greenhouse gases are responsible for global warming. Maybe it was the sun that warmed the greenhouse, that was actually responsible for the polar ice caps melting for the last 20,000 years? The industrial revolution certainly wasn't around back then. Next your list of greenhouse gases excludes the most dominant one, water vapor. We are talking climate change here, not what AB 1493 limits you to looking at. Tell the truth. (Dodd, 9/15/04).

Agency Response: Staff disagrees with the comment. The Staff Report acknowledges that there are several natural sources of greenhouse gases (including water vapor) that are responsible for the greenhouse effect. The Staff Report also notes that the concentration of CO₂ has risen by 30 percent since the late 1800's. Further, the Staff Report cites that IPCC's conclusion that most of the global warming observed over the past 50 years is attributable to human activities. Therefore, we believe that the fact sheet accurately characterizes the current scientific information that is discussed in greater detail in the Staff Report as well as other responses presented in this package.

With respect to the effect of water vapor, see the response to comment 46.

49. Comment: The IPCC and other alarmists, such as the authors of a recent study predicting an 8.3°C (14.1°F) summertime warming in California, assume implausible rates of economic growth. (Competitive Enterprise Institute, 9/21/04)

Agency Response: The ISOR relies upon The Third Assessment Report of the International Panel on Climate Change by the IPCC in 2001 and *Climate Change Impacts on the United States*, by the National Assessment Synthesis Team in 2001 with respect to discussing the potential impacts of climate change associated with various scenarios. Scenarios examined in the IPCC Assessment, which assume no major interventions to reduce continued growth of world greenhouse gas emissions, indicate that temperatures in the US will rise by about 5-9°F (3-5°C) on average in the next 100 years. See the response to Comment 49 for a discussion of rates of economic growth.

50. Comment: In the IPCC scenario with the lowest cumulative emissions and lowest temperature increase, per capita GDP in 2100 is more than 70 times 1990 levels in Asian developing countries and nearly 30 times 1990 levels in the rest of the developing world. These growth assumptions would be unrealistic even in a high-emissions scenario. "No significant country has ever achieved a 20-fold increase in output per head in a century, let

along the 30-fold or 70-fold increases projected by the IPCC for most of the world's population." Similarly, whereas the International Energy Agency projects electricity generation in developing countries to increase to 3.2 times the 2000 level by 2030, the IPCC low-emissions scenario projects 5.5-fold increase in consumption during that period. Incredibly, the same "low-case" scenario implicitly projects that in 2100, average income levels in Russia, North Korea, South Africa, Malaysia, Libya, Algeria, Tunisia, Saudi Arabia, Israel, Turkey, and Argentina exceed average income in the United States. Inflated growth projections lead to overblown emission scenarios, which in turn lead to overheated warming projections. (Competitive Enterprise Institute, 9/21/04).

Agency Response: Staff disagrees with the comment. The ISOR relies upon The Third Assessment Report of the Intergovernmental Panel on Climate Change by the IPCC in 2001 with respect to discussing the potential impacts of climate change associated with various scenarios. The Commenter refers to Scenario B1, which is "the IPCC scenario with the lowest cumulative emissions". However, this scenario is *not* a low-economic-growth scenario. Instead, it achieves low emissions due to low energy intensity. The final energy intensity of Scenario B1 is 1.4 million Joules per dollar, compared with 2.3 to 5.9 million Joules per dollar for the other IPCC scenarios. Scenario B1 is by no means the scenario with the least economic growth.

Each IPCC scenario has its own economic growth profile. Per capita income growth in developing countries over 1990-2100 ranges from a factor of 24 to 300, depending on the scenario. These factors imply an average growth rate of 2.9% to 5.2% per year.

The Commenter refers to a projection by the International Energy Agency (IEA) of a factor of 3.2 increase in electricity generation in developing countries over a 30-year period. This implies an average growth rate of 3.9% per year, which falls within the range of growth rates implicit in the IPCC scenarios.

The Commenter questions whether growth of that magnitude would be able to continue over a century. However, for climate change scenarios, the point is not whether individual countries can maintain exponential growth. The point is whether developing countries collectively can keep up the pace. For example, the World Bank projects a real per-capita GDP growth 2005-2015 of 5.4% per year for East Asia and 4.0% per year for South Asia. By the time the economies in those areas mature, other developing countries could take their turn as fast-growing "tigers". Also, economies are developing faster now than in the past. Two centuries ago it took Britain almost 60 years to double its national output. In recent years, China accomplished the same feat in only 10 years.

The IPCC scenarios span a range of economic growth assumptions. Staff concludes that the economic growth rates are plausible because projections by the IEA and World Bank fall within this range.

51. Comment: When the IPCC's main climate model is run with more realistic inputs – the finding that the net cooling effect of aerosols is small, the discovery of a tropical cloud thermostat, and the assumption (based on the past 25 years of history) that greenhouse

gas concentrations will increase at a constant rather than exponential rate – the projected 21st century warming drops from 2.0-4.5°C to 1.0-1.6°C. Similarly, in the alternative” emissions scenario developed by James Hansen, the NASA scientist whose 1988 congressional testimony put global warming on the public policy map, the world in the next 50 years warms 0.75 ±0.25°C, a warming rate of 0.15 ±0.05°C per decade. (Competitive Enterprise Institute, 9/21/04).

Agency Response: “The IPCC’s main climate model” probably refers to the MAGICC model used to produce the primary global-mean temperature projections given in Figures 9.13 and 9.14 of the IPCC Third Assessment Report (TAR). The claim that more realistic inputs change these results significantly is wrong. Although no reference is cited, this probably refers to work by Michaels and collaborators who attempted to use an early, user-friendly version of MAGICC to address these issues. The researchers did not have access to the model code, and so were unable to address these issues correctly. Their results are flawed and any conclusions drawn from these results are incorrect. More specifically, for the items noted in the comment, all three suggestions are wrong. The sensitivity of the TAR results to aerosol forcing uncertainties is very small. The effect of the ‘tropical cloud thermostat’ is automatically included in the physics of coupled AOGCMs – and this is a minor effect anyhow. Concentrations of the primary greenhouse gas, CO₂, do not generally rise exponentially in the scenarios used for the TAR global-mean temperature projections. For the A1FI and A2 scenarios the rate of change does increase with time over the 21st century. However, for the A1B and A1T scenarios the changes are near-linear, while for the B1 and B2 scenarios, concentrations tend to stabilize by the end of the 21st century. The possibility that CO₂ concentrations might increase at a “constant rather than exponential rate” is already covered by the TAR calculations. Finally, the alternative emissions scenarios put forward by Hansen are *ad hoc* and not based on any analysis of the primary drivers for emissions (population, economic changes, technology, etc.). Furthermore, these scenarios are not relevant to the issue of developing mitigation strategies. They already incorporate (albeit implicitly) mitigation strategies, and were put forward as examples of what might be possible if appropriate policies were put in place.

52. Comment: The mathematical form of most climate models also supports the conclusion that any anthropogenic global warming during the 21st century is likely to be small. Nearly all models predict that, once anthropogenic warming starts, the atmosphere warms at a constant rather than accelerating rate. As noted earlier, the troposphere has warmed 0.08°C per decade since 1979 while the surface appears to have warmed 0.17°C per decade since 1976. Even under the questionable assumption that all recent warming is due to man-made greenhouse gases, with no help from urban heat islands, solar variability, or the Pacific Decadal Oscillation, the linear form of model projections implies that the world will warm 0.8°C to 1.7°C over the next 100 years. (Competitive Enterprise Institute, 9/21/04).

Agency Response: This comment continues to repeat the misunderstandings of climate research that have appeared in many previous comments. There is no reason why the current climate models (what the commenter means by “mathematical form” is not clear) are likely to project “small” global warming.

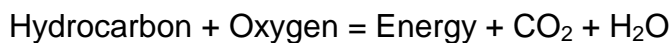
The satellite-based tropospheric temperature record that the commenter refers to has very large structural uncertainties (e.g., Santer *et al.*, 2003). The comment mentions one specific version of this satellite dataset, generated by John Christy and colleagues at the University of Alabama. Two other versions of the same raw satellite data (produced by research groups at Remote Sensing Systems in California and at the University of Maryland) are not mentioned by the commenter. These two versions show pronounced warming of the troposphere, which is presumably why they have been ignored by the commenter.

Urban heat islands are routinely accounted for in the construction of datasets used for evaluating temperature changes at the Earth's surface. A number of research groups around the world have independently quantified this effect. The general conclusion from this work is that "urban warming" makes only a minor contribution to the large-scale increase in Earth's surface temperature over the 20th century.

Finally, the comment proposes a model based on linear extrapolation of previous trends. Climate models are based on the dynamics, physics and chemistry of the atmosphere and climate system – not on simple extrapolation of previous trends.

(2). Section 2.2—Climate Change Pollutants

53. Comment: The basic chemical equation behind energy production in a hydrocarbon based world is:



This is what happens in a car engine, in a power plant AND in the human body. To characterize CO₂ as a pollutant is not proper. If you eliminate CO₂ then you eliminate energy. The world can NOT function without energy. The Ca Air Resources Board is not authorized to regulate how much energy is produced in the state, nor has it properly evaluated the impacts of the proposed reduction in energy produced (Dodd, 8/19/04).

Agency Response: The basic equation provided is correct. However, the commenter is incorrect with respect to the characterization of the intent of the regulation. The regulation does not address how much energy is produced in the state. Rather, the intent of the regulation is to reduce climate change emissions from motor vehicles in a manner that is economical to the owner or operator of a vehicle taking into account the full life-cycle costs of the vehicle. The Staff Report provides substantial documentation supporting this objective. Further, the applicable definition of greenhouse gases (Health and Safety Code 42801.1) in the enabling legislation includes carbon dioxide.

54. Comment: The ARB is not authorized to address black carbon as a GHG. All mentions of black carbon must be deleted. If the ARB insists that it has the right to add black carbon (which in my opinion IS a GHG and IS a particulate pollutant that should be regulated), it is obligated to add H₂O in the form of water vapor, which is commonly

referred to as the principal cause of the greenhouse effect (20,000 ppm of water vapor vs. 376 ppm of CO₂). The failure to do one or the other is illegal, as any future legal challenge will prove. The ARB was directed to address greenhouse gas emissions. It was NOT limited to anthropogenic (manmade) emissions. The failure to address natural emissions is a major deficiency. The majority of the greenhouse effect is the result of natural greenhouse gases (water vapor and CO₂). Without addressing these there can be no realistic expectation of addressing the greenhouse effect and global warming. Since the ARB has chosen to only address CO₂ from vehicles this it is really only addressing vehicle efficiency and gas mileage criteria. (Dodd, 8/19/04).

Agency Response: Black carbon is arguably an air contaminant subject to ARB regulation. However, because there is not a well defined "Global Warming Potential" for black carbon that would allow its effects to be weighted consistent with the other pollutants, the state of the science did not allow its inclusion in the regulation at this time.

As discussed in the Staff Report, water vapor plays an important role in the Earth's greenhouse effect. However, unlike other pollutants such as CO₂ and HFCs, anthropogenic activities have not had a discernable direct impact on global-scale atmospheric concentrations of water vapor.

The proposed regulation does not focus only on CO₂. Several other greenhouse gases emitted by motor vehicles were also considered as the standards were developed. Further, rather than specifying reductions of particular pollutants, the regulation is structured to provide automobile manufacturers with the flexibility to achieve the reductions in the most cost-effective way possible using their technologies of choice. The regulation also evaluates emission reductions using a CO₂-equivalent currency (i.e., reductions are adjusted per their global warming potential). Thus, reductions can be compared on an apples-to-apples basis.

55. Comment: I consider that the "facts" in your fact sheets are so misleading that they would form a very good basis for having the courts declare your entire AB 1493 rulemaking on Vehicle Emissions to be invalid. The "facts" in these sheets are what has been used in your Staff Report evaluation of AB 1493. Please also correct the misstatements that have been made there. The fact sheet "Reducing Climate Change Emissions from Motor Vehicles" says that "transportation is California's largest source of carbon dioxide...creating more than 30% of the total climate change emissions." This is JUST PLAIN WRONG. IF you believe your numbers, then transportation may contribute to 30% of the manmade CO₂ emissions in the state. The overall statement implies that you are addressing 30% + of the total greenhouse gas climate change problem. This is false. At best, CA's 30% of manmade CO₂ emissions is less than 1% of the global 3PPM of CO₂ emitted per year which is less than 1% of the total 376 ppm of CO₂ in the air, which is less than 1% of all the greenhouse gases in the air (~30,000 ppm of water vapor being the dominant piece). In other words, you are addressing a trivial part of the entire problem (if it is a problem), AND the California Public is entitled to know that you plan on spending billions to have a zero impact on the global climate. (Dodd, 9/15/04).

Agency Response: Staff disagrees with the comment. Per the direction provided in Assembly Bill 1493 (2002), the ARB developed a proposed regulation to reduce climate change emissions from motor vehicles. Numerous technologies and technology packages were considered to arrive at standards that could be achieved in a manner that provided manufacturers with flexibility and are economical to vehicle owners or operators over the full life cycle costs of a vehicle. The reductions in greenhouse gas emissions from the regulation will not in themselves solve the climate change problem, but are rather an important step at realizing this goal. Other states as well as countries are already following California's leadership on this issue. The Staff Report acknowledges that there are several natural sources of greenhouse gases that are responsible for the greenhouse effect. The Staff Report also notes that the concentration of CO₂ has risen by 30 percent since the late 1800's. Further, the Staff Report cites the IPCC's conclusion that most of the global warming observed over the past 50 years is attributable to human activities. Therefore, we believe that the fact sheet accurately characterizes the information that is discussed in greater detail in the Staff Report.

56. Comment: The amount of greenhouse gases in the atmosphere is being drastically altered by human activity. With respect to the fact sheet, the reference to drastically is not correct. This is disputed in the scientific community. What is not in dispute is that global warming is happening or that burning fossil fuels is adding to the CO₂ in the air. What is in dispute is what is the impact. Does a change of less than 0.03 ppm of CO₂ due to Ca vehicles per year out of a total of 30,376 ppm of greenhouse gases warrant the use of the term drastically? (Dodd, 9/15/04).

Agency Response: The Staff Report acknowledges that there are several natural sources of greenhouse gases that are responsible for the greenhouse effect. The Staff Report also notes that the concentration of CO₂ in the atmosphere has risen by 30 percent since the late 1800's. Further, the Staff Report cites the IPCC's conclusion that most of the global warming observed over the past 50 years is attributable to human activities. Therefore, we believe that the fact sheet accurately characterizes the current scientific information that is discussed in greater detail in the Staff Report.

(3). Section 2.5—Indicators of Climate Forcing and Climate Change

57. Comment: Measurements of sea levels are made at 13 coastal sites in California and they are available at <http://tidesandcurrents.noaa.gov/sltrends.shtml>. The trend data is summarized in Table 3 of this Declaration. Although no site has a century of data, the sea level changes are expressed as changes in feet per century. The change varies from -0.48 to +1.06 feet per century with an average of 0.55 feet per century. (Declaration of Jon M. Heuss)

Agency Response: The commenter quotes a figure of 0.55 feet per century (which is equal to 16.8 cm per century) as the average rate of sea level increase for Californian coastal sites. This figure is within the range of global-mean sea-level change estimates (an increase of 10-20 cm over the 20th century) given by the IPCC TAR. Local sea-level

changes are often subject to substantial decadal variations, which is why records of at least 50 years in length are required in order to obtain more reliable trend estimates.

58. Comment: Sea level is a relative measure. Changes can be caused by a change in the water but also by settling or uplifting by the land mass. If only the water level was changing, one would expect the rate of change to be similar at all the sites in California. Because of the large variation in the rate of sea level changes at the different sites in California, it appears that land movement contributes significantly to the observed changes in California. For this reason, changes in sea level should not be used as an indicator of climate change in California. Although the 0.55 feet per century is within the range of estimates presented in the TAR, which reports a range of 0.33 to 0.66 feet per century, that estimate is controversial. Based on satellite altimetry measurements since 1992, Morner (2004) and his colleagues at the INQUA Commission on Sea Level Changes and Coastal Evolution conclude the sea level is not rising. (Declaration of Jon M. Heuss)

Agency Response: Sea levels along the California and West coast have indeed been rising rather uniformly at a number of different locations, including San Francisco, Los Angeles, and San Diego. However, it is wrong to suggest that warming of the world's oceans should lead to similar sea-level increases everywhere. As has been known for well over a decade, greenhouse warming can alter ocean circulation patterns, which in turn can lead to considerable spatial variability in sea-level changes (Mikolajewicz *et al.*, 1990).

59. Comment: The Staff Report also presents a discussion of trends in snowmelt and spring runoff. A plot is presented which shows the percent of yearly runoff from Sacramento that occurs in the springtime (April to July). The plot shows a decrease in this percentage from about 45% to about 34% from the early 1900s to 2000. This percent of annual runoff that occurs in the springtime is thought to be a measure of snow-pack, and the report speculates that the decrease in percent in spring runoff is an indicator of global warming. The Staff Report states that "throughout the 20th century, the April to July spring runoff in the Sierra Nevada has been decreasing. This decreased runoff was especially evident after mid-century, since then the water runoff has declined by about twelve percent." (Declaration of Jon M. Heuss).

Agency Response: The April through July fraction of annual river discharge has been declining in California, not only for the estimated full natural flow used by the California Department of Water Resources, but also for individual Sierra headwater streams, and for a broad array of snowmelt-dominated rivers in the western United States and western Canada. This change in spring runoff is mostly related to a shift in the snowmelt runoff component of the annual water discharge, which in turn has been driven by warmer winter and spring temperatures. The spring runoff changes have been greater in watersheds that have a larger proportion of intermediate (1000'-7000') elevations than high (7000'-14000') elevations, because temperatures at intermediate elevations hover closer to the melting point and rain/snow boundaries.

60. Comment: There are at least two problems with the Staff Report's analysis of the snowmelt and spring runoff issue. First, the percent of annual runoff that occurs in the spring cannot be used to determine the trend in runoff, because the percent of annual

runoff can be significantly affected by changes in runoff that occur at other times of the year. Instead, the volume of spring runoff, rather than the percent, is a much better measure of spring snowpack, because it is unaffected by variations, in runoff at other times of the year. Second, the analysis of the underlying spring and annual river runoff data volumes from all river systems available indicates that there could have been a downward trend in the volume of the runoff from about 1900 to 1929, but since then, there is no discernable downward or upward trend in spring runoff. (Declaration of Jon M. Heuss)

Agency Response: Staff disagrees with the comment. The April through July fractional runoff is a good indicator of the proportion of snowmelt that is occurring during the spring and summer season, which is the period when demand for water is increasing due to agricultural usage. A recent paper by Stewart *et al.* (2005) uses fractional runoff (April through July, and for the individual months from March through July) and two other streamflow measures of the timing of snowmelt runoff, each of which indicate that snowmelt runoff is coming earlier.

This April-through-July runoff fraction is an important indicator because if there are earlier flows (due to more rain/less snow or earlier snowmelt), the water is more difficult to manage. This is due to the fact that in the winter and early spring, there is still a chance of a significant storm. Man-made reservoirs must therefore reserve some space for a possible flood, since many of California's reservoirs are both water supply reservoirs and flood protection vessels.

The actual spring flow volume would be a good measure if we had the luxury of having many years of data. But as it is, there is considerable year-to-year variability in the actual volume of runoff, so that the changes from climate warming are difficult to detect – it is much easier if they are scaled by the annual runoff to control for the additional year-to-year variability.

61. Comment: For the sake of clarity, the complete discussion from the Staff Report is repeated below:

"The warming of global climate could increase evaporative rates, thereby potentially increasing precipitation and storms in the State. Snowmelt and runoff volume data can be used as a climate change indicator to document changes in runoff patterns. These specific regional changes are related, at least in part, to the climate change associated with the observed global mean warming. In California, large accumulations of snow occur in the Sierra Nevada and southern Cascade Mountains from October to March. Each winter, at the high elevations, snow accumulates into a deep pack, preserving much of California's water supply in cold storage. If the winter temperatures are warm, more of the precipitation falls as rain instead of snow, and water directly flows from watersheds before the spring snowmelt. Thus, there is less buildup of snow pack; as a result, the volume of water from the spring runoff is diminished. Lower water volumes of the spring snowmelt runoff may indicate warmer winter temperatures or unusually warm springtime temperatures. Figure 2-6 [reproduced here as Figure 14] shows that throughout the 20th century, annual .April

to July spring runoff in the Sierra Nevada has been decreasing (Roos, 2003). This decreased runoff was especially evident after the mid-century; since then the water runoff has declined about 12%.”

The Staff Report also references the EPIC report (California Environmental Protection Agency, 2002), which contains a further discussion of this indicator. Under the "Technical Considerations" section, the following discussion is presented:

"Since the relationships of runoff to precipitation, snow, and other hydrologic variables are natural, it is preferable to work with natural or unimpaired runoff.

The spring runoff is calculated purely from stream flow. These are the amounts of water produced in a stream unaltered by upstream diversions, storage, or by export or import of water to or from other basins. To get unimpaired runoff, measured amounts have to be adjusted to remove the effect of man-made works, such as reservoirs., diversions, or imports (Roos, 1992). The water supply forecasting procedures are based on multiple linear regression equations, which relate snow, precipitation, and previous runoff terms to April-July unimpaired runoff."

Under the "Strengths and Limitations of the Data" section, the report goes on to state as follows:

"Data have been collected for almost one century for many monitoring sites.

Stream flow data exist for most of the major Sierra Nevada watersheds because of California's dependence on their spring runoff for water resources and the extreme need for flood forecasting. This information presents spring rainfall, snowmelt, calculated depletions, and diversions, in part from other rivers and reservoirs. Raw data are collected through water flow monitoring procedures and used along with(many other variables in a model to calculate the unimpaired runoff of each watershed. Over the years, instrumentation has changed and gradually improved; some monitoring sites moved to different locations. The physical shape of the streambed can affect the accuracy of flow measurements at monitoring sties, but most sites are quite stable."

The discussion in the Staff Report concludes that "annual spring runoff in the Sierra Nevada has been decreasing," and "since then [the mid-century] the water runoff has declined about 12%" (Declaration of Jon M. Heuss).

Agency Response: See response to comment 62.

62. Comment: The above statements (comment 61) are apparently intended to demonstrate that the volume of the spring runoff is declining. The data plot to which the discussion refers is a data plot of the percent of water year runoff that occurs in the April to July timeframe. The data plot shows a decline, but this data plot indicates nothing about the volume of spring runoff, only the volume percent of spring runoff as compared to the annual runoff. The percent of spring runoff could decline even if the volume were

increasing or constant, if the runoff at other times of the year increased (for example, due to more rainfall in the summer or fall). The spring runoff volume could be constant or even increasing, and it would not necessarily be reflected in the chart that the Staff Report includes. (Declaration of Jon M. Heuss)

Agency Response: The commenter is correct: this “fractional runoff” depends not only on spring conditions but, also on conditions during the other seasons. However, because we have such a strongly Mediterranean climate in California, there is little precipitation in summer and fall, so the largest influence on this ratio are the flows during spring relative to those in winter and spring.

63. Comment: This plot is also presented in a report by the Office of Environmental Health Hazard Assessment entitled “Environmental Protection Indicators for California” (the “EPIC report”). The EPIC report does shed light on how the runoff is estimated - theoretically; it is an estimate of “unimpaired runoff.” Furthermore, it is not a measured quantity, but rather a “modeled” quantity (although measurements of river flow, and river height and other variables are taken). The “modeled quantity” attempts to take into account diversions, storage etc., that would otherwise confound an analysis of total unimpaired volume over a number of years. (Declaration of Jon M. Heuss)

Agency Response: The commenter is correct in asserting that “unimpaired runoff” is not based on stream gage measurements alone. Nevertheless, the “unimpaired runoff” results mentioned are valid. Papers by several authors (Wahl 1992; Dettinger and Cayan 1995; Cayan *et al.* 2001; Stewart *et al.* 2005) have detected very similar reductions in late spring and early summer streamflows. These studies used a much larger network of streams that were selected by the U.S. Geological Survey and Environment Canada as being largely unregulated by dams or diversions. The evidence from this work indicates that a broad region of western North America, including mountainous regions in California, have experienced earlier snowmelt in recent decades.

64. Comment: The Sacramento River runoff chart presented in the Staff Report shows that the downward trend in the percent of runoff is due to the lack of high percent runoff years after about 1950, and the increasing number of low percent runoff years. There are four years with percent runoff values of just over 45%, and three years where the percent runoff is 25% or less. The percent calculations and the raw volume data for the Sacramento River and other river systems were obtained from the ARB (Shulock, C, 2004). Since the percent of runoff occurring in the spring can be heavily influenced by the total runoff in a given year, we examined the total runoff in the four highest and three lowest years since 1950. This is shown in Table 4 below.

The table shows that the percent of runoff is affected not only by the volume of spring runoff, but also by the total runoff. In the four highest percent runoff years, the average total runoff was 17% less than average. In the three lowest percent runoff years, the average total runoff was 33% greater than average. Thus, trends in the percent of runoff occurring in the spring appear to be a poor indicator of trends in snow-pack. (Declaration of Jon M. Heuss).

Agency Response: Staff disagrees with the comment. The commenter assumes that the fraction of annual runoff occurring in April through July is being used as a measure of spring snowpack. This is not the case. Rather, the intent is to use this fractional runoff as an index of the amount of snowmelt that is occurring *earlier* or *later* than the historical climatology. The April-July fractional flow, along with other measures that have been used in the literature (Cayan *et al.* 2001; Stewart *et al.* 2005), indicates that runoff from snowmelt-affected watersheds over a broad footprint of the West is now occurring one to three weeks earlier than it was in the 1950's through early 1970's. These alternative hydrological measures include the "first pulse" of snowmelt runoff that commences in early spring. This "first pulse" is not derived using flow in any other season, and is quite strongly correlated with the April-July fractional flow. Both of these flow measures are strongly correlated to winter and especially spring temperature fluctuations: the rising trend in spring temperatures is associated with earlier spring streamflows.

65. Comment: Because the percent of runoff occurring in the spring is a poor indicator of trends in snow-pack, the actual volume of spring runoff over the last century has been examined. (These data were included with the data provided by ARB.) The available data are the April-June and yearly runoff values in thousands of acre feet (taf) for the following river systems:

- Sacramento River Index
- San Joaquin
- Kings
- Truckee at Farad

The Sacramento River Index volumes from 1906 to 2000 for April through July are shown in Figure 15. The data show that the runoff has varied between 2,000 and 14,000 taf over the last century. Very high years are years in which the runoff exceeds 12,000 taf. Years in which spring runoff exceeded 12,000 taf are 1906, 1907, 1938, 1952, 1958, 1983, 1995, and 1998. The lowest runoff years are those with volumes below 3,000 taf. Those are 1924, 1931, 1934, 1976, 1987, 1988, 1992, and 1994. Two of the highest runoff values and one of the lowest runoff values have occurred in the last decade. The runoff can vary significantly from one year to the next. For example, in 1983 the runoff was 13,600 taf. The next year it dropped by 60% to 5,500 taf. (Declaration of Jon M. Heuss).

Agency Response: Although many California snow courses are at relatively high elevation and particularly susceptible to warming signals, it is noteworthy that spring (April 1) snowpack over many other regions of the western United States has also declined significantly. This has been shown for the Pacific Northwest and for a much broader region of the western United States. More recently, Mote *et al.* (2005) found that spring snowpacks have declined over much of the western U.S. from 1950 to 1997.

In California, snowpack trends are complicated by the fact that snowpack in higher, cooler elevations has experienced little change, or actually increased slightly, while snowpack in lower, warmer elevations (with December-to-February temperatures greater than roughly -

2°C) has decreased by between 5 and 30%. The variability in Californian snowpack changes is partly attributable to changes in precipitation, but much of the snowpack decline has been linked to warmer temperatures over the last three decades. This has been shown by researchers who note that while some of the snowpack decline can be attributed to natural variability, there is a substantial component that is consistent with the global pattern of anthropogenic temperature increases (Howat and Tulaczyk, 2005)..

Because there is great inter-annual variability in total runoff, it is important to normalize for this volatility by considering the timing of snowmelt. This is the motivation behind the April-July “fractional runoff” and some of the other hydrological measures previously discussed.

66. Comment: The trends in the Sacramento spring volume data were also examined. This is shown in Figure 16. Starting in 1906, the trend appears to be downward, but the significance of the slope is low. Further examination of the data appears to show a general downtrend in the data from 1906 to the latter 1920s, and then no change since then. This is shown in Figure 17, which breaks the data into two parts, and performs a regression on the 1906-1929 data, and a separate regression of the 1930-2000 data. As shown in the above figure, the 1906-1929 period seems to be characterized by lower high-runoff years and lower low-runoff years. Since then, there is no discernible trend. Note that there have been three very high spring runoff years (above 12,000 taf) in the last two decades. This certainly is contrary to the Staff Report’s interpretation that “spring runoff in the Sierra Nevada has been decreasing.” (Declaration of Jon M. Heuss).

Agency Response: Because of the large year-to-year component, it is the spring “fractional runoff” rather than the total spring runoff amount that is crucial to understand how warming is affecting snow accumulation and snowmelt (see response to comments 59, 64, and 65). Thus the quote from the staff report remains accurate, given that the fraction of melting occurring in spring has been reduced both as to its time range and early onset.

67. Comment: As shown above, the data can be separated at 1929-1930. The data indicate a distinct difference in these two periods. There are a several possible explanations for the reduction in spring runoff from 1906 to 1930. One is that this results from successively lower amounts of snow in the winter in the Sierra Nevada. Another possible explanation is that measurement methods for flow and river height and other variables were changing. As presented earlier, the EPIC report indicates that modifications have been made to instrumentation and data collection techniques over the last century. It is also possible that significant changes in instrumentation and measurement methods may have been made in the first 30 years of the century that, leading to an observed “trend.” Both possibilities should be examined before reaching the conclusions contained in the Staff Report. (Declaration of Jon M. Heuss).

Agency Response: Other studies (e.g., Wahl, 1992; Dettinger and Cayan, 1995; Stewart *et al.*, 2005) have examined fluctuations and changes within a set of actual stream gage data (not reconstructed data) from western North America snowmelt-dominated streams identified by the US Geological Survey and also Environment Canada. These

investigations find trends similar to those that the California Department of Water Resources has estimated for the Sacramento River system. The message from this body of research is that both climate fluctuations and climate change are involved in producing streamflow *timing* changes. See also response to comment 64.

68. Comment: The spring runoff volume data from the other river systems were also examined. These are shown in Figures 18, 19 and 20. All of the data seem to display the same trends - decreasing: runoff until the late 1920s, and constant since then. (Declaration of Jon M. Heuss).

Agency Response: See response to comments 65 and 66. The warming influence is present in the changes in the streamflow timing, not the amount. This is critical to California's water supply system because earlier snowmelt generally means less stored water is available later in the year.

69. Comment: It is noteworthy and probably not coincidental that all of these river systems show the same trends - reduced spring runoff from 1906 to 1930, and flat or increasing since then. Increased snow in one area usually also means increased snow in a nearby area. Alternatively, if measurement or instrumentation methods were upgraded in one area, it is likely that they were upgraded elsewhere as well. (Declaration of Jon M. Heuss).

Agency Response: See response to comments 65 and 66.

70. Comment: In summary, the use of April through July runoff volume rather than percent of annual flow undercuts the conclusions presented by the Staff Report. The above analysis shows that the trend line in April through July runoff has been flat since 1930. The negative trend line in percent of annual volume shown in Figure 12 is an artifact of the variability in the total annual volume. This analysis also undermines the use of the percentage number as a credible environmental indicator. (Declaration of Jon M. Heuss).

Agency Response: A large body of scientific evidence indicates that the winter and spring warming in recent decades has produced advances in the timing of streamflow and reductions in spring snowpack. Spring flow volume is too strongly affected by interannual changes in precipitation to reveal this warming signal.

(4). Section 2.6—Potential Impacts on California

71. Comment: The changes that we could see under high global emissions will be great. A lot of the effects that we will see because greenhouse gases will accumulate will be seen by subsequent generations, our kids, their kids. The choices and the actions that we take today, we may not see a strong effect of. But if the science is correct, it's likely that subsequent generations will. (Dan Cayan, Director of Climate Research Division at the Scripps Institution of Oceanography, University of California at San Diego)

Agency Response: Staff agrees with this comment. No further response necessary.

72. Comment: In the Staff Report, the CARB staff states that unprecedented warming is occurring in the northern hemisphere over the past century because of anthropogenic emissions of greenhouse gases. The Staff Report also states that observations in conjunction with climate models indicate that detectable changes are under way. It infers that there is a scientific consensus that climate is changing at a rate unmatched in the last 1,000 years due to human activities, and appears to predict more heat waves and heat-related deaths. In addition, the Staff Report appears to suggest or predict that the increased heat will produce higher ozone which will cause even more deaths. The Staff Report also expresses concern over rising sea levels and reduced winter snow pack. The purpose of this Declaration is to address the foregoing claims and predictions in the Staff Report. (Declaration of Jon M. Heuss)

Agency Response: No response necessary, as more detailed comments and responses follow.

73. Comment: Extensive evidence shows the existence of excess mortality associated with heat waves around the world. The evidence shows that mortality increases when a certain threshold of temperature and humidity are reached. An extensive study of U.S. heat waves from the 1960s through the 1990s by Davis et al., (2003) revealed that the best indicator for heat stress is the “apparent temperature” (AT) which combines the ambient temperature and the humidity into one variable (Steadman, 1979). Above a certain AT threshold excess mortality occurs. Davis et al. examined the daily meteorological and mortality data for 28 U.S. cities and identified the threshold AT for each city. Each city had a different threshold. Cities in the southeastern U.S. had higher thresholds than cities in the Northeast or Midwest. In other words, the heat-mortality relationship is the weakest in the Southeast because of more widespread use of air conditioning and acclimatization. Another trend that the authors noted in most cities was a decline in the dose-response relationship with time. For example, in Los Angeles, annual heat-related mortality rates (defined as excess deaths per standard million population on days in the threshold AT is equaled or exceeded) declined from about 30 in the 1960s and 1970s to about 20 in the 1980 and to about 15 in the 1990s. In Dallas and Houston, the decline was even more dramatic as it went from about 35 in the 1960s to zero in the 1990s. For the 28-city average, the rates were 41.0 (1960-70s), 17.3 (1980s), and 10.5 (1990s). The studies demonstrate that past mortality-temperature dose-response functions cannot be used to predict future mortality rates associated with heat waves. Such extrapolations will greatly overestimate the impacts. In addition, by the 1990s, 13 of the 28 cities had no heat-related mortalities. This suggests that heat-related mortality could be eliminated in the future, and questions the estimates of future heat wave mortality made by both the Staff Report and Hayhoe et al. (Declaration of Jon M. Heuss)

Agency Response: The first part of this comment states that the “best indicator for heat stress” is apparent temperature. While apparent temperature has frequently been used as an index of heat stress, recent studies suggest that indices that capture a greater set of meteorological variables – such as those based on air mass characterization -are better indicators of “oppressive” heat conditions (Kalkstein 1998, Kalkstein 1991, Sheridan and

Kalkstein, 2004). People respond to a range of weather conditions, including temperature, wind speed, cloud cover, and duration of heat, that can have synergistic effects, rather than individual variables such as temperature and humidity (Kalkstein and Greene 1997). Apparent temperature does not capture these interactions, while an air mass-based approach does. Recognizing the importance of capturing multiple and interacting weather conditions, agencies such as the NWS and the World Health Organization have selected an air-mass based approach for the heat warning systems they are developing throughout the US and the rest of the world (WHO/WMO/UNEP, 1997).

The second part of the comment suggests that the spatial variability in AT thresholds and heat-related mortality rates identified in Davis et al (2003) can be explained by differences in air conditioner use and acclimatization (e.g. that the weaker response in southern cities is due to these socio-economic factors). We don't fully agree with this conclusion. Although estimates of decreases in heat-related deaths attributed by increased air conditioner use have indicated drops of 10-25 percent (Kalkstein, 1998), these numbers are much less dramatic than those developed by Davis et al. (2003). The different thresholds reported in Davis et al. (2003) suggest that populations are adapted to the climate where they live. Regions in the Southeast that are frequently hot are likely to have the infrastructure to cope with the heat more effectively than regions in the Northeast and Midwest. For example, in many southern cities, poor, vulnerable people are likely to live in frame dwellings with metal roofs and windows on four sides. These buildings remain much cooler during excessively hot conditions. However, in the northern cities, many vulnerable people live in black-roofed row homes with poor circulation and brick construction. These homes are most likely to heat up rapidly, especially in upper floors where many of the heat-related deaths are found.

Further, the magnitude of the threshold itself is not a full measure of the strength of the heat-mortality relationship as suggested by the comment: "Cities in the southeastern U.S. had higher thresholds than cities in the Northeast or Midwest. In other words, the heat-mortality relationship is the weakest in the Southeast because of more widespread use of air conditioning and acclimatization." It is the relative magnitude and frequency of "extreme" (or threshold exceeding) events, i.e. *weather variability*, not the relative threshold level that contributes most to elevated heat mortality (Kalkstein 2000). A city might have a high threshold temperature that is not crossed often, while another may have a lower threshold that has more frequent extremes. For example in southern cities, the standard deviation of weather conditions around the mean is low; that is, there is little day-to-day change in the weather. This consistency weakens the general population response to heat because southern populations are not exposed to the large meteorological swings that occur in the more northerly cities. This is why hot cities like Miami, New Orleans, and even Phoenix have lower heat-related death totals than Chicago, New York, and Philadelphia (Kalkstein and Greene, 1997). In the North, rather benign weather is occasionally punctuated by very excessive heat, and the unexpected and uncommon nature of these events is the main reason that they have such a dire impact on human health.

The third part of this comment highlights Davis et al. (2003) findings of a decline in heat-related mortality rates and suggests that these results indicate that past mortality-temperature dose-response functions cannot be used to predict future mortality rates, as was done in the Hayhoe et al. 2004 paper. We believe that heat-related mortality rates are decreasing as a result of adaptation measures, and agree that this empirical evidence points to the need for caution when using historical relationships when predicting future mortality rates. For this reason, the Hayhoe et al. (2004) paper does not rely simply on the historical heat-mortality relationship but incorporates a method for adjusting for acclimatization based on an “analogue summer” approach. The analogue summer approach assumes that people will most likely respond to heat under climate change as they do today during the very hottest summers (Hayhoe et al 2004).

The final part of the comment suggests that heat-related mortality could be eliminated in the future, based on the historical downtrends. We do not agree with this prediction for several reasons. First, the decline in heat-related mortality is, in our opinion, not as rapid as the Davis et al. (2003) paper suggests. Some of the most dramatic heat mortality events have occurred over the past decade or so, including the 1995 heat event in Chicago, which is unprecedented, and several events in Philadelphia during the 1990s. Second, even if the Davis downtrend is to be believed, there is no evidence to suggest that it will continue at the present rate. There are likely limitations to society’s ability to adapt to a changing climate. Many cities are already approaching air conditioning saturation in the U.S. (Kalkstein, 1998), and clearly the impact of air conditioning is reaching a maximum. Furthermore, as stated above climate variability and not average temperatures is what contributes most to elevated heat-related mortality. With climate change, variability is projected to increase which will make adaptation more difficult. For once we adapt to higher temperatures, new thresholds will be set and passed by increasing magnitude and frequency of extreme events, continually putting us behind in our adaptation mechanisms.

Finally, we note that the commenter implies that any increased threat of mortality can be addressed with increased air conditioning. However, increased use of air conditioning would substantially increase greenhouse gas emissions from electrical generation, thereby further contributing to anthropogenic emissions.

74. Comment: The Staff Report’s claim that some of the excess mortality during heat waves is due to ozone rather than heat is based on epidemiology studies. These studies are time-series studies in which daily counts of deaths in a geographic area are regressed against levels of air pollution as measured at central monitoring stations in that area. In the time-series study, inferences regarding the association of air pollution with adverse health effects depend upon relating fluctuations in daily counts of the health effect of interest to levels of air pollution on the same or previous days. In 2002, the most commonly used software package (S-plus) for Generalized Additive Model (GAM) analyses of time-series studies was found to yield erroneous results when used with the default convergence criteria, casting doubt on the results of most time-series studies of air pollution (HEI, 2003). Most time series studies of ozone have not been reanalyzed following the discovery of the software problem so they should not be used to generate dose-response functions.

Reanalyses of time series studies have focused mainly on PM. Thus, the results of most time series studies of ozone cannot be trusted. As with PM, it is likely that reanalyses of the ozone studies using more stringent convergence criteria would lead to smaller effects estimates and reduced significance of the ozone associations. Even more important, the reanalyses prompted by the software convergence problem once again brought into focus a number of issues, such as the proper control of weather and temporal trends in time-series analyses, which had been considered settled. These issues are far more serious than the convergence problems that led to their resurfacing and they are discussed below. (Declaration of Jon M. Heuss)

Agency Response: Staff disagrees with the comment. This comment challenges the link of air pollution with adverse health effects, stating that the epidemiological studies that have shown such links are based on times-series analysis, which are unreliable. In particular, the commenter points to two concerns: 1) the fact that the Generalized Additive Model (GAM) from a common statistical program had been found to yield erroneous results, and 2) the inadequate control for other time varying factors such as weather and other temporal trends that may affect health outcomes. While we acknowledge the challenge of time-series analysis and the concerns raised with GAM, studies suggest that these concerns do not change the basic conclusion that high ozone levels can lead to health effects. The Health Effects Institute conducted a reanalysis of the of the air-pollution and health data to test the significance of the error identified with the GAM statistical approach and found that “in general, [in the re-analysis] the estimates of effect in the National Morbidity, Mortality, and Air Pollution Study (NMMAPS) decreased substantially, but the qualitative conclusions did not change.”

Furthermore, one does not need to rely on time-series studies to find documented links between air pollution and health. There are a number of other statistical techniques that have been used in studies linking air pollution to mortality. For example, Krewski et al. (2000), whose analysis demonstrated an increase in mortality with air pollution, uses a long-term cohort study to link air pollution to mortality rather than the standard time-series approach. In fact Health Effects Institute reports that some have noted that the calculated health impact of short-term air pollution based on time-series studies is substantially smaller than that of long-term air pollution based on cohort studies.

75. Comment: At least three major issues that must be addressed when considering time-series studies. First, it is necessary to consider the potential need for adjustments to account for temporal trends in the health effect of interest due, for example, to temporal trends in the structure of the population or to episodic viral infections. Second, the association of pollutants must be separated from the effects of climate and weather. Third, adequate statistical adjustments must be made, so that the association of ozone with adverse effects on human health can be considered apart from the associations of other criteria pollutants with adverse effects on human health. (Declaration of Jon M. Heuss)

Agency Response: Staff agrees that these factors as well as others need to be considered when considering and interpreting the results of time-series studies.

76. Comment: The Health Effects Institute (HEI) Expert Panel (2003) has noted that methods used for controlling temporal trends and weather can have profound effects on the results of time-series analyses of air pollution data. In addition, there appears to be no objective statistical test to determine whether these factors have been adequately controlled in any analysis. The HEI Expert Panel stated as follows:

“Ritov and Bickel (1990) have shown, however, that for any continuous variable, no strictly data-based (i.e., statistical) method can exist by which to choose a sufficient number of degrees of freedom to insure that the amount of residual confounding due to that variable is small. This means that no matter what statistical method one uses to select the degrees of freedom, it is always logically possible that even if the true effect of pollution is null, the estimated effect is far from null due to confounding bias.”

In other words, it is impossible to adjust temporal trends without accurate information from external sources regarding the appropriate degrees of freedom to be used. Such information does not exist. No conclusions can be drawn from time-series studies unless the results are robust to extensive sensitivity analyses. Most time-series studies in the literature have undertaken only limited sensitivity analyses, if at all. This is an issue that transcends the convergence problem and applies to any time-series study of air pollution whether or not GAM was used for analyses. This problem, and the work of the HEI expert panel, does not appear to be recognized and addressed in the Staff Report and its references. (Declaration of Jon M. Heuss)

Agency Response: Staff disagrees with the comment. See the response to comment 74.

77. Comment: The confounding associations of air pollutants with temporal trends, weather, and co-pollutants make the choice of models important. It is clear that the uncertainties in the estimates of pollutant effects are almost certainly understated by consideration of the statistical uncertainty computed under a fitted model alone. Much more uncertainty derives from the lack of information regarding the choice of appropriate models for adjusting confounding by other covariates, and the choice of appropriate lag structures. As Lumley and Sheppard (2003) point out:

“Estimation of very weak associations in the presence of measurement error and strong confounding is inherently challenging. In this situation, prudent epidemiologists should recognize that residual bias can dominate their results. Because the possible mechanisms of action and their latencies are uncertain, the biologically correct models are unknown. This model selection problem is exacerbated by the common practice of screening multiple analyses and then selectively reporting only a few important results.”

More recently others have expressed similar concerns in the peer-reviewed literature. In a recent publication, which uses the method of Bayesian Model Averaging (BMA), Koop and Tole (2004) state as follows:

“The main empirical finding of the paper is that standard deviations for air pollution-mortality impacts become very large when model uncertainty is incorporated into the

analysis. Indeed they become so large as to question the plausibility of the previously measured links between air pollution and mortality.”

BMA is not new. In the area of air pollution epidemiology it has been used by Clyde to investigate the influence of model choice on estimated air pollution effects. It might be argued that BMA is a 'shotgun' approach to analyses of epidemiological data. However, in the absence of biological information on appropriate lag structures and covariate adjustments, it is most definitely one approach to investigating the uncertainty associated with model choice. If nothing else, it has the virtue of being an objective arbiter of model choice. (Declaration of Jon M. Heuss)

Agency Response: The paper by Koop and Tole that the commenter refers to asserts that there are multiple statistically acceptable models to describe time-series data sets, and that there is no consensus as to which is/are the “real” one(s). This is true – the subject has been raised before. The authors suggest a Bayesian averaging methodology to address this problem. They claim that the available time-series literature includes too few potentially explanatory variables. They propose an approach that is purely statistical, and includes every possible variable they can think of, and all possible interactions of these variables. Unfortunately, they also include variables and lag times that have been shown by physiological research to have no biological plausibility. There is no reason to include variables or lag times in the models that can be excluded a priori on physiological grounds. Inclusion of such variables complicates the models, can lead to computational difficulties, and confuses interpretation of the results. In addition, the approach included weather variables in the regression model that relate to mortality only because they impact air pollution concentrations, and that would not have an independent effect. Therefore, these variables should not be considered confounders if one is trying to assess the causal effects of air pollution.

Further, the uncertainties discussed in the Koop and Tole paper(s) refer to the uncertainties associated with developing a Bayesian model for the connections between air quality and mortality. The difficulties associated with such Bayesian studies using commonly available statistical data for mortality have been known for a long time. The real problem is the difficulty of accurately assessing the specific exposure of the population being evaluated. The other problem is that air pollution monitoring is only done at a few locations, and at limited times, and as a result cannot capture the full exposure to pollutants faced by a general population.

Second, specific studies of individuals have shown clear connections between exposure to air pollution and mortality. So, the real concern here is one of risk. Rather than focusing on Bayesian modeling analyses of general populations, one needs to consider the potential risks of climate change, which extend well beyond just considering mortality.

78. Comment: In summary, because of the very small risks being estimated, the difficulties of controlling weather and temporal trends and in the choice of the appropriate lag structure, the results of currently available time series analyses of air pollution cannot be accepted with any degree of confidence. In addition, even if one were to take the

results of existing time-series studies at face value, these results are mixed with some studies suggesting a role for ozone in mortality while others do not. Consequently, the derivation of a dose-response function for ozone and mortality from any time-series study is inappropriate. (Declaration of Jon M. Heuss)

Agency Response: We acknowledge that there are challenges that must be considered in the analysis and evaluation of time-series studies. In particular, the commenter highlights the difficulties of controlling weather and temporal trends and the choice of appropriate lag structures and concludes that the derivation of a dose-response function for ozone and mortality from any time-series study is inappropriate. However, the conclusions of the Health Effects Institute report that the commenter references do not support his conclusion. Rather, the report concludes that despite the fact that some time-series studies linking air pollution with mortality have not adequately addressed certain statistical challenges, the expert re-analysis of the data taking these issues into account suggests that the general conclusions drawn in the original studies remain unchanged.

79. Comment: In their analysis, CARB is concerned that higher temperatures will lead to higher ozone concentrations (CARB, 2004). This concern arises because the relationship that higher temperatures produce higher ozone levels has been known since the 1970s and is based on both ambient observations (Wolff and Lioy, 1978) and smog chamber experiments (Countess et al., 1981). The relevant question, however, is what is the relationship between temperature and ozone today in California and what will it be over the next several decades. This relationship will be examined in the South Coast Air Basin (SOCAB) because this is the region that historically experiences the highest ozone levels in California. (Declaration of Jon M. Heuss)

Agency Response: No response necessary.

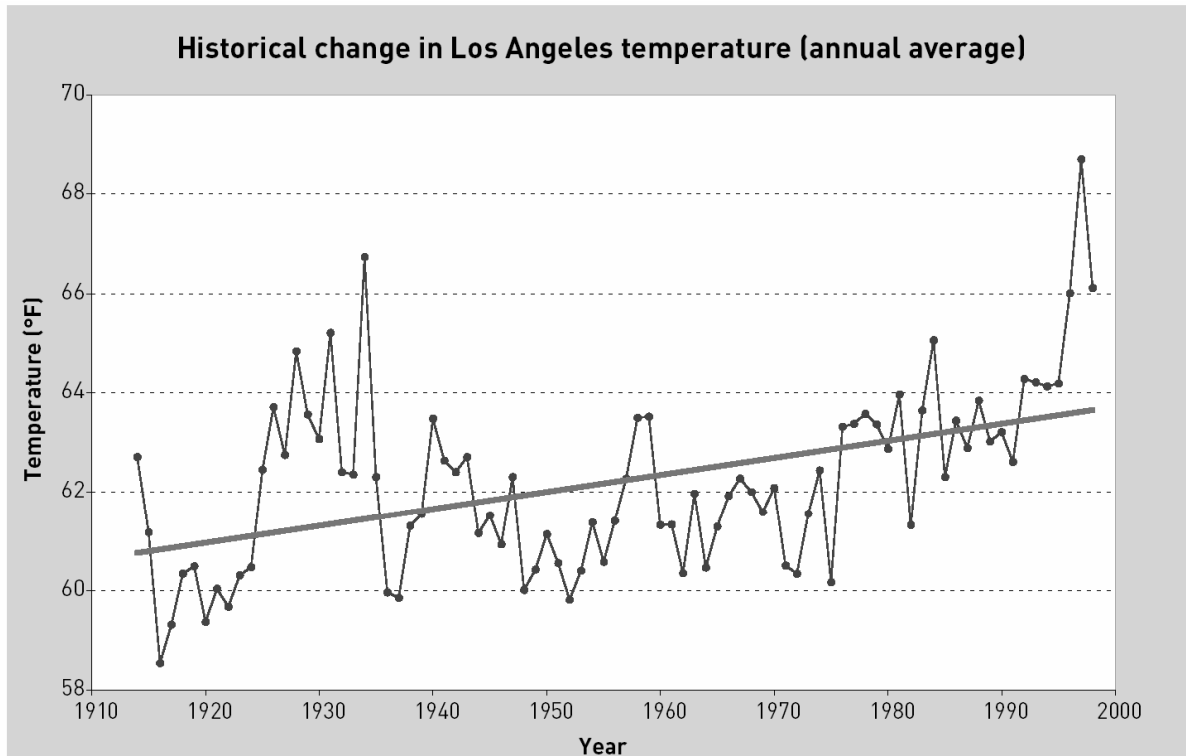
80. Comment: To investigate the current relationship, the temperature trends in the SOCAB will be determined for the period from 1970 to 2003 since this is the period that the IPCC (IPCC, 2001) attributes the increased temperature to anthropogenic greenhouse gas emissions. Since ozone concentrations are the highest during the summertime, the focus will be on the June through August trends. The ozone/temperature relationships in the SOCAB will also be examined during this period using ambient monitoring data. Then the ambient temperature trends will be used to evaluate expected temperatures in the 2020 and 2030 time frames. The analysis terminates at 2030 because we assume a hydrogen economy is in place after that. (Declaration of Jon M. Heuss)

Agency Response: Staff disagrees with the comment. The commenter's analysis incorrectly assumes that the rate of temperature change from 1970 to 2003 simply continues to 2020 and 2030. This assumption ignores emission growth and the fact that greenhouse gases accumulate and take many decades to be removed from the atmosphere. By focusing on average June-to-August temperature and ozone increases, the analysis also ignores the peak air pollution episodes that determine the stringency of California's ozone control programs. Climate change will increase the frequency, length, and intensity of heat waves affecting peak ozone events. The commenter also ignores the

increasing trend in global background ozone that is caused, in part, by emissions of the greenhouse gas methane and the increasing trend in temperature. Background ozone has increased at 10-30 ppb over the past century and is projected to increase over the next 30 years. As a result of these shortcomings, the commenter's analysis is flawed.

81. Comment: The maximum and minimum temperature trends for the sites in the LA Basin for June through August from 1970 to 2003 are shown in Figure 12. The slopes of the linear regression lines are shown in Table 1. Most of the sites exhibit a negative trend for the maximum temperature and a positive trend for the minimum temperature. On the average, the trend for the maximum temperature is $-0.0145^{\circ}\text{F}/\text{year}$ and the trend for the minimum temperature is $+0.0384^{\circ}\text{F}/\text{year}$. As a result, a maximum temperature trend of 0.0 and a minimum temperature trend of $+0.038$ will be assumed to project future temperatures. (Declaration of Jon M. Heuss)

Agency Response: The commenter provides new material to support his assertion that climate change has not meaningfully impacted temperature. In response, the study of the variability of surface air temperature change is very important, especially in terms of detecting anthropogenic climate. In order to detect anthropogenic climate change, one needs to compare the observed changes with the typical climate variations. Figure 12 (Declaration of Jon M. Heuss) shows the maximum and minimum temperature trends for the sites in the LA Basin for June through August from 1970 to 2003. For the purposes of climate change detection, the observational record used in this Figure is too short to determine accurately the unperturbed variability of the climate system, which is usually defined on timescales of many decades or longer. Every 4 years on average in southern California, the winter is wetter, the seas are higher, and the waves are stronger. This phenomenon is related to the El Niño (or warm) phase of a complex ocean-atmosphere cycle known as the El Niño Southern Oscillation. Changes in the frequency El Niño and La Niña-type conditions could result in different patterns of precipitation and temperature in Southern California depending upon the particular time period studied.



Historical temperature trend from 1914 to 1998 for Los Angeles Civic Center.

¹ Historical temperature and precipitation data from the National Climatic Data Center, Asheville, NC (<http://www.ncdc.noaa.gov>).

An analysis of historical records shows that Los Angeles has generally been getting warmer over the last century, with the average annual temperature rising nearly 3°F since 1914, according to historical weather data collected at the Civic Center in Los Angeles, California. The commenter's analysis also incorrectly assumes that the rate of temperature change from 1970 to 2003 simply continues to 2020 and 2030. This assumption is erroneous for the reasons described in the response to comment 80.

82. Comment: Based on the analysis of temperature data from 1970-2003 in the South Coast Air Basin (SOCAB), the minimum daily temperature is increasing by 0.038 degrees Fahrenheit (°F) per year and there is no change in the maximum daily temperature. Assuming this, the maximum daily temperature in 2020 and 2030 will not change from 2003 and the 2003 daily minimum temperatures would be expected to increase by 0.646°F and 1.026°F for the 2020 and 2030 future-years, respectively. (Declaration of Jon M. Heuss)

Agency Response: Staff disagrees with the comment. As previously indicated, the commenter's analysis incorrectly assumes that the rate of temperature change from 1970 to 2003 simply continues to 2020 and 2030. For example, recent peer-reviewed modeling analyses project that the average summer temperature increase over a 50-year timeframe

will be 2.2 to 5.6°F, whereas the commenter projects no increase. (Aw, J. and Kleeman, M.J, 2003). The commenter's position is contrary to the large body of published scientific studies. For example, both the IPCC (2001) and the NAST (2001) reports project that warming in the 21st century will be significantly larger than in the 20th century. Scenarios examined in these assessments, which assume no major interventions to reduce continued growth of world greenhouse gas emissions, indicate that temperatures in the US will rise by about 5-9°F (3-5°C) on average in the next 100 years.

83. Comment: Figure 2-8 of the Staff Report shows the relationship between ozone and temperature in the SOCAB. However a closer examination of the data reveals that this relationship has changed over time, and the ozone concentrations have become less sensitive to temperature. This is illustrated in Figure 13. Not only were the ozone concentrations at a fixed temperature lower in 2001-2003 than they were in 1986-1988, but the sensitivity of ozone to temperature has been dramatically reduced. The rate of increase with temperature over the interval between 90 and 100°F dropped from about 5 ppb per °F in 1986-1988 to about 2.5 ppb per °F in 2001-2003. The relationship has changed because of the on-going emission reduction program that has reduced ozone concentrations in the Basin. (Declaration of Jon M. Heuss)

Agency Response: Although temperature is one of the most important aspects of climate change and weather in general, correlating ozone changes to those in temperature provides only partial insight into the smog formation process and its dependence on meteorology. Other factors, such as increased biogenic and anthropogenic emissions and increased chemical reaction rates, etc., must also be accounted for. The commenter's statement that the sensitivity of ozone to temperature has been dramatically reduced and that the on-going emission reduction program that has reduced ozone concentrations in the Basin contradicts the results of ozone air quality modeling simulation by other scientists. (Hayhoe et al, 2004).

84. Comment: The association of high ozone with high surface temperatures has been reported by others. The U. S. EPA's July 1996 Criteria Document for Ozone summarizes several studies of the relationship between peak ozone and daily maximum temperature. Based on data from the late 1980's, at several eastern rural sites, the rate of increase was 1 to 3 ppb per °F. At several eastern urban sites, the rate was 2 to 5 ppb per °F. At two western sites, there was a weaker temperature dependence, reflecting lower man-made ozone in the mix. Thus, the sensitivity of ozone to temperature varies depending on the extent of man-made ozone present. Since there is an on-going emission reduction program nationally as well as in California, one would expect that the sensitivity of peak ozone to temperature would be decreasing throughout California and the rest of the nation as it has decreased in the South Coast. (Declaration of Jon M. Heuss)

Agency Response: The statement is incorrect, as described in the response to comments 121 through 123. Additionally, biogenic VOCs are very temperature-sensitive, and these emissions will not be abated in future years. Air quality in the Central Valley and Sierras could be especially influenced by climate change due to increased biogenic VOCs. Soil microbes produce NO_x and their activity may also increase with warmer temperatures,

leading to an increase in NO_x emissions and a consequent increase in ozone. Forest fire patterns may be altered, with consequences for PM and ozone.

It should be also noted that another impact of climate on ozone pollution in the troposphere arises from the probability that higher temperatures will lead to greater demand for air conditioning and greater demand for electricity in summer. Most of our electric power plants emit NO_x. As energy demand and production rises, we can expect amounts of NO_x emissions to increase, and consequently levels of ozone pollution to rise as well. In short, as indicated in the staff report (page 20), temperature in conjunction with sunlight and stable air masses tends to increase the formation of ozone. Success with efforts to reduce anthropogenic emissions will not change the important role of temperature with respect to ozone formation.

85. Comment: Sillman and Samson (1995) investigated the impact of temperature on ozone formation in urban, regional and global scale model simulations. The urban and regional simulations were carried out with a three dimensional model while the global scale simulations were carried out with a one-dimensional model. Sillman and Samson summarize much of what is currently known about the relationship of ozone and temperature (references have been omitted for clarity) as follows: "It is widely known that elevated O₃ concentrations in polluted environments are associated with warm temperatures. A variety of factors, including synoptic and boundary layer dynamics, temperature-sensitive emissions, and photochemistry, have been suggested as possible causes for the observed O₃ - temperature relationship. Emissions of biogenic hydrocarbons increase sharply with temperature, and it has been recently suggested that emission rates for anthropogenic volatile organic compounds (ROG) also increase with temperature. Abnormally high temperatures are frequently associated with high barometric pressure, stagnant circulation, and suppressed vertical mixing due to subsidence, all of which contribute to elevated O₃ levels. The importance of photolysis to the formation of O₃ provides a direct link between O₃ and time of year, and temperature-dependent photochemical rate constants also provide a link between O₃ and temperature." The simulations Sillman and Samson carried out show that the primary cause of the increase with temperature in urban and polluted rural areas is the temperature-dependent rate of decomposition of PAN (peroxyacetylnitrate) and other similar compounds. At lower temperatures, PAN acts as a major sink for NO_x and odd hydrogen (free radicals) that limits the build-up of ozone. At the global scale, increased temperature actually resulted in lower ozone concentrations. A 5°C increase in temperature resulted in a 6% reduction in ozone. Analysis of the impact of the temperature increase at the global scale showed that while ozone formation was increased, ozone destruction terms were increased more. (Declaration of Jon M. Heuss)

Agency Response: Staff disagrees with the comment. Please see the response to comments 80, 82, 83, 84, 87, 109, and 135. On a regional scale, scientists find a strong correlation between higher ozone levels and warmer days. The critical concept is that evaporation and biogenic emissions increase and chemical reactions speed up with increasing temperatures. A modeling analysis of greenhouse gas impacts on California by Katharine Hayhoe, *et al.* (Emissions Pathways, Climate Change, and Impacts on

California) indicates that the average summer temperature (June – August) in California will increase 2.2 – 5.6 °F by 2049 from the climatological mean (1961-1990) of 73.0 °F. Further, both the IPCC (2001) and the NAST (2001) reports project that temperatures in the US will rise by about 5-9°F (3-5°C) on average in the next 100 years.

As the troposphere warms on a global scale, one can also expect changes in ozone air quality. However, because of the short-lived nature of the chemical constituents and variations across space and time, the uncertainty is too large to make any precise predictions from global scale modeling simulations. Global-scale increases in temperature and water vapor predicted for climate change after 2050 are expected to offset some of the increase in tropospheric ozone associated with increasing pollutant emissions, but not reduce background ozone levels. However, understanding the interactions between ozone and climate change on global scale, and predicting the consequences of change requires enormous computing power, reliable observations, and robust diagnostic abilities. Such a characterization is well outside the scope of the introduction to climate change presented in the Staff Report.

86. Comment: When ARB indicates that ozone air quality can be profoundly affected by changes in climate and meteorology, ARB is not presenting new information, but merely drawing the conclusion that since GHGs increase temperature, and increased temperature for many different reasons favors ozone production, that ozone will increase, *all other things being the same*. However, not all other things are the same. The reduction in ozone precursors in California over the last 20 years has reduced peak and average ozone and the numbers of exceedances of the 1-hour and 8-hour ozone standards. This has occurred despite a significant increase in total vehicle miles traveled and an increase in total fuel consumption (and GHG emissions) from on-highway vehicles. So clearly, other factors are at play. (Declaration of Jon M. Heuss)

Agency Response: The ARB staff did not draw the conclusion "that since greenhouse gases increase temperature, and increased temperature for many different reasons favors ozone production, that ozone will increase, all other things being the same". This is merely the commenter's speculation of the ARB's statement on page 20 of the Staff Report that: "Climate change can lead to changes in weather patterns that can influence the frequency of meteorological conditions conducive to the development of high pollutant concentrations. High temperatures, strong sunlight, and stable air masses tend to occur simultaneously and increase the formation of ozone and secondary organic carbon particles". The ARB's statement explicitly lists possible changes.

87. Comment: There are a number of concerns with ARB'S presentation of the relationship between ozone and temperature, as follows:

- The presentation on ozone only tells a small part of the story, leaving the reader with the impression that any increase in GHGs and/or temperature will lead to higher ozone. Such is not the case.

- Figure 2-8 is based on ozone-temperature sensitivity in the 1996-1998 time period. There have been dramatic reductions in ozone and in ozone sensitivity to temperature, and these trends should continue, with or without GHG controls for light duty vehicles and trucks.
- As ozone concentrations continue to decline in the future, so will ozone concentrations become less sensitive to temperature changes in the future.
- ARB includes no analysis or attempt to quantify the increase in either temperature or ozone over the next 30 years, if current temperature trends continue.

Overall, with these serious deficiencies in ARB'S discussion. one cannot draw any meaningful conclusions on the need for GHG reductions to reduce ozone in California. (Declaration of Jon M. Heuss)

Agency Response: Staff disagrees with the comment. Please see responses to comments 80 through 86. In addition, this comment ignores the impact of climate change on the peak air pollution episodes that determine the stringency of California's ozone control programs, as well as the increasing trend in global background ozone that is caused by emissions of the greenhouse gas methane and other short-lived pollutants (NOx and VOC) (IPCC TAR, Ch.4). While the ARB staff was unable to predict future temperature increases, a recent peer-reviewed modeling analysis by university and federal scientists used a combination of global climate models and regional-scale climate modeling to project detailed, regional changes, i.e., that the average summer temperature increase over a 50-year timeframe in California will be 2.2 to 5.6°F. The global climate model has not been linked with a regional ozone model, and therefore ARB staff was unable to project future ozone increases. However, an example of the magnitude of possible impacts is the ozone increase observed during the European heat wave of 2003. Average ozone peaks in the Netherlands during June to August were 13 ppb higher [Fischer et al.], and population-weighted exposure to ozone peaks increased by 23 ppb in the United Kingdom.

For additional information, please see the following recent publication; Hayhoe et al, Emissions pathways, climate change, and impacts on California. Applied Physical Science Ecology, August 24, 2004, vol. 101 no. 34: 12422-12427
<http://www.pnas.org/cgi/content/abstract/101/34/12422?view=abstract>.

88. Comment: In contrast to the ARB claim, there are a number of reasons to expect that any increases in temperature will have a de minimus impact on ozone concentrations. Importantly, the relevant temperature determining the ozone effect should be the mid-day maximum temperature since that is the temperature that is driving the photochemistry and PAN decomposition at the time of the peak. Since maximum temperatures have not been increasing in the South Coast, little or no ozone effect is expected due to photochemistry. Temperature may also play a role by increasing biogenic emissions, but that impact is also driven primarily by daily maximum temperatures. The small increase in minimum temperatures would be expected to influence diurnal and other evaporative emissions.

However, since the major emission reductions that are on-going will reduce both ozone concentrations and the sensitivity of ozone to temperature, no increase in ozone is expected. In addition, on the global scale, any increases in temperature are expected to decrease ozone concentrations. Thus, there will be a reduction in background ozone that will tend to offset any potential increase in ozone in urban areas. (Declaration of Jon M. Heuss).

Agency Response: Staff disagrees with the comment. Please see responses to comments 80 through 87 and 132. In addition, even a small increase in ambient air temperature may lead to non-attainment of an ozone standard on a regional basis since control strategies are based on future air quality model results using current temperatures. Further, long-range transport of emissions from Asia (expected to increase with increasing industrialization there) are likely to play a larger role in adversely impacting California's air quality in the future. This is especially true at higher elevations (e.g. Mountain Counties) where the influence of long-range transport is seen more clearly. NO_x can be transported long distances in the cooler layers of the upper troposphere as PAN, later producing ozone with high efficiency.

89. Comment: The Staff Report and the use made in the Staff Report of its scientific references require further examination, if the connection between the proposed regulation and the California climate is a significant factor in the Board's deliberations. There is no reliable evidence in the Staff Report or its references that the reductions in greenhouse gas emissions sought in the Staff Report will have any significant effect on levels of ozone, or any other criteria or precursor pollutant. There is also no reliable evidence that the reductions in greenhouse gas emissions sought in the Staff Report will reduce the health risks and other adverse effects attributed in the Staff Report to global climate change. (Declaration of Jon M. Heuss)

Agency Response: Staff disagrees with the comment. The statement is incorrect as described in the responses to comments 79 through 88, 101, 120, and 611.

90. Comment: According to the U.S. Environmental Protection Agency, the heat-trapping properties of greenhouse gases cause the average surface temperature of the Earth to be about 33°C higher than it would be otherwise. Over 90 percent of the greenhouse effect is associated with water vapor, whose quantity is not significantly affected by human activity. Approximately 3°C is attributable to all other greenhouse gases, the most significant of which is carbon dioxide. It is therefore not surprising that, several researchers have estimated that a doubling of carbon dioxide would increase temperatures by another 3°C. It should be noted, however, that a doubling of anthropogenic carbon dioxide emissions will not cause a doubling of ambient carbon dioxide concentrations because of the influence of natural sources of carbon dioxide and uncertainty regarding the rate at which higher concentrations of carbon dioxide will be removed by natural "sinks." (NERA Economic Consulting and Sierra Research, Inc., Attachment B-5, The Potential Effect of the Proposed Regulations on Ambient Temperature and Ozone Concentrations, September 2004).

Agency Response: Many different aspects of the commenter's statement are incorrect. Clouds, more than water vapor, also play a major role in the current greenhouse warming. Water vapor is an important feedback that enhances the impact of greenhouse gases and is thus indirectly increased by CO₂ emissions.

This statement on CO₂ is incorrect: The estimate of 3°C warming for a doubled concentration of CO₂ is not an estimate, it is based on applying the known physics and chemistry of the atmosphere/climate system and doing the simulation. It is not a guess, nor is it predetermined. It is disappointing that the commenter did not bother to read the IPCC Synthesis Report and the underlying research on CO₂ emissions, future abundances and the carbon-cycle feedbacks.

A slow build up to a doubling of current fossil fuel CO₂ emissions that is then held constant at about 15 PG-C/yr is exactly the stabilization scenario that leads to CO₂ abundances of 1000 ppm (about 3 times current abundances).

The importance of removal of excess CO₂ by a range of changes in a warmer, high-CO₂ climate has been assessed by experts on the carbon cycle and found to introduce a relatively small uncertainty.

"Further uncertainties, especially regarding the persistence of the present removal processes (carbon sinks) and the magnitude of the climate feedback on the terrestrial biosphere, cause a variation of about -10 to +30% in the year 2100 concentration". (IPCC, 2001)

91. Comment: The NRDC recently completed a study, Smog in the Forecast, which illustrates a possible range and order of magnitude of the effects of global warming on ozone levels and public health in California (see Attachment A). Despite tremendous efforts to control air quality, California has the most polluted air in the nation, and high zone levels.

Ground-level ozone pollution, or smog, is a persistent environmental health problem that can aggravate allergies, asthma, and respiratory illness, particularly in children and the elderly. Studies in California have linked high ozone levels to decreased lung function in school children, school absenteeism, higher incidence of asthma in children, and increased hospital admissions.

California already faces a major challenge in controlling ozone levels, and global warming will likely compound that challenge. Ozone formation is more sensitive to temperature and weather than other pollutants. In scenarios examined in this study, global warming conditions in California would increase already unhealthy levels of smog; this in turn could lead to a rise in respiratory symptoms like shortness of breath, lung inflammation and asthma, as well as increased admissions and even death. (Roland Hwang, NRDC, 9/23/04).

Agency Response: No response necessary as the Staff Report also discusses the potential impacts of climate change on ozone levels.

92. Comment: Our new modeling effort demonstrates future increases in ozone pollution brought on by global warming's higher temperatures. In the year 2050, 1-hour peak ozone concentrations could increase by an average of 3.2 parts per billion (ppb) in the Los Angeles region, and 2.0 ppb in the San Diego region. In the year 2090, the daily 1-hour maximum of ozone in the air across Los Angeles could risk by 4.8 ppb, and 3.1 ppb in San Diego.

Areas already burdened with high ozone levels could see even greater increases in ozone pollution. In 2050, some Los Angeles residents could see an 8.4 ppb rise in the daily 1-hour maximum for ozone (Figure ES-1a). The regional average increase alone, 3.2 ppb, would be roughly equivalent to the pollution created by an additional 20 million cars and light trucks on the road (about 139 tons of hydrocarbons and nitrogen oxides). Current ozone levels are already hurting Californian's health, and this projected increase in ozone pollution could make matters worse. In both the San Diego and Los Angeles regions, hospital admissions for asthma in people under 65 are predicted to rise, as would the mortality rate. (Roland Hwang, NRDC, 9/23/04).

Agency Response: No response necessary as the Staff Report also discusses the potential impacts of climate change on ozone levels.

93. Comment: The United Nations Intergovernmental Panel on Climate Change ("IPCC") estimates that global temperatures have risen only 0.6°C over the entire 20th century. Most of the increase occurring over the last 50 years is attributed to human influence. The pre-industrial atmospheric concentration of carbon dioxide has been estimated at 278 ppm. It had increased to 365 ppm by 1998. (NERA Economic Consulting and Sierra Research, Inc., Attachment B-5, The Potential Effect of the Proposed Regulations on Ambient Temperature and Ozone Concentrations, September 2004).

Agency Response: This statement is correct, but fails to recognize that the contributions from CH₄, CFCs, N₂O and tropospheric O₃ (also greenhouse gases) are comparable to CO₂ – see RF figure in IPCC TAR.

Global climate models project that the warming will not be evenly distributed - land areas will experience greater warming than the oceans, higher latitude regions (regions closer to the poles) are expected to warm more than equatorial regions, and the northern hemisphere is projected to warm more than the southern hemisphere. The global average surface temperature has increased over the 20th century by about 1.1°F (0.6°C). While the record shows a great deal of variability, the upward trend is unambiguous. Even though, in a numerical sense, this increase may not seem like a lot, this temperature rise is happening at an extremely rapid rate, a rate of change not seen on the planet for at least the last 10,000 years. It is the combined threat of the unusually large magnitude of this temperature increase and the speed at which it is occurring that causes great concern among scientists.

94. Comment: According to Oak Ridge National Laboratory, global carbon dioxide emissions from fossil fuel combustion (including gas flaring) were 6,611 million metric tons carbon in calendar year 2000. Data on highway gasoline use for 2001 reported by the Federal Highway Administration indicates annual consumption of 129.7 billion gallons, which is equivalent to 314 metric tons of carbon (almost all of which is emitted in the form of carbon dioxide). Absent changes in CAFÉ standards, the National Research Council estimates that gasoline consumption will increase to 195 billion gallons per year by 2030, which is equivalent to 473 million metric tons of carbon. (NERA Economic Consulting and Sierra Research, Inc., Attachment B-5, The Potential Effect of the Proposed Regulations on Ambient Temperature and Ozone Concentrations, September 2004).

Agency Response: This is a misleading statement of unconnected facts that appears to compare global fossil fuel carbon emissions to U.S. (rather than global) gasoline use.

95. Comment: Ignoring the fact that not all gasoline is consumed in vehicles subject to CAFÉ standards, and assuming a 17 percent rebound effect, reducing the fuel consumption of all gasoline-fueled vehicles by 25 percent (the reduction associated with the proposed standards) would reduce carbon emissions from gasoline-fueled vehicles by 103 million metric tons per year. This is 1.56 percent of the current estimate of total anthropogenic carbon dioxide emissions and 1.7 percent of the 6,059 million metric tons of carbon per year increase in anthropogenic carbon dioxide emissions during the last 100 years. If all anthropogenic emissions caused an increase in temperatures of 0.6°C, then a change in carbon dioxide emissions of 103 million metric tons carbon per year would be expected to change temperatures by 0.01°C ($0.017 \times 0.6^\circ\text{C}$). (NERA Economic Consulting and Sierra Research, Inc., Attachment B-5, The Potential Effect of the Proposed Regulations on Ambient Temperature and Ozone Concentrations, September 2004).

Agency Response: The commenter misses the point that:

- The magnitude of the CO₂-equivalent reduction (1.6% of C emissions) is almost as large as the entire aviation or shipping sectors (about 2 %);
- The present-day warming today is only a fraction of the “committed” warming that we will experience in the coming decades (due to the past greenhouse emissions), and that the rate of warming is predicted to accelerate in the next decades, under even the most optimistic reductions of emissions; and
- The CO₂-equivalent reductions called for in the Staff Report represent a significant step at reducing California’s emissions of climate change pollutants from motor vehicles.

96. Comment: To estimate the effect of a 0.01°C temperature increase on ozone concentrations, the U.S. EPA’s Empirical Kinetic Modeling Approach (“EKMA”) model was used. The OZIPM-4 version of the EKMA model was run using a default example case provided by EPA incorporating a morning temperature of 294°K (69.5°C) rising to 308°K (94.7°C) in the late afternoon. The temperature profile was then uniformly increased by

0.6°C (1.08°F) and the model was re-run. The peak ozone levels for the second run increased by 1.73 ppb, from 0.16969 ppm to 0.17142 ppm. Using the temperature decrease predicted for a nationwide reduction in motor vehicle fuel consumption of 25 percent (0.01°C), the proportional change in peak ozone concentration would be 0.03 ppb, which is 0.00003 ppm. This amounts to an increase of 0.02 percent in the peak ozone level ((0.00003/0.16969)*100). (NERA Economic Consulting and Sierra Research, Inc., Attachment B-5, The Potential Effect of the Proposed Regulations on Ambient Temperature and Ozone Concentrations, September 2004).

Agency Response: The US EPA recommends the use of comprehensive photochemical grid models to properly assess ozone air quality model simulation results. The EKMA model is considered as a screening tool. Although EKMA and OZIP are relatively easy to use, they are limited to single day episodes. EKMA/OZIP require multiple single runs, thus introducing additional errors and biases into the calculations. Also, EKMA only predicts a single region-wide peak ozone value, and as such cannot be used to evaluate spatial and temporally-varying emission scenarios or meteorological conditions.

Temperature is one of the most important meteorological variables influencing air quality in urban atmospheres because it directly affects gas and heterogeneous chemical reaction rates and gas-to-particle partitioning. The commenter states that "the temperature profile was then uniformly increased by 0.6°C (1.08°F) and the model was re-run". This temperature increase of 0.6° C is too small. Simulations from leading climate models of changes in decadal average surface temperature for the US (excluding Alaska and Hawaii) based on historic and projected changes in atmospheric concentrations of greenhouse gases and sulfate aerosols indicate that for the 21st century, the models project warming ranging from 3 to 9°F for the US.

97. Comment: A 21st century warming in the range of 1.0-2.5°C, especially when combined with the boost in crop and forest productivity from an atmosphere richer in plant food (i.e. carbon dioxide) would likely have a small but beneficial impact on the U.C. economy. (Competitive Enterprise Institute, 9/21/04).

Agency Response: "Projected climate change will have beneficial and adverse effects on both environmental and socio-economic systems, but the larger the changes and rate of change in climate, the more the adverse effects predominate (IPCC Synthesis Report 2001)." Even a 21st century temperature rise at the lower end of the IPCC scenario projections (1.5-2.5°C, as noted above) would probably yield a preponderance of negative impacts. Such impact assessments do not incorporate risks of negative impacts from future large-scale discontinuous (abrupt) climate change (see Synthesis, Fig. SPM-3). However, agricultural impact assessments typically do include the CO₂ fertilization effect mentioned by the CEI. It is unclear to what the "U.C. economy" refers, but IPCC projections were not done at the California (CA) or U.S. level.

98. Comment: According to the IPCC, "It is now widely agreed that major loss of grounded ice [in the West Antarctic ice sheet] and accelerated sea level rise are very unlikely during the 21st century." Indeed, the West Antarctic ice sheet is thickening rather

than thinning, and large areas of Antarctica are cooling, as are the coastal regions of the Greenland ice sheet. Satellite altimetry indicates no net change in sea-level in the past decade, leading the scientist conducting the study to eschew “fear of any massive future flooding as claimed in most global warming scenarios,” and to reject the IPCC’s projection of an 8-86 centimeter (3-34 inch) sea-level rise in the 21st Century as “untenable, not to say impossible.” (Competitive Enterprise Institute, 9/21/04).

Agency Response: The comment fails to mention that the Greenland ice sheet is losing mass and thinning at the margins. The claim that satellite altimetry data “indicates no net change in sea-level in the past decade” is simply incorrect. The best current estimates from satellite altimetry data are that global-mean sea level has increased by roughly 3 mm/yr over 1993-2003.

99. Comment: The IPCC finds “no compelling evidence to indicate that the characteristics of the tropical and extra-tropical storms have changed” during the 20th century. The frequency and intensity of Atlantic tropical storms decreased during five decades from 1944 through 1995 – a period of net global warming and rapidly rising CO₂ concentrations. More than a dozen recent studies find no increase in the frequency or severity of extreme weather events in North America or the world generally. (Competitive Enterprise Institute, 9/21/04).

Agency Response: For a response to the part of this comment pertaining to hurricanes, see the response to comment 619. For the part of this comment pertaining to extreme weather events, we note that Milly *et al.* (2002) have reported global increases in the frequency of catastrophic flood events. Increases in dry conditions, and in the frequencies of intense precipitation have also been identified.

In many cases, we observe that recently occurring rare events have analogs from the past. Real changes, however, must be viewed in a long-term context based on a large sample to minimize “weather noise”. Furthermore, the changes in the mean values (*e.g.*, sea level, temperatures, *etc.*) when overlapping with “usual weather variability” will and do strengthen some of the events (*e.g.*, temperature hot spells, coastal flooding due to strong storms, *etc.*) that otherwise would not be considered as particularly “extreme” events.

Changes in extreme events over the United States are available from <http://www.noaa.ncdc.gov> extremes event pages. Here, the “Climate Extremes Index” in the warm season is shown over the course of the 20th Century to have a U-shaped change, with extremes (defined by hurricanes, heavy precipitation, extremes of heat and cold, droughts and wet spells) about as high now as they were during the first few decades of the 20th Century. Over the past 95 years of record, three of the five largest values of the Climate Extremes Index have occurred since 1990.

100. Comment: Predications of sharp increases in U.S. mortality from more frequent and severe heat waves overlook people’s proven capacity to adapt to and protect themselves from climate-related stresses. During the past several decades, the sensitivity of the American population to extremes of heat and humidity has declined significantly in

most major U.S. cities notwithstanding an overall rise in urban temperatures, whether due to climate change or the growth of urban heat islands. The decline in heat-related mortality results from a combination of factors: improved medical care, increased availability and use of air conditioning, greater public awareness of the potential dangers of heat stress, and both human biophysical and infrastructural adaptations. Southern cities, where summer heat and humidity are common and adaptation to climatic warmth is widespread, exhibit little or no (sic) evidence of increased mortality on hot and humid days. Global warming will likely have minimal impacts on total heat-related mortality in the United States. (Competitive Enterprise Institute, 9/21/04).

Agency Response: This comment suggests that people will be able to adapt to rising temperatures and therefore global warming is likely to have little impact on heat-related mortality in the future. We agree that there is a range of approaches to adapting to rising temperatures that may reduce heat-related mortality. These adaptation measures such as the development of heat warning systems and infrastructure changes should be promoted. However, it is difficult to assess the extent to which such measures will decrease heat-related mortality when faced with projected extremes – such as the heat wave that occurred in Europe in the summer of 2003, which has been linked to over 20,000 deaths (IFRC 2004). In a recent study published in *Nature*, Stott et al. (2004) show, at a confidence level of greater than 90%, that more than half of the risk of 2003-like extreme European summers is attributable to human influences on the climate system. Furthermore, although the 2003 heat wave is believed to be the hottest summer in Europe in the last 500 years, by 2040, half of Europe's summers could be as hot as the summer of 2003 (Stott et al. 2004).

Under these types of extremes it is impossible to assume adaptation will address all of the mortality. Findings on the effect of adaptation measures, such as the use of air conditioning, on reducing heat-related mortality have been mixed. While some studies have shown air conditioning can reduce heat-related deaths by 25% (Phelps, 1996), other studies have identified long periods in New York City when mortality during heat waves did not change significantly despite the increased use of air conditioning (Ellis and Nelson 1978, Marmor 1975, Kalkstein, 1998).

Finally, as mentioned previously, the greatest human health response to weather is based on variability. Climate models suggest variability will increase. As such, heat-related mortality will not diminish as the comment suggests. The weaker response in southern cities is primarily based upon the lower summer climate variability (see response to comment 73). Infrastructure changes also play a role, however, changes in urban infrastructure for vulnerable populations such as the elderly and poor are not expected. These vulnerable people will continue to live in row homes that are poorly suited to the heat.

Furthermore, as the climate warms and society begins to acclimatize to new conditions, thresholds of impacts are likely to increase, but the extreme temperatures are also likely to increase. Population health will react negatively to these new, higher “extremes” until they adapt. Then, once we adapt to the newer extremes, they will increase again, continually

putting us behind in our adaptation mechanisms. Thus, we will likely continue to be “one step behind,” as far as adaptation goes.

101. Comment: Predictions of more frequent and severe air pollution episodes in U.S. cities, although intuitively plausible because heat promotes ozone formation, ignore the history of dramatic air quality improvements over the past 30 years and the panoply of regulatory requirements that ensure continuing reductions in air pollution over the next two decades. Notes air quality analyst Joel Schwartz: “Since 1975, a period during which climate alarmists argue that the climate has already significantly warmed, the national-average number of exceedances of the 1-hour ozone standard declined 95 percent (from 10 to 0.5 days per year), while the number of 8-hour ozone exceedances declined about 60 percent (from 14 to 6 per year). (Competitive Enterprise Institute, 9/21/04).

Agency Response: Staff agrees that the number of ozone exceedances has been declining due to more stringent emission controls. However ozone levels in California still often exceed federal and state standards and any mechanism that increases ozone formation is of significant concern. Results of several research studies indicate that climate change may affect exposures to air pollutants by a) affecting weather and thereby local and regional pollution concentrations; b) affecting anthropogenic emissions, including adaptive responses involving increased fuel combustion for fossil fuel-fired power generation; c) affecting natural sources of air pollutant emissions; and d) changing the distribution and types of pollution, and health effects. Biogenic VOC emissions are very temperature-sensitive, and those emissions will not be abated in future years. Estimates of biogenic emissions should consider variations in climate and land use, which have a strong impact on emissions rates.

For example, roughly 60% of all biogenic VOCs are estimated to occur in the summer, when temperatures are higher than at other times of the year. Although pollution control measures have reduced concentrations of the regulated pollutants, adverse effects of air pollution are still found at current concentrations using epidemiologic approaches. Adaptations to climate change needs to include ensuring responsiveness of air quality protection programs to changing pollution levels. Future research should include basic atmospheric science work on the association between weather and air pollutants; improving air pollution models and their linkage with climate change scenarios; and closing gaps in the understanding of exposure patterns and health effects.

102. Comment: Predictions of malaria outbreaks in Europe and the United States, although intuitively plausible because mosquitoes breed faster in warmer and wetter weather, ignore the fact that malaria is primarily a disease of poverty, not of climate. Malaria outbreaks were common in such northerly climes as Minnesota, Canada, Britain, Scandinavia, and Russia during the 19th Century, when average global temperatures were cooler than today. The resurgence of malaria in some developing countries is due to decreased spraying of home with DDT, anti-malarial drug resistance, and incompetent public health programs, not to any ascertainable changes in climate. Even if certain U.S. regions become warmer and wetter, malaria will not make a comeback as long as

misguided policies do not cripple wealth creation or impede the use of proven vector-control measures. (Competitive Enterprise Institute, 9/21/04)

Agency Response: Climate is one factor that determines the distribution and incidence of malaria. Temperature affects both the *Plasmodium* parasite and the *Anopheles* mosquito, with thresholds at both temperature extremes limiting the survival or development of the two organisms. *Anopheles* must live long enough to bite an infected person, allow the parasite to develop and then bite a susceptible human. As noted, while climate is an important driver of malaria, it is not the only one. It is reasonable to expect that developed countries that maintain an effective health infrastructure would not likely experience major outbreaks of malaria. Please also see response to comment 610.

103. Comment: Predictions of mass extinctions due to global warming overlook the ecological benefits of rising CO₂ levels and the observed expansion of habitat ranges. CO₂ enrichment of the atmosphere raises the optimum temperature for plant growth. For example, an extra 300 parts per million (ppm) of CO₂ would increase optimum temperature for most plants by about 4 to 8 °C – exceeding global warming projections in all but the most lurid scenarios. As atmospheric temperature and CO₂ levels have risen, the range of plant habitats has expanded pole-ward in latitude and upward in elevation, with no loss of habitat at lower latitudes and elevations. Animals that depend on those plants for sustenance have similarly been able to extend their ranges. Thus, during the past century, “individual animal species, like individual plant species, have measurably increased the areas of the planet’s surface that they occupy, creating more overlapping of ranges, greater local species richness, and an improved ability to *avoid* extinction.” (Competitive Enterprise Institute, 9/21/04)

Agency Response: This is an extremely narrow and incorrect view of the science. The ecological “benefits” of increased CO₂ are limited to plants that already have sufficient water and nutrients. This effect has been included in studies of the impact on crops and ecosystems, and it is not found to offset the disruption caused by climate-change-induced habitat shift. For example, the poleward migration of plant and animal species has already been observed, consistent with large-scale warming. Often this is accompanied by decreased viability or increased competition (from species that likewise moved poleward) in the equatorward range. The CEI quote contradicts the research of most the scientific community. This research is summarized in the IPCC Synthesis Report:

“Models of cereal crops indicate that in some temperate areas potential yields increase with small increases in temperature but decrease with larger temperature changes (medium to low confidence). In most tropical and subtropical regions, potential yields are projected to decrease for most projected increases in temperature (medium confidence). Where there is also a large decrease in rainfall in subtropical and tropical dryland/rainfed systems, crop yields would be even more adversely affected. These estimates include some adaptive responses by farmers and the beneficial effects of CO₂ fertilization, but not the impact of projected increases in pest infestations and changes in climate extremes. The ability of livestock producers to adapt their herds to the physiological stresses associated

with climate change is poorly known. Warming of a few °C or more is projected to increase food prices globally, and may increase the risk of hunger in vulnerable populations.”

Please also see response to comment 610.

104. Comment: Fears of global warming-induced ice age are a hobgoblin. In a popular disaster scenario, ice melt and increased rainfall from global warming reduce the salinity and density of ocean surface water to the point where it no longer sinks as it cools. This supposedly shuts down the Atlantic Meridional Overturning (AMO), a convective system that pulls warm water from the tropics to the higher latitudes. A massive infusion of fresh water may have disrupted the AMO and caused a regional cooling 8,200 years ago, when a huge ice dam burst, allowing lakes Agassiz and Ojibway to drain swiftly through the Hudson Strait to the Labrador Sea. However, there are no comparable fresh water bodies that could pour into the ocean at a similar rate today. Moreover, a weakened or even inactive AMO would not shut down the Gulf Stream, a wind-driven system that transports warmth to Northern Europe. Even in climate models that project a weakening of the AMO during the 21st Century, Europe continues to warm albeit “more slowly than the rest of the world.” (Competitive Enterprise Institute, 9/21/04)

Agency Response: The comment is apparently referring to a Hollywood film (“popular disaster scenario”), and not to science. No scientific study has suggested the possibility of a “global warming-induced ice age,” or the shut-down of the Gulf Stream.

What is discussed in the scientific literature, however, is the risk of changes in the Atlantic Meridional Overturning (AMO), which is sometimes referred to as the Atlantic thermohaline circulation (THC) or (in popular articles) the “ocean conveyor belt”. This circulation transports heat towards the northern Atlantic and Europe. A weakening, latitude shift or breakdown of the AMO has occurred many times in climate history. It is a sensitive system easily affected by density changes in the northern Atlantic: a reduction in surface water density hinders the sinking of water into the deep ocean, which is a crucial “motor” of the AMO.

In the past, such a density reduction has been caused repeatedly by freshwater drainage or ice sheet surges into the Atlantic. In the future, such a density reduction may occur: (a) through surface warming, warm water having a lesser density; (b) through increased precipitation and river runoff; or (c) through melt-water runoff from Greenland (where enhanced melting is now observed). Large-scale freshening (salinity reduction) is underway in the relevant ocean areas and now well documented.

The threshold where these trends might cause a critical change in the Atlantic currents is highly uncertain, and most scientists consider a breakdown of the AMO a “low probability – high impact” risk of global warming, *i.e.*, a kind of “climatic accident” that is difficult to predict, but cannot be ruled out. A recent detailed questioning of 12 leading international experts on the AMO found that four of these experts thought the risk of an AMO shut-down was over 5% for a global warming of 2°C by 2100, and exceeded 50% for a warming of 4-5 °C by 2100; the majority thought the risk was smaller but not insignificant.

The consequences of an AMO shut-down would be numerous. Potential consequences include a relative regional cooling, shifts in the tropical rainfall belts, and an additional rapid sea level rise of ~1 meter around northern Atlantic coasts.

105. Comment: ARB describes CO₂ as a “climate change pollutant,” but that assumes the validity of the catastrophic warming theory. It would be more accurate to describe CO₂ as a biosphere fertilizer or nutrient. (Competitive Enterprise Institute, 9/21/04).

Agency Response: This is an extremely narrow and incorrect view. The ecological “benefits” of increased CO₂ are limited to plants that already have sufficient water and nutrients. This effect has been included in studies of the impact on crops and ecosystems, and it is not found to offset the disruption caused by climate-change induced habitat shift. See response to comment 103.

106. Comment: Scores of laboratory and field studies show that higher CO₂ concentrations help most plants grow faster, stronger, and more profusely, utilize water more efficiently, and resist pollution and other environmental stresses; and all animals directly or indirectly depend on plants as a food source. Based on empirical studies, the 100 ppm increase in atmospheric CO₂ content over the past 150 years has increased mean crop yields by the following amounts: wheat, 60 percent; other C3 cereals, 70 percent; C4 cereals, 28 percent; fruit and melons, 33 percent; legumes, 62 percent; root and tuber crops, 67 percent; and vegetables, 51 percent. Were it not for the extra CO₂ put into the atmosphere by fossil fuel combustion, either many people now living would not exist, or many forests not standing would have been cleared and turned into farmland – or both. (Competitive Enterprise Institute, 9/21/04).

Agency Response: CO₂ fertilization is a known effect, and has been factored into the projections of the agricultural impacts of future CO₂ (the “draw-down” of atmospheric CO₂ by plants, crops, and trees has also been factored into projections of future atmospheric CO₂ abundance). However, there is considerable uncertainty as to whether this fertilization “effect” has any impact except where growing conditions are ideal. The results of the FACE experiment (W. Schlesinger, Duke) are ambiguous, and do not clearly show that elevated CO₂ levels cause enhanced growth. Similar experiments in prairie grasslands also fail to show a pronounced growth effect. The CEI fails to provide references to the cited “empirical studies” that claim increased agricultural productivity under a 100 ppm increase in atmospheric CO₂. These results are probably extrapolated possibly from limited greenhouse studies, and are certainly not based on field studies.

107. Comment: CO₂ emissions are literally greening the planet, enhancing biodiversity and global food security. Continuing CO₂ enrichment of the atmosphere may be necessary to feed a global population expected to increase by 3.3 billion over the next 50 years – and limit pressures to convert forests and wetlands into cropland. (Competitive Enterprise Institute, 9/21/04).

Agency Response: Staff disagrees with the comment. See response to comment 106.

108. Comment: The IPCC and other alarmists offer no convincing evidence that CO₂ emissions pose a significant threat to people or the planet. AB 1493 lacks a compelling scientific rationale. (Competitive Enterprise Institute, 9/21/04).

Agency Response: The National Academies of 11 different countries (including the United States) issued a joint statement on the "Global response to climate change" in June 2005. This statement reaffirmed the 2001 IPCC conclusion that "most of the warming in recent decades can be attributed to human activities". The 11 Academies noted that "It is clear that many of the world's poorest people are likely to suffer the most from climate change. Long-term global efforts to create a more healthy, prosperous and sustainable world may be severely hindered by changes in climate".

These conclusions of the world's most eminent and authoritative scientific organizations are in stark contrast to the commenter's unsupported assertion that there is "no convincing evidence that CO₂ emissions pose a significant threat to people or the planet".

109. Comment: The Staff Report also draws broad, inappropriate, and misleading conclusions regarding the relationship between an increase in temperatures due to greenhouse gas emissions and an increase in ground level ozone in California. The Staff Report provides only a cursory discussion, leaving the reader with the impression that any increase in greenhouse gases and/or temperature will lead to higher ozone levels, which is clearly not the case. One need only look at California's own data to show that there is no correlation between increasing carbon dioxide emissions and increasing ozone levels. According to California EPA's Environmental Protection Indicators for California (EPIC) report of April 2002, since 1980 both peak ozone levels across the state and the total annual exposure to unhealthy levels of ozone have declined dramatically. For example, in the South Coast Air Basin peak ozone levels have been reduced by over 60 percent since 1980, and total annual exposure to unhealthy ozone levels has declined by over 70 percent since 1990. (Statement of John Cabaniss, 9/23/04).

Agency Response: The ARB did not draw the conclusion that " *any increase in greenhouse gases and/or temperature will lead to higher ozone levels* ". This is merely the commenter's speculation of the ARB's statement in the Staff Report (page 20) that: "Climate change can lead to changes in weather patterns that can influence the frequency of meteorological conditions conducive to the development of high pollutant concentrations. High temperatures, strong sunlight, and stable air masses tend to occur simultaneously and increase the formation of ozone and secondary organic carbon particles". In fact, the ARB's statement specially mentions the importance of factors beside temperature on ozone.

110. Comment: The ARB should be commended for its part in achieving these significant improvements in ozone air quality. But it should be understood that these improvements occurred due to the reduction of ozone precursor emissions during this time frame. During the same time period, again as reported in the EPIC report, there was about a 70 percent increase in total vehicle miles traveled and an increase in total on-road fuel consumption

(and therefore carbon dioxide emissions) of almost 30 percent. (Statement of John Cabaniss, 9/23,04).

Agency Response: The commenter notes that ozone improvements have occurred despite increases in greenhouse gas emissions. Although this is true, that does not mean that greenhouse gas emissions and climate change have no effect on ozone formation. A modeling analysis of greenhouse gas impacts on California by Katharine Hayhoe, et al. (Emissions pathways, climate change, and impacts on California) indicates that the average summer temperature (June – August) in California will increase 2.2 – 5.6 °F by 2049 from the climatological mean (1961-1990) of 73.0 °F. Long-term projections for surface air quality in California or in the United States must account not only for future changes in emissions but also for changes in climate.

111. Comment: Since ARB and the California air quality management districts have programs in place to continue to reduce ozone precursors, there is every reason to believe that Californians will continue to see declining ozone levels in the future despite any further increases in greenhouse gas emissions from vehicles. (Statement of John Cabaniss, 9/23,04).

Agency Response: Staff agrees that the number of ozone exceedances has been declining due to more stringent emission controls. However ozone levels in California still often exceed federal and state standards and any mechanism that increases ozone formation is of significant concern. Results of several research studies indicate that climate change may affect exposures to air pollutants by a) affecting weather and thereby local and regional pollution concentrations; b) affecting anthropogenic emissions, including adaptive responses involving increased fuel combustion for fossil fuel-fired power generation; c) affecting natural sources of air pollutant emissions; and d) changing the distribution and types of pollution, and health effects. In general, ozone has proven the most resistant to efforts to reduce its presence in the environment. Biogenic VOC emissions are very temperature-sensitive, and those emissions will not be abated in future years. Estimates of biogenic emissions should consider variations in climate and land use, which have a strong impact on emissions rates.

112. Comment: Despite the significant increases in carbon dioxide greenhouse gas emissions over the past century, California's average temperature has increased by only 0.7 degree F, as reported in the Staff Report and confirmed from Historical Climatology Network data. One hundred years ago there were very few motor vehicles in California, while today there are over 25 million vehicles registered in the state. Even if this gradual warming trend continues for the next thirty years, the temperature increase would be only 0.22 degree F. With the expected reductions in ozone precursors and the related sensitivity of ozone to temperature, this small temperature increase would be expected to increase ozone by no more 1 ppb, an almost unmeasurable value compared to the ozone health standards. See attached Air Improvement Resource paper. (Statement of John Cabaniss, 9/23/04).

Agency Response: As noted in response to comments 130 and 131, the increase in global mean surface temperature expected over 2000-2030 is 0.6-0.8°C. This is almost independent of the scenario modeled, since part of the increase is a delayed response to the rapid rise in CO₂ abundance over the past 50 years. The derived value of 0.22°F is incorrect, and has no scientific basis. The climate record clearly shows an accelerated warming in the last two decades (warmest for the last 500-1000 years), and climate models predict an acceleration of warming over the next 30 years.

113. Comment: The ARB Staff Report also draws broad conclusions between an increase in temperature (due to GHGs) and an increase in ground level ozone in California. The discussion is presented below.

“Climate change can lead to changes in weather patterns that can influence the frequency of meteorological conditions conducive to the development of high pollutant concentrations. High temperatures, strong sunlight, and stable air masses tend to occur simultaneously and increase the formation of ozone and secondary organic carbon particles – weather conditions associated with warmer temperatures and increased smog. Figure 2-8 shows the relationship between ozone and temperature in the South Coast Air Basin, and indicates that ozone air quality can be profoundly affected by changes in climate and meteorology.” (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: The quoted paragraph speaks for itself, and does not state a singular, direct cause and effect. In fact, the ARB's statement in the Staff Report (page 20) specially mentions the importance of factors beside temperature on ozone. Still, in this paragraph ARB did intend to point out that climate change can impact the factors leading to ozone formation.

114. Comment: There are a number of concerns with ARB's presentation of the relationship between ozone and temperature, as follows:

The presentation on ozone only tells a small part of the story, leaving the reader with the impression that any increase in GHGs and/or temperature will lead to higher ozone. Such is not the case. Figure 2-8 is based on ozone-temperature sensitivity in the 1996-1998 time period. There have been dramatic reductions in ozone and in ozone sensitivity to temperature, and these trends should continue, with or without GHG controls for light duty vehicles and trucks. ARB includes no analysis or attempt to quantify the increase in either temperature or ozone over the next 30 to 40 years, if current temperature trends continue. Overall, with these serious deficiencies in ARB's discussion, one cannot draw any meaningful conclusions on the need for GHG reductions to reduce ozone in California. (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: The ARB did not draw any conclusions between an increase in temperature (due to greenhouse gases) and an increase in ground level ozone in California. The assumption that ozone will continue to become less sensitive to temperature in the future seems speculative and unproven. This hypothesis should be

tested using a comprehensive air quality airshed model simulation. Although temperature is one of the most important aspects of climate change and weather in general, correlating ozone changes to those in temperature provides only partial insight into the smog formation process and its dependence on meteorology. Other factors, such as increased biogenic and anthropogenic emissions and increased chemical reaction rates, etc., must also be accounted for. In general, one would expect that the position that an air basin occupies on the NO_x - VOC isopleth diagram for ozone is changing over time, and that the sensitivity of ozone to temperature is likely changing. The commenter has not provided data to support his sensitivity argument.

115. Comment: The following paragraph from the 1995 journal article entitled “Impact of Temperature on Oxidant Photochemistry in Urban, Polluted Rural Remote Environments” sums up much of what is currently known about the relationship of ozone and temperature (references have been omitted for clarity): [1]¹

“It is widely known that elevated O₃ concentrations in polluted environments are associated with warm temperatures. A variety of factors, including synoptic and boundary layer dynamics, temperature-sensitive emissions, and photochemistry, have been suggested as possible causes for the observed O₃– temperature relationship. Emissions of biogenic hydrocarbons increase sharply with temperature, and it has been recently suggested that emission rates for anthropogenic volatile organic compounds (ROG) also increase with temperature. Abnormally high temperatures are frequently associated with high barometric pressure, stagnant circulation, and suppressed vertical mixing due to subsidence, all of which contribute to elevated O₃ levels. The importance of photolysis to the formation of O₃ provides a direct link between O₃ and time of year, and temperature-dependent photochemical rate constants also provide a link between O₃ and temperature.” (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04). .

Agency Response: Staff disagrees with the comment. The above paragraph appears in the overview/background section of the 1995 article by Sillman and Samson. The conclusions of the quoted journal article state that “Results of the modeling exercise and accumulated observations confirm the widely acknowledged view that O₃ concentrations in polluted environment are closely linked to temperature. ...However, the pattern of observation from both urban and rural locations suggests that the relationship between O₃ and temperature is significantly stronger than the models would predict”. Thus, the paper indicates that O₃ concentrations in polluted environment are closely linked to temperature.

116. Comment: Thus, ARB is not presenting new information, but merely drawing the conclusion that since GHGs may increase temperature, and increased temperature for many different reasons favors ozone production, that ozone will increase, all other things being the same. However, not all other things are the same. The reduction in ozone precursors in California over the last 20 years has reduced peak average ozone and the numbers of exceedances of the 1 – hour and 8 – hour ozone standards. This has occurred despite a 69 percent increase in total vehicle miles traveled and a 29 percent increase in total fuel consumption (and GHG emissions) from on-highway vehicles. So

clearly, other factors are at play. (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: Staff disagrees with the comment. Please see responses to comments 79 through 89, 110, 111, 114 and 115. In addition, long-term projections for surface air quality in California or in the United States must account not only for future changes in emissions but also for changes in climate. Improving our understanding of linkages between climate, atmospheric chemistry, and global air quality and our ability to assess future states of the atmosphere will require coupling local- and regional-scale air quality models with global-scale climate and chemistry models. At the same time, there is an ongoing need to improve our understanding of how meteorology affects specific processes. California is planning with others, such as U.S. EPA, to collaboratively support the research necessary to assess the potential consequences of global climate change for air quality.

117. Comment: The improvement in ozone in California has been documented in the “Environmental Protection Indicators for California” (EPIC) report produced by the California EPA.[2] The EPIC report shows that both peak ozone across the state, and the total annual exposure to unhealthy levels of ozone for the average person, have declined dramatically over the last 10 to 20 years. For example, peak ozone has declined from almost 0.50 ppm in 1980 in the South Coast Air Basin to about 0.18 ppm in 2000, a decline of 64 percent (see p.35 of EPIC). Moreover, total annual exposure to unhealthy levels of ozone has declined from 23-24 ppm-hrs per person in 1990-1991 to 4-5 ppm-hrs per person in 2000, a decline of over 70 percent (p.37). (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: The public has certainly benefited from efforts at the national, state, and local level to reduce emission of ozone precursors. In spite of substantial growth in population, number of motor vehicles, and vehicle miles traveled, there has been remarkable improvement in air quality. However, many areas of the state continue to experience unhealthy air quality, particularly unhealthy levels of ozone and particulate matter. Further, identifying and implementing strategies to continue to make progress towards achieving healthy air quality has become exceedingly difficult. That is because the major sources have been substantially controlled as have many of the smaller individual sources. Under current regulatory efforts, every ton of emission reductions is important and anything that offsets progress will lead to greater adverse health effects experienced by the population. Hence, the ARB as well as other stakeholders believe that a discussion of the potential impacts of climate change should acknowledge its potential impact on temperature and the associated impact of temperature on air quality, as is the case with the Staff Report.

118. Comment: These ambient ozone trends are confirmed by the data shown in Figure 1. Figure 1 presents the number of exceedances of the Federal 1 – hour ozone standard since 1980 for the Los Angeles-Riverside-Orange County CSMA. Both the monitor with the maximum number of exceedances recorded and the average number of exceedances recorded across all monitors are presented in Figure 1. Both trends exhibit a significant

reduction in the number of 1 – hour ozone exceedances since 1980. For example, the average number of exceedances has declined from a peak of over 70 in 1981 to below 10 in 2004 – a reduction of more than 85 percent. (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: The public has certainly benefited from efforts at the national, state, and local level to reduce emission of ozone precursors. In spite of the substantial growth in the population, number of motor vehicles, and vehicle miles traveled, there has been remarkable improvement in air quality. However, many areas of the state continue to experience unhealthy air quality, particularly unhealthy levels of ozone and particulate matter. Further, identifying and implementing strategies to continue to make progress towards achieving healthy air quality has become exceedingly difficult. That is because the major sources have been substantially controlled as have many of the smaller individual sources. Under the current regulatory efforts, every ton of emission reductions is important and anything that offsets progress will lead to greater adverse health effects experienced by the population. Hence, the ARB as well as other stakeholders believe that a discussion of the potential impacts of climate change should acknowledge its potential impact on temperature and the associated impact of temperature on air quality, as is the case with the Staff Report.

119. Comment: Despite the increase in fuel usage and GHG emissions from on-highway vehicles over the last 20 years, ozone emissions from on-highway vehicles have declined dramatically. Ozone precursor emissions trends are shown in Figure 3 along side total estimated vehicles miles traveled (VMT). Ozone precursor emissions of ROG and NOx are estimated to decrease by 75 and 48 percent, respectively, during the 1985 to 2005 period. During this time, however, VMT increases by 69 percent. So despite significant increases in vehicle activity, ozone precursor emissions (Figure 3) have declined in step with measured decreases in ozone concentrations (Figure 1). (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: Staff agrees that ozone precursor emissions from on-highway vehicles have declined dramatically over the last 20 years, in step with measured decreases in ozone concentration. This does not mean, however, that California should ignore factors such as climate change that will serve to increase ambient ozone levels.

120. Comment: Figure 4 presents the estimates of on-highway ozone precursor emissions and VMT 20 years into the future (to 2025). These data show that future ROG and NOx reductions for on-highway vehicles will continue to occur, which will result in further ozone reductions below current levels. In addition, significant reductions in off-highway mobile source ROG and NOx emissions are expected to occur due to implementation of ARB requirements for off-highway gasoline equipment, portable fuel containers, and Federal standards for off-highway diesel engines and low sulfur diesel regulations starting in 2010.

The key conclusions from these data are the following:

- Ozone precursors will continue to decline dramatically for the next 20 years.
- Thus, ozone will continue to improve over the next 30 years in California, even if an increase in GHG causes a small increase in temperature. (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: See response to comment 111. In addition, even if the commenter had done the proper modeling to account for the more likely 3-9° temperature increase expected, and could still demonstrate overall ozone levels will improve, this would not eliminate the fact that rising greenhouse gas emissions will continue to be part of the admittedly smaller, though substantial, public health effects from ozone.

121. Comment: Due to the dramatic reduction in ozone precursors, the temperature sensitivity of ozone is also falling dramatically, and will continue to fall over the next 30 years. Thus, even if GHGs cause a very small increase in temperature, this will be more than offset by a reduction in ozone-temperature sensitivity. (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: Staff disagrees with the comment. The assumption that ozone will continue to become less sensitive to temperature in the future seems speculative and unproven. This hypothesis should be tested using a comprehensive air quality airshed model simulation. Additionally, biogenic VOC are very temperature-sensitive, and these emissions will not be abated in future years. Air quality in the Central Valley and Sierras could be especially influenced by climate change due to increased biogenic VOC. Soil microbes produce NO_x and their activity may also increase with warmer temperatures, leading to an increase in NO_x emissions and a consequent increase in ozone amounts. Forest fire patterns may be altered, with consequences for PM and ozone.

122. Comment: The following figure shows the change in temperature sensitivity from 1986-1988 to 2001-2003 in Los Angeles County. The results have been combined for the eight monitors in the county with adequate data for both time periods. Results are consistent for all eight monitors; the individual monitor results are shown in the Attachment to this document. The most dramatic reductions in temperature sensitivity are for those monitors with the highest results. By 2020, ozone's response to temperature could be similar to the lowest 'projected' line shown, which was created by assuming the same percent reduction in sensitivity from 2003-2020 as occurred between 1986-1988 and 2001-2003. While this is not an exact estimate of the 2018-2020 ozone-temperature sensitivity, it is clear that the overall trend in both ozone concentration and temperature sensitivity will continue downward due to reduced ozone precursor emissions as part of the on-going South Coast Air Quality Management Plan to meet regulatory ozone standards. As ozone precursor emissions continue to decline in the future, ozone formation will likely become less sensitive to temperature changes. (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: Staff disagrees with the comment. Please see responses to comments 80 through 91. The assumption that ozone will continue to become less

sensitive to temperature in the future seems speculative and unproven. This hypothesis should be tested using a comprehensive air quality airshed model simulation.

123. Comment: Any ARB claim of increased ozone due to higher temperature or GHGs must take future-year ozone-temperature sensitivities into account. At a minimum, ARB should be evaluating ozone-temperature sensitivity utilizing the most recent ambient data available. Figure 2-8 in the ARB Staff Report only contains data from the 1996-1998 period. (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: The legislature, in enacting AB 1493, directed ARB to achieve the maximum feasible and cost-effective reduction in motor vehicle greenhouse gas emissions. ARB staff has presented extensive evidence regarding climate change science, but it is important to note that for purposes of the rulemaking process these issues are not relevant.

With regard to the scientific issues, the ARB's future research plan includes investigation on sensitivity of regional air quality to climate change. This issue would include research to explore the effect of changes in specific meteorological variables on chemical transformations, transport, and ambient atmospheric concentrations for specific locations in California. Ambient concentrations of ozone and fine particulates are dependent on several meteorological variables including temperature, clouds, water vapor, wind speed, and precipitation patterns. Changes in these meteorological variables may directly alter emissions such as biogenic emissions, which could result in further changes in ambient concentrations. Examination of the direct influence of meteorological changes on emissions is in our future research plan; however, indirect adaptations of emissions to climate change, such as changes in energy demands, is also being investigated by other agency such as the California Energy Commission.

124. Comment: The ARB Staff Report and EPIC report indicate that ARB believes that GHGs have increased temperatures in rural and less populated areas of California by about 0.7°F over the last century. This would seem to be ARB's assessment of the long term impact of GHGs without the "heat island" effect, since the value came from rural and less populated areas where the heat island effect would be minimal. (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04)..

Agency Response: The ARB's assessment of 20th century warming in California (0.7°F) is derived from historical records for stations in counties with populations of less than 100,000 people. As a result, it is probably not biased to any significant extent by the "heat island" effect. However, it is inaccurate to assume that this is the ARB's assessment of the long-term impact of greenhouse gases on warming in California. In fact, the ARB report clearly states that there is uncertainty in trying "to predict exactly ... the rate at which the mean temperature will increase."

125. Comment: Trends in average annual temperature from the 1890's until today are also shown in Figure 6. This figure shows average annual temperature in California from the Historical Climatology Network (HCN) data. The sites used are a mixture of currently

urban and rural areas (although in the 1890's, very few sites would have been considered "urban"). (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: The issue of which stations are rural and which are urban is probably not significant. The large scale analysis of Jones *et al.* (1990), Peterson *et al.* (1999), and Peterson (2003) indicate that urbanization does not significantly impact large scale area averaged time series. Specifically looking at the USHCN data set, removing stations with a potential urban heat island bias from the analysis has very little impact on temperature trends. See agency response to comment 124.

126. Comment: These data indicate a relatively warm period in 1895-1910, followed by a cooler period until 1923, followed by an erratic period between 1920 and 1940, followed by a cooler period from 1940 to 1978, followed by a warmer period that continues to the present. The cyclical nature of these data point out the concerns involved in examining temperatures over shorter time periods: if one were to examine only the trend from 1970 to today, the upward trend certainly would show a steeper increase, because all of the warmer weather of the 1920s and 1930s would be ignored. Over the entire period shown in Figure 6, the average temperature shows an increase of about 0.7^oF, which is the same increase as stated in the ARB Staff Report for rural and less populated areas. (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: This is exactly why detection and attribution studies (which seek to understand the causes of climate change) focus on temperature changes over long periods (50 to 100 years) rather than on changes over 1-2 decades only.

127. Comment: The ozone figures shown earlier relate maximum ozone concentration to maximum temperature, the figure above shows the trend in annual average temperature. Unfortunately, AIR has not been able to access maximum and minimum temperature data over this period from the HCN database. (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: To be as comprehensive as possible, the Staff Report included a discussion of the state of the science with respect to climate change. It also included a discussion of the potential impacts of climate change on California and the world. One potential impact is related to exacerbating ozone levels due to elevated temperatures. As with all aspects of the Staff Report, the sources were fully documented. Further, the report was subjected to external review by an independent panel including a climate change expert.

128. Comment: To evaluate trends in maximum average temperature, AIR evaluated measurements from the National Climatic Data Center (NCDC) available for the period from 1950-2003. As shown in Figure 6, the 1950-1975 time period was relatively cool and the time period since then has been warmer. Therefore, an analysis which begins in 1950 should be biased toward overestimating the maximum temperature increase relative to that estimated had a full century's data been available. (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: The U.S. national temperature time series has “ups and downs” in response to variability in the regional and global climate system. This variability is related to a wide variety of factors, such as El Niño, the Arctic Oscillation, *etc.* Therefore, time series that start at a very warm time show less warming than time series that start in cool times. U.S. mean temperatures over 1950 to 2004⁶ show a trend of 0.21°F/decade. By comparison, starting at the earliest year available in that system (1895) the trend is 0.10°F/decade. If one instead starts the analyses in 1976, the trend is 0.56°F/decade. The commenter is correct in noting that the choice of the analysis period directly impacts the results, though in all the cases cited here, the temperature is warming. Which period is the most appropriate to use (in other words, which period gives the most relevant information, neither underestimating nor overestimating the pertinent change) will vary based on the exact question being asked.

129. Comment: To attempt to eliminate the heat-island effect which is not GHG related, AIR estimated temperature trends for monitoring stations in the state where the population is less than 5,000 people per square mile. A curve was then fit through the data to evaluate the temperature increase at the intercept (0 people per square mile). The results are shown in Figure 7. The change in maximum temperature for the 53-year period is estimated to equal 0.38°F. Note the scatter plot – there are many stations in California where the temperature was cooler in 2003 than in 1950, rather than warmer. Also, as indicated above, the starting and ending years for this analysis favor a temperature increase, where if maximum daily temperature data were available over a longer period, there may be no rural maximum temperature increase estimated. (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: It is unclear what data AIR used in their analysis. The data are listed as coming from the National Climatic Data Center (NCDC), but it is not clear whether they used homogeneity adjusted U.S. Historical Climate Network temperatures, or data from stations with no adjustments to account for station moves or changes in instrumentation. If they used inhomogeneous data, that would be a likely leading explanation of the scatter in their results. Also, AIR analyzed trends in daily maximum temperature. It has been well documented that minimum temperature has been rising faster than maximum over the last 50 years (Easterling *et al.*, 1997). It is also unclear just what AIR is showing on their Figure 7. The Y-axis is labeled “1950-2003 Temperature Change (F)”. In a regression analysis, temperature change is typically expressed in units of degrees F or C per month or year. One possible interpretation is that the AIR Figure 7 shows the regression slopes multiplied by 54 years of data to give units of degrees F. Another interpretation is that the Figure might illustrate the annual temperature in 2003 minus the annual temperature in 1950. If the latter is the case, it is a very unstable analysis, which is extremely sensitive to the values of the particular year chosen. Such an analysis would be expected to have a large scatter.

Examination of temperature trends for global rural stations versus the full data set found no difference (Peterson *et al.*, 1999). Comparison of hundreds of US rural and urban

⁶ Based on US Climate at a Glance, <http://www.ncdc.noaa.gov/oa/climate/research/cag3/cag3.html>.

stations found that the urban heat island effect on US temperatures was miniscule (Peterson, 2003; Peterson and Owen 2005). Comparison of trends at urban stations on both windy days (when urban heat islands should be minimized) and calm days (when urban heat islands should be enhanced) showed no significant difference (Parker, 2004). This is compelling evidence that increased urbanization is not significantly impacting *in situ* climate observations. Please see response to comment 38.

130. Comment: This analysis shows a 0.38^oF increase in maximum temperature over 53 years. If it is assumed that the next 30 years would see the same rate of temperature change, the increase in average maximum temperature would be 0.22^oF greater than that measured today. The ozone versus temperature correlations presented earlier in Figure 5 can be used to determine (sic) what change in ozone would be expected from a 0.22^oF increase in average maximum temperature (but this ignores the expected further decline in ozone versus temperature sensitivity discussed above). If GHG emissions increase the average maximum temperature by 0.22^oF then an 85^oF maximum temperature of today could be an 85.22^oF maximum temperature 30 years from now. Using the correlation based on the 2001-2003 ozone data (shown in Figure 5), the 0.22^oF difference would correspond to an increase in ozone of only 0.3 ppb (or 0.0003 ppm). This increase equals 0.3 percent of the current State 1 – hour ozone standard of 90 ppb (or 0.09 ppm). (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: The expected rise in global mean surface from 2000 to 2030 is 0.6-0.8^oC (1.1-1.4^oF). There is no scientific basis for the 0.22^oF number quoted here. Specific predictions for California have larger uncertainty (see Hayhoe *et al.* paper) but predict on average (over a number of years) a similar increase. (see IPCC 2001 and the US National Assessment).

131. Comment: Using the same approach at 95^oF, an increase of 0.22^oF to a daily maximum of 95.22^oF results in an estimated ozone increase of 0.5 ppb or 0.6 percent of the state 1 – hour ozone standard. Again, these estimates rely on the 2001 – 2003 ozone-temperature correlation of Figure 5. (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: The expected rise in global mean surface temperature from 2000 to 2030 is 0.6-0.8^oC (1.1-1.4^oF). There is no scientific basis for the 0.22^oF number quoted. Specific predictions for California have larger uncertainty (see Hayhoe *et al.* paper) but predict, on average, (over a number of years) a similar increase. (see IPCC 2001 and the US National Assessment).

132. Comment: Now realizing that 30 years from now, ozone concentrations will be even less sensitive to temperature increases, the estimated increases in ozone presented here are likely high. Moreover with natural background ozone levels estimated at between 10 and 20 ppb, [3] it is apparent that changes in ozone of this magnitude (less than 1 ppb or levels measured in the tenths of one percent of the standard) are inconsequential to ozone air quality in California. (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: Staff disagrees with the comment. Please see responses to comments 110, 111, 114, 115, and 119 through 123. The assumption that ozone will continue to become less sensitive to temperature in the future seems speculative and unproven. This hypothesis should be tested using a comprehensive air quality airshed model simulation. The commenter stated the presence of natural background concentrations of ozone as 10-20. This estimate does not include the influence of global industrialization, which has raised global background concentrations of ozone to 20-30 ppb; in fact, many areas near major urban areas have regional background ozone levels that are higher. The increasing background concentration of ozone makes the importance of anthropogenic emission reductions even greater and once again, it will be necessary to consider any and all feasible control measures.

133. Comment: The significant conclusions of this analysis are as follows:

- California ozone concentrations will continue to decline with continued decreases in ozone precursor emissions.
- Historical data over the last 20 years show that ozone concentrations have declined dramatically despite significant increases in on-highway GHG emissions.
- Historical data over the last 20 years show that ozone concentrations have declined dramatically during this period of “increasing temperatures” that ARB attributes to GHG emissions.
- Los Angeles County monitoring data show that ozone is becoming less sensitive to temperature change over time. Furthermore, ozone concentrations will likely continue to become less sensitive to temperature changes in the future as ozone precursors are reduced further.
- An analysis representing 30 years from today, using conservative assumptions for both the GHG-related increase in maximum temperature and for the impact of temperature on ozone, results in estimated ozone increases of well below 1 ppb from GHG-related temperature increases. Changes in ozone concentrations of this magnitude will not have a significant impact on ozone air quality in California.

(Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: Considerable progress has been made and must continue to attain healthy air quality for all Californians. Achieving further reduction in ozone precursors is becoming increasingly difficult. Anything that has the potential to exacerbate poor air quality such as climate change is a threat to public health. Further, biogenic VOCs are very temperature-sensitive, and these emissions will not be abated in future years. Air quality in the Central Valley and Sierras could be especially influenced by climate change due to increased biogenic VOC. Soil microbes produce NO_x and their activity may also increase with warmer temperatures, leading to an increase in NO_x emissions and a consequent increase in ozone amounts. Forest fire patterns may be altered, with consequences for PM and ozone. . Long-term projections for surface air quality in California or in the United States must account not only for future changes in emissions but also for changes in climate. Please see more detailed responses to following comments.

134. Comment: Historical data over the last 20 years show that ozone concentrations have declined dramatically despite significant increases in on-highway GHG emissions (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: Staff agrees that ozone precursor emissions from on-highway vehicles have declined dramatically over the last 20 years, despite increases in on-highway greenhouse gas emissions. This does not mean, however, that California should ignore factors such as climate change that will serve to increase ambient ozone levels.

135. Comment: Historical data over the last 20 years show that ozone concentrations have declined dramatically during this period of “increasing temperatures” that ARB attributes to GHG emissions (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: The ARB did not draw any conclusions between an increase in temperature (due to greenhouse gases) and an increase in ground level ozone in California. In fact, ARB’s statement in the ISOR (p. 20) specifically mentions the importance of factors other than beside temperature on ozone. Ozone pollution is produced by a complex series of chemical reactions involving automotive and industrial emissions of volatile organic compounds, nitrogen oxides from the same sources, and sunlight. As temperatures increase during the day, solar energy enhances those chemical reactions and increases the amount of ozone produced. Correspondingly, as temperatures decrease, the chemical reactions are slowed and smog is seldom formed. The U.S. EPA has compiled an annual 90°F temperature profile for more than 90 ozone non- attainment areas for 1967 through 1989. The results indicate that a temperature yardstick is a good indicator of how many days per year weather conditions (i.e., high temperatures, low wind speeds, and temperature inversions) are conducive to smog formation (Rethinking the Ozone Problem in Urban and Regional Air Pollution, Washington: National Academy of Sciences, December 1991).

136. Comment: An analysis representing 30 years from today, using conservative assumptions for both the GHG-related increase in maximum temperature and for the impact of temperature on ozone, results in estimated ozone increases of well below 1 ppb from GHG-related temperature increases. Changes in ozone concentrations of this magnitude will not have a significant impact on ozone air quality in California. (Statement of John Cabaniss, 9/23/04, Air Improvement Resource, Inc., 9/20/04).

Agency Response: Ozone is an air quality problem today for much of the world's population. Regions can exceed the ozone air quality standards (AQS) through a combination of local emissions, meteorology favoring pollution episodes, and the clean-air baseline levels of ozone upon which pollution builds. The IPCC 2001 assessment studied a range of global emission scenarios and found by 2030, near-surface increases over much of the northern hemisphere are estimated to be about 5 ppb (+2 to +7 ppb over the range of scenarios). By 2100 the two more extreme scenarios project baseline ozone increases of >20 ppb, while the other four scenarios give changes of -4 to +10 ppb. Even

modest increases in the background abundance of tropospheric ozone might defeat current AQS strategies. The larger increases, however, would gravely threaten both urban and rural air quality over most of the northern hemisphere despite the projected emission reductions from current and planned control measures assumed in the commenter's analysis.

137. Comment: AB 1493 responds to the opinion that industrial emissions of greenhouse gases, chiefly carbon dioxide (CO₂) from fossil fuel combustion, will dramatically warm the planet, with potentially catastrophic impacts on people, economics, and eco-systems. However, evidence continues to build that any increase in average global temperatures from manmade greenhouse gases will likely be close to the low end (1.4°C, 2.5°F) of the Intergovernmental Panel on Climate Change's (IPCC) global warming projections for the next 100 years. (Competitive Enterprise Institute (CEI), 9/21/04).

Agency Response: The first statement is the major conclusion of more than 1,000 scientists involved in preparing the IPCC's Third Assessment Report (2001). This is not an "opinion". It is a scientific conclusion, based on the physical understanding of the climate system, empirical evidence, climate model simulations, and rigorous "fingerprint" detection studies. There is little credible evidence to the contrary in the scientific literature. The CEI provides no scientific information in support of their statement that "any increase in global temperatures from man-made greenhouse gases will likely be close to the low end". It is possible that the CEI's confusion arises from recent efforts to design a greenhouse "path" that would keep the warming at the low end of the IPCC scenarios. Even these scenarios advocate very strong controls on greenhouse gas emissions.

138. Comment: Forecasts of significantly greater warming, such as the IPCC's high-end (5.8°C, 10.4°F) projection, are based on questionable climate history, misleading surface temperature records, the pretence that scientists know enough about natural climate variability to attribute all or most recent warming to greenhouse gas emissions, errant climate models, implausible emission scenarios, and unconfirmed feedback effects. Moreover, predictions of rapidly rising seas, "super-storms," mass extinctions and other eco-disasters are based on speculation and fear, not science. (Competitive Enterprise Institute, 9/21/04).

Agency Response: This statement is incorrect and demonstrates a lack of understanding of climate research. The IPCC temperature projections (both high- and low-end) are not based on climate history ("questionable" or otherwise), or on surface temperatures, or even on the attribution of current warming to human activities. They are based on the basic physics, chemistry, dynamics and energetics of the atmosphere and climate system that have been proven over and over again in the laboratory and in field measurements. Similarly, natural climate variability is not included in these increases and could make it better or worse. It is useful to note that the "natural" climate variability over the last 500 to 1,000 years has been much less than 0.5°C. Rising sea level, ecosystem degradation, and more intense continental precipitation have already been observed over the 20th century warming and we expect these trends to worsen in the 21st. The specter of "eco-disasters"

is being raised by the CEI – not by the IPCC. We recommend that the CEI turn to published IPCC assessments for authoritative information on climate change.

139. Comment: ARB cites the U.S. National Assessment’s projection of a 3-5°C (5-9°F) increase in average U.S. temperatures in the next 100 years. However, the National Assessment’s scary climate scenarios have no scientific credibility. The National Assessment relied on two outlier climate models – the “hottest” and the “wettest” out of some 26 models available to the Clinton team. Worse, as University of Virginia climatologist Patrick Michaels discovered, and National Oceanic and Atmospheric Administration scientist Thomas Karl confirmed, the two underlying models – British and Canadian – were incapable of replicating past U.S. temperature trends regardless of the averaging period used (five-year, ten-year, or 25-year). Models that cannot hind-cast past climate cannot be trusted to forecast future climate. (Competitive Enterprise Institute, 9/21/04).

Agency Response: Staff disagrees with the comment. Analyses at the global scale for the two primary models used in the National Assessment indicate that there is general agreement with the observed long-term trend in temperature over the 20th century, but the Canadian Climate Model is significantly more sensitive to greenhouse gases compared to the Hadley Centre Model, and may be thought of as the “hotter” of the two models. This higher climate sensitivity of the Canadian model may be due to projection of an earlier melting of the Arctic sea ice than the Hadley model. It is not yet clear how rapidly this melting may take place.

The Canadian Climate Model is seen to have a relatively high sensitivity to increases in greenhouse gases compared to other models, but its sensitivity is quite comparable to a model not used in the National Assessment, NOAA’s Geophysical Fluid Dynamics Laboratory R15 model. So, although the Canadian model does appear to be one of the more sensitive models to increases in greenhouse gases, it is not an outlier. By comparison, the Hadley Centre model appears to have moderate sensitivity to increases in greenhouse gases.

140. Comment: “One area of considerable concern is the effect of climate change on California’s water supply..”. First, what does this have to do with vehicle emissions? Is reducing the CO₂ emission from vehicles going to change the water supply runoff? Second, since the snow pack runoff has been decreasing for the last 100 years, why haven’t we built dams to catch the excess? Why is the ARB talking about this? Also, the sea level has been rising for the last 20,000 years (about 160 feet), due to warming oceans and melting ice caps. It will probably continue. So build seawalls out of concrete which generates CO₂ emissions. Don’t solve a rising sea problem with vehicle emissions or pretend that they are related. (Dodd, 9/15/04).

Agency Response: Staff disagrees with the comment. The Staff Report discusses the potential impacts of climate change on the water supply as well as other ecological systems. The purpose of the information is to provide the public and other interested stakeholders with a complete picture of the science of climate change including the

potential impacts on California and the world. The scientific support for consideration of such effects is well documented in the Staff Report and in the responses to previous comments.

(5). Section 2.7—Abrupt Climate Change

141. Comment: In the popular imagination, global warming is associated with a parade of horrors: floods, extreme weather, mass extinctions, “killer” heat waves, deteriorating air quality, even a new ice age. Such scares do not survive scrutiny. (Competitive Enterprise Institute, 9/21/04).

Agency Response: As discussed in the Staff Report, recent and rapidly advancing evidence demonstrates that the Earth’s climate repeatedly has shifted. And abrupt climate change may be more likely in the future. Thus, in addition to the gradual (albeit accelerated) climate changes projected by current climate models, Californians need to be aware of the possibility of much more sudden climate shifts. These shifts have a scientifically well-founded place among the possible futures facing the State and should be among the possibilities accommodated in planning and adaptation measures. Therefore the Staff Report (page 24) also discusses the current scientific understanding with respect to abrupt climate change.

b. ISOR Section 3—California Actions to Address Climate Change

142. Comment: We would also like to acknowledge California’s ongoing efforts to develop a statewide strategy to reduce greenhouse gas emissions from all major sources across the state. California, through this proposed rule and myriad other actions from promoting renewable energy to green building standards, recognizes the importance of taking steps now to deal with global warming that will adversely affect California’s air quality, water supplies and coastal resources. (Haxthausen, Environmental Defense, 11/05/04).

Agency Response: No response necessary.

c. ISOR Section 5—Maximum Feasible and Cost-Effective Technologies

(1). Overall Feasibility--Support

143. Comment: The ISOR provides a well-grounded assessment of the technological potential for vehicular greenhouse gas (GHG) emissions reduction. The ISOR identifies the numerous options automakers have at their disposal to meet the proposed standards cost-effectively. The technologies analyzed by CARB staff represent a practical and affordable set of options that automotive engineers can use to redesign light duty vehicles in order to achieve lower GHG emissions.

The GHG emissions reduction targets and timetable laid out in the proposal can readily be met by automakers consistently within the requirements of AB 1493. In particular, the

reduction targets can be met without restricting consumer choice of sport utility vehicles or any other style of vehicle popular in the market today or over the time horizon covered by the regulation. In fact, the proposed regulations will expand consumer choice by stimulating the adoption of better technology and stimulating the creativity of auto designers and engineers to provide cars and light trucks that meet market needs while saving consumers money and protecting the environment.

Environmental Defense's review of the ISOR's estimates of maximum feasible GHG reductions by vehicle class indicate that these values are fully in line with the automotive technology assessments in which we have been involved and which we have reviewed. Many of the technologies analyzed in the draft staff proposal were described by experts from automobile companies, suppliers, engineering consultancies, and academics at the March 2003 International Vehicle Technology Symposium hosted by CARB. Systems analysis results presented at that symposium, designed to account for both positive and negative interactions among technologies, identified potential CO₂ emissions reductions of up to 40% for light duty vehicles operating on gasoline. The proposal's assessment falls well within that range.

The proposal's estimates are conservative in that they rely neither on the most advanced technology already available, such as hybrid-electric vehicles (HEVs) nor on assumptions regarding the engineering progress likely to be stimulated by the advent of motor vehicle GHG regulation. For example, our estimates of the technical potential through use of HEVs but without either mass reduction technology or air conditioning system improvements, is a fleetwide CO₂ emissions reduction of 43% in a mid-term time frame -- a value that exceeds the reductions that would be required under CARB's proposed GHG emissions standards.

CARB's analysis of the economic impacts associated with the proposed regulations relies on well-established methodologies and uses conservative assumptions. The analysis demonstrates that the proposed reductions in greenhouse gas emissions from new motor vehicles can be achieved in a way that is both cost-effective and economical to consumers. These results are consistent with numerous previous studies that have found that reductions of greenhouse gas emissions from motor vehicles can be achieved in ways that would repay vehicle owners well within a vehicle's lifetime. (John M. DeCicco, Ph.D., and Kate M. Larsen, Environmental Defense; letters of support also received from Natural Resources Defense Council, Bluewater Network, Environment California, Communities for a Better Environment, Union of Concerned Scientists, Sierra Club, Coalition for Clean Air, Conservation Law Foundation, Alliance for a Clean Waterfront, As You Sow, The David Brower Fund, Clean Water Action, Coalition of Concerned National Park Retirees, Community Clean Water Institute, National Parks Conservation Council, Neighborhood Parks Council, Rainforest Action Network, San Francisco Bicycle Coalition, San Francisco Tomorrow, Santa Barbara Channelkeeper, Vote Solar Initiative, Community Action to Fight Asthma)

Agency Response: Staff agrees with the comment.

144. Comment: Environmental Defense finds staff's proposal to be extremely well grounded in the engineering and the economics of this issue. The estimates are very consistent with the kinds of potential technology-based reductions of greenhouse gas emissions that we've seen that are really well known in the engineering community. Many of the technologies described by staff are on the road. These proposals can be met with essentially design refinement. Evolution of conventional technology doesn't require anything exotic. That's one of the reasons why these costs are so low and so cost effective from a consumer point of view. (John DeCicco, Senior Fellow with Environmental Defense)

Agency Response: Staff agrees with the comment.

145. Comment: New York believes that staff's proposal provides auto manufacturers with the flexibility necessary to bring compliant vehicles to the market. This is accomplished through the use of phase in periods to reach both the near and midterm standards as well as a vast array of existing and emerging technologies that are expected to be widely available within the next decade. The proposal provides additional flexibility by allowing manufacturers to participate in an alternative compliance program. (David Shaw, Director of the Air Resources Program at the New York State Department of Environmental Conservation).

Agency Response: Staff agrees with the comment.

146. Comment: The NESCAFF study found that cost-effective technologies exist to reduce motor vehicle greenhouse gases for a range of reductions of up to 47 percent. NESCAUM and NESCAF believe the standards proposed by the ARB staff make sure that significant GHG reductions for motor vehicles will be achieved expeditiously, while at the same time provide an adequate lead time for manufacturers to meet the standards. (Coralie Cooper, NESCAUM)

Agency Response: Staff agrees with the comment.

147. Comment: The UCS conducted an independent study to assess the technological potential and cost of reducing vehicle -- greenhouse gas emissions in California in accordance with the regulation. We used the modal energy and emissions model, which was developed using federal highway funds through the Universities of Michigan and California. Like CARB's analysis, our analysis is based on vehicle simulation modeling. We modeled five classes of vehicles and we looked at two different levels of technology.

What remains important here is consistency across the vehicle classes. So together these two studies illustrate the feasibility and cost effectiveness of the proposed regulations. (Louise Bedsworth, Union of Concerned Scientists)

Agency Response: Staff agrees with the comment.

(2). Overall Feasibility--Opposition

148. Comment: The staff proposal goes far beyond what is reasonable and achievable in the timeframe considered. The proposal even goes beyond what the National Academy of Sciences and the federal government found to be technically and economically feasible.

The ARB staff proposal mandates the use of all those technologies identified as capable of improving fuel economy on all vehicles. This type of technology mandate fails to properly account for various driving conditions our vehicles are required to accommodate. It does not account for preferences of consumers for certain levels of performance. It does not acknowledge different approaches that automobiles take in designing vehicles and the technologies already in use.

Forcing expensive and sometimes unproven technologies on Californians goes far beyond the requirements of AB 1493, leading to costly vehicles that may well sacrifice the attributes that most consumers want. In fact the proposed standard based on how California now defines them are so extreme that not even a zero-emission hydrogen-powered vehicle would meet them. This means California would have to consider disbanding the fuel cell partnership and closing down the hydrogen highway. (Fred Webber, The Auto Alliance)

Agency Response: Staff disagrees with the comment. Neither the National Academy of Sciences nor the federal government has conducted a comprehensive study that examined the greenhouse gas reduction potential of combining vehicle technologies for the California market. That is why staff relied on the NESCCAF study that addressed many of the shortcomings of previous studies of greenhouse gas reduction technologies. Furthermore, staff is not aware of any determination by either agency as to what is technically and economically feasible in the 2009 to 2013 timeframe. Staff also went beyond the NAS study to focus the analysis on the California market.

As noted in various other responses, the staff proposal is based on extensive modeling by AVL that demonstrated that none of the technologies identified impair vehicle performance or the attributes that consumers expect from their vehicles, or limit the driving conditions vehicles are required to accommodate. Furthermore, the baseline vehicles in the NESCCAF study were selected specifically to represent the range of vehicle types that manufacturers currently offer.

Concerning the comment on vehicle costs, see responses in section III.A.2.c(4). Regarding the commenter's reference to hydrogen powered vehicles, see response to Comment 545.

149. Comment: One of the primary vehicles used throughout California's agricultural industry is the pickup truck. Pickup trucks up to 8500 pounds GVWR are subject to these proposed regulations. Indeed, it is likely that these pickup trucks are one of the most numerous vehicles used today in the California agricultural industry. This size of pickup is used extensively throughout California on farms, ranches, vineyards, orchards, livestock

and dairy operations, and other agricultural facilities. Anyone who travels throughout the state's numerous agricultural areas will see thousands of these trucks. They are used for the widest variety of tasks and are prized for their utility and durability.

Another vehicle type used extensively in the agricultural community is large SUVs with GVWRs both above and below 8500 lbs. Farmers and ranchers and others often use these SUVs in the agricultural industry to haul trailers, or carry cargo, where an enclosed load carrying area is needed.

Since people in the agricultural community use their vehicles for commercial and noncommercial transportation they will be affected by these proposed regulations. The costs of the proposed regulation, estimated by ARB staff at over \$1000 per vehicle when fully implemented, are unacceptable.

Farmers and ranchers already face a myriad of state-only regulations that put them at a competitive disadvantage by operating in California. While the agricultural industry supports clean air measures that are on an incentive and cost-efficient basis, we do not believe mandatory regulations or a one-size fits all approach is the most economically viable option for California to achieve its clean air goal. These proposed CA-only vehicle requirements will make pickups and SUVs more expensive to buy than if purchased in other states. With all respect, our organizations strongly recommend that ARB not adopt the proposed regulations. (letter signed by California Farm Bureau Federation, Alameda County Farm Bureau, Contra Cost County Farm Bureau, El Dorado County Farm Bureau, Imperial County Farm Bureau, Kern County Farm Bureau, Lake County Farm Bureau, Mendocino County Farm Bureau, Monterey County Farm Bureau, San Joaquin County Farm Bureau, San Mateo County Farm Bureau, Trinity County Farm Bureau, Tulare County Farm Bureau, Yolo County Farm Bureau, Yuba-Sutter County Farm Bureau; similar letter received from Tulare County Farm Bureau.)

Agency Response: Staff disagrees with the comment. Large pickup trucks and SUVs typically sell for \$25,000 and up. Therefore, the estimated increase in vehicle price is less than 4% of the purchase cost and is offset by the operating cost savings in a few years. In fact, staff's analysis shows that the operating cost savings are realized immediately resulting in a net monthly savings on a typical new vehicle loan. Furthermore, the operating cost savings continue to occur beyond the payback period providing savings throughout the vehicle's lifetime. Accordingly, staff does not believe that the regulation is particularly burdensome to farmers or other California consumers.

(3). Section 5.2—Technology Assessment

150. Comment: The baseline technology assumptions are said to be based on "market research" by one of the Northeast States Coalition for a Clean Air Future (NESCCAF) contractors. According to the NESCCAF report, Martec, Inc. "conducted detailed market research into Original Equipment Manufacturer (OEM) product plans and developed a database of estimated 2009 vehicle platforms under baseline conditions." (Based on our private communications with OEMs representing well over 50% of total

vehicle sales, there was no such disclosure of product plans to Martec. To the contrary, it appears that Martec may have contacted and attempted to interview the engineering or product staffs for some OEMs, but did not receive any concrete information.) (Appendix C to letter from Alliance of Automobile Manufacturers)

Agency Response: Martec is an established market based research and consulting firm with offices in the United States, Europe and Asia. In the transportation sector, Martec's customers include automobile manufacturers and major suppliers of automobile components. These companies utilize Martec's expertise in market and technology trends in the automotive industry to assist them in planning future commercial activities. In response to this comment, Martec stated they have been continually engaged with OEMs and component, technology and system suppliers to evaluate the relative merits of individual new technologies, components and systems. It is staff's perception that Martec's contacts are routine rather than formal requests for interviews at the top levels of an OEM. These longtime ongoing contacts, and conclusions based thereon, may be more reliable than information received from the top levels of the OEMs, who have expressed opposition to this regulatory process and who in fact have sued the ARB in both state and federal court.

151. Comment: ARB staff overestimated the potential for reducing carbon dioxide emissions by mistakenly applying the benefits of automatic transmission design improvements to vehicles equipped with manual transmissions. For example, ARB staff failed to account for the fact that 13% of passenger cars are equipped with manual transmissions and assumed that 100% of passenger cars would benefit from improvements in automatic transmissions. (Declaration of Thomas C. Austin, Appendix C to the letter from the Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. It would have been inordinately expensive and time consuming to model all of the discrete technology combinations such as transmission types and valvetrain technologies incorporated into motor vehicles. Accordingly, the baseline vehicles used in the NESCCAF study were selected to include the dominant technologies, which included automatic transmissions, for each of the five vehicle classes in model years 2002 and 2009. As noted by the commenter, the benefit of improved automatic transmissions was assigned to the small percentage of passenger cars with manual transmissions. However, adjusting the passenger car standard to account for the small fraction (13%) of the fleet with manual transmissions would reduce the 2016 emission standards by less than 1%. This is within the margin of error of the NESCCAF study (ranging from -1.3 % for large truck to +0.5% for small car) as illustrated in table 2-3 of the NESCCAF report comparing the simulated results for the 2002 baseline vehicles to their published CO₂ emissions. Considering the magnitude of this adjustment, the impact on manufacturers' ability to meet the greenhouse gas emission standards is negligible.

152. Comment: The fuel economy benefits of automatic transmission improvements were inadvertently assigned to manual transmissions as well. (Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. See response to Comment 151.

153. Comment: Some of the ISOR listed technologies have technical obstacles that must still be overcome before they are feasible for high volume production in the near and mid term time frame (e.g., camless valve actuation and homogeneous charge compression ignition for either gasoline or diesel). (DaimlerChrysler)

Agency Response: Staff acknowledges that some of the technologies used to determine the proposed greenhouse gas emission standards are still in the development stage and defined them as “emerging” technologies. These technologies include camless valve actuation, homogeneous charge compression ignition, and integrated starter/generator (although it should be noted that vehicles using integrated starter/generator systems are being marketed today). Accordingly, “emerging” technologies were used to determine the mid-term greenhouse gas emission standards that phase in between 2013 and 2016. This provides manufacturers with an eight year leadtime before they would need to begin incorporating these technologies on their vehicles.

154. Comment: General Motors believes that ARB has substantially overestimated the fuel economy improvements that would be expected to result from many of the technologies included in its technical justification for the proposed standards. In particular, discussions between General Motors and AVL raise the following concerns:

The use of automated manual transmissions with dual wet clutches (AMTs) is nearly universal in the configurations that were used by ARB to set the standards. So the standards are highly dependent on the results projected for these types of transmissions. There are some significant issues with both the benefits analysis and the applicability of these types of transmissions:

- All of the AMT benefits are miscalculated due to the omission of important transmission losses. The June 2004 draft of the ARB report briefly described AMT technology, but did not go into any detail regarding clutch design. The analysis done by AVL assumed manual transmission efficiency values and only an added 15 Watt electrical load meant to represent gear-shifting-actuator loads. Neither transmission spin losses nor clutch actuator losses were accounted for in the AVL analysis. AVL has indicated that their analysis was specifically for dry-clutch AMTs. However, in the August 2004 ISOR, the AMT description (but not the analysis) was revised to include dual wet clutch designs in the AMT technology. Such a clutch design includes a hydraulic actuator pump that consumes significant energy, and according to LuK (AVL’s source for AMT information) would result in a 4-6% lower drive cycle efficiency (ref. LuK presentation at SAE’s Emerging Transmission Technologies TOPTEC in August 2003) than the dry clutch configuration analyzed by AVL. This loss is not included anywhere in the analysis, and its omission contributes significantly to the benefit claimed for transmission technology used to determine the standards.
- Some vehicle segments have seamless transmission operation as an important marketable requirement. These types of transmissions are simply not smooth enough

for those market segments. Yet they are assumed to be applied in every vehicle segment.

- Single-clutch AMTs are not an acceptable alternative in the U.S. market. With an additional dry clutch to increase acceptability, dry dual clutch transmissions can only handle maximum torque of approximately 400 N-m. This torque level is approximately that of a V6 midsize car. At higher torque levels, a hydraulic system is required, accompanied by additional pump losses, mass, and increased electrical loads. Even hydraulic systems might not work on heavier trucks given extreme loads and durability concerns.
- The actual implementation of AMT transmissions into nearly all of the vehicle fleet (which is what the standard assumes) would require retirement of almost every North American investment in light-duty transmission manufacturing capacity and the addition of an equal amount of new AMT capacity somewhere in the world.

Agency Response: The ARB did not estimate any fuel economy improvements resulting from the regulation as it requires a reduction in fleet greenhouse gas emissions. Nevertheless the ARB understands that the technical issues raised in this greenhouse gas emission reduction comment and responds as follows.

The NESCCAF report indicated a dual wet clutch automated manual transmission was modeled by AVL. However, after rechecking in response to this comment, AVL indicated that a dry clutch version was actually modeled. It should be noted that during the modeling exercise, AVL indicated its expertise in modeling newer transmissions, unlike advanced engines, was constrained because of limited detailed data on advanced transmission internal parameters. As a result, their estimates of the benefits of advanced transmissions were conducted using conservative assumptions in the modeling in order to protect against overly optimistic reductions in CO₂ emissions from their use.

Staff noted at the September hearing that data it had received from Ricardo regarding their simulations of reductions in CO₂ emissions attributable to 6 speed automatic transmissions and actual real world test data from ZF, builders of 6 speed automatic transmissions, both yielded a 7-8% CO₂ emission reduction. Therefore, since this is the same benefit AVL attributed to the 6 speed automated manual transmission, it would be appropriate to substitute a 6 speed automatic transmission in place of a 6 speed automated manual transmission whenever the latter was utilized in the modeling results. Thus, the CO₂ reductions obtained from the groups of technologies would be preserved utilizing the 6 speed automatic transmission.

Staff had an opportunity to drive a prototype vehicle equipped with a dual clutch automated manual transmission, and found that it was as smooth shifting as current automatic transmissions, with only a brief lag in response on hard acceleration from a stop, much the same as some drive-by-wire systems on current vehicles. Staff is aware of plans to utilize a 6 speed automated manual transmission even in some luxury models, so that this transmission concept remains an important option to automakers for reducing CO₂ emissions. Staff agrees, however, with the comment that dry single clutch automated manual transmissions would not be suitable for use in North American products because

they lack the smoothness achieved from current automatic transmissions. That is why they were never intended to be utilized in our list of technologies for reducing CO₂ emissions.

Since both Ford and General Motors, as well as numerous other manufacturers already have available 6 speed automatic transmission manufacturing plants, there would be no need for additional investment resources for building new plants or redirection of new AMT capacity outside of North America. Numerous transmission suppliers such as ZF or Aisin will have such units available for purchase by manufacturers that would prefer not to make further investments in transmission plants. Costs for 6 speed automatic transmissions in our study were representative of such suppliers. Such costs include the transmission suppliers' costs for development and investment in facilities for building the units in large volumes to supply a number of manufacturers.

155. Comment The use of aggressively downsized (41-52% smaller), highly turbocharged, intercooled, direct-injected engines with dual cam phasing is used to set the standard in all but one of the vehicle segments. So the standards are very dependent on the results projected for these types of engines. There are some significant issues with both the benefits analysis and the applicability of these types of engines:

- The projected benefit for the turbocharged, downsized, direct-injected, cam-phasing engines is based on very aggressive assumptions about the specific output that is possible for these types of engines. The most unlikely of these assumptions is that the engines will use premium fuel instead of regular fuel. All of the AVL analysis for these engines is based on premium fuel. Without premium fuel, the specific output possible from these engines will be significantly reduced and the engine sizes will be overly optimistic due to selection of very low engine displacements driven by unrealistic Brake Mean Effective Pressure (BMEP) curve assumptions that depended on high boost levels and premium fuel usage.
- Typical turbocharger installations require an intercooler, which increases vehicle drag.
- There are significant discrepancies between the benefits projected by AVL for downsized turbocharged MPFI engines and downsized turbocharged GDI-S engines. AVL has indicated through a direct comparison of turbocharged MPFI versus turbocharged GDI-S DCP engine maps that engine fuel consumption differences between these two technologies are as much as 12% at typical Federal Test Procedure engine operation conditions. Such large differences in fuel consumption are unexplained by the relatively minor physical differences between the engine technologies. This discrepancy affects a technology package used to justify the emission standard in four of the five vehicle classes.
- AVL has confirmed that the application of aggressively downsized turbocharged engines did not include consideration of vehicle launch, drive quality, and transient engine/transmission/turbo response. The simulation results provided by AVL indicate that the vehicles configured with these engines will have serious drive quality problems. General Motors believes such deteriorations in performance are not acceptable, and they demonstrate that not enough verification of “equal performance” was done. Demonstration of sufficient vehicle launch, drive quality, and transient

performance should be required prior to consideration of this and other “torque-modifying” new powertrain technologies.

Agency Response: Wherever possible, staff was sensitive to drivability and performance characteristics of modeled systems to ensure customer satisfaction relative to launch feel, acceleration characteristics and overall smoothness and refinement. AVL focused on 0 – 60 mph as the metric to measure acceleration performance rather than initial launch times, so that it is difficult to assess initial response from the modeling data available to staff. However, with the use of a downsized direct injection variable geometry turbocharged engine that retains a compression ratio similar to a conventional engine and a 6 speed automated manual transmission, launch feel and acceleration characteristics of the modeled turbocharged applications were expected to be similar to engines that were being replaced. However, since the automated manual transmission does not incorporate a torque converter to multiply initial acceleration torque, use of a 6 speed automatic transmission (that has a torque converter) in these applications would contribute substantially in achieving the desired “launch feel” that General Motors is seeking, while retaining the projected greenhouse gas reductions projected for this technology combination. In assessing smoothness and refinement for example, staff assumed in the analysis that 6 cylinder engines would be replaced by 5 cylinder turbocharged models rather than 4 cylinder versions in order to preserve 6 cylinder-like characteristics. In its assessment, staff evaluated both a 4 cylinder turbocharged model and a 5 cylinder turbocharged Volvo and concluded that a 4 cylinder engine might not be a comparable replacement for a current 6 cylinder engine. The Volvo, however, was the full equivalent of the 6 cylinder base vehicles that staff has driven in terms of these drivability parameters. If manufacturers conclude that turbocharged engine approaches do not meet their perceived customer requirements, there are other technology approaches that could be pursued that would not affect launch feel yet would also meet our greenhouse gas standards.

While addition of an intercooler may affect vehicle drag slightly, there are numerous other refinements to vehicles still available to restore the original aerodynamic drag or to further improve it. These include underbody shields, revised grille openings, improvements in wheelhouse configurations and many more.

Regarding the greater than expected benefits between GDI-S turbo and MPFI turbo, one of the biggest benefits is an approximate 10% increase in output from the GDI-S turbo. At constant 0-60 mph time, the higher specific output allowed a slightly larger downsizing of the GDI engine and a longer axle ratio, which together result in reduced CO₂ emissions. GDI-S turbo technology allows a significantly higher compression ratio (2-3 ratios), which is very beneficial for reducing CO₂ emissions at part loads. Finally, GDI combustion technology increases burn rate, providing improved thermodynamic efficiency and again lower CO₂ emissions. It is important to note that the engine data and maps used for this project came from actual engines developed by AVL.

156. Comment: Portions of the analysis done by AVL appear to have included the assumption of premium fuel usage. AVL states that regular fuel was assumed for all of the

engine configurations that used some form of variable valve actuation, but engine specific output levels taken directly from AVL output results match exactly with other premium fuel AVL work on variable valve actuation. Further investigation of this issue by AVL indicated that in most, but not all, cases their assumptions fell within very aggressive regular fuel specific output levels. Whether through an assumption of premium fuel usage or an overestimate of what is possible with regular fuel, the result is an over-estimate of the specific output possible with each of these technologies, which enables unrealistically aggressive engine downsizing – and fuel consumption reductions – to be simulated while maintaining equal performance. This discrepancy contributes to an over-assumption of the specific output capability (and thus the chosen engine size) of every DCP, DVVL, and CVVL engine in the AVL analysis. (General Motors)

Agency Response: Staff disagrees with the comment. AVL has considerable experience with turbocharged engines, both port fuel injected and direct injected. They have access to the engine maps associated with such engines in Europe as well as their own maps from engines actually developed by AVL. These maps are utilized by the CRUISE model to obtain their emission reduction estimates. Since GM has only one or two vehicle models that are turbocharged and they do not appear to incorporate direct injection, their limited experience may result in being unaware of improvements that have been incorporated in the most modern engines of this type. When questioned further about the GM comment, AVL maintained they were confident in their assessment that the results could be obtained using regular fuel.

157. Comment: The staff report's analysis assumes the use of regular unleaded gasoline for technologies that require more expensive, higher-octane gasoline; once this inconsistency is corrected, those technologies do not provide the assumed economic benefit. (Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. The technologies do not require more expensive higher-octane gasoline. See response to Comment 156.

158. Comment: The AVL study used a computer simulation tool and consistent methodology. However, AVL has described their study as a generic study whose results can be used to compare relative differences between groupings of technologies, not for projecting specific consumption targets for specific vehicles. As a generic study, the AVL work did not cover some important details and constraints that are a reality for vehicle manufacturers:

- All of the engine maps used in the simulation study were based on AVL's most optimistic, upper-limit projections of the full capability of the engine technologies, assuming full application of technology without sufficient constraints which reflect real-world combustion system dilution tolerance, airflow capacity, piston-to-valve clearances, oil system capacity at low speeds, idle speed control techniques, and noise vibration and handling (NVH) concerns. The AVL engine maps assumed a best case for all of these aspects of engine design, and in several cases their "best-in-class" results were a smoothed composite of results from multiple engines – no individual

engines represented the engine maps used for setting the standards. A study like this does not provide a quantitative target value that is suitable for setting fuel consumption regulations. The maps used by AVL to represent DCP, CCP, DVVL, and CVVL all had significant fuel consumption improvements at light loads where, in the real world, the improvements would be limited by combustion system dilution tolerance versus airflow capacity tradeoffs and by piston-to-valve clearance constraints.

- AVL has indicated that all of the vehicle/powertrain configurations chosen for the standard were chosen to maintain equal performance. However, seven of the ten configurations used for setting the near-term standard have worse 50-70 mph performance than their baseline cases; four of those cases (large truck 04, large truck 05, small truck 04, and minivan 04) are significantly worse and would be considered unacceptable when compared to the baseline.
- AVL did not consider any gradeability or drive quality metrics when choosing engine sizes. In nine of the ten configurations used for setting the near-term standard, the gradeability calculated by AVL was worse than the baseline gradeability; five of those cases (large truck 04, large truck 05, small truck 04, minivan 04, and minivan 05) showed significant degradation in gradeability to the point where they would likely be considered unacceptable. AVL made no explicit calculations concerning drive quality (the typical response to accelerator pedal inputs required by the driver) so it is impossible to quantify the impacts. Drive quality issues are frequently prevalent when the calculated gradeability is poor and when aggressive engine downsizing is attempted, so it is expected that there would be drive quality problems with several of the chosen configurations. Since the standards set by ARB were almost entirely based on configurations where drive quality problems are likely to occur, the standards should not be considered feasible unless more analysis validating acceptable drive quality is performed.
- The method used by AVL to input transmission shift patterns and torque converter lock patterns was explicit and well defined. However, the actual shift patterns and lock/unlock patterns were not chosen in a reproducible, consistent manner. There was no explicit test of the shift points to ensure that they were not too early (which would hurt drive quality, cause shift busyness problems, and exaggerate fuel economy benefits) or too late (which would help drive quality at the expense of fuel economy), and there was no tabulation of the number of shifts per test cycle (usually accepted as a fair indicator of shift busyness).
- The method used by AVL to adjust their baseline simulations to actual test vehicle performance and fuel economy results was to first “tweak” drivetrain efficiencies to dial-in vehicle 0-60 performance, and then “tweak” transmission shift and lock patterns to dial-in vehicle fuel economy. While a method such as this might produce a simulated fuel economy number that equals the test data, it does not result in a reliable baseline simulation. If, for example, the quoted engine power for the baseline engine was higher than actual (resulting in a “fast” 0-60 simulation result), the AVL method would artificially reduce the baseline drivetrain efficiency to match performance. Then, in order to match fuel economy numbers (assuming everything else about the simulation is in order), the AVL method would have to artificially make the shift/lock points too early. The result would be a baseline simulation result with unrealistic drivetrain efficiencies and shift/lock points.

- Given the observed degradations in gradeability and the well-defined but unvalidated transmission shift/lock methods used, it is inappropriate and overly optimistic for ARB to assume in Table 5.2-4 that all vehicles would benefit from additional aggressive shift logic and early torque converter lockup. The ARB report states that “drivability and acceleration concerns must be accounted for carefully in these alterations of shifting schedules.” This is true, but it was not done by AVL or ARB. The ARB report states “...care must be exercised to ensure smooth, responsive drivability and low noise, vibration, and harshness. AVL was conservative in its modeling of these features to ensure good drivability and minimum vibration.” As described above, no systematic aggressiveness test was performed. The Table 5.2-4 adjustments are not justified. ARB had access to a full-featured simulation at AVL, but chose not to use simulation results, instead multiplying an unsimulated, unrealistic adjustment by the AVL results.

In summary, this analysis runs a very high risk of overestimating benefits and underestimating costs by applying multiple new technologies that can have unexpected effects in combination, usually resulting in identification of additional constraints. This problem is compounded by the use of technologies that are still early in the development stage, which might not develop to fruition and which cannot be modeled with precision. (General Motors)

Agency Response: Staff disagrees with the comment. Concerning the first point, the modeling team used “mule” vehicles that represented the individual class norms and then made adjustments to them so that comparisons between various technologies *could* be made. A completely idealized vehicle could have been developed based on class attributes, but it was concluded that using a mule vehicle and adjusting its specifications would provide more identifiable results for setting greenhouse gas emission reduction standards.

Regarding the use of optimized engine maps, AVL used blended engine maps for only a few of the more traditional technologies. The blended maps essentially represented best in class attributes that could be achieved through good engineering practices. In practice, an individual engine might not achieve these results because of design compromises as can be seen by the scatter of results from similar engines in production. As a result, AVL acknowledged the ability to predict the results for a particular engine might be off slightly but typical engines should behave similarly. As a practical matter, ARB staff did not use any of the very few runs estimating the benefits of advanced technologies where a blended map was utilized by AVL, because the particular cases reliant on them did not incorporate enough new technology to improve CO₂ emissions significantly. Therefore, this concern does not even apply to the ARB results.

Regarding performance characteristics, AVL focused primarily on achieving comparable or slightly better 0–60 mph performance than the baseline 2002 vehicle in the class. In the study, the 50-70 mph acceleration task was chosen to be an elasticity test, i.e., maximum acceleration with the transmission locked in top gear (and the torque converter locked as well). This gives a good indication of the engine’s full load torque curve but does not represent normal driving operation. In reality, the passing situation would yield a downshift

for vehicles equipped with automatic or automated manual transmissions and unlocking the torque converter on the automatic transmissions. Generally when allowing for a normal transmission downshift and unlocking the torque converter, performance is only slightly worsened compared to the baseline acceleration task. This was deemed an acceptable tradeoff in order to avoid selecting a larger engine than necessary with its associated higher CO₂ emissions. For example, in modeling the large truck case 04, the torque converter was not allowed to unlock during full throttle acceleration, to get a better comparison to automated manual transmissions. The unlocking of the torque converter allows the engine to speed up and develop more power, similar in effect to a downshift. The large truck case 04 was rerun in response to GM's comment to model allowing the torque converter to unlock, as would be the case in a production vehicle. The resultant passing time increased by only 7% compared to the baseline case. The remaining discrepancies are due to a slightly lower overall transmission ratio as well as differences in engine full load curves and auxiliaries.

For gradeability, a situation very similar to the passing task is present. For the case of large truck case 04, the torque converter is locked at 50 mph in top gear. If the converter is unlocked, reflecting what would normally happen in use, the gradeability becomes almost the same as the baseline case (8.21% vs. 8.71%). Nonetheless, when comparing a 4 speed automatic transmission baseline vehicle with a six speed transmission vehicle simulation, of course top gear gradeability will be lessened when utilizing a transmission with a tall overdrive ratio for top gear – that is the one of the primary benefits from a higher number of gear ratios in a six speed transmission since it provides lower CO₂ emissions. But in examining the model runs cited as inadequate, staff found that for the same *engine rpm*, the ability to climb a grade was generally the same or better for the advanced scenarios, not worse (even without considering unlocking the converter, where applicable). What this means is that instead of climbing a steep grade in top gear, the advanced vehicle would normally downshift to fifth gear and would then have generally *better* grade climbing ability than the baseline vehicle in top gear, based on the modeling results. Similarly, when engine downsizing is coupled with a transmission possessing more gear ratios, engine drivability or responsiveness is generally preserved since more gear ratios are available to better match the engine speed and torque output to a given driver command. GM's competitors generally utilize smaller engine displacements and transmissions with more gear ratios that automotive reviewers seem to prefer in terms of responsive performance and powertrain refinement.

Finally, regarding the comment addressing AVL's methods in adjusting their baseline simulations to actual test vehicle performance and fuel usage, AVL countered that their baseline model correction is dependent on the accuracy of performance data published by industry. The hypothetical case mentioned is possible if inaccurate data is provided. To avoid errors such as suggested, AVL confirmed drivetrain efficiencies with industry experts and verified that the chosen transmission shift and converter lock-up schedules were realistic compared to calibrations for similar production vehicles in the market place.

159. Comment: Integrating fuel economy technologies into a vehicle is a very complex process that almost always results in some benefit deterioration for each application of a

fuel economy technology. Vehicle integration involves a balance of all the vehicle attributes. This balancing often results in fuel economy benefits of a technology described in the public literature, by component suppliers, or produced by sub-systems simulations being significantly reduced when the technology is actually integrated into the vehicle. A major reason for ARB's overestimation of vehicle fuel economy potential is a disregard for this critical issue. (General Motors)

Agency Response: This comment speaks to fuel economy technologies, benefits and potential, and is therefore arguably irrelevant. Nevertheless the ARB understands the technical greenhouse gas emission reduction issues raised by the comment and responds as follows.

The NESCCAF study specifically intended to model combined technologies in a manner that preserved attributes that customers expect in new vehicles. Accordingly, every effort was made to consider noise, vibration, harshness, performance and other considerations. While staff agrees that unforeseen engineering issues may arise when trying to integrate several new technologies in a vehicle, the solutions need not reduce the projected benefits. For example, when incorporating cylinder deactivation in the Chrysler 5.7 liter Hemi engine, additional work was needed to reduce low frequency noise present during deactivation modes. Their solution was to incorporate a redesigned muffler and exhaust pipe connector that didn't affect the CO₂ reduction benefits of the technology. Honda encountered similar issues when designing the cylinder deactivation system in the Odyssey V6 minivan, but overcame engine vibration and noise issues by incorporating active engine mounts and noise cancellation technology. The engine also incorporates electronically controlled variable valve timing and lift seamlessly. Neither of these solutions would affect the CO₂ reductions that could be achieved with these systems. On the other hand, General Motors tried to solve similar problems by adding an expensive control valve in the exhaust system to attenuate certain frequencies that could have affected performance and the CO₂ reduction benefits of cylinder deactivation. That approach could also introduce durability/reliability concerns at higher mileage. General Motors apparently witnessed the better approaches and apparently delayed introduction of cylinder deactivation until they designed a better solution. When General Motors finally introduced cylinder deactivation more than a year later than they first announced, it incorporated attenuation features very similar to the Chrysler approach rather than GM's initial approach and retained all of the potential benefits of the technology. Staff therefore expects that automotive engineers working with advanced concepts and electronic technologies currently available can solve unforeseen engineering issues while retaining the benefits of the basic approaches.

160. Comment: Four of the ten vehicle configurations used to set the near-term standard were combinations of OHV engine technologies that are unlikely to be applied in the real world. Minivan 04 applied CVVL along with CCP. Small truck 05, large truck 04, and large truck 05 all applied DeAct plus DVVL plus CCP. The application of either CVVL or DVVL to OHV engines is not realistic as the mechanisms that might provide such function (especially in combination with DeAct and CCP) do not exist and are not being considered for development. Two major roadblocks preventing the combination of these

technologies are (1) the fact that DeAct technology already uses a dedicated valve lifter and lifter housing that would preclude adding a new mechanism in the lifter valley and (2) the strict packaging requirements currently met by OHV engine designs would be violated if a large new CVVL or DVVL mechanism were added to the top of the cylinder head. Because these technology combinations have not been demonstrated in any realistic form, they violate the statement by ARB that “the technologies being explored are currently available on vehicles in various forms or have been demonstrated by auto companies and/or vehicle component suppliers in at least prototype form.” (General Motors)

Agency Response: Staff disagrees with the comment. The Minivan 04 case included the cost of conversion to an overhead camshaft configuration to accomplish the continuously variable valve lift in conjunction with a coupled camshaft phaser arrangement – an overhead valve engine design for this case was not considered as stated in the comment. Therefore, Minivan 04 was appropriately modeled as an overhead camshaft arrangement. Also, the small truck was assumed to have an overhead camshaft engine as the baseline engine, not an overhead valve arrangement as indicated in the comment.

Regarding the use of discrete variable valve lift, even in conjunction with cylinder deactivation, this arrangement can be accomplished on an overhead valve engine. One would start with discrete variable valve lift on intake valves for all cylinders. Then a third step (closed) lifter would be added to intake valves on one half the cylinders for cylinder deactivation (which requires higher cost solenoids – one per deactivated cylinder). Then a two step lifter would be added for exhaust valves for deactivation on one half the cylinders. Then add 2 step solenoids to get to one per non deactivated cylinder (no cylinder pairing possible). Then discrete variable valve lift and cylinder deactivation can occur independently at any time – a deactivated cylinder does not use discrete variable valve lift while deactivated. Thus, discrete variable valve lift in conjunction with cylinder deactivation can be accomplished on an overhead valve engine with little extra revision.

161. Comment: The AVL results for hybrid vehicles differed significantly from the estimates that ARB made. AVL’s results for hybrids (which were based on analysis of simulation results) had significantly lower fuel consumption improvements than the ARB results (which were based on scaling of one production hybrid vehicle with performance significantly worse than that of any of the baseline vehicles). (General Motors)

Agency Response: The greenhouse gas benefits for hybrid electric vehicles (HEVs) included in the Initial Statement of Reasons published on August 6, 2004, were derived by scaling the benefits up or down from one production HEV (the Toyota Prius). Staff used this approach because real world data on the greenhouse gas benefits of commercially produced HEVs was limited since the only HEVs being marketed when staff conducted its evaluation of greenhouse gas reduction technologies were small and midsize passenger cars. However, in the Addendum to the Initial Statement of Reasons published on September 10, 2004, staff substituted the greenhouse gas benefits for HEVs with performance equivalent to their conventional counterparts as modeled by AVL. Staff recognizes that HEV technology is still being refined, and therefore, defined HEVs as a long-term technology that would not likely be available across all vehicle classes in

significant numbers until after full implementation of the greenhouse gas regulations. Accordingly, HEV technology was not used to determine the greenhouse gas emission standards.

162. Comment: Without actually looking at system effects, it is very easy to double-count benefits and neglect important constraints. These sorts of problems are evident in many studies that use the “shopping-cart” approach. As a result, these studies tend to overestimate the possible benefits while underestimating the needed technology content and cost. AVL has identified some of the system interactions. But they have applied enormous technology content and cost. For example, they have applied aggressively downsized, turbocharged, intercooled, premium-fuelled, direct-injected, variable valvetrain engines – a technology combination that has previously not been considered realistic, especially not for widespread application on the majority of the vehicle fleet. Another example is the application of AMTs on virtually the entire fleet. This is an all-new transmission of a type considered inappropriate for North America driving habits, where transmission smoothness is considered vital. Technologies such as camless valvetrains and HCCI combustion are emerging technologies that are at an early stage of development. It is premature to use them as the justification for setting regulatory standards. (General Motors)

Agency Response: The purpose of the modeling performed by AVL was precisely to avoid the double counting issue that could emerge from a shopping cart simple summation approach to estimating emission benefits of combinations of technologies. The sophisticated modeling was performed to evaluate these technologies incorporated into a system.

While turbocharged engines have not seen widespread use in the U.S. at this time, the technology shows great promise. Application of variable geometry turbochargers in conjunction with 6 speed automatic transmissions combined with direct injection engines with compression ratios significantly higher than MPFI turbocharger systems should be capable of good launch feel characteristics while improvements in engine mount technology can reduce noise and vibration characteristics. There are also evolving technologies in engine block design to enhance these same characteristics while improvements in acoustical materials also quiet engine noise and vibration. Despite the GM comment, staff has noted that Fritz Indra, who recently retired from the position of GM powertrain executive director of advanced engineering, was interviewed by Automotive News in their April 11, 2005 edition. In the article, he was noted as saying the powerplant of the future is a downsized turbocharged gasoline engine with vertical direct injection. It is not clear to staff why the comments submitted in this rulemaking seem to take issue with or contradict not only what the modeling results are demonstrating, but also what is apparently being said by GM’s experts who are responsible for planning their future powertrain development.

According to the experts at AVL, the engines modeled by AVL would operate satisfactorily on regular fuel, and would not require premium fuel. (See responses to comment 156.) Both AVL and manufacturers in Europe already have considerable experience with direct

injection engines in turbocharged applications, so that this is no longer new technology. One could argue that diesel engines have not been realistic in the U.S. either, but improvements in diesel technology coupled with interest by consumers in reduced operating costs make new approaches such as turbocharged/direct injected engines (whether gasoline or diesel) worth pursuing. Input staff has received is that the 6 speed automated manual transmission will see widespread application in a range of future models in the U.S, some of which are luxury models. These transmissions also provide a level of shift quality that is just as smooth as today's best automatic transmissions. However, staff agrees that the newest 6 speed automatic transmissions can also provide substantially reduced CO₂ emissions as was projected for the automated manual transmission modeled in the study, and manufacturers would be free to use them instead.

While General Motors apparently believes that HCCI combustion engines are at an early stage of development, other manufacturers are working aggressively to bring them to market soon, at least for operation over a portion of the engine operating range. Camless valvetrains were slated for the mid-term in the ARB study, so that there is considerable time to further refine and develop these systems, and some suppliers are working hard to make them mainstream in the mid term. The technologies ARB is relying on in its estimates are generally available or currently under development. By setting CO₂ equivalent emission standards, staff intended to promote further development of current and emerging technologies. The more tentative technologies were relied on for the mid-term. This technology forcing process has been very successful in the Low Emission Vehicle program and is entirely appropriate here as well.

163. Comment: Although there is a general discussion in the August 6 ISOR of the way in which each technology can reduce CO₂ emissions, there is no reference to any literature describing the magnitude of the CO₂ emission reductions that are achievable. This may result from the fact that the relevant literature addresses the technology issue in its most commonly understood form, by describing potential effects on fuel economy or fuel consumption, not as methods to reduce CO₂. (Sierra Research Report No. SR2004-09-04, Appendix C to the letter from Alliance of Automobile Manufacturers)

Agency Response: It is no surprise that the relevant technical literature does not frame each technology as a means to reduce greenhouse gases, as ARB is breaking new ground by doing so here. The clearly stated goal of the regulations is to reduce greenhouse gas emissions from motor vehicles in California. Regarding literature references to the individual technologies evaluated by staff, none were included in the August 6, ISOR because the purpose of the discussion was to provide a general description on how the individual technologies function to reduce CO₂ emissions and their potential to reduce vehicle CO₂ emissions, along with other greenhouse gases incorporated into the standard. The focus of staff's powertrain technology evaluation was on the CO₂ benefits that can be achieved by combining individual CO₂ reduction technologies. Accordingly, staff relied on the results obtained by the vehicle simulation modeling of technology combinations by AVL for the NESCCAF study.

164. Comment: When the California legislature passed and Governor Davis signed AB 1493, they saddled ARB with an impossible task. ARB can achieve “maximum feasible” greenhouse gas reductions only by encroaching on the federally preempted field of fuel economy regulation. ARB cannot achieve “cost effective” greenhouse gas reductions no matter what set of regulatory tools it employs. To the extent that AB 1493 constrains vehicle size and weight, it will adversely affect auto safety. (Marlo Lewis, Jr. and Sam Kazman, Competitive Enterprise Institute)

Agency Response: The comment raises three issues: Adoption of greenhouse gas reductions by ARB infringes on the federal preemption on fuel economy regulations; cost-effective greenhouse gas reductions are not achievable, and the constraints on vehicle size and weight of AB 1493 adversely affect vehicle safety.

Regarding infringement of federal preemption of fuel economy regulations, see response to Comments 587 through 595.

Concerning the second issue-ARB cannot achieve cost-effective greenhouse gas reductions- staff has amply demonstrated that technology is available to reduce greenhouse gas emissions and that application of the technology is cost-effective to the consumer.

Regarding any constraints imposed on vehicle size and weight by AB 1493, the bill specifically prohibits the adoption of greenhouse gas emission standards that require manufacturers to reduce vehicle weight. Accordingly, ARB only considered greenhouse gas reduction technologies that could be implemented without reducing either vehicle size or weight. See also responses to comments 191 through 194.

165. Comment: Credit was claimed for significant reductions in aerodynamic drag and rolling resistance despite evidence that customers will not accept such changes and despite the fact that customers do not routinely use original equipment replacement tires. (Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. Reductions in vehicle aerodynamic drag can be achieved through several means. These include smoothing the underbody of the vehicle, hiding windshield wipers when not in use, reducing the seams between body panels, improving the flow of air used for engine temperature management, improving the design of the vehicle body to provide smoother airflow, and others. Since the comment includes no specifics as to which of the approaches to reducing aerodynamic drag customers are likely to object to, it is difficult to directly respond to the comment. However, given that there are several means to reduce aerodynamic drag that do not dramatically affect overall vehicle design, staff continues to believe it to be a valid technology available to manufacturers to reduce greenhouse gas emission from their vehicles.

Regarding lower rolling resistance tires, aftermarket replacement tires usually adopt the same improvements in technologies that are present in the original equipment tires by the

time replacement tires are needed. In addition, from a feasibility standpoint the credit provided to manufacturers is not affected by the characteristics of the replacement tires.

166. Comment: The staff's ISOR (page 56) states that the "rolling resistance force due to friction between the tires and the road can be improved via shoulder design improvements or with design and material modifications to the tread pattern, tire belts, or the traction surface." Rolling resistance is actually not primarily due to friction with the road (less than 5 percent), but rather through the energy lost as heat during the constant deformation of the sidewalls, called "hysteresis" (80-95 percent of the losses). Furthermore, reducing rolling resistance is one way to use improved tire technology to reduce CO₂ emissions. Lighter weight materials and smaller diameter tires can reduce the rotational inertia (thus reducing the load on the vehicle during acceleration), and improved sidewall design can reduce aerodynamic resistance. Neither of which is part of the formal definition of "rolling resistance." (Roland Hwang and David Doniger, National Resources Defense Council)

Agency Response: Staff agrees with the clarification and accepts the comment. This issue does not affect the treatment of tires in the regulation.

167. Comment: There is no reference to the CO₂ reduction potential associated with weight reduction. In fact, two tables from the NESCCAF report (II-8 and III-1) summarizing the CO₂ reduction potential of various technologies were modified to delete estimates for the weight reduction before they were reproduced in the August 6 ISOR. The ISOR points out that CARB "will not rely on weight reductions in setting its climate change emission standards," but also states that "manufacturers would still have the option of lowering weight to improve CO₂ emission performance." One effect of this omission is to deprive CARB of any quantitative estimate by the CARB staff of the likely weight reductions for some vehicle models in California if the proposed rules take effect, or likely changes in the overall weight of the California new-vehicle fleet if CO₂ emissions are to be controlled. (Sierra Research Report No. SR2004-09-04, Appendix C to the letter from Alliance of Automobile Manufacturers)

Agency Response: As noted in the response to comment 164, AB 1493 specifically directed staff to exclude vehicle weight reduction as a means to reduce greenhouse gas emissions. Accordingly, staff did not include weight reduction in the technologies evaluated to establish the proposed greenhouse gas emission standards. While in the ISOR staff commented that manufacturers may choose to lower vehicle weight to improve greenhouse gas emission performance, technical feasibility has been demonstrated without reducing vehicle weight

168. Comment: Based on explanations provided by AVL during previous CARB workshops, the estimates contained in the ISOR for the percent emission reductions of individual technologies have not consistently been adjusted to a "constant performance" basis. (However, the effect of combinations of technologies described later includes adjustments to maintain constant performance.) (Sierra Research Report No. SR2004-09-04, Appendix C to the letter from Alliance of Automobile Manufacturers)

Agency Response: Modeling of individual technologies was performed only to determine their relative potential to reduce greenhouse gas emissions and the results used as a guide to determine the appropriate combinations of greenhouse gas technologies. Accordingly, they were modeled without adjusting for “constant performance.” because vehicle level performance was not measured in that portion of the analysis. Using the results from modeling individual technologies, the appropriate technology combinations were identified and the vehicle model adjusted to maintain “constant performance.”

169. Comment: It should be noted that the effect of the variable displacement air conditioning compressor is apparently based on operation with the air conditioner turned on. There is proportionally less benefit when accounting for the fraction of time the air conditioner is used. (Sierra Research Report No. SR2004-09-04, Appendix C to the letter from Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. When modeling the benefits of improved air conditioning technologies, AVL assumed operation of the air conditioning system over the full test cycle. However, the greenhouse gas benefits determined from the AVL modeling were adjusted to account for the percentage of annual operation of vehicle air conditioning in California, reflecting data from a comprehensive study on vehicle air conditioning use by the National Renewable Energy Laboratory. For California, this percentage was determined to be 29%. The methodology used to determine the benefits for improved vehicle air conditioning systems is clearly explained in section 5.2 of the Initial Statement of Reasons.

170. Comment: The ISOR states that indirect air conditioning emissions can be reduced by elimination of “air reheat.” Because this requires automatic climate controls, it was not assumed in CARB’s feasibility analysis. The analysis also did not quantify the potential benefits of revising glass angles, increased cabin insulation, and changing vehicle color. (Sierra Research Report No. SR2004-09-04, Appendix C to the letter from Alliance of Automobile Manufacturers)

Agency Response: Elimination of air reheat does not require in-cabin automatic climate controls. Typically such automatic systems regulate fan speed and heat blend air doors to maintain a constant set temperature in the cabin. They typically rely on temperature sensors placed in strategic positions in the cabin and may include specialized sensors to determine solar load or use of infrared sensors to determine occupant skin temperature. Such systems are not necessary to gain the benefits of a variable displacement compressor. Instead, the discharge air from the air conditioning system evaporator can be set at a given level and the variable displacement compressor will modulate the displacement to provide only the level of cooling desired by the operator of the vehicle. This no different than in current manual air conditioning systems where a dial or slide lever is used to set the discharge temperature at the desired level, but instead uses waste heat to raise the temperature of the chilled discharge air from the evaporator. The cooling level in the cabin is regulated only by the discharge air temperature selection in a manual system. While such a system may require adjustment from time to time by the operator of

the vehicle to maintain comfort, it can be very adequate for most vehicles. More upscale vehicles may utilize automatic systems, but they are mainly a convenience feature.

171. Comment: The ISOR estimates that leakage emissions from air conditioners can be reduced by 50% through “upgrades to a few key components (e.g., compressor shaft seal)”; however there is no testing or other documentation referenced to support this estimate. (Sierra Research Report No. SR2004-09-04, Appendix C to the letter from Alliance of Automobile Manufacturers)

Agency Response: ARB's Technical Support Document, "Mobile Air Conditioning Systems - Direct Emissions Technology Assessment," provides supporting documentation for the estimated 50% reduction in leakage emissions. This estimate is largely based on collaboration that occurred during the SAE Alternate Refrigerant Symposium that was held in Phoenix in 2003.

Attendees of the symposium included key stakeholders and experts from all the major original equipment manufacturers, mobile air conditioning system designers, and system and component suppliers. Attendees participated in several working groups, and the consensus of these expert groups was that enhanced HFC-134a systems could result in approximately a 50 percent reduction in refrigerant leakage emissions from baseline HFC-134a systems. This could be accomplished through improved fittings, elastomers, and compressor seals. This estimate was formalized during the presentation, "Alternative Refrigerants Assessment Workshop," presented at the SAE 2003 Alternative Automotive Refrigerant Symposium held in Phoenix, Arizona on July 14-18, 2003, by Bill Hill of General Motors Corporation and Ward Atkinson of Sun Test Engineering.

Furthermore, it is well accepted and supported by the available research literature that a 50% reduction in leakage from current mobile air conditioning systems is feasible via improvement to key components. Additional evidence that such a goal is achievable is found in the recently developed initiative by SAE referred to as the "I-MAC 50/30." This initiative is widely supported by stakeholders within industry, government, and non-governmental organizations. This initiative solely focuses on the advancement and improvement of HFC-134a air conditioning systems that will result in a 50% and 30% reduction in direct and indirect emissions, respectively.

It should be noted that no test procedures exist yet to quantify such reductions and this is a subject of active ongoing research. ARB has engaged the U.S. EPA, the European Commission, the Society of Automotive Engineers (SAE), and the Mobile Air Conditioning Society Worldwide (MACSW), to promote the development of test procedures. As a result, a new SAE J standard is now in development for determining refrigerant leakage. The new standard will be evolutionary in nature. Initially, the standard will consist of component prescription, as described in the ISOR. Subsequently, mini-shed and whole vehicle testing will be developed. Harmonization of test protocols is an active area of discussion that U.S. EPA is leading with stakeholders worldwide.

172. Comment: As the NRDC stated at previous workshops, we believe the staff's estimate of the direct leakage of HFC-134a is likely undercounted by about 50 percent. We base this estimate on a review of previous leakage rate estimates, applied to the California fleet (see attachment B). One reason for why CARB staff's estimate being too low is that it could represent a "best practices" versus "real-world" maintenance and operation practices. We also believe that there could be significant operating cost savings to a significant portion of the fleet due to reduced AC servicing. Each servicing avoided will save the owner or operator about \$100. It is reasonable and logical to assume that some significant portion of the fleet will see reduced maintenance cost due to lower leakage AC systems. (Roland Hwang, NRDC, 9/23/04).

Agency Response: The basis for estimating HFC emissions is fully documented in the Staff Report and accompanying appendices. It is based on the largest data set considered thus far for estimating HFC leakage from motor vehicles in California. However, as discussed in the report, there are other sources that suggest that HFC emissions may be somewhat higher than the staff estimate, while still others suggest that they may be somewhat lower. Staff's assessment is that there is substantial agreement between the estimates from the various sources and that further studies will lead to refined estimates. The Staff Report acknowledges that improved containment may lead to a further reduction in operating costs or savings to the consumer. Further, the Staff Report indicates the potential savings to consumers associated with improvements to refrigerant containment were not assumed in the estimated costs of the regulation given the limited information that was available.

173. Comment: I would like to offer one comment with respect to the relationship between reducing greenhouse gases like carbon dioxide and reducing criteria pollutants, that is also an important part of California's emission goals.

Our industry firmly believes that all of the light-duty power train options, including light-duty diesels, can be combined with appropriately designed and optimized emission control technologies to meet all applicable California conventional emission requirements during the proposed implementation years that we're considering here for reducing climate change emissions.

The Chairman and staff are well aware of the impressive track record of gasoline stoichiometric technology that's in the marketplace already today achieving in some cases near-zero tailpipe emission levels of criteria pollutants.

I did want to also indicate that there's a growing body of evidence of the impressive technology development associated with clean diesel technology. And, again, Chairman and staff are well aware of some of these. We believe that in the 2009-2016 timeframe technologies like particulate filters, NOx-absorbent technology, and/or selective catalytic reduction technologies will allow manufacturers to use clean diesel as an option even here in California and, thus, all of the technology options that staff includes in their report for reducing climate change emissions do not preempt those vehicles from still meeting

criteria pollutant requirements here in California. (Joseph Kubsh, Manufacturers of Emission Controls Association)

As detailed in the draft staff report issued in June 2004 and again in the August 2004 staff report, a large set of technology combinations have been evaluated for their ability to reduce carbon dioxide emissions from passenger cars and light-duty trucks. These include state-of-the-art and future advanced gasoline and diesel powertrains. Implicit in this analysis is the ability of these powertrain options to meet California's applicable conventional emission standards for pollutants such as CO, NO_x, and non-methane organic gases (NMOG). Our industry firmly believes that all of these light-duty powertrain options combined with the appropriately designed and optimized emission control technologies can meet all applicable California emission requirements during the proposed implementation years associated with the climate change regulations being discussed here today. (Joseph Kubsh, Manufacturers of Emission Controls Association)

Agency Response: Staff agrees with these comments. As noted in the comment, there have been significant advancements in clean diesel technology in response to the emission requirements of California's Low-Emission Vehicle (LEV) program and the federal Tier 2 program. Diesel vehicles can offer significant greenhouse gas benefits and are often promoted by vehicle manufacturers as a viable greenhouse gas emission reduction technology. The development of cost-effective and durable diesel aftertreatment technology will provide manufacturers another technology option for meeting the greenhouse gas emission requirements and diesels were included in staff's technology assessment.

174. Comment: The CO₂ reduction potentials of gasoline lean-burn direct injection and advanced diesel technologies developed for Europe cannot be directly applied to the California market due to the more stringent ULEV II NO_x standards. In order to meet ULEV II standards, BMW would need to develop a viable NO_x reduction technology for gasoline lean-burn direct injection engines and there is at present no certainty that such a technology breakthrough would be available in the proposed timeframe. Similarly, a selective catalytic reduction system would have to be developed and successfully deployed in order for a diesel high-speed direct injection engine to meet the ULEV II NO_x standard. In addition, a number of engine internal measures would have to be implemented with the potential to jeopardize the inherent efficiency of the diesel engine. (BMW Group)

Agency Response: Staff disagrees with the comment. Other commenters (Manufacturers of Emission Controls Association) have stated that "Our industry firmly believes that all of the light-duty power train options, including light-duty diesels, can be combined with appropriately designed and optimized emission control technologies to meet all applicable California conventional emission requirements during the proposed implementation years that we're considering here for reducing climate change emissions," and that "all of the technology options that staff includes in their report for reducing climate change emissions do not preempt those vehicles from still meeting criteria pollutant requirements here in California" (see comment 173).

While technologies such as lean-burn gasoline direct injection and advanced diesel engines can provide significant CO₂ emission benefits, controlling the high levels of oxides of nitrogen (NO_x) emitted by these engines is problematic. However, some manufacturers are indeed targeting the 2009 model year for introduction of diesel vehicles that meet California emission requirements. In addition, there is continuing work taking place on developing NO_x adsorbers for controlling emissions from lean burn gasoline engines. Also, staff outlined other technology paths that could be explored to achieve the proposed emission reduction requirements.

175. Comment: CO₂ reduction technologies planned for Europe, such as gasoline lean-burn DI and diesel HSDI, cannot be carried over to California because of the present inability to meet the SULEV II NO_x standards. Because of BMW's limited size, economies of scale require that we deploy sustainable technologies that can be used on a worldwide basis within the market BMW competes. In order to meet the objectives of both the European and California regulations, BMW would be compelled to develop specific propulsion technologies for a limited market only, again requiring a significant amount of resources. (BMW Group)

Agency Response: Staff disagrees with the comment. Staff has identified numerous greenhouse gas reduction technologies that are compatible with California's existing emission control programs and applicable to vehicles BMW currently markets in California. BMW is an industry leader in the application of continuously variable valve timing and lift and 6 speed transmissions and could investigate the application of other greenhouse gas technologies such as integrated starter/generator systems to its vehicles as additional means to comply with the greenhouse gas regulations. Integrated starter/generator systems can further enhance engine performance in a manner that is consistent with BMW's performance image. The 2005 Honda Accord V-6 equipped with an integrated starter generator is one example of this approach.

176. Comment: BMW began early on to introduce fuel efficient low emission technologies such as fully-variable valve timing ("VANOS"), continuously-variable valve lift ("Valvetronic"), and 6-speed automatic and manual transmissions. However, the early deployment of such fuel efficient technologies makes it even more difficult for manufacturers like BMW to make further CO₂ reductions in their fleets without limiting the types of vehicles that could be sold in the state of California. (BMW Group)

Agency Response: Staff disagrees with the comment. Staff has identified technology paths that would not require BMW to limit the types of vehicles that could be sold in California. See response to comment 175.

177. Comment: The ZEV mandate necessitates high numbers of conventional PZEV-SULEV vehicles to which the envisioned CO₂ reduction measures cannot be applied. Depending on manufacturer status, at least 30 percent of the manufacturer's California fleet will be comprised of such vehicles when the proposed GHG emission standards become effective. Therefore, only the balance of a manufacturer's fleet would be available

for employment of the most promising CO₂ reduction technologies, making it even more difficult to achieve CARB's proposed greenhouse gas emissions standards on a fleet-wide basis. Therefore, if BMW wanted to use the most effective gasoline lean-burn direct injection and diesel high-speed direct injection engines on a large portion of its model spectrum to meet the proposed greenhouse gas emissions standards, we could not comply with the ZEV mandate since we could no longer produce sufficient numbers of conventional gasoline PZEVs. Further, hydrogen vehicles that could qualify as ZEVs or PZEVs will not meet the proposed greenhouse emissions standards when they are fully phased in by MY 2016. In particular, H₂ ICE vehicles (with A/C refrigerant CO₂) would only achieve a CO₂ rating of 290 g/mi, questioning our long term H₂ ICE strategy for the California market and the state's vision of a hydrogen economy. (BMW Group)

Agency Response: Staff disagrees with the comment. Compliance with the ZEV mandate and the greenhouse gas regulations is not mutually exclusive. Use of lean burn or diesel technology is not required to meet the standards. Technical feasibility of the greenhouse gas regulations was demonstrated with technologies that are fully capable of meeting PZEV-SULEV emission standards. Regarding the capability of low greenhouse gas technologies to meet criteria pollutant standards, see comment 173. Regarding BMW's comments on the use of gasoline lean-burn and high speed direct injection diesel vehicles, see responses to comments 174 and 175. Concerning the comment on hydrogen vehicles, see response to comment 545.

178. Comment: As noted in the 2002 study of fuel economy by the National Research Council:

"Technology changes require very long lead times to be introduced into the manufacturers' product lines. Any policy that is implemented too aggressively (that is, in too short a time) has the potential to adversely affect manufacturers, their suppliers, their employees, and consumers. Little can be done to improve the fuel economy of the new vehicle fleet for several years because production plans are already in place. The widespread deployment of even existing technologies will probably require 4 to 8 years. For emerging technologies that require additional research and development, this time lag can be considerably longer...Thus, while there would be incremental gains each year as improved vehicles enter the fleet, major changes in the transportation sector's fuel consumption will require decades." (NRC, p. 5)

The ARB goes considerably beyond these guidelines for industry lead times by requiring not just widespread, but 100% penetration of technologies defined by the ARB as "near-term" within 8 years, and by then requiring 100% penetration of emerging, "mid-term" technologies in the following 4 years. It is unrealistic for ARB to rely heavily on technologies such as camless valve actuation in this time frame, since these mid-term technologies unquestionably are still in the research and development stage described by the NRC as requiring "considerably" longer lead times. (General Motors)

Agency Response: Staff disagrees with the comment. Reductions in greenhouse gas emissions are being pursued aggressively in Europe and Japan and other regions of the world as a result of government agreements/regulations affecting the vehicle manufacturers in these countries. The reductions being sought elsewhere would occur more rapidly than what is being required in the ARB regulations. Based on input staff has received from companies producing vehicles in those countries, our lead time is fully consistent with their product plans for bringing these technologies to market world wide.

Meanwhile, increasingly the competitiveness of a company depends on being able to bring new designs to market quickly in response to consumer trends. This reduction in lead time is an ongoing reality in today's market.

ARB also provided not just one path for the mid term, but several that could be pursued. If General Motors isn't comfortable with camless valve actuation, it could pursue integrated starter generator systems in conjunction with other advanced engine technologies for meeting the standards, which is what recent news reports indicates they are planning for their larger sport utility vehicles in the near future (before the operative date of this regulation).

179. Comment: The technologies identified by ARB do not provide sufficient benefit to comply with the proposed mid term standards. (DaimlerChrysler)

Agency Response: Staff disagrees with the comment. The benefits were derived from state of the art modeling by AVL. Furthermore, AVL took a conservative approach when it modeled many of the technologies precisely to prevent overstatement of the greenhouse gas benefits.

Ford, DaimlerChrysler, and General Motors submitted confidential comments asserting that the technologies identified by staff would not achieve the stated greenhouse gas reductions when deployed on their vehicles (Ford designated all of its comments as confidential). However, none of the confidential comments submitted by the manufacturers suggest that they undertook a thorough analysis of the greenhouse gas reduction potential of the technology combinations identified by staff when applied to their respective vehicle fleets. Furthermore, due to the paucity of data provided in the comments, staff was unable to determine the factual basis for the manufacturer statements. Accordingly, staff remains confident in the benefits modeled by AVL.

180. Comment: MMC staff reviewed the list of proposed technologies as detailed in the ISOR. The finding was that the most promising technologies involve the development of camless valve activation and 6-speed automatic transmissions. All other technologies fall into two groups – not feasible or already adopted into current design vehicles. Specifically not feasible (with explanation) are: downsizing with turbocharging (consumer preference), variable compression ratio (technologically infeasible) and Diesel and Lean Burn Direct Gas Injection (promising fuel efficiency however infeasible to meet emissions standards). The maximum reduction expected for the combination of all fully developed technologies is 11%. (Ellen J. Gleberman, Mitsubishi Motors North America, Inc.)

Agency Response: Staff disagrees with the comment. It is interesting to note that MMC believes camless valve actuation is promising whereas GM does not. Although MMC doesn't favor downsized, turbocharged engines, such powerplants are emerging in some European models in California as an option to six cylinder naturally aspirated engines. Initial evaluations of these models by automotive experts have been favorable. In any case, modeling by AVL suggested the benefits of a direct injection engine incorporating electrohydraulic camless valve actuation in conjunction with a six speed transmission along with electric power steering and an improved alternator would yield about a 30% reduction in greenhouse gas emissions, thereby enabling a manufacturer to achieve the mid-term proposed standards. Also available, for example, would be an integrated starter generator system and many more to provide even greater reductions. MMC's 11% estimate is unreasonably low.

181. Comment: Regarding HEV strategy – in the mid 1990s, Mitsubishi produced prototype advanced HEV vehicles which were provided to the ARB as a demonstration program. Because ARB policy at that time was not supporting HEV technologies, Mitsubishi ended the project and dismantled its HEV Development Team. Based on this experience and the knowledge gained, Mitsubishi recognizes it is unable to develop a HEV as development of an advanced HEV requires massive investments of capital and manpower beyond Mitsubishi's capabilities at this time. (Ellen J. Gleberman, Mitsubishi Motors North America, Inc.)

Agency Response: As noted in the response to comment 290, HEVs were not included in the technology packages used to determine the greenhouse gas emission standards. Staff identified more conventional technologies that are less resource intensive than Mitsubishi can use to meet the greenhouse gas requirements. Accordingly, Mitsubishi does not need to develop HEV technology to comply with the proposed emission standards.

182. Comment: A fuel economy technology that relies on engine downsizing may be appropriate for a car, but if that engine is also used in a truck application then that technology and downsizing of the engine may not be appropriate. (DaimlerChrysler)

Agency Response: Though using the term "fuel economy technology," the commenter is referring to greenhouse gas reduction technologies evaluated in the staff report. In selecting the appropriate technologies for each of the vehicle classes, staff was careful to include only those technologies that could reduce greenhouse gas emissions while retaining the baseline performance in each of the vehicle classes. Therefore, technology packages that included engine downsizing were not generally considered for the truck classes because of the higher load carrying and towing demands placed on these vehicles. Technology packages that include engine downsizing were used primarily for the small car, large car, and minivan vehicle classes where vehicle performance can be maintained under all driving conditions. Of the nine greenhouse gas reduction technology packages for truck applications used to determine the greenhouse gas emission standards, one included turbocharging with engine downsizing. Recommended as a mid

term technology for small trucks that are not used to carry or tow large loads, this package included a turbocharged direct injection gasoline engine with engine downsizing. Modeling by AVL demonstrated equivalent performance compared to the baseline small truck.

183. Comment: ARB incorrectly applies anticipated fuel economy improvement factors to vehicles that either already have the technologies in the 2002 baseline, or which are not applicable for the technology. An example is to apply a fuel economy improvement factor for improved automatic transmissions to all vehicles, even though significant numbers of vehicles have manual transmissions that cannot be improved in this fashion or to this degree. (General Motors)

Agency Response: Though using the term “fuel economy,” the commenter apparently is referring to the reduced greenhouse gas emissions of the 2009 baseline vehicles compared to their 2002 counterparts. As noted in the NESCCAF study, all of the baseline vehicles for 2009 were assumed to incorporate increased technology content, reflecting the findings by Martec that manufacturers will continue to incorporate improved technology on their vehicles taking into account existing regulatory requirements. The baseline vehicles for 2002 and 2009 were chosen to closely match the technology of the class average for the respective vehicle class (e.g., cars, minivans, and trucks). For example, all 2009 baseline vehicles were assumed to incorporate cam phasing to some degree and either 5- or 6-speed transmissions, technologies that are not present on the 2002 baseline vehicles. In addition, the 2009 baseline vehicles in the minivan and small and large truck classes were modeled to meet federal Corporate Average Fuel Economy (CAFÉ) requirements for trucks that mandate a 2.5 mpg increase for 2007.

Concerning the comment that greenhouse gas reductions were assigned to the portion of the 2009 fleet that include manual transmissions, see response to Comment 151 above.

184. Comment: We suggest that the regulations not encourage the increased dieselization of a fleet. From our perspective we think fundamentally that there is insufficient data on emissions system's durability and in-use emissions to adequately judge whether or not diesels can truly reach parity with gasoline technology. So in terms of the current knowledge base from our standpoint, we think that increasing dieselization to meet these greenhouse gas emission goals would be poor public policy. (Paul Wuebben, Clean Fuels Officer, South Coast Air Quality Management District)

Agency Response: While diesel vehicles have lower greenhouse gas emissions than their equivalent gasoline counterparts, we do not believe that the greenhouse gas regulations encourage dieselization of the California fleet. California's emission requirements are fuel neutral, therefore, diesel vehicles must meet the same low-emission requirements as vehicles operating on other fuels if they are to be marketed in California. Furthermore, California's durability and On-Board Diagnostic system requirements will assure that any diesel vehicles emit at low levels throughout their lifetime. Thus even if there is increased diesel penetration due to manufacturers' future product planning decisions, there will be no effect on ambient air quality.

185. Comment: ARB staff has overestimated the potential for reducing carbon dioxide emissions by calculating fuel savings from a single set of driving cycles, without considering how the design changes required to meet the proposed standards affect fuel economy based on driving patterns that more accurately represent the way that typical Californians drive. (Declaration of Thomas C. Austin, Appendix C to the letter from the Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. ARB staff did not start by calculating operating cost savings to determine the potential for greenhouse gas reductions, but rather attempted to quantify the operating cost savings associated with the various greenhouse gas reduction technology packages. Also see response to Comment 547.

186. Comment: The stated CO₂ reduction potentials of the selected technology packages are too high. Therefore, in order to reach CARB's stated percentages for these various technology packages, additional CO₂ reduction technologies would need to be deployed. Consequently, such additional measures would increase the cost of compliance with the proposed CO₂ standards, provided that expanded technology combinations could be found and realized. (BMW Group)

Agency Response: Staff disagrees with the comment. The greenhouse gas reduction potentials of the selected technologies were demonstrated using well established vehicle and engine modeling techniques by AVL on five vehicles representing the statistical average for their respective vehicle class. Therefore, technical feasibility of the greenhouse gas emission standards was demonstrated for the fleet as a whole. Similar to the case in other emission programs such as the LEV and ZEV programs, the effort needed to comply with the emission standards depends on each manufacturer's emission baseline and consequently, compliance costs will vary from manufacturer to manufacturer.

187. Comment: The ISOR and supporting documents contain misstatements about the current state of mobile air conditioners. It is stated that "most" compressors are currently fixed displacement designs (p. 7, Appendix C1, Draft Technology and Cost Assessment, April 1) and that variable displacement compressors (VDC) are "not yet commonly employed in the U.S." (p. 1, Appendix C4). The NESCCAF report acknowledges that "some fraction of the U.S. market already incorporates VDC technology" and that "this will impose a modest error on fleetwide emissions impacts" modeled (NESCCAF, Appendix D-19). In fact, this error appears to be significant, and the resulting assessment of feasible emission reductions incorporated in the standards therefore overestimated. (General Motors)

Agency Response: Staff disagrees with the comment. Staff relied on the best available information at the time of writing the ISOR, and the references used were clearly cited. Staff used the expert input of mobile air conditioning stakeholders to draw the most accurate, broad generalization about the state of the current fleet. Because the real benefit of variable displacement compressors stems from external control, and most

vehicles don't have such controls, the fixed displacement compressor enjoys a much larger share of the fleet. Very few models in California use variable displacement compressors; most applications are on small vehicles where clutch cycling can result in drivability issues. These compressors are used more commonly in Europe where small engines are more widely utilized. Therefore, staff agrees with the assessment of the NESCCAF report that fixed displacement compressors dominate the baseline fleet and any error in the 2002 greenhouse gas emission baseline resulting from not including the small fraction of vehicles employing VDCs is minor.

188. Comment: Pollution from motor vehicles has been successfully dealt with using narrowly focused aftertreatment strategies that deal with a limited number of motor vehicle components. Aftertreatment or other control of carbon dioxide emissions is not possible. Instead, vehicle climate change emissions are inherently linked to the amount of fuel consumed. Fuel consumption is impacted by virtually every aspect of vehicle design and construction, ranging from engine and transmission modifications to possible changes in the shape, size, and materials of passenger cars and light trucks. (Statement of John Cabaniss, 9/23,04).

Agency Response: Staff focused on improvements to vehicles that reduced climate change emissions. These included not only CO₂ reductions, but reductions in air conditioning refrigerant losses, and provisions for counting reductions in nitrous oxide and methane emissions from improvements in aftertreatment systems. It is also incorrect to maintain that criteria pollutant emissions have been dealt with using narrowly focused aftertreatment systems that deal with a limited number of motor vehicle components. In order for an aftertreatment system to achieve high conversion rates, substantial revisions have been made such as improvements to fuel control systems and combustion chamber designs, addition of swirl control valves, use of variable valve timing to control NO_x emissions, and more.

The proposed greenhouse gas reductions would require still further changes to engines, but they are not inconsistent with past changes to reduce criteria pollutant emissions. Also, it should be noted that California's existing emission control programs, which continue to receive waivers of federal preemption, have affected fuel usage substantially. For example, lean burn technologies that provide for reduced fuel usage have not been able to achieve the low emission levels required in California, so that they have been a non-option for manufacturers. Similarly, diesels that provide reduced fuel usage have had a difficult time meeting California emission standards, thereby precluding their use in the state for several years. Thus, there has been an interplay of emissions and foregone fuel usage options in California for decades. However, with emerging emission control improvements, both of these technologies are gaining renewed interest for reducing climate change emissions.

In addition, ARB has traditionally looked at vehicles and fuels as a system. Thus the improvements in vehicle technology and emission performance have gone hand in hand with improvements to fuel (low sulfur diesel, reformulated gasoline). The various fuel-enabled technology improvements continue to receive waivers of federal preemption.

189. Comment: Vehicles are designed, built, distributed, and marketed for the entire U.S. market, not just for California. While it has generally been possible for the industry to produce vehicles with separate California-only aftertreatment strategies to meet California's air pollution requirements, such an approach would not be feasible given the comprehensive nature of the necessary changes to comply with the ARB greenhouse gas proposal. (Statement of John Cabaniss, 9/23,04).

Agency Response: Some companies have shared with staff that they plan to introduce new greenhouse gas emission reduction technologies on all their vehicles worldwide to achieve the greatest economies of scale and lowest overall costs. All major manufacturers claim to be "global" companies and will have to meet greenhouse gas emission requirements in other countries for similar models they market in the U.S. They will have little choice but to improve their vehicles for these markets. While manufacturers can continue to build lower technology vehicles in the U.S. market, it may not be a good long term strategy. Carlos Ghosn, highly successful chief operating officer of Nissan, remarked recently that one of the causes of the decline of some "domestic" companies is that they are not truly global companies. With more of a world view in designing their products, they might be more competitive and achieve reduced product costs. Thus, there is the very real likelihood that complying with California's proposed greenhouse gas requirements would benefit these companies rather than cause them increased costs.

190. Comment: We believe there was a clear error made in the way the benefits of the Light-Duty Truck II standards were calculated because the staff did the benefit estimate off the 2002 baseline and failed to account for the increasing stringency of the CAFE standards for trucks that NHTSA has just set and failed to account for minivans.

As best we can tell from the data files, spreadsheet files that we got from the staff, when the staff calculated what the benefits were for the Light-Duty Truck II standards, it compared CO₂ emissions under the midterm standard to CO₂ emissions in the 2002 baseline case with minivans excluded from the baseline.

The staff report explains in one section how between now and 2009 there are going to be improvements in the fuel economy of light-duty trucks due to a number of different technology changes. And there are estimates for what those fuel economy improvements are. But as best we can tell, when the staff got to the final step of comparing fuel economy or CO₂ emissions under the proposed standards to what they otherwise would be, the staff went back to the 2002 baseline and forgot to account for the fact that because of the new standards adopted by NHTSA that come in 2007, raising the light-duty truck standards from 20.7 miles per gallon to 22.2, fuel economy is going to improve in the absence of any regulation by the State of California. And that wasn't accounted for. And just as importantly, that minivans were like -- a baseline because minivans weren't used to set the standard, and the staff didn't account for the fact that minivans have higher fuel economy than the other Light-Duty Truck IIs. And the net effect is that the benefits that are associated with the Light-Duty Truck II standards are far less, we believe, than what the staff has estimated. (Tom Austin, Sierra Research)

Agency Response: Staff disagrees with the comment. Concerning calculation of the benefits for the LDT2 category, see response to Comment 242. Regarding minivans, see response to Comment 281.

191. Comment: I just wanted to go on record today and say that we're very supportive of the Board's proposal. We disagree with some of the allegations raised by outside groups, which we believe to be front groups for the auto industry, that there are safety implications from the proposal. The weight reductions that are at issue in that argument are not going to flow from the Board's proposal, which is a carefully thought-out and comprehensive technology package, completely free of any implications for the weight or vehicle attributes as the Board has said.

And even in the context of the arguments that they're being made, the issue that weight and safety are interrelated is a myth. In fact, weight is a function of vehicle size, which is sometimes confounded with weight in the data. And it's also function of vehicle design. So smaller vehicles are as safe, if you look at driver death rates, as larger or heavier vehicles. (Laura MacCleery, Public Citizen)

Agency Response: Staff agrees with the comment. No further response needed. It is possible that the confounding data on this issue is one reason that the Legislature forbade ARB from weighing weight reduction versus other technical approaches that can be used to reduce greenhouse gases.

192. Comment: My name is Laura MacCleery, and I am the Counsel for Automobile Safety and Regulatory Affairs at Public Citizen.

Often, in our experience, whether the issue is rollover safety or air bags, the auto industry wages what the Supreme Court called in a landmark air bags case the "regulatory equivalent of war" against improvements in safety standards. This proposed regulation has solicited a similarly intense response from all sides, including, recently, a rather robust debate about its alleged implications for vehicle safety. I hope I can clarify the most important misconceptions in this debate.

A myth now in circulation is that this proposal will compel automakers to reduce the weight of the vehicles they produce. This claim has no basis in fact. The Board has laid out clear and extraordinarily comprehensive technology packages for all vehicles, including SUVs and pickups, to meet the proposed standard without adjusting weight, as required by law.

Even more to the point, weight is not a good predictor of a vehicle's safety. Vehicle size and design, not weight, are the critical factors....Suggestions that vehicle safety is a matter of "simple physics" ignore critical issues—for example, differences in vehicle height and rigidity, and how well the occupant survival space is maintained in a crash, as well as the performance of safety technologies like frontal and side impact air bags. Honda, for example, recently announced a new structural design for the front of vehicles that can

absorb up to 50 percent more force in frontal crashes. That means, in practical terms, 50 percent less violent force will be suffered by the people inside the vehicle in the so-called second collision between the occupant and vehicle interior.

Moreover, the advent of improved vehicle design and material, including smaller engines; light, high strength steel and composites; air bag technologies; and other innovations, are redefining the present and future relationship between vehicle weight and size, making dire predictions associated with reductions in vehicle weight even more doubtful. (Laura MacCleery, Public Citizen)

Agency Response: Staff agrees with the comment. No further response needed.

193. Comment: Downsizing has a direct negative impact on vehicle crashworthiness. In general, there is a positive correlation between vehicle size and safety, and between vehicle weight and safety. Fuel economy, on the other hand, is negatively correlated with size and weight. For this reason, there is a clear tension between crashworthiness and efforts to improve fuel economy. Given the direct connection between fuel economy and CO₂ emissions, ARB's proposed rule raises this very same safety problem. (Marlo Lewis, Jr. and Sam Kazman, Competitive Enterprise Institute)

Agency Response: Staff disagrees with the comment. California's greenhouse gas regulations do not require or encourage manufacturers to downsize the vehicle fleet. Rather, ARB's technical analysis shows that manufacturers can achieve the required emission reductions through technology improvements. ARB's technical analysis further shows that the technology improvement route will likely be a more cost-effective approach for reducing greenhouse gas emissions than reducing vehicle weight. Thus arguments about safety, even if relevant, are largely the manufacturers' attempt to set up a false choice—safety versus greenhouse gas reduction. If manufacturers choose to downsize their vehicle fleets, that is their decision, but it is not an outcome of this regulation.

194. Comment: ARB states that its "staff efforts do not rely on weight reductions in setting its proposed climate change emission standards..." Nonetheless, it admits that "manufacturers would still have the option of lowering weight to improve CO₂ emission performance."

In fact, it is highly likely that downsizing would be one of the major techniques that carmakers would use to comply with ARB's rule. At a minimum, the rule would restrict the ability of carmakers to upsize their products. In either case, this would have a lethal impact on auto safety. ARB's report, however, simply fails to address this issue. (Marlo Lewis, Jr. and Sam Kazman, Competitive Enterprise Institute)

Agency Response: Staff disagrees with the comment. See comments and agency responses 191 through 193.

195. Comment: The staff report says that turbocharging with engine downsizing and automated manual transmissions are actually going to reduce the cost of vehicles while

simultaneously improving fuel economy, and that these technologies are not going to be used in the no-regulation case. But if you pass a regulation, you're going to somehow force the auto industry to use technologies which will save them money. This essentially assumes that manufacturers are not going to act in their own economic interests in the absence of a regulation.

The problem here -- and we're not saying that turbochargers and automated manual transmissions are not technologies that can be made available. The problem is they can't be made available at the zero cost or negative cost that your staff assumes. And the reason for that -- I'll use turbocharging as an example. We provided very detailed analysis of why we think there are problems with a turbocharging analysis. But one of the simplest problems to understand is that the fuel economy benefits that your staff analysis assigns to turbocharging are based on modeling done by AVL with premium fuel. So you end up with a 20-cent-per-gallon hit to achieve that level of fuel economy. And the additional cost for the premium fuel was not addressed in the staff analysis. And it totally wipes out the economic benefit of the fuel economy advantage. (Tom Austin, Sierra Research)

Agency Response: Staff disagrees with the comment. Some manufacturers have dismissed turbocharged engines from consideration in the U.S. based on old technology considerations. Adopting the proposed requirements will cause manufacturers to reinvestigate approaches, including turbocharging, to consider whether new technology might yield a desirable powertrain concept for consumers and save cost at the same time. New turbocharged engines with variable geometry turbochargers, direct injection with increased compression ratios that still can operate on regular fuel, and improvements in noise, vibration, and harshness techniques can be incorporated to yield very competitive engines, and still be less costly to build than some conventional engines.

Automated manual transmissions (dual clutch) are gaining market share in Europe, and many models destined for the U.S. will also utilize this transmission. The transmission has fewer parts than an automatic six speed and should be easier and less costly to build. However, staff has maintained that manufacturers could continue to utilize a six speed automatic transmission and still meet the proposed greenhouse gas emission reduction requirements. Once again, AVL continues to maintain that regular fuel would be sufficient to meet the proposed requirements and that premium fuel would not be needed.

196. Comment: Regarding the advanced technology alternative fuel vehicle group, those could play a stronger role. Plug-in hybrids and natural gas vehicles are being developed, as you know, by original equipment manufacturers. There could be some additional credit mechanisms employed to perhaps enhance their utilization. Alternative fuel hybrids, for example, could provide a significant opportunity for diversification of our energy supply and set the stage for what you might consider a net zero carbon fleet average standard. And while I appreciate that a net -- a zero net carbon strategy or a renewable fuel standard, if you will, is somewhat beyond rulemaking today. But when you look at the role of upstream and downstream emissions that it would be an important adjunct in the future perhaps to pursue. (Paul Wuebben, Clean Fuels Officer, South Coast Air Quality Management District)

Agency Response: The intent of this regulation is to achieve the maximum feasible and cost effective reduction of greenhouse gas emissions from motor vehicles, regardless of technology or fuel. Consequently, the credit structure is designed to provide credits for alternative fueled vehicles based on their environmental impacts. There are, however, other regulations and incentive programs that encourage the use of alternative fuels including plug-hybrids and natural gas vehicles. In addition, a 15 day change was made to better account for plug in hybrid greenhouse gas emission reductions.

197. Comment: Neither the feasibility nor the cost of the alternative fuel adjustment is even addressed. Section 5.2.C “Alternative Fuel Vehicles” proposes factors for calculating carbon dioxide equivalent emission reductions resulting from the sale and use of dedicated alternative fuel vehicles. The 16% to 23% emission reductions from conventional gasoline vehicles for fuels provided by the oil and gas industry might appear to offer promising options for reducing CO₂ equivalent emissions to vehicle manufacturers compared to potentially expensive alterations of conventional gasoline powered vehicles. Use of this option could require significant increases in alternative fuel use in California.

However, the section never addresses:

- The potential supply sources for quantities of fuels that would be needed for large-scale transportation sector use;
- The potential cost of these incremental supplies;
- The potential cost of constructing the incremental infrastructure required to deliver these fuels to the consumer, including pipelines, terminals, delivery to service stations, and new equipment at existing service stations.

Simply put, the feasibility or cost of delivering large incremental quantities of liquid petroleum gases, natural gas for vehicle use, or E-85 ethanol were not even addressed in the ISOR. (WSPA, API)

Agency Response: The primary focus of the regulation is to reduce climate change emissions from conventional vehicles. As such, staff’s analysis demonstrates that the requirements are cost-effective and feasible for automakers to meet by modifying their fleet of conventional vehicles. The regulation does not rely on alternative fuels for compliance; rather the analysis of alternative fueled vehicles was presented to provide an accounting of the costs and environmental impacts of these fuels as they have already been produced and placed in varying quantities.

To date, the market for alternative fueled vehicles has been limited and is expected to remain so when the regulations take effect in 2009. Keeping this in mind, ARB staff based the alternative fuels analysis on work performed by TIAX that assumed a maximum penetration of 200,000 vehicles. The cost for each fuel was derived assuming this volume and includes the incremental cost to provide fuels to meet this size market. As noted in the ISOR, the analysis does not include additional infrastructure costs that would result from the industry wide use of the alternative fuels in volumes greater than 200,000 vehicles. Rather, the analysis evaluates the costs and benefits of limited introduction of

alternative fueled vehicles by a single manufacturer in the limited volumes that the alternative fuels have experienced to date.

The adjustment factors contained in the regulation are essential as automakers have already (in the absence of this regulation) placed alternative fueled vehicles including CNG, ethanol, LPG and hydrogen fuel-cell vehicles and are expected to do so in the future.

198. Comment: In addition to the lack of analysis of the feasibility or cost of actually supplying the fuels required by alternative fuel vehicles, the proposed alternative fuel vehicle adjustment factors do not rely on generally-accepted sources and appear unrealistic.

As noted in our earlier comments on this proposed regulation, WSPA and API support a “wells to wheels” approach for assessing greenhouse gas emissions from different fuel/vehicle technologies. However, the ISOR appears to have ignored our earlier comments on the June Staff Report that more generally accepted and accurate modeling and input information be adopted when addressing any alternative fuel vehicle adjustment. (WSPA, API)

Agency Response: TIAX has a long history and extensive experience in analyzing fuel cycle emissions. They have worked with those entities referenced in the comment in technical forums and meetings. The fuel cycle analysis contained within the ISOR is consistent with prior work performed by TIAX on a collaborative basis with WSPA and individually with its members. WSPA has had considerable input on how the wells to wheels analysis is conducted for criteria pollutants in California. This is best reflected in the treatment of oil refinery emissions.

The choice of an adjustment factor for alternative fuels acknowledges the extremely limited alternative fuels market and is intended to simplify the certification of vehicles meeting the regulation by dealing only with exhaust emissions. The adjustment factors for each fuel identified are generally consistent with other analyses that quantify the fuel cycle emissions of alternative fuels.

199. Comment: The ISOR sources cited (the TIAX LLC and EPRI reports referenced on Table 5.2-13, page 78) are not posted on the CARB website and not readily available for review. However, the sources appear to be little changed from the June 14 draft Staff Report (Table 5.2-13) and there is no reference to the more developed and generally-accepted modeling work noted in our earlier comments. Further, we are unaware of any effort to develop the wells-to-wheels assessments by a more collaborative process as we suggested.

We continue to believe that the Argonne National Laboratories (ANL) Greenhouse Gases, Regulated Emissions, and Energy use in Transportation (GREET) model would be the best one to use, along with input values recommended by its developer (Michael Wang at Argonne) and values used in other authoritative studies such as collaborative WTW

studies led by GM. For example, General Motors Corporation, Argonne National Laboratory, BP, ExxonMobil, and Shell, "Well-to-Wheel Energy Use and Greenhouse Gas Emissions of Advanced Fuel/Vehicle Systems – North American Analysis," June 2001, Argonne National Laboratory. (WSPA, API)

Agency Response: The references used and cited in the ISOR were available for public review during the 45-day comment period. As noted in the response to Comment 198 above, the analysis performed by TIAX is generally consistent with those cited in the comment. For example, the GREET model was used to determine greenhouse gas emissions for the analysis of the greenhouse gas adjustment factor in the ISOR. As such, the upstream portion of the fuel cycle emissions was therefore calculated on a consistent basis.

When necessary, TIAX used California-specific models and data to determine marginal emissions. Since all of the marginal criteria pollutant emissions relate primarily to fuel transport, these steps were readily calculated without the GREET model. Furthermore, some of the details of local criteria pollutants are not straightforward inputs to GREET. In sum, the use of the other studies identified in the comment would not fundamentally alter the results presented in the ISOR nor change the adjustment factors contained within the regulation.

200. Comment: There have been significant and unexplained changes to the "total CO₂ emissions (g/mi)" for different alternative fuel vehicle technologies between the June and August reports. Three of the CO₂ g/mi emission rates were changed by more than 30%, two by about 10%, an "electricity" emission rate was added, and the hydrogen emission rate was dropped from Table 5.2-13. Further, given the State's initiative to add hydrogen to the Clean Fuel Outlet Program, the omission of a hydrogen alternative fuel vehicle adjustment factor from this table in the ISOR is odd. (WSPA, API)

Agency Response: The analysis in the ISOR covers a broad range of alternative fuels and vehicle technologies. When available, the analysis in the ISOR used actual vehicle test results to quantify emissions. However, during the rulemaking process, the emissions estimates were modified as better vehicle data was obtained. The comparison of dissimilar vehicles earlier in the process resulted in a wider range of CO₂ emission rates. Where minor differences occur within the ISOR, the adjustment factors contained in the regulation are based on the results presented in Table 6.4-1.

As discussed in the ISOR, the vehicle technologies identified in Table 5.2-13 are those fuels with the potential to be commercially viable in 2009. As a result, hydrogen fuel-cell and hydrogen combustion vehicles were not included in the table as these technologies are expected to be produced and placed, not commercially, but in limited quantities as part of research and development programs. However, to determine the appropriate emission values for those vehicles produced as part of technology development programs, an adjustment factor for hydrogen fuel cell and hydrogen combustion was included in Table 6.4-1.

201. Comment: A case for an advanced high efficiency gasoline vehicle should be added to this table for a truly balanced view of options available. Including only the “Conventional Vehicle” case is not consistent with the extremely optimistic fuel economy and electricity use values assumed for the HEV20 and Electric cases. (WSPA, API)

Agency Response: The ISOR includes a review of those alternative fuels that may be commercially produced in the 2009 timeframe. To determine the relative fuel cycle emission benefits and costs, staff used the attributes of a conventional vehicle during this timeframe. The ISOR already devotes most of the technical evaluation to determining the environmental and cost implications of meeting the regulation with an advanced high efficiency gasoline vehicle.

202. Comment: There is a basic question whether the data in Table 5.2-13 is realistic. For example, according to this table, “upstream CO₂ equivalent emissions (g/mi)” account for 23% of “total CO₂ emissions (g/mi)” for “conventional vehicles” (i.e., $102.7/(346.7+102.7)$). This is significantly higher than would be calculated using data available from the U.S. Energy Information Administration and other references mentioned above – which typically show upstream values on the order of 20% or less of the total. (WSPA, API)

Agency Response: Staff disagrees with the comment. The fuel cycle climate change emissions associated with the importation of finished gasoline products to California as calculated in the staff report are approximately 21% to 23%. Using baseline national GREET values, the result is 21.5%. The estimates contained in the ISOR are somewhat greater as they are derived using the marginal rather than average transportation energy inputs used by the U.S. Energy Information Administration. Modifying the estimates to account for California specific emissions increases the estimates by roughly 15 percent (1 to 3% greater) as noted in the comment.

203. Comment: CRRRC submitted a report to the Board in response to the Fleet Refuse Rule that documents the failures of the natural gas engines, alternative fuel engines that we've had in the refuse industry over the last four years. Some of them have been extensive with engine failures and fuel tank failures and what not.

Number one is that our experience shows that natural gas engines at least for the vocation that we have are not ready for commercial use. They're more expensive and they have more problems than we'd normally expect for a commercially available vehicle. We're trying to do the best we can with what we've got right now. But they're not working in the ways that they were proposed to work in the regulations and by the manufacturers that were proposing before you during those rulemaking processes.

And then also we support rule making that includes a dual path or a fuel neutral policy. We've seen that that's much better than rules that dictate the individual technologies or constrained your ability to use technologies that could achieve the emission goals. (John McNamara, California Refuse Removal Council)

Agency Response: This comment is largely irrelevant, as most if not all of the commenters' members' vehicles are not subject to the proposed regulations. We note, however, that the proposed regulation is fuel neutral. It appropriately credits the greenhouse gas emissions from conventional and alternative fuel vehicles.

204. Comment: I am writing to point out the air pollution that is caused by trucks and buses in California, especially in metropolitan areas. As much emphasis that has been placed on cars' clean emission, I have noted that buses, trucks and other diesel engine vehicles are the major contributors to air pollution, and they are not being tested and regulated the same way as private vehicles are.

I would like to know what kind of standards and regulations are set for reducing the smog generated by commercial diesel trucks and buses operating in California. Please adopt a regulation that enforces buses and trucks to have cleaner engines now and not some time in the future. (Mike Tabba; one similar letter received).

Agency Response: This comment addresses issues outside the scope of this rulemaking. No response needed.

205. Comment: There are several technology combinations included in the average cost estimates that appear unrealistic in terms of emissions compliance and technological readiness. For example, it is assumed that the use of a Diesel engine (HSDI) is feasible in small trucks despite any demonstration that emissions control technology is available to achieve the applicable NOx emissions standard with a Diesel engine. Other questionable technologies are electro-hydraulic continuously variable valve actuation (CVAeh) and gasoline homogeneous charge compression ignition (gHCCI). Both of these technologies are at a relatively early stage of development and it is not clear that they can be cost-effectively employed in the mid-term. The ISOR materials and related documents from CARB staff provide no evidence or reasoned analysis to support an assumption that those technologies can be employed in a cost-effective manner during the forecasted period. (Sierra Research Report No. SR2004-09-04, Appendix C to the letter from Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. European manufacturers do not share the negative assessment of Sierra Research in the potential of diesels to meet Low-Emission Vehicle standards. Several manufacturers are working intently to achieve Low-Emission Vehicle standards' capability and plan to bring them into California in the 2007-9 timeframe. A few years ago, HCCI combustion in diesels was also thought to be in the distance, but some European manufacturers are working on production intent diesel HCCI engines for the near future at least for a portion of the engine operating range. With continuing improvements in sensor technology and electronic controls, it would be premature to count gasoline HCCI out as well for the mid term. Regarding electrohydraulic camless valve actuation, it is noteworthy that MMC considers this to be one of the best candidate technologies for successfully meeting the proposed regulation. Also, BMW has successfully achieved a high level of continuously variable valve control in their double vanos/valvetronic systems incorporated across their engines. These systems

do not need a throttle, thereby greatly reducing pumping losses. They closely match the benefits of electrohydraulic camless valve actuation systems and provide an alternative approach to the camless system, though with greater complexity.

206. Comment: The ARB staff report assumes that the automotive industry has the economic and human resources necessary to develop and produce the technology changes outlined in the staff report in time envisioned by the staff's proposal. That assumption is not consistent with any evidence in the record before ARB or the independent analysis performed by Sierra Research, Inc., which is contained in Appendix C. Sierra Research's observations are born out by the experience of the manufacturers who have begun to deploy some of the technologies discussed in the staff report. (Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. It is not clear from the materials placed into the record by the Alliance or its members that their economic and human resources are not adequate to meet the proposed requirements. While some estimates of the costs and resources are contained in the submittals, there are no total industry capital resource estimates provided that would allow some perspective as to the relative proportion these additional resources would consume. For example, numerous analysts and industry representatives have suggested that the volume of vehicles GM sells does not warrant the numerous vehicle brands that they are striving to maintain. If GM decided to forego one of its brands, would the savings in tooling, rebadging and marketing be more than enough to offset the additional costs and other resources that would be required to meet the proposed greenhouse gas requirements? It would seem that GM, as the world's largest automaker, for example, should have sufficient resources to incorporate the needed technologies into its vehicles over the next 11 years. Staff is aware of other manufacturers smaller than General Motors that will be incorporating most of the technologies outlined by staff as needed to achieve the proposed requirements well before 2016. Perhaps an equally important question is whether GM or other automobile manufacturers claiming limited investment resources can afford *not* to incorporate the needed technologies of its competitors, thereby making competitive vehicles that are more attractive to consumers since they would be realizing substantial operating cost savings. Contrary to the commenter's assertion, there is sufficient evidence in the record on this issue. See agency response to comments 178, 215, 220, 221, 223, 224, 229 and 324.

(4). Section 5.3—Incremental Costs of Technologies

207. Comment: As we're listening here today in 2004 about cost estimates from industry, about how they have estimated past air pollution control measures and the costs. And typically we see -- actually very consistently we've seen from regulators -- we see the auto industry and regulators overestimating the true cost of actual compliance.

We've seen over and over again throughout history, really through the last four decades of motor vehicle pollution control, a consistent story here of cost overestimation for actual regulatory compliance. In the 1970's we saw auto makers, in this case Chrysler in advertising claimed \$1600 for a catalytic converter, which turned -- and the actual cost

turned out to be between 875 and 1,350. The auto estimate in this case for catalytic converters was about 1.6 to 3.2 times too high.

Another case study, 1990's, not 10 years ago, the auto industry was claiming \$788, ARB staff was estimating \$120. The actual cost according to ARB estimate was \$83. Auto estimate was about 10 times too high. ARB's estimate, while not right on the money, was much closer, was 1.4 times.

During the 1990's when California was debating the low-emission vehicle program about a decade ago. This is actually -- the reason I brought this up is that this is actually -- you saw a presentation by Tom Austin yesterday from Sierra Research. Ten years ago, he and his colleagues produced some estimates for the auto industry on the cost of compliance for the LEV program. In this case TLEV's, LEV and ULEV standards.

The estimate for a LEV I standard vehicle was a thousand dollars, for a ULEV standard was almost \$1500. So that's the track record which this particular company and this particular analyst have had in predicting air pollution actual costs.

But I've reviewed the past history of motor vehicle pollution control. And consistently what we see is 2 to 10 times overestimation by the industry. So the \$3,000 you actually heard yesterday from Mr. Tom Austin is actually very consistent and to be expected of what the industry has predicted in the past in terms of their cost overestimations. (Roland Hwang, Natural Resources Defense Council)

Agency Response: The comment supports the staff analysis. No response needed.

208. Comment: I'd also like to submit for the record a report that we commissioned several years ago on a retrospective look on different cost estimates by industry for regulations that the federal government has promulgated over the years. It covers DOT, OSHA, FDA. It's quite comprehensive. And in every case it found that the prospective view of the costs of the regulatory compliance were overstated, sometimes by a factor of 10. And it explains some of the economic factors in the missed analysis for that. So that's for the record for the Board. (Laura MacCleery, Public Citizen)

Agency Response: The comment, and the substantial evidence provided in the reports mentioned, supports the staff analysis and the reasonableness of the Board accepting the staff cost estimates over those provided by the auto manufacturers. No response needed.

209. Comment: AB 1493 is based on proven technologies. Looking back on the LEV program and some of the research that we did, in 1994 Sierra Research estimated a cost of implementing the LEV program at \$788 per vehicle. The staff estimate at that time was \$114 per vehicle. The actual ended up being \$83. If you're interested in transportation-related improvements in greenhouse gas emissions, you are the only game in town. I strongly recommend you accept the staff report. Business is behind you, and jobs will be created. Consumers will thank you. (Bob Epstein, Environmental Entrepreneurs or E2)

Agency Response: The comment supports the staff analysis. No response needed.

210. Comment: The price of passenger cars in the 2009 baseline case was inflated by the use of unrealistic assumptions about technology changes that will be made in the absence of a regulation. (Alliance of Automobile Manufacturers) This overestimation was due to unrealistic assumptions about expensive technology changes that will be made in the absence of a regulation, including increased use of overhead cam (OHC) engines and 6-speed automatic transmissions. Such changes are not necessary to maintain compliance with the federal CAFÉ standards and should not have been assumed. By inflating the “no regulation” baseline, ARB has underestimated the actual cost increase associated with the design changes necessary to meet the proposed standards. (Declaration of Thomas C. Austin, Appendix C to the letter from the Alliance of Automobile Manufacturers)

Agency Response: The use of these technologies on 2009 baseline vehicles was not predicated solely on compliance with CAFÉ requirements. In the highly competitive vehicle market, manufacturers will strive to improve the performance of their vehicles and will need to incorporate advanced features that consumers desire. The 2009 baseline vehicle content was determined by Martec based on input from their automotive industry contacts that are involved in developing and supplying future models.

211. Comment: The CARB staff is claiming that, in the absence of a regulation, manufacturers will incorporate design changes into large cars that will increase their price by \$427 and reduce their fuel consumption by 6.6%. But under the proposed regulation, manufacturers will be able to make design changes costing only \$362 that provide an additional reduction in fuel consumption of 22.1%. In constructing the final cost estimates, the CARB staff estimates that an average price increase of \$219 will be associated with meeting the near-term standards for large cars. This is based on the assumption that half of the vehicles will use the above-described technology combination that saves \$65 and the other half will use a combination of technologies that does not include turbocharging and costs \$504. (The alternative technology combination benefits from the assumed use of the transmission that saves \$105, but not from the savings assumed from resizing the engine.) No rationale is stated for why the option that saves money would not be universally used. (Sierra Research Report No. SR2004-09-04, Appendix C to the letter from Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. The 2009 baseline vehicles contain technologies based on industry research conducted by Martec. These choices are made based on an array of factors that manufacturers consider to ensure their vehicles are attractive in the marketplace. In complying with the proposed regulation manufacturers are not constrained to the specific technology packages selected to determine the greenhouse gas emission standards. These packages were selected to demonstrate technologies are available that are technically feasible and cost-effective to the consumer. Should manufacturers choose to universally use a technology package that offers savings over the 2009 baseline vehicle, then they are free to do so. The technology package that offered a savings included a turbocharged, downsized engine

approach that is not universally accepted by all manufacturers. In the past, these engines were noted for lag in acceleration response and refinement issues. Therefore, it is expected that other paths would be taken in these cases. However, in light of improvements in turbocharger technology applied to direct injection engines, it appears manufacturers are indeed looking at this approach with renewed interest. For example, one of GM's new engines, the 3.6 liter V-6 has provisions for a turbocharged variant incorporating direct injection. In addition, their Ecotec 2.0 liter engine can accommodate a supercharger, and would also likely be able to accommodate a turbocharger with few revisions if they chose to do so. Manufacturers with origins in Europe are also currently marketing advanced new turbocharged engines in California models that are acquiring positive reviews in automotive publications.

212. Comment: The staff report has substantially underestimated the costs of the technologies it examines, and has substantially overestimated the theoretical operating cost savings associated with the proposed regulation. When the shortcomings in the staff analysis are corrected, the costs of the regulations for the average consumer, and indeed for nearly any Californian, will more than double the potential fuel economy savings that the requisite technologies could provide. (Alliance of Automobile Manufacturers - conclusions drawn from Appendix C, Sierra Research)

Agency Response: The comment refers to the cost study by Sierra Research that was commissioned by the manufacturers. The conclusions of this study are addressed in the response to comment 254.

213. Comment: How CARB determined the cost premium for an aluminum block was not explained. (Sierra Research Report No. SR2004-09-04, Appendix C to the letter from Alliance of Automobile Manufacturers)

Agency Response: Staff derived the approximate cost from the Martec spreadsheets. In looking at the costs for implementing ehCVA for a V6 engine with an OHV system compared to one with an OHC system, the difference in cost is about \$250. This relative difference is the cost credit for the extra OHC system components relative to those for the OHV system since the description of the changes did not include changing the block, only the cam-related components. For going to DOHC from OHV alone as a separate line item, Martec indicated a cost differential of \$500 for a V6 engine, which included not only the additional valvetrain components but also going to an aluminum block. Therefore, the difference in the costs would be \$250, which would represent the portion of the cost for a V6 aluminum block. We raised the cost to \$300 for a V8 engine.

214. Comment: In many cases the ARB estimates of the costs of the feasible technologies are too low (e.g., turbocharging and downsizing) and the estimates of the benefits of technology are too high (e.g., variable valve lift and timing). (DaimlerChrysler)

Agency Response: Staff disagrees with the comment. Staff double checked Martec's estimate of the costs of turbocharging with a company producing turbochargers. There was interaction with both Martec and the turbocharger company in conjunction with ARB

staff to assure that our costs were correct. As stated in the staff report, staff's long term interaction with Martec gives us confidence in their methods and results as confirmed in the Low Emission Vehicle program. Regarding the benefits of advanced technologies, perhaps DaimlerChrysler's estimates of the benefits of advanced technologies would improve once they embark on use of such features as variable valve timing and lift (assuming this comment originates primarily with the Chrysler group, which has no engines in its lineup with this technology combination). The benefits projected for the technologies were generally derived from the AVL results, wherein they relied on advanced engine maps obtained from their own engine developments or from European manufacturers that utilize these technologies in production vehicles.

215. Comment: The staff report failed to account for the integration costs of certain vendor-supplied components that cannot merely be added without other design changes. (Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. Staff accounted for the integration costs of vendor supplied parts into a manufacturer's product line through the use of a 1.4 multiplier. This multiplier was utilized based on evaluation of a report by Argonne National Laboratory on exactly this subject and consideration of a similar multiplier used by the federal Environmental Protection Agency for such analyses. The Alliance's contractor had full access to ARB spreadsheets and is fully aware of this methodology and its application. As stated at the hearing, the costs of parts determined by Martec were for those provided by suppliers that design, engineer, and produce them without assistance from any particular manufacturer. Therefore, the 1.4 multiplier used by ARB staff is entirely appropriate for accounting for the integrating costs borne by original equipment manufacturers to incorporate supplier parts in their designs.

216. Comment: Given that some safety steps would be required as discussed by risk assessments by EPA and others (cited by ARB), R-152a systems would undoubtedly cost more than comparable R-134a systems. Safety items could include refrigerant sensors, purge valves, and associated electronic controls. It seems certain that, with increased safety-related costs and little or no efficiency advantage, R-152a systems would violate the AB 1493 requirement that new technologies save consumers money. In addition, the NESCCAF analysis on which CARB bases its mobile air conditioning assessment specifically excludes fixed costs for new technologies, such as engineering and investment, as well as incremental variable costs at the vehicle manufacturers, such as increased warranty expense (NESCCAF, Appendix D-20). It also excludes conversion costs within the service industry, which would be extensive for a flammable material such as R-152a. (General Motors)

Agency Response: Staff disagrees with the comment. Information released by SAE suggests that the cost increment to manufacturers associated with the switch to R-152a would be on the same order as the costs associated with making improvements to the existing R-134a system. And in the case of the base R-152a system (without a secondary loop), there would be an indirect emission reduction benefit of approximately 10 percent.

Similar to the cost for other technologies, the manufacturer's component cost for improved air conditioning systems included engineering, investment and warranty costs that are typically borne by the component supplier. Additional costs to the manufacturer such as incorporating the components on their vehicles is properly accounted for in the RPE factor used by staff to determine the retail price paid by the vehicle purchaser. Finally, we note that AB 1493 does not require that each potential technology identified by staff must save consumers money, but rather that the standards as a whole must be economical to the consumer.

217. Comment: NESCCAF shows a 2009 forecast that continues with overhead valve (OHV) engines as the "dominant" technology for large trucks and minivans, among the five segments analyzed (Table II-4, p. II-7). While this representation is a simplification, it accurately reflects that OHV engines will continue to exist in large penetrations in 2009, especially among trucks. However, ARB's technology packages require conversion of all engines to overhead camshafts. To do this ARB starts with Martec's \$500-600 OHV-DOHC conversion cost (NESCCAF, p. B-2), but lessens it by \$250-300 by claiming that Martec's assumed aluminum engines can be iron instead, and that \$250-300 is the proper cost premium for an aluminum engine (ISOR, p. 82). Additionally, ARB claims that this upgrade will provide for deletion of EGR valves, saving \$25. These errors contribute significantly to underestimating the costs of achieving the proposed greenhouse gas emission standards. (General Motors)

Agency Response: Staff disagrees with the comment. When changing from an OHV configuration to an OHC configuration, it is not necessary to incorporate an aluminum engine block at the same time. In fact, in truck application in particular, a GM engineer explained to staff that a cast iron block is preferred since such engines are better able to withstand overheating events. This is because engine rebuilding would be a viable option for a cast iron block to renew operation, whereas aluminum engine blocks generally would be scrapped in such an event. For example, the Ford F150 truck uses an overhead camshaft engine design, but uses an iron block. Therefore, staff correctly did not include the incremental cost of an aluminum block in its cost estimates. Also see response to comment 206 to explain the basis for the cost that was used. For engines with variable valve timing, exhaust gas recirculation effects can be achieved through the variable valve timing system in an overhead camshaft engine, thereby eliminating the need for a separate EGR valve and related control system. This would correctly further reduce costs. Please also see the response to comment 213.

218. Comment: The ISOR estimates that the retail price equivalent (RPE) for turbocharging is -\$210; the claimed cost savings is based on the assumption that V-6 engines can be replaced with less expensive inline engines when turbocharging is used to achieve constant performance. There are other downward adjustments to the RPE for other technologies that CARB also assigns when turbocharging is assumed. These adjustments are not described in the ISOR; however, they can be seen in the spreadsheets that CARB used to construct the values reported. (Sierra Research Report No. SR2004-09-04, Appendix C to the letter from Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. The cost savings from engine downsizing are listed in the spreadsheets from Martec that can be found in the NESCCAF report referenced by the ISOR. While the ISOR does not identify the technologies for which ARB assigns further cost reductions, they are contained in the spreadsheets from which the vehicle retail price increase were derived and which were provided to Sierra by ARB shortly after the ISOR was published.

219. Comment: The cost estimates used in the NESCCAF report were given with numerous caveats, as noted in Attachment B of the NESCCAF interim report. For example, an upgrade to a 42-volt electrical system is noted as needed for electrical power steering for large trucks and electromagnetic camless valve actuation. Upgraded batteries are needed for the motor assist and start-stop hybrid systems. Increases in transmission torque capacity are noted as potentially needed but not specifically modeled for diesels and turbocharged engines. Modifications to base engine components are excluded for direct injection systems and noise vibration and handling (NVH) modifications are excluded for cylinder deactivation.

Automated manual transmissions are noted to have no North American capacity. This is an important caveat in view of the major investment and other costs associated with changing over capital-intensive transmission factories. The ARB report states a belief that “transmission suppliers would absorb the bulk of investment costs, not the vehicle manufacturers” (ISOR, p. 85), but this overlooks the reality that all expenditures are ultimately borne by consumers. It is noted that continuously variable transmission (CVT) costs are based on a competitive component sourcing environment without major licensing cost additions and high volumes – none of which are realistic assumptions given the status of this technology.

In addition, there are numerous instances of additional costs for vehicle integration that would be expected for these new technologies that are not specifically noted by NESCCAF. These additional costs must all be considered to comply with the Legislature’s requirement in AB 1493 that the rule provide the “maximum feasible and cost effective reduction in greenhouse gas emissions.”

The presentation of this list of cost omissions and simplistic assumptions in Attachment B of the NESCCAF report reveals that the authors were aware that important cost issues were being excluded from the analysis. Yet not only did ARB not compensate for these omissions, ARB added the unrealistic assumption that the NESCCAF costs for several “emerging technologies” would be reduced another 30%. The NESCCAF report states that “Martec assumed that at least three high-volume automakers would use each technology at volumes of at least 500,000 units per year and at least three competing suppliers were available to supply each automaker for each technology. This would create a highly competitive purchasing environment that would drive prices and costs to competitive levels” (NESCCAF, p. II-18). The Martec estimates reflect “Fully learned, high volume production of current technology designs” (NESCCAF, p. II-18). Thus, learning curve effects are already incorporated in the NESCCAF costs. The NESCCAF report only

allows that “to the extent that basic scientific advances in design or manufacturing do occur, future costs may be lower than estimated” (NESCCAF, p. II-18). (General Motors)

Agency Response: Staff have carefully reviewed the manufacturers’ argument that our cost estimates fail to capture all relevant costs, and we remain confident in our estimates. Regarding the specific issues raised here, staff specifically focused on electrohydraulic power steering for use on large trucks to avoid the need for a 42 volt electrical system. Similarly, staff also indicated that electrohydraulic camless valve actuation systems were assumed because they have lower energy requirements to operate and have greater control flexibility than electromagnetic systems and would not require a 42 volt electrical system. Staff *did* include the cost of an *advanced* 36 volt, 55AH adsorbent glass mat lead acid battery set for flywheel integrated starter generator systems in its analysis.

As noted in the response to Comments 235 and 632, with careful planning manufacturers can minimize the cost of modifications to base engine components needed to facilitate direct injection systems by including them during the design of new engines or updating of existing engines. Manufacturers are expected to incorporate improved engines across their model lines as the requirements phase in, and considerable leadtime is provided for this between now and 2016 when the greenhouse gas requirements are fully implemented. In addition, at least one domestic manufacturer is already designing engines with the capability to incorporate direct injection systems (see responses to comments 211 and 233), while others (primarily European) are marketing direct injection engines today. Concerning costs for NVH modifications for cylinder deactivation applications, see response to Comment 254.

ARB staff relied on the Martec cost estimates of automated manual transmissions from an independent transmission supplier, which assumed high volumes. If the transmission is to compete successfully with current 6 speed automatics, its cost must be competitive in relation to the reduced CO₂ emissions it provides compared to the 6 speed automatic. As noted above, staff concluded that AVL’s assessment of the benefits of 6 speed automated manual transmissions was too conservative and that the 6 speed automatic achieved a 7-8% reduction in CO₂ emissions (the value assumed by AVL for the automated manual transmission). Therefore, a 6 speed automatic transmission may be substituted wherever the automated manual transmission was used and the benefits of the packages essentially retained. General Motors already is underway in conjunction with Ford Motor Company in design and production of their own 6 speed automatic transmission and accompanying manufacturing facilities. Nonetheless, cost estimates received by staff confidentially from a manufacturer planning on introducing the 6 speed automated manual transmission across its product line confirmed the ARB cost estimates as accurate. Although General Motors cites potential licensing issues and no current high volume capability or competition for the latter transmission, staff’s experience is that suppliers introducing new technologies are usually able to *reduce* costs with additional high volume, not increase them. Regarding the CVT transmission, staff agrees that issues such as cost/benefit, durability and customer acceptance due to potentially increased engine noise and other characteristics could still be issues limiting penetration of this option. That is why staff did

not use it in most of its scenarios. In the end, it is the vehicle manufacturer that would need to choose the best technology for its products from the array of available options.

Once again, staff used the multiplier of 1.4 in its analysis to arrive at a retail price equivalent for a product based on the assumption of parts obtained from a supplier. Therefore, integration costs and other costs associated with use of supplier parts were fully accounted for in the 1.4 multiplier.

In addition, as stated in the ARB staff report, a further 30% discount was assumed for a limited number of components where unanticipated improvements in production processes or simplifications/consolidation in parts after additional further development would be likely. ARB experience with new technologies is that their costs continue to improve beyond our expectations based on early estimates as demonstrated in the Low Emission Vehicle program. For example, in that program, staff assumed future advanced catalyst systems would always include a close coupled catalyst in conjunction with a toeboard catalyst to achieve improvements in cold start capability needed to achieve the lowest emission standards in the program. Yet Honda has been able to achieve these low emission levels with a single *underfloor* catalyst, much to our surprise, which reduces costs. General Motors, in the 1980s was able to reduce the size, weight, and cost of their starter motors considerably, despite little improvement in their basic design for decades. General Motors relied on use of their new "magnaquench" technology, which focused on use of rare earth elements for an improved permanent magnet in their starters.

220. Comment: The staff report assumes that manufacturers are going to employ technologies that will actually lower their costs only if they're regulated. And for a variety of reasons, we believe that that definitely will not happen.

In the case of the automated manual transmission, Martec submitted some cost information that the staff is relying on that essentially said that there wouldn't be any piece price difference between automated manual transmissions and conventional automated -- conventional automatic transmissions. However, Martec knows full well, and advised NESCCAF of this, that the manufacturing capability to produce those transmissions does not exist and that there would be substantial additional cost associated with building and tooling the manufacturing facilities to make those automated manual transmissions that have not been accounted for in the staff's analysis.

Furthermore, and to comment on a statement there wouldn't be any tear up required of existing facilities. This is a prime example of where there would be substantial tear up of existing facilities required. We have an enormous amount of automatic transmission manufacturing capacity installed in this country. None of it is suitable for producing automated manual transmissions of the type that are assumed in the staff analysis. There would be a lot of capital investment that would have to be retired prematurely.

This is one of the problems that ends up reducing costs the way the staff analyzed it. And in our analysis adds several hundred dollars of costs per car when you account for the fact that we would have to invest a lot to make this technology come to light and we would

have to retire a lot of existing manufacturing capacity prematurely. (testimony of Tom Austin, Sierra Research)

Agency Response: In staff's analysis, downsized turbocharged engines and automated manual transmissions were examples of technologies that, if utilized, could save manufacturers cost compared to current powertrain approaches. Although General Motors has indicated it has concerns about the acceptability of downsized turbocharged engines to meet consumer demands in this country, other manufacturers are not so negative. There is little evidence that General Motors has done much development of the approach, which is a currently popular engine technology in Europe. With direct injection, improved active engine mounts, improved induction noise attenuation techniques, noise cancellation technology, variable geometry turbochargers, plus new low pressure turbocharger technology as utilized by Volvo in its luxury vehicles, turbocharging deserves another look. Diesels also have not been popular in the United States, but many companies are now touting their advantages and are working to bring them here. Just because it isn't being done currently doesn't mean that it shouldn't be reevaluated in light of significant new technology developments.

Regarding the automated manual transmission, the cost estimates obtained by Martec were for a unit obtained from a supplier. The supplier would have absorbed the cost of engineering and development, manufacturing plants and other costs such as warranty coverage. As indicated earlier, staff obtained confirmation from a manufacturer planning on introducing this transmission across their product line that our costs were accurate. If General Motors is unable to build facilities to manufacture such a transmission and end up with a lower unit cost than that of a supplier, they should buy the unit from the supplier and avoid the investment; we have already factored in the increased cost to the consumer this would engender. Also, as indicated earlier, General Motors and Ford could continue to build their new 6 speed automatic transmission and obtain all the benefits ascribed to technology combinations utilizing the 6 speed automated manual transmission in our report; no tear-up of existing facilities is required.

221. Comment: The technology changes that are required to comply with this proposed regulation go far beyond the kind of technology changes required to comply with your exhaust and evaporative emission standards. They are closer to the level of changes that are associated with doing something like a whole new vehicle, like an electric vehicle.

And I would invite you to go back to the early 1990's and look at what your staff said about what the cost of electric vehicles would be in 2003 due to unforeseen innovations. And also look at what we said the cost of electric vehicles would be in 2003. And you'll see that the estimates we made of what was going to happen with those kinds of complex technology changes were pretty much on the mark. And we think we're on the mark here too. (testimony of Tom Austin, Sierra Research)

Agency Response: Staff disagrees with the comment. Compliance with the greenhouse gas requirements does not require manufacturers to embark on a vehicle technology development program that even approaches the scope required for electric vehicles in the

early 1990's. All of the technologies identified by staff in demonstrating technical feasibility of the greenhouse gas emission standards are simply advanced conventional internal combustion engine or transmission technologies and, in many cases, already employed on some vehicle being sold today. As such, the costs for these technologies are well defined.

222. Comment: Volumes based on California sales levels could not possibly reach the high levels assumed by Martec. No manufacturer sells over 500,000 vehicles annually in California, and three manufacturers selling at least 500,000 units per year would account for almost the entire California market. Because most specific technologies are not applicable across all vehicle segments, it would not be possible to reach the Martec volume assumptions even if they were applied on all possible vehicles in the relevant segments in California. As a result of these factors, the cost and retail price increases borne by consumers in the time period covered by this regulation would be much higher than the "fully learned, high volume" levels that might ultimately be reached. (General Motors)

Agency Response: Staff disagrees with the comment. The technologies costed by Martec were for those provided by suppliers that had absorbed development costs of the technologies, investment to build the units and warranty coverage and other costs. The assumption was that the products would be sold to a number of manufacturers worldwide that would be improving the climate change emissions of their vehicles in response to regulations or voluntary agreements already in force in other jurisdictions. This would occur in the same timeframe as the proposed regulation, or earlier.

223. Comment: It is unrealistic to factor in a 30% reduction beyond the fully learned, high volume levels based on a possibility of "basic scientific advances in design or manufacturing" (NESCCAF, p. II-18). Basic scientific advances are by nature not predictable and usually develop and progress toward implementation over long time frames. Reliance on basic scientific advances is in conflict with the technologies being available in the near or mid terms. Furthermore, given the pace of new technology introductions and replacement laid out by ARB in its technical justification, it is questionable whether maturation of technologies to "fully learned" levels might ever occur. The expected rate of change is simply too fast and disruptive, and expected product lifetimes too short, with new technology packages forced across the fleet in four year waves moving from the near term technologies in 2009-2012, to mid term technologies in 2013-2016 to, presumably, long term technologies described in the ARB technical analysis in 2017. Indeed, the shortened product lifecycles implied by this progression are not consistent with normal cost levels or rates of return, where powertrain technologies such as new engines or transmissions need useful economic lives of 10-20 years to be economically justifiable. (General Motors)

Agency Response: Staff addressed the comment regarding application of an additional 30% reduction in cost to emerging technologies in response to comment 225. ARB staff never envisioned that manufacturers would build a set of technologies for four years and then discard them for another new set of technologies for the next four years. Rather, staff expected that a manufacturer would plan for a rollout of new technologies that would begin

in 2009 and then build on the initial efforts with additional near and mid term technologies that would be commensurate with previous investments. These technologies were presumed to continue to be utilized beyond 2016 and would provide for amortization of costs. For example, a manufacturer might begin to introduce downsized turbocharged direct injected engines in the near term and build on them by adding integrated starter generators and additional electrical accessories and improved air conditioning systems for the mid term. Using Honda as an example, they have already introduced an overhead cam V6 engine in the Odyssey minivan that utilizes variable cam timing and variable valve lift in addition to cylinder deactivation. A reasonable next step would be for them to incorporate the technology utilized in their Accord V6 mild hybrid that incorporates an integrated starter generator. It provides engine off capability and launch assist for even further reduced climate change emissions. Additional improvements such as electric power steering could also be transferred to the Odyssey. Improved air conditioning could further reduce climate change emissions from both the Accord and the Odyssey. Further developments could center on even better valve control systems, either by developing and incorporating camless valve actuation or incorporating more flexible valve control systems much like those of BMW that don't normally require the use of a throttle, direct injection engine technology, and pursuit of homogeneous charge compression ignition systems. While not all of these approaches would necessarily be needed, many might end up being desirable and cost effective. The ARB regulation is intended to provide incentive to investigate further technologies that can reduce climate change emissions. While General Motors suggests that these concepts are unfamiliar to them, some of their engineering descriptions available on their websites from time to time indicate otherwise. For example, in describing GM's new 3.6 liter V6 engine, they indicated it is already designed to be compatible with both turbocharging and direct injection technologies with no additional redesign or strengthening needed.

Regarding the adequacy of the lead time afforded by the regulation, see comments 297 through 299, 302 and 303.

224. Comment: There is a fundamental mismatch between the cost assumptions used by ARB and the timing of the proposed standards that result in a violation of the cost effectiveness requirements set by the legislature. Costs in the 2009-2016 timeframe would not be "fully learned," they would be at much higher levels reflecting introductory conditions for new technologies. Costs would reflect transitional investment and cost issues that have been omitted from the ARB analysis. (General Motors)

Agency Response: Staff disagrees with the comment. One of the purposes of a regulation is to provide a market for advanced technologies that will accelerate economies of scale from high volume production. As indicated in the cost analysis, suppliers would be producing high volumes of parts with other competitors in the marketplace. Many of the near term technologies are already commodity items such as turbochargers, advanced valvetrain systems and components (cam phasers, variable valve lift mechanisms, cylinder deactivation solenoids and lifters, etc), direct fuel injectors, and more. There will be higher volume production of electric power steering, improved alternators, electric water pumps that should drive down their costs. For some of the mid term technologies, such as

integrated starter generators, higher volumes will be required to meet the requirements that will also drive down costs and accelerate technology learning as better ways are found to simplify the systems and manufacturing processes.

225. Comment: Cost estimates for technology changes provided by a third party, Martec, were arbitrarily discounted by 30% to account for “unforeseen innovations in design and manufacturing.” (Alliance of Automobile Manufacturers)

No basis has been established for qualifying the “unforeseen innovations in design and manufacturing” that the ARB staff assumes will occur. The 30% discount applied by ARB staff is especially problematic considering it is being applied to cost estimates made by prospective vendors of the technology, who can be assumed to have an optimistic view of the potential future price reductions. (Declaration of Thomas C. Austin, Appendix C to the letter from the Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. When considering that technologies such as integrated starter generators and diesel aftertreatment are just entering the marketplace, and technologies such as electrohydraulic camless valve actuation are not even in production, there is every reason to expect that with additional development and experience, simplified or consolidated designs will emerge or ones that utilize even more advanced technology will become available and drive down costs. We have seen this time and again in the rollout of the Low Emission Vehicle program over the last 15 years; in fact ARB has been mildly criticized for not building in such likely discounts (see comments 258 and 259.) The drive to cut costs in the automotive industry is intense and the competition keen, so that component manufacturers will certainly make improvements to their designs in such an environment, especially when the technology is new or emerging. See also response to comment 219.

226. Comment: The ARB relies on an interim report by NESCCAF issued in March 2004 as the basis for its financial and technical analysis, although ARB makes significant adjustments to the NESCCAF estimates. It is unclear if NESCCAF might make adjustments in their final report from the interim version used by ARB. This process of using an incomplete report from a non-governmental organization as the basis for CARB’s financial and technical justification has raised problems in the transparency of the analysis and our ability to comment on it. The process also appears to have resulted in significant errors in the translation of data and assumptions from NESCCAF to ARB, which has resulted in omission of significant categories of costs and a significant underestimation of the costs to consumers of the proposed ARB regulations. (General Motors)

Agency Response: The technology costs and modeling results that were used in both the interim and final NESCCAF reports were finalized when the Initial Statement of Reasons was published. In addition, staff supplied the raw data used for both versions of the NESCCAF study to industry’s representative (Sierra Research) shortly after the Initial Statement of Reasons was published. Staff appreciated the input from Sierra in ferreting out any remaining errors. Staff conducted further quality control checks to ensure the

addendum was free of any further processing errors. All conclusions reached in the Addendum were then available for further public review and comment.

227. Comment: The NESCCAF report explains its cost estimates, compiled by the Martec consulting group, as follows (NESCCAF, p. II-17):

“As noted at the outset of this section, Martec’s cost estimates do not attempt to capture all costs to the manufacturer of incorporating new technologies, nor do they include estimates of cost impacts at the consumer level as reflected in the purchase price of a new vehicle. Additional manufacturer-level costs that were not captured in this analysis but that could be associated with the use of new technologies include:

- Engineering costs, including advanced R&D, vehicle design and development engineering for integrating new technologies and software development;
- Warranty and possible recall costs;
- Factory capital costs associated with vehicle-level technology changes;
- Manufacturing costs for powertrain or vehicle assembly.

The costs described by Martec represent an estimate of the cost to the manufacturer for the hardware needed to incorporate a given greenhouse gas reducing technology on a high-volume production vehicle. Associated system-level material content such as wires, control module drivers, etc. are included in these estimates – if purchased from a supplier, these all represent a variable cost to the automaker. However, the estimates do not necessarily capture the complete set of variable costs that might be associated with the introduction of new technologies – for example, applying some technologies might require body and chassis re-designs that would in turn incur additional costs.”

This cost methodology is also described in discussing mobile air conditioners:

“In accordance with the costing methods for other portions of this study, alternative A/C system costs include only the high volume variable costs of components and do not consider the fixed costs of system introduction (e.g., engineering, and any incremental production, manufacturing, or assembly plant costs).” (NESCCAF Appendix D-20)

These descriptions make clear that important whole categories of cost have been excluded from the estimates supplied to NESCCAF by Martec. More precisely, the Martec assessments comprehend the price that an automobile manufacturer such as GM would have to pay to a component supplier to purchase the component hardware to implement these technologies. (General Motors)

Agency Response: Staff disagrees with the comment. There is no conflict between what was described by the NESCCAF report as to what the cost estimates provided by Martec include and the cost analysis performed by ARB staff. Staff included all the other expenses incurred by the manufacturer listed in the above comment when purchasing a supplier part by using the 1.4 multiplier that came from an evaluation of a similar value

determined by Argonne National Laboratory (which was in turn based on a cost model from Chrysler and another from Energy and Environmental Analysis) and one currently used by EPA. By providing more than 4 years of lead time, much of the new technology can be incorporated when vehicle platforms are redesigned, thereby avoiding unnecessary costs from tearing up current platforms to integrate the new components and systems.

228. Comment: ARB staff's analysis of the incremental costs of the controls that were being proposed rested upon a draft study performed by NESCCAF. NESCCAF's draft study in turn rested upon reports by three consulting firms, one of whom (Martec) had conducted anonymous interviews with various companies in the automobile industry in order to develop cost estimates for some technologies. Martec was never asked to provide any of the basic information it gathered from its anonymous sources. Martec would not even disclose the identity of the sources. In addition, not all the information or analysis from Martec was apparently used by ARB in ARB's cost estimates. The ARB staff apparently used some estimates from Martec without modification, but modified some of Martec's estimates. The extent to which ARB's modifications rely on other anonymous sources whose identity the ARB staff has not disclosed is unclear. In addition, much of the summary information sent to ARB by Martec and the other NESCCAF-affiliated sources was not placed in the rulemaking file at the time when the staff report was issued in August 2004. Because of ARB staff's reliance upon anonymous sources and material outside of the rulemaking file, it is difficult to assess the credibility of the information, though in many instances it appears that ARB staff did not follow the advice of NESCCAF and/or Martec. (Declaration of Thomas C. Austin, Appendix C to the letter from the Alliance of Automobile Manufacturers)

Agency Response: It is the nature of Martec's business to not disclose their sources of information. They stated their estimates were the result of solicitation of cost estimates of emerging technologies from suppliers and manufacturers and their own analysis of these inputs. Mr. Austin testified at the September 2004 hearing that he didn't have much difficulty with most of Martec's cost estimates, so apparently his concerns were overcome between the time he prepared his declaration and the hearing. ARB staff relied strongly on Martec's cost estimates, and departed from them only in some select cases of emerging technology. While Martec considered the effects of high volume production of parts from at least 3 suppliers in order to estimate learned-out costs in a competitive environment, they also specifically stated "Martec did not apply a generalized learning curve function that forecast currently unknown design or manufacturing process changes for the product – the product costed was the one that was mechanized and understood today by industry members – although not necessarily in production today." Therefore, except for a difference in opinion about the necessity of utilization of an aluminum block in overhead camshaft engines, an additional 30 % reduction in cost for product innovation for a select few components that are relatively infant technologies, and reliance on NESCCAF for estimates of hybrid vehicle costs (which were not relied upon in establishing the proposed greenhouse gas emission standard), all the costs were essentially obtained from the Martec estimates.

229. Comment: ARB's estimates do not include the basic research and development costs that are associated with developing advanced technologies and the investments needed to bring the technologies to market. Instead, ARB's cost estimates are based primarily on per-unit charges estimated by component suppliers for what ARB refers to as "long term, learned out" production volumes of 500,000 units in a single plant using "flexible manufacturing" processes that enable a variety of models to be produced in one plant. Such costs do not account for the sizable investments that would be necessary for establishing the advanced manufacturing facilities that may be entailed. (Statement of John Cabaniss, Association of International Automobile Manufacturers, and American Honda Motor Co.)

Agency Response: Staff disagrees with the comment. As explained in numerous previous responses, any integration costs incurred above the supplier component costs were accounted for in use of the 1.4 multiplier used by ARB staff to arrive at a retail price equivalent for the packages used for our analysis. As stated in their methodology summary, "Martec assumed that any long term decision by an automaker to manufacture the content of the technology system or component provided a cost equivalent to the purchase price from a supplier of the same content – that is equivalency in the make and buy business cases at the system or component level hardware. " It is inappropriate for industry to double count for research and investment already accomplished by suppliers. Integration costs of supplied parts into a manufacturer's production system and their vehicles are covered by the 1.4 cost multiplier utilized by staff.

230. Comment: A primary concern is that ARB's cost estimates were vastly understated because they do not include the basic research and development costs associated with developing advanced technologies and the investments needed to bring the technologies to market. Instead ARB's cost estimates are based primarily on per-unit charges estimated by component suppliers for what ARB refers to as, quote, "long-term, learned-out production volumes of 500,000 units in a single plant using flexible manufacturing processes." (John Cabaniss, Director of Environment Energy, Association of International Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. See response to comment 229.

231. Comment: It is unreasonable for California's specific rulemaking to be based on assumptions about sales or use of vehicles outside of California. (John Cabaniss, Director of Environment Energy, Association of International Automobile Manufacturers, and American Honda Motor Co.)

Agency Response: The rulemaking is *not* based an assumption that greenhouse gas technologies would migrate to vehicles nationwide. As noted in the ISOR (p. 81), staff expects that due to voluntary agreements and regulations already in force in Canada, Europe and Japan, as well as adoption of California's greenhouse gas requirements by states in the northeast and elsewhere, there will be plenty of demand for high volume production of greenhouse gas reduction technologies anticipated in the ISOR.

232. Comment: My understanding of the technical estimates, the cost estimates that were undertaken by the staff is that there would be some efficiencies of volume because other states or national standards would quickly follow California action and Californians would not be the only ones who would have to bear the costs of the work that would have to be undertaken in order to meet these standards. And that concerns us a little bit. The Council has concerns about regulations that give rise to higher cost of doing business or living in California versus other places. And I do note that there's a large chasm between cost estimates by ARB staff and the auto industry here and the estimates there. And in part these estimates are based on the assumptions that the other states will follow. So perhaps consideration of some type of implementation contingency that the other states or the U.S. does follow might be something you may want to consider. Or perhaps just ask the staff what the cost impact would be if only California consumers had to pay these higher costs of engineering and producing these cars. (Bob Lucas, California Council for Environmental and Economic Balance)

Agency Response: Concerning the difference in cost estimates between ARB and the industry, see response to comment 254. Regarding the statement that staff's cost estimates depend in part on adoption of California's program by other states, demand for low greenhouse gas technologies resulting from commitments already in place in Europe, Japan, and other parts of the world to reduce vehicle greenhouse gas emissions, in addition to the 1.7 million affected vehicles sold annually in California, assures adequate production to support staff's analysis. Therefore, adoption of California's program by other States is not required to assure high volume demand for the low greenhouse gas technologies staff identified.

233. Comment: ARB has identified a long list of technologies that could be used to reduce greenhouse gas emissions from vehicles. However, ARB failed to adequately consider consumer preferences in determining the maximum feasible emission reductions. Most vehicle purchasers expect to get technology tailored to their particular vehicle choice, not generic technology. This is especially true for engine technology. Purchasers of Honda vehicles expect to get Honda engines and purchasers of Fords expect to get Ford engines. Given the variation in market share among the automakers, it is unreasonable to expect that all technologies can be delivered in generic lots of 500,000 units.

One example is the assumption about engine downsizing in conjunction with turbochargers. Many customers expect a certain engine configuration when they purchase a vehicle. Many midsize and near-luxury purchasers would balk at a smaller in-line 4 or 5 cylinder engine instead of their customary V6. Similarly, it would be difficult to convince many consumers purchasing large pickup trucks, sport utility vehicles or large passenger cars to forego the tried and true V8 engine in favor of a smaller V6 turbocharged engine. The realities of consumer acceptance of engine downsizing are ignored in the staff report. (John Cabaniss, Director of Environment Energy, Association of International Automobile Manufacturers, and American Honda Motor Co.)

Agency Response: Staff disagrees with the comment. In order to realize cost savings from high volume production, manufacturers use the same engine in multiple applications.

In addition, manufacturers are moving towards the development and production of modular engines that are used worldwide and share the same components such as valvetrains. Furthermore, there are relatively few Tier 1 or Tier 2 component suppliers from which manufacturers can purchase engine and drivetrain components. These factors, coupled with the demand for advanced componentry arising from commitments in Europe, Canada and Japan to reduce vehicle greenhouse gas emissions assures high volume demand for the technologies identified by staff. Accordingly, there is no reason that any manufacturer cannot continue to manufacture its own engines. Nonetheless, some manufacturers may still choose to purchase engines from outside companies for their products. Installation of a Honda V-6 engine in the GM Saturn Vue model provides one such example.

Concerning the examples cited in the comment, the methodology used to demonstrate technical feasibility of the greenhouse gas regulations has either been misstated or misunderstood. For example, none of the technologies used to set the greenhouse gas emission standards for large trucks include turbocharging with engine downsizing. Therefore, ARB does not expect purchasers of these vehicles to have to choose smaller turbocharged V6 engines. More fundamentally, NESCCAF did not model all engine sizes or configurations that are used in the vehicle classes evaluated. Instead, a vehicle was chosen for each class that best matched the class average statistics for performance, weight, engine displacement, greenhouse gas emissions, etc. Therefore, while a vehicle using a V6 was used to represent the large car class, greenhouse gas emissions from vehicles using larger V8 engines as well as smaller inline four cylinder engines were accounted for in the class average statistics. Accordingly, manufacturers can continue to market vehicles with V8 engines to their customers that prefer a larger engine. It is expected, however, that manufacturers would incorporate as many of the same greenhouse gas reduction technologies that were selected for the class average vehicle such as improved valvetrains, better transmissions, improved air conditioning systems, and others on their V8 engines.

234. Comment: The fact that the Staff Report omits R&D and facility costs is an issue of overwhelming importance. It is like estimating the cost of a house by carefully accounting for the price of each piece of lumber while simultaneously ignoring land and labor costs. The error is so enormous that it makes quibbling over the variable piece cost of individual technologies utterly meaningless. (Statement of John Cabaniss, Association of International Automobile Manufacturers, and American Honda Motor Co.)

Agency Response: Staff disagrees with the comment. See response to comment 229.

235. Comment: The technologies analyzed in these studies (NESCCAF and ARB) cover a wide range of dissimilar items, and one cannot generalize with precision about their specific implementation cost structures. A program to evaluate implementation by an automobile manufacturer would always involve much more specific attention to the details of implementation of each technology onto a specific engine or transmission, in a specific set of powertrain factories, applied to specific vehicles with their own unique implementation/integration issues, etc. Warranty costs would be estimated based on

experience and expectations for each technology on a case-by-case basis. In short, there would be specific engineering and financial attention to the cost categories that were ignored in the NESCCAF and ARB analyses. (General Motors)

Agency Response: ARB staff rarely has access to detailed information regarding specific implementation costs of a manufacturer. When provided access to limited information of this type, staff experience is that the estimates are very inflated. In this rulemaking, General Motors and other manufacturers refused to engage in detailed discussions regarding greenhouse gas reduction technologies. (See agency response to comment 553.) Therefore, staff relied on estimates of technologies provided by Martec. As indicated previously, these costs were for fully developed components or assemblies produced solely by the supplier. In the case of integrating a supplier-provided six speed automatic transmission into an existing powertrain, for example, the development issues probably are not extensive and integration support is usually provided by the supplier as a part of their contracts with manufacturers. Incorporating a cylinder deactivation system, variable valve timing phasers, variable valve lift systems and similar components, however, could require more development and some advance planning to ensure lowest implementation costs. For example, on recent new engine designs, General Motors acknowledged they took into account that the engines would eventually incorporate direct injection fuel systems, turbocharging, variable valve lift and other potential technologies. By taking these possibilities into account when designing a new engine or updating an existing engine, future integration costs become much lower since potential tear up and redesign are avoided. By providing extensive lead time in the regulation, maximum advantage is afforded vehicle manufacturers to minimize costs by planning for lower greenhouse gas powertrains during new or updated engine development.

In order to estimate component integration costs, staff relied on a study by Argonne National Laboratory and some of our previous work in the Low Emission Vehicle program that took such costs into account in developing an adjustment factor applied to supplied parts in arriving at a retail price equivalent. For some technologies, use of such a factor will underestimate the retail costs, but for others it will overestimate the costs. Overall, though, it is the best means yet available for making this assessment when actual manufacturer financial information is not available and closely guarded. Staff's previous cost estimates in the Low Emission Vehicle program have proven to be very reliable and they are consistent with the results of this assessment.

236. Comment: The staff report's vehicle cost estimates were based on an unrealistic 40% markup factor to vendor-supplied parts prices, which is less than half of the markup required to account for manufacturer costs for research, development, engineering, warranty, overhead, sales and marketing, profit, and dealer margin. (Alliance of Automobile Manufacturers) The 40% markup factor is only appropriate in cases where vendors have responsibility for research and development (R&D), engineering, and warranty costs. However, the vendor cost estimates on which ARB is relying specifically exclude R&D, engineering, and warranty costs. The appropriate markup factor is 105% (i.e., a 2.05 multiplier). (Declaration of Thomas C. Austin, Appendix C to the letter from the Alliance of Automobile Manufacturers)

Agency Response: Mr. Austin's characterization of the Martec costs is incorrect. The Martec costs were for components engineered and produced by suppliers independent of the vehicle manufacturers. Vehicle manufacturers also hold suppliers accountable for warranty and recall costs. Mr. Austin confuses the issue by claiming that the costs Martec provided were somehow for parts where the vehicle manufacturers had intimate involvement and provided substantial resources to engineer and produce them. Such was not the case in the Martec estimates. See also response to comment 229.

237. Comment: Without offering an analysis, NESCCAF and ARB apply a "retail price equivalent" (RPE) mark-up of 40 percent" (NESCCAF, p. II-24; ISOR, p. 80) to cover the Martec-supplied costs into the price paid by consumers. This 40% RPE factor is of tremendous importance to this analysis since it must account for all the engineering, investment, labor, material, overhead, and other manufacturing costs not comprehended by Martec, as well as service and warranty costs, automobile manufacturer profit to achieve an adequate return on investment, costs and profits in the distribution network, especially the dealership markup, and any other items." (General Motors)

Agency Response: Staff disagrees with the comment. See response to comment 236.

238. Comment: Although some of the costs in our total cost structure are classified as "fixed," and might be viewed in a more limited context as not increasing due to rising vehicle content and complexity, all costs classified as "fixed" do vary over some time frame, usually defined as more than one year. The proposed regulations begin in slightly over four years and extend for twelve years, and the proposed increases in vehicle content are of such significant scale that fixed cost categories would be sure to increase. Some of the cost categories such as engineering and vehicle-level capital costs listed as excluded by Martec fall into these "fixed" cost categories. Because of the long time frames covered by this analysis and the scale of the technology changes applied by NESCCAF/ARB, these fixed cost categories would be expected to increase roughly in proportion to the increases in variable costs. (General Motors)

Agency Response: Staff disagrees with the comment. Engineering and vehicle-level "fixed" capital costs that GM believes will increase over the long term phase in of the proposed regulation due to the higher vehicle content required can be reduced substantially. In fact, GM itself provided the best description of how this might be accomplished in comments placed on the GM website. The comments were made by Thomas G. Stephens, group vice president of GM Powertrain in discussing 2004 product information. In his description of the various new engines, he indicated that new engines were being designed with the expectation that advanced technologies might be needed in the future. For example, he said

"No engine more concisely demonstrates GM Powertrain's approach to business than the 3.6L V-6 VVT. This 60-degree DOHC V-6 was developed jointly for global application, drawing on the best practices and creative expertise of GM technical centers in Australia, Germany, North America, and Sweden."

He goes on to say,

“From the start, it was developed as the flexible foundation for multiple variants of its basic design.....The basic architecture allows displacements from 2.8L to 3.8L, with major castings shared by all variants. This means a line of distinct engines, potentially very different in character and suitable for a wide variety of vehicles, which require finish work rather than ground-up development. Moreover, this global V-6 is designed to allow several content options without extensive re-engineering. In addition to the normally aspirated, sequential port fuel injection package represented by the 3.6L V-6 VVT, the engine is prepared for spark-ignition direct-injection – technology that promises significant fuel economy improvements – in both stratified-charge and stoichiometric-charge form. It also accommodates turbocharging with a wide range of horsepower and torque ratings and no degradation in durability.”

In other words, by planning new engine designs for incorporation of a range of new technology applications from the start, engineering and vehicle level capital costs can remain essentially fixed over a long period of time even when vehicle content is increasing.

239. Comment: As justification for its 1.4 RPE factor, ARB cites two studies: 1) USEPA “Progress Report on Clean and Efficient Automotive Technologies Under Development at EPA; Interim Technical Report,” January 2004 and 2) “Comparison of Indirect Cost Multipliers for Vehicle Manufacturing,” Vyas, A., Dan Santini, Roy Cuenca, Argonne National Lab, April 2000. NESCCAF offers no explanation for the 1.4 factor, while ARB states that 1.4 is between the RPE factors of 1.26 in the EPA paper and the factors of 1.5 and above in the Argonne (ANL) paper (ISOR, p. 80)

Examination of these sources reveals that the EPA paper offers no justification for the 1.26 RPE factor, simply asserting that it is used “when implementing new emissions regulations” (ISOR, p. 65) and “in regulatory development, EPA uses a retail price equivalent mark-up factor of 1.26 to adjust a manufacturing price increase to a retail price increase. This factor accounts for manufacturer overhead and profit” (p. 63). The examination of GM’s cost structure reveals that 1.26 is far too low to fill that role.

The ANL paper offers an analysis of RPE factors from three sources, ANL, Energy and Environmental Analysis (EEA), as quoted in a 1995 report from the U.S. Office of Technology Assessment, and a 1996 presentation by an automobile company executive, Chris Borroni-Bird, at a technology conference. The ANL RPEs derived from these sources are as follows (p. 7):

Multiplier for	ANL	Borrioni-Bird	EEA
In-House Components	2.00	2.05	2.14
Outsourced Components	1.50	1.56	1.56

The difference between the “in-house component” RPE and “outsourced component” RPE is that, for the case of outsourced components, ANL removed from the RPE costs for freight, warranty, amortization and depreciation, and engineering. ANL assumed that, for outsourced components, the supplier would incur these costs. However, the Martec cost estimates that form the basis of the NESCCAF and ARB analyses do not include these cost in the underlying technology cost estimates – costs such as warranty and engineering are specifically mentioned as excluded, as are large pieces of the required capital investment that forms the basis for depreciation and amortization. Therefore, the RPEs of approximately 1.5 calculated for outsourced components are not applicable to the cost estimates provided by Martec, even if the components were ultimately outsourced. The higher RPEs of 2.0 or above would apply, in this ANL analysis, to a cost basis that did not include warranty, etc., with the difference between 1.5 and 2.0 covering these categories of cost.

ARB should use a retail price equivalent factor of not less than 2.0 for this analysis. Anything less will result in the omission of significant categories of manufacturer costs, and substantial underestimation of consumer costs related to the proposed regulation. As discussed in greater detail in the Alliance comments, this means that the ARB cost effectiveness data is deficient, and the proposed regulation does not comply with the cost effectiveness requirements of AB 1493. (General Motors)

Agency Response: Staff disagrees with the comment. See responses to Comments 629 through 636.

240. Comment: Previous similar experience in the late 1970s in a period of market fluctuation due to rising gasoline prices showed that major quality problems would probably result from this type of effort. Yet ARB does not include any increased warranty or other quality-related costs in its analysis. (General Motors)

Agency Response: Technical feasibility of the proposed greenhouse gas emission standards was demonstrated through the use of conventional technologies, most of them currently being used on vehicles today. While some of the technologies applicable in the mid-term are still under development, all have been demonstrated in vehicle applications and none require the major tear up of vehicles that might lead to quality problems and associated costs. Furthermore, as noted in the response to comment 236, warranty costs are typically borne by the component suppliers who are being asked to shoulder most of the risks associated with the development of new components and have been included in staff’s cost analysis and are included in the RPE adjustment factor.

241. Comment: The markup factor that the staff used was a markup factor that was clearly supposed to be used in the case where the vendors bore the cost of engineering

and R&D and warranty. But in this case the vendor cost estimates that the staff analysis is based on did not include those costs. And the NESCCAF report makes it clear that they didn't.

Staff applied a 40 percent markup factor, or a 1.4 multiplier to the vendor cost estimates that were made by Martec. However, when we look at the source of that 1.4 multiplier, it's an analysis done by Argonne National Labs, which we've reviewed. We don't really take issue with what Argonne did. But Argonne made it very clear that they believe that that 1.4 multiplier was an appropriate multiplier for a component where the vendor is actually taking full responsibility for research and development and engineering and warranty costs. And they gave as an example that being an appropriate multiplier for something like a large electric vehicle battery.

Argonne specifically said that a different multiplier would have to be applied in cases where we're talking about a component designed by an original equipment manufacturer; manufactured by a vendor, sold to the manufacturer, but the manufacturer actually took responsibility for R&D and engineering and warranty. And, in fact, the NESCCAF report specifically says -- and this is a direct quote from the NESCCAF report -- that additional manufacturer level costs that were not captured in this analysis but that could be associated with the use of new technologies include engineering costs, including advanced R&D, vehicle design and development, engineering for integrating new technologies and software development, and warranty and possible recall costs.

The Martec numbers did not account for these costs. That's laid out very clearly in the NESCCAF report. And the multiplier that the staff put on the Martec numbers was not the appropriate multiplier given that these costs had to be covered by that multiplier.

When you look at the work that Argonne did on appropriate markup factors for vendor costs, the Argonne work from which this 1.4 factor was extracted would support using a multiplicative factor of 2.05 when we're talking about the kind of components that are in the staff's analysis on this rulemaking. (Tom Austin, Sierra Research)

Agency Response: Staff disagrees with the comment. For a detailed discussion of the appropriate markup factor for vendor costs, see responses to comments 629 through 636.

242. Comment: Martec sent a letter to Tom Austin, which has been entered into the record, which supports Tom's position and indicates that the appropriate multiplier is not 1.4 that staff has used, but rather 2.44, which if you take staff's number, multiply that thousand by this multiplier after dividing by the old multiplier. For that error alone puts the cost about \$1750, which is higher than the fuel savings reductions that Tom pointed out yesterday, that I haven't heard anybody comment on so far. (Jim Lyons, Sierra Research)

Agency Response: See responses to comments 629 through 636.

(5). Section 5.4—Lifetime Cost of Technologies to Vehicle Owner-Operator

243. Comment: CARB failed to account for California's average 8% sales tax in doing its calculations of net lifetime costs of technology changes. (Alliance of Automobile Manufacturers)

Agency Response: ARB normally does not include sales tax when calculating the compliance costs for emission regulations. However, even after adjusting the vehicle retail price increase to include applicable sales tax, the regulations are still cost-effective to the consumer. The relevant calculations were shown in the Second Notice of Public Availability of Supporting Documents and Information (the second 15-day notice).

244. Comment: A barrier to incorporating mobile air conditioning (MAC) systems directly into the standards and testing is the difficulty of evaluating the consumer cost savings from MAC improvements. This measure is critical to meeting the AB 1493 economic test that technologies should save consumers money. (General Motors)

Agency Response: In a similar manner to other vehicle technologies identified in the regulation that yield reductions in greenhouse gas emissions, the likely increase in procurement costs for the consumer associated with improved air conditioning systems will be offset by reductions in operating and maintenance costs. The net result will be a function of the alternative MAC system. For instance, an improved R-134a system will result in net savings to the consumer due to the reduced need for maintenance over the vehicle life. Further, we note that AB 1493 does not require that each potential technology identified save consumers money; the legislation requires that the regulations as a whole be economical to the consumer.

245. Comment: Charges to recover the conversion costs to an alternative refrigerant also contribute to this violation of the requirement that AB 1493 technologies save consumers money. Additional consumer difficulties could be expected if an alternative refrigerant implemented to meet California requirements result in repair difficulties for Californians traveling in other states. These technical and economic comments can also be applied to other alternative refrigerant candidates being explored, such as carbon dioxide. (General Motors)

Agency Response: Staff disagrees with the comment. These challenges are well recognized and the gradual and phased introduction of new technology is expected to help with the transition. Given developments in other parts of the world, such as Europe and Japan, the Mobile Air Conditioning industry is well aware of the need to prepare for the introduction of alternative technologies. ARB is actively engaged and following the leadership displayed by other government agencies and industry to promote worldwide discussions focused on the prevention of disruptions in supply and servicing. Further, we note that AB 1493 does not require that each potential technology identified save consumers money; the legislation requires that the regulations as a whole be economical to the consumer.

246. Comment: Fuel cost savings were apparently based on inflated estimates of vehicle service life, which may have resulted from a significant mathematical error in the analysis of odometer data from the State's vehicle inspection and maintenance program. (Alliance of Automobile Manufacturers) Lifetime reductions in total gasoline consumption and CO₂ emissions were estimated by CARB based on an assumed 202,329 lifetime average mileage for passenger cars and 223,969 lifetime average mileage for light-duty trucks. (Sierra Research Report No. SR2004-09-04, Appendix C to the letter from Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. See response to comment 649.

247. Comment: The present value of fuel cost savings is based on the unrealistic combination of a 5% discount rate and a 16-19 year payback period, which substantially overstates the value to new vehicle purchasers. (Alliance of Automobile Manufacturers) Since the unsubsidized interest rate on vehicle loans significantly exceeds 5%, the ARB analysis is based on the assumption that consumers are willing to borrow money at an interest rate higher than 5% in order to achieve a 5% return on their investment in fuel economy. (Declaration of Thomas C. Austin, Appendix C to the letter from the Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. The average values chosen for assumptions on the discount rate and the average vehicle lifetime are supported by sound data. The discount rate is supported by the historical (10-year) interest loan rates and general inflation rates of about 7-8% and 2-3%, respectively. The difference between these variables approximated the way in which vehicle consumers' value money in present time and in a future year. The vehicle lifetime averages of 16 years and 19 years, respectively, for PC/LDT1 and LDT2 categories are based directly on California Department of Motor Vehicles data on vehicle registrations and reported mileage. It should be noted that the resulting operating cost savings of the proposed standards are estimated to yield payback, or break-even, periods well short of the assumed average vehicle lifetimes. The near-term standard (for model year 2012) is estimated to result in a 2-year payback period to average consumers, and the mid-term (model year 2016) resulted in a 5-year payback. These payback periods, being well short of the allowable maximum feasible assumptions of 16-19 years, indicate that from the perspective of vehicle consumers the stringency of the greenhouse gas standards has been set quite conservatively.

248. Comment: ARB applied a discount rate of 5% to evaluate the net present value of fuel savings that consumers will experience as a result of this regulation over the life of each vehicle. A discount rate of 5%, applied across the full vehicle lifetime, is far below the range that would be considered justifiable for performing this type of evaluation. The result is that the benefits to consumers of fuel savings are greatly overestimated.

There is an extensive body of economic literature devoted to consumer behavior and their valuations of energy efficiency improvements. This range of valuations was reflected in the 2002 National Research Council fuel economy report (National Research Council,

“Effectiveness and Impact of Corporate Average Fuel Economy (CAFÉ) Standards,” Washington, D.C.” National Academy Press (2002), p. 66). They applied a 12% discount rate for evaluations of fuel savings over the life of the vehicle. Another set of NRC valuations, reflecting shorter-term consumer thinking, applies no discount rate but includes fuel savings only for the first three years of vehicle operation. The ARB’s analysis applying 5% over the entire vehicle lifetime of 16 and 19 years for cars and trucks, respectively, falls outside this range. (General Motors)

Agency Response: Staff disagrees with the comment. The ARB staff finds support for its lifetime net present value assumptions both in available data on discount rates and vehicle usage and in the text of the 2002 Assembly Bill 1493. As described in response to comment 247 above, the ARB staff does find sound supporting evidence for its assumptions on vehicle discount rate and vehicle lifetime. Moreover, the direction of the text of 2002 Assembly Bill 1493 is subtly but importantly different than the many research studies on these economic assumptions. The NRC study and others that have researched consumers’ implicit valuation of vehicle operating cost savings due to various cost-saving technologies. These studies are attempts at including consumer purchasing decisions into their investigation of fuel saving options. However, this ARB task specifically deals with the evaluation of proposed vehicle emission reductions that are “Economical to an owner or operator of a vehicle, taking into account the full life-cycle costs of a vehicle.” That is, the ARB staff is directed to include the *full life-cycle* costs of the vehicle, regardless of whether some consumers in surveys reveal that they choose not to personally value savings in the later years of the life of the vehicle.

249. Comment: The staff report fails to use realistic estimates for the value of future savings from reduced gasoline consumption, making the economic analysis unreliable. The approach taken in the August 2004 staff report does not reflect mainstream economic analysis. This is underscored in the extramural review document “Peer Review Comments and Responses” (Sept. 2004), pages 71-75, posted on ARB’s website. (Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. Table 10.2-2 of the staff report provides estimates of annual operating cost savings from 2009 to 2030. Staff used data from the EMFAC model to derive estimated operating cost savings from reductions in gasoline consumption. Staff also assumed a conservative price of \$1.74 per gallon for gasoline based on the California Energy Commission Integrated Energy Policy Report. That price is already well below prices for the past year, five years ahead of the implementation start date.

As shown in Table 10.2-2 of the staff report, the consumers could save \$5 to \$10 from reduced gasoline consumption for each additional dollar they spent on new vehicles. Staff also showed in the addendum to the report that at higher gasoline prices, the value of future savings from reduced gasoline consumption to the consumers could be significantly higher. The issues raised in the “Peer Review Comments and Responses” (Sept. 2004), pages 71-75, relate to the appropriateness of the discount rate used in the staff report, impact on used vehicle prices, rebound effect, and manufacturer’s response to the

regulations. These issues have been addressed elsewhere in the Staff Report and are not directly related to the estimation of operating cost savings from the regulated vehicles.

250. Comment: The staff report attempts to address the issue of consumers' valuation of future fuel economy savings by assigning a type of private discount rate to the reduced operating costs it attributes to the technologies it identifies. The discount rate assumed in the staff report, which is 5%, has no support in any independent empirical analysis. ARB's designated external reviewer considers this issue to be "key" to the economical analysis in the staff report and recommends that it be re-examined. (In addition, the external reviewer concurs with the Alliance declarant on the importance of differences in loan rates for new and used vehicles, which is completely ignored in the staff's analysis. (See Declaration of Stephen P. Douglas pgs. 14-17)) The peer-reviewed literature – some of which the Board's external reviewer considered but all of which the staff documents ignore – indicates that the private discount rate applied in the market for personal-use vehicles is far above 5%. (Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. As described in the response to comments 396 through 406, there is sound empirical evidence for the chosen discount rate, based on historical interest rates and inflation rates. Also stated above, the estimated payback, or break-even, periods are well short of the assumed average vehicle lifetimes, meaning that the choice of the discount rates is, in fact, far from being critical in the assessment. For example, if the discount rate is increased to an unreasonably high value of 15%, the results for the analysis still indicate that results are well within the justifiable vehicle lifetime parameters for stringency as set by the terms of AB 1493. With this higher discount rate of 15%, the fully phased in mid-term standard (for model year 2016) average consumer payback period increases from 5 years to 6 years. Again, because these payback periods are well below the allowable maximum feasible assumptions of 16-19 years, from the perspective of vehicle consumers the stringency of the greenhouse gas standards has been set quite conservatively.

251. Comment: The fuel savings calculated for light-duty trucks is substantially overstated by CARB's failure to account for the fuel economy improvements required under the 2007 federal standards and by CARB's failure to account for the effect of minivans on baseline fuel economy. (Alliance of Automobile Manufacturers)

Although the ARB staff report acknowledges that LDT2 fuel economy improvements will occur between 2002 and 2009, the final calculations are clearly based on the assumption that the 2009 baseline fuel economy level is equal to the 2002 baseline with minivans removed. This error results in the fuel economy improvement associated with the proposed LDT2 standards being overstated by 46%. (Declaration of Thomas C. Austin, Appendix C to the letter from the Alliance of Automobile Manufacturers)

Agency Response: The comment is incorrect in that staff did include the greenhouse gas reductions associated with the minivans in the baseline greenhouse gas emissions for 2002 and 2009 for the LDT2 category. However, the comment is correct in that staff did not account for the fuel economy improvements for trucks required by federal regulations.

These requirements will result in a 6.7% reduction in the fuel consumption of light-duty trucks by 2007. Nonetheless, even when the resulting operating cost savings are adjusted to account for the federal requirements, the regulations remain cost-effective to the consumer.

252. Comment: Fuel cost savings were estimated as if the federal test procedures for fuel economy reflect real-world consumption of fuel under actual driving conditions. That assumption is not supported in the record and is inconsistent with assumptions applied by ARB in other regulatory analyses and in emissions compliance testing. (Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. Fuel cost savings were derived from data generated over the same test cycles used to determine compliance with California and federal emission standards. This approach is completely consistent with other regulatory analyses and emission compliance testing by the ARB.

253. Comment: Estimated fuel cost savings ignore the “rebound effect,” which is the well-documented increase in travel associated with reductions in vehicle fuel cost. (Alliance of Automobile Manufacturers)

Agency Response: ARB included the “rebound effect” in its broader economic assessment of the effect of the proposed regulation. However, the “rebound effect” was purposely not included in the private cost assessment of the average individual driver, because this effect is only secondarily important in assessing broader impacts of the proposed regulation. The life-cycle vehicle cost impacts of the proposed regulation are the initial vehicle cost and the lifetime fuel savings. From the perspective of consumers who can purchase vehicles that employ greenhouse gas reduction technologies that result in operating cost savings, it is the lifetime savings that are of import, not what the consumers secondarily do with those private savings. Because the extent to which the consumer rebound effect does occur may have relevance when estimating the net effects of the regulation on overall vehicle miles traveled and its resulting societal impact, it is included in ARB’s exploratory “Other Consideration” analysis.

254. Comment: The average per-vehicle cost of technology required to comply with the proposed regulation is approximately \$3,000 per vehicle for the average of all cars and light trucks. The lifetime gasoline savings would average about 1,000 gallons. The cost of the technology is more than double the net present value of gasoline savings. (Appendix C to letter from Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. The comment is referring to the study by Sierra Research, “Review of the August 2004 Proposed CARB Regulations to Control Greenhouse Gas Emissions from Motor Vehicles: Cost Effectiveness for the Vehicle Owner or Operator.” The study was commissioned by the Alliance of Automobile Manufacturers.

The study found that on average vehicle costs would increase by about \$3000 and that lifetime fuel saving would amount to about \$1000. Therefore, the study concluded that the greenhouse gas requirements were not cost-effective. However, Sierra rejected promising and cost-effective emerging engine technologies as elements of a greenhouse gas regulatory compliance strategy. Even though companies such as General Motors have revealed publicly they are designing core engines for compatibility with such technologies as turbochargers and gasoline direct injection systems, Sierra rejects both as of little value in reducing greenhouse gas emissions. They also did not consider HCCI (homogeneous charge compression ignition) engines or camless valve actuation systems that provide substantial, cost-effective greenhouse gas reductions.

It also appears that Sierra did not have the necessary engine maps for advanced engine technologies to properly quantify their benefits. For example, all of the turbocharging applications selected by ARB are combined with a gasoline direct injection engine (GDI-S). This combination was chosen precisely because GDI engines can operate at higher compression ratios than conventional gasoline engines while still using regular fuel, thereby allowing the full benefits of engine downsizing to be realized. Sierra noted that it did not have access to engine maps for GDI-S engines (page C1-21 of the study) and, therefore, dismissed the benefits afforded by this combination of technologies out of hand. As in the past, Sierra rejected the near-certainty of reasonable innovation by industry in response to regulatory requirements.

Instead, Sierra resorted to extremely expensive weight reduction measures such as aluminum body structures employed by very expensive sport luxury cars such as the Audi A8 or Jaguar XJ8. This step alone resulted in a cost increase of more than \$2000 per car. Use of aluminum in high volume vehicle lines is not credible. Besides its cost, a weight reduction approach was not taken by ARB staff since this was prohibited by AB 1493 and to ensure full model availability.

In addition, Sierra's estimates of some technology costs were not reasonable. Sierra indicated they used a cost estimate for continuously variable valve timing and lift technology based on BMW's Valvetronic system (\$808), even though they were aware of a simpler, less costly design approach that was outlined in the ARB staff analysis (\$581). Sierra indicated a 6 speed automatic transmission would cost \$624 vs. ARB's estimate of \$105 compared to a 4 speed automatic. Given that General Motors and Ford are jointly developing a 6 speed automatic transmission that will be used widely across their product line before 2009, it is not credible that they would choose to spend that much per vehicle. If it really costs them that much, they should buy the transmissions from a supplier. Sierra also estimated cylinder deactivation would cost \$456 per vehicle vs. \$105 by ARB staff. Although Sierra generally accepted the base system hardware cost estimate used by ARB, they added an exorbitant cost for noise, vibration, and harshness (NVH) control that accompanies the feature. It appears Sierra may have relied on a production prototype General Motors NVH system for this feature that included an expensive stainless steel control valve in the exhaust. We noted that General Motor's actual production system, after more than a year delay in introduction, appears to mimic the simpler, much less

costly NVH control system used for the Chrysler 300C instead. ARB's cost estimate was based on the latter system, and is the more credible estimate.

Sierra also double counted for supplier investments in designing and building their products. Even though Martec made it clear that their cost estimates were for components engineered and produced by a supplier, Sierra uses a markup factor in their estimates that should only be used if a part is designed and produced in house by the manufacturer. As noted in the response to comment 629, they end up double counting for supplier research and development, investment in plants and tooling to produce the products, and associated warranty coverage.

Finally, for estimating the cost increase for passenger cars and light trucks (PC/LDT1) due to the regulation, a spreadsheet analysis shows Sierra apparently used costs of components and other changes from the large car category only. They did not reduce them for smaller cars (nor did they adjust for the larger 8 cylinder cars). Smaller cars generally have 4 cylinder engines rather than 6 and constitute about 35% of the passenger car market, while large cars with 8 cylinder engines comprise less than 10%. The overall effect would be to overestimate costs for the PC/LDT1 category. It is not clear from their report what was done for the trucks (LDT2).

In its analysis of fuel savings, the assumptions used by Sierra are significantly different than those used by ARB. Specifically, Sierra used a higher discount rate, a larger rebound effect, lower lifetime vehicle miles traveled, and different driving cycles to determine consumer fuel savings. Staff's responses to comments addressing these specific issues can be found elsewhere in this document.

Ford, DaimlerChrysler, and General Motors also challenged staff's cost analysis in their confidential comments. Consistent with their comments on technical feasibility, leadtime and product cadence, no supporting data was included that would enable staff to make a reasonable determination as to the accuracy of the manufacturers conclusions. Accordingly, staff continues to believe that its cost analysis remains valid.

In conclusion, staff believes that Sierra has overstated the costs of the greenhouse gas regulations by using a faulty technical analysis and inflated component costs. Furthermore, the assumptions used by Sierra in it's analysis of fuel savings appear unreasonable in the context of vehicle usage in California, staff's own analyses of California consumer behavior in response to higher vehicle prices and fuel savings, and other data analyzed by staff in determining the cost benefits to consumers.

255. Comment: With correcting these errors, the staff's numbers would change from a cost of a thousand bucks per vehicle to about \$1,800. The lifetime fuel savings would shrink from about \$3,000 to about \$1,700. So with these five errors you get to the point where the cost of the proposal regulation exceeds its benefits.

Fixing the remaining errors is how we get to our estimate that the actual cost of the regulation will be \$3,000 and the actual benefits will only be \$1,000. Because the costs

end up being so much higher than the benefits, the economic analysis that your staff did we think is not applicable and the real effect is going to be an adverse effect on the California economy. And because of other factors, the rebound effect that you've heard about being one of them, we believe that the net effect of this regulation will be an increase in ozone precursors, which will be more than enough to offset the essentially unmeasurable change in temperature that would result from the regulations, and so you're going to end up with a net adverse environmental impact. (Tom Austin, Sierra Research)

Agency Response: Staff disagrees with the comment. Regarding differences in cost estimates, see the response to Comment 254. Regarding the rebound effect, see response to comment 253.

256. Comment: The proposed regulation will cost California new car buyers not an up front cost of a little over a thousand dollars, but by our calculations, this is going to be an up front cost of over \$3,000. The \$3,000, in our opinion, will not be recoverable through fuel cost savings, nor will that \$3,000 surcharge provide any measurable improvements in air quality.

The current estimated costs still substantially underestimate the real costs of the regulation. Sierra Research found that when all costs are considered, not just the ones selected in the staff report, the real costs of this proposal is closer, as I mentioned earlier, to \$3,000 for motor vehicles in the state of California. And as we discussed in our comments, this cost is not fully recoverable by fuel cost savings, nor does it provide any measurable improvement in air quality. (Fred Webber, The Auto Alliance)

Agency Response: Staff disagrees with the comment. Regarding differences in cost estimates, see the response to Comment 254. Regarding the rebound effect, see response to comment 253.

257. Comment: CARB estimated that the average price increase associated with the 2016 standards is about a thousand dollars average for cars and trucks combined and that that will generate lifetime fuel savings -- as best we can understand the way the staff has calculated fuel savings from the backup spreadsheets that they were good enough to provide us, lifetime fuel savings on a present value basis of about \$3,000. And so you end up with this net \$2,000 economic benefit, which is why you get the economic conclusions that you heard earlier today.

We on the other hand come up with numbers that are exactly the reverse of this. We've estimated the cost of compliance for cars and trucks combined to be about \$3,000 per vehicle on average, and that the lifetime fuel savings will only be about \$1,000. (Tom Austin, Sierra Research)

Agency Response: Staff disagrees with the comment. See response to Comment 254.

258. Comment: There is a clear historical pattern of automakers exaggerating the cost of compliance, and often regulatory agencies overestimating the cost, albeit to a much

lesser extent. Based on a review of previous analysis, we find that the auto industry and its allies have overestimated the actual costs by a factor of about 2 to 10 times the actual costs. Regulatory (CARB and EPA) also tend to overestimate costs, albeit to a much lesser extent. A typical regulator estimate of actual automaker compliance costs is 1 to 2 times the actual costs. Hence, based on historical experience it is fair and reasonable to assume that both the automakers and the CARB staff cost estimates will be higher than actual costs.

The reasons for these overestimates are:

- (1) Unanticipated innovation
- (2) Conservative estimates by both regulators and industry
- (3) Regulators lacking full access to industry data
- (4) Intentional inflation by industry with the purpose to weaken or delay regulations.

(Roland Hwang and David Doniger, Natural Resources Defense Council)

Agency Response: Martec's costs were derived from a detailed study of component manufacturer's costs for well-defined hardware. In addition, staff reduced some component costs to account for unanticipated improvements in production processes and design improvements. Accordingly, staff believes its cost estimates to be correct and well supported in the record. Staff agrees that reasons (1) and (3), and potentially (2) and (4) are at play here.

259. Comment: As we're listening here today in 2004 about cost estimates from industry, about how they have estimated past air pollution control measures and the costs. And typically we see -- actually very consistently we've seen from regulators -- we see the auto industry and regulators overestimating the true cost of actual compliance.

We've seen over and over again throughout history, really through the last four decades of motor vehicle pollution control, a consistent story here of cost overestimation for actual regulatory compliance.

In the 1970's we saw auto makers, in this case Chrysler in advertising claimed \$1600 for a catalytic converter, which turned -- and the actual cost turned out to be between \$875 and \$1,350. The auto estimate in this case for catalytic converters was about 1.6 to 3.2 times too high.

Another case study, 1990's, not 10 years ago, the auto industry was claiming \$788, ARB staff was estimating \$120. The actual cost according to ARB estimate was \$83. Auto estimate was about 10 times too high. ARB's estimate, while not right on the money, was much closer, was 1.4 times.

During the 1990's when California was debating the low-emission vehicle program about a decade ago. This is actually -- the reason I brought this up is that this is actually -- you saw a presentation by Tom Austin yesterday from Sierra Research. Ten years ago, he

and his colleagues produced some estimates for the auto industry on the cost of compliance for the LEV program. In this case TLEV, LEV, and ULEV standards.

The estimate for a LEV I standard vehicle was a thousand dollars, for a ULEV standard was almost \$1500. So that's the track record which this particular company and this particular analyst have had in predicting air pollution actual costs.

But I've reviewed the past history of motor vehicle pollution control. And consistently what we see is 2 to 10 times overestimation by the industry. So the \$3,000 you actually heard yesterday from Mr. Tom Austin is actually very consistent and to be expected of what the industry has predicted in the past in terms of their cost overestimations. (Roland Hwang, Natural Resources Defense Council)

Agency Response: See response to Comment 254.

260. Comment: The Board and the public need a specific, and properly documented response to each element in the analysis of the staff report contained in Appendix C, with references to the data sources that support the response. If it intends to rely on extramural reviews, it is obviously also important that the reviewers be given current information. (Alliance of Automobile Manufacturers)

Agency Response: Staff has addressed in detail, with references to documents on record, all of the elements in Appendix C in responses to numerous Comments listed throughout the FSOR.

261. Comment: CARB assumed that technologies that simultaneously reduce vehicle price and improve fuel economy will be used only if a regulation is adopted. (Alliance of Automobile Manufacturers)

If such technologies were available, manufacturers would act in their own self-interest and apply them voluntarily. ARB's analysis therefore implies irrational behavior on the part of manufacturers. In the case of turbocharging, ARB mistakenly concludes that the technology would save money because it failed to account for the fact that, to achieve the engine downsizing assumed, premium fuel would be required, which would cost 20 cents more per gallon. ARB also failed to account for the value customers assign to the smoothness associated with V6 engines. Although turbocharging with premium fuel would allow equal power to be achieved with a 4-cylinder engine, the engine would not be as smooth and the value of the vehicle would be diminished. In the case of automated manual transmissions, ARB staff failed to account for the costs associated with retiring existing production facilities and building new manufacturing facilities. (Declaration of Thomas C. Austin, Appendix C to the letter from the Alliance of Automobile Manufacturers)

Agency Response: The comment is referring to the packages that incorporate engine downsizing with a turbocharged GDI-S engine. First, the technologies identified for the 2009 baseline vehicles were derived from Martec's determination of the technologies that manufacturers would use on their vehicles in 2009. As noted in the response to comment

155, the higher compression ratios enabled by GDI-S engines allow fairly aggressive downsizing of the engine.

Regarding the assertion that the technology packages that included engine downsizing and turbocharging would require the use of premium fuel, see the response to comment 155.

Regarding smoothness of the downsized engines, for 6 cylinder engines staff assumed that the base engine would be downsized to a 5 cylinder configuration specifically to maintain engine smoothness (page 65 of the ISOR) and value to the customer. See also the response to comment 155.

Finally, as noted by staff at the September hearing, manufacturers could substitute 6 speed automatic transmissions and achieve the same emission reductions modeled by AVL for 6 speed automated transmissions. Accordingly, manufacturers with existing 6-speed transmission facilities would not incur any additional expense. See also response to comment 154.

262. Comment: As also indicated in Appendix C, there are additional and perhaps even more fundamental problems with the analysis of costs and benefits in the staff report. (Alliance of Automobile Manufacturers)

One of the most significant problems with the analysis of costs and benefits in the staff report is the assumption that the technologies described in the report will be implemented nationwide, in the absence of any rule that requires such a result. If the market actually demanded the relevant technologies, they would be in general use today or the industry as a whole would be planning to introduce them now on a full-product-line basis. There are no plausible future estimates for gasoline prices in this country that suggest that such a demand will exist, within the time horizon of this proposed regulation. If the technologies envisioned in the staff report were to be deployed mainly in the markets covered by the regulation, the engineering costs discussed in Appendix C would grow many-fold. (Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. Since the comment was made back in September, 2004, world consensus is that fuel costs are not expected to decline from current levels and already there is evidence that larger vehicle sales are tumbling in response to this reality. Nonetheless, staff specifically did *not* assume that the technologies would be implemented nationwide. Staff indicated that worldwide demand for the technologies that would be added to vehicles sold in California and perhaps some other states would be in demand worldwide as a result of voluntary agreements and regulations in force in other countries. As a result, staff assumed the volume of new technology applications would grow due to demand in countries other than the United States. See also the response to comments 231 and 232.

263. Comment: The assessment of engineering costs and fuel economy savings contained in the staff report presents an incorrect picture of the impact the proposed rules

would have on the average new-vehicle purchaser in California. Only the segment of the population that applies a very high personal value to operating cost savings – higher than most consumers – or that has a stronger than typical preference for particular vehicle designs or new technology packages will find the technology packages that the staff report presents as cost-effective to be truly “economical” for that consumer over the life of the vehicle. This indicates that there is a basic need for reconsideration of the analysis taken in the staff report to the basic issue of cost-effectiveness, as that term was defined by the Legislature for purposes of greenhouse gas regulation. (Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. The assessment is geared for the purchase of an average new vehicle from model year 2009 and later. The net present value is based on actual operating cost savings from over the lifecycle of new vehicles. Staff agrees that some vehicle owners value savings higher than or lower than the straightforward average actual fuel savings based on average annual vehicle travel and the average discount rate. However, AB 1493 specifically directs that the ARB regulations must achieve the maximum feasible and cost effective emission reductions. Cost effective is defined in the bill as “Economical to an owner or operator of a vehicle, taking into account the full life-cycle costs of a vehicle.” The ARB staff analysis thus must be based on the *full life-cycle* costs, regardless of whether some consumers in surveys reveal that they choose not to personally value savings in the later years of the life of the vehicle. The commenter reads into the language “economical to the consumer over the lifecycle of the vehicle” a requirement that individual consumers must place a high personal value on the savings afforded by the projected technology packages. This simply is not the case.

264. Comment: If it is true that there is an overall economic benefit measured by net savings to the consumer through fuel cost savings, why hasn’t the market already responded to this potential through the purchase of more fuel efficient vehicles? Does this reflect a potential that costs are underestimated or that consumers will not choose to pay more to purchase a vehicle in order to achieve greater fuel cost savings later? (Bob Lucas, CCEEB)

Agency Response: See response to comment 263.

265. Comment: The Board’s Initial Statement of Reasons (ISOR) estimates that the cost of individual technologies necessary to meet the proposed new regulatory standards ranges from a low of \$20 for electric power steering in a small car to a high of \$5,311 for an advanced hybrid system on a large truck (see page 83 of the ISOR). The ISOR also estimates that the average per vehicle cost to apply the maximum feasible mid-term technology is \$1,115 for passenger cars and light-duty trucks and \$1,341 for heavier trucks (see tables 6.2-6 and 6.2-7 of the September 10, 2004 Addendum to ISOR). The Board’s staff report speculates that consumers will be eager to pay this \$1,000-plus surcharge on the theory that more fuel efficient vehicles will save them money over the sixteen years/200,000 miles they are assumed to own and drive their vehicles. We believe that the above-estimated price increases could easily be understated by two or three fold and know that in the real world, the average Californian owns his or her vehicle

for less than six years. Moreover, experience teaches us that the average consumer is not likely to pay a \$1,000-plus fuel economy surcharge unless his or her investment can be recouped in 2 or 3 years. (Peter K. Welch, California Motor Car Dealers Association)

Agency Response: Staff disagrees with the comment. With regard to the accuracy of staff cost estimates, please see the responses in section III.A.2.c(3).

With regard to consumer purchase behavior, the staff evaluation concluded that the operating cost savings from the regulations more than offsets any increase in vehicle monthly payments for both new and used vehicle purchasers. Vehicle purchasers are likely to respond to the vehicle price increases estimated by staff in a similar fashion as they do to vehicle price increases due to other factors that influence the price of new vehicles such as increased vehicle content. Using a conservative assumption that the average price for a new vehicle is \$20,000, the approximate \$1000 increase in vehicle price estimated for 2016 when the regulations are fully phased-in represents only a 5% increase in the average cost of a new vehicle. Furthermore, new vehicle purchasers are likely to realize a higher resale value for their vehicles commensurate with the increase in vehicle prices, due to the generally improved vehicle attributes that staff foresees resulting from the regulation. In addition, 16 of the 22 technology packages identified by staff provide a payback within five years or less, well within the ownership period of the average new vehicle purchaser. The effect of increased prices on consumer purchase behavior is addressed in more detail in section III.A.2.i

266. Comment: Because it does not have and cannot obtain access to the specific business plans of its members, the Alliance requested an independent “best case” analysis of how the industry as a whole might attempt to comply with the proposed regulation. Confidential submissions to Sierra Research from some members of the Alliance indicate the following:

Some vehicle manufacturers face capital constraints that will limit their ability to invest in new technology and have insufficient engineering resources to implement changes at the pace required by the proposed regulation. (conclusion from Appendix B to letter from Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. Once again, most of the technologies needed to meet the proposed greenhouse gas requirements are being developed by suppliers. Because the requirements are being phased in over a period spanning more than a decade, there should be sufficient resources to gradually incorporate the needed technologies without large capital outlays. See also the response to Comment 206.

Further, the reliability of the cited additional analysis (see agency responses to comment 254)-and of the confidential submissions to that analyst by industry members presenting a clear litigation threat that they have now acted upon-is questionable.

267. Comment: As a result, the likely response by some of the manufacturers who would be regulated by the proposed rules would involve the discontinuation of many popular products from the fleet regulated by the California rule – even though that strategy (so-called “mix shifting”) is very costly from a business perspective. This approach will be needed because no combination of technologies and other vehicle changes will be sufficient to bring the relevant manufacturers into compliance with the regulation when fully implemented, and because sufficient credits will not be available to permit manufacturers in a deficit position to avoid mix-shifting. (Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. As noted in the response to Comment 238, industry is already making provisions when redesigning its engines to incorporate many of the suggested technologies needed to meet the proposed greenhouse gas requirements. Industry is painting a bleak picture of their ability to incorporate the needed technologies largely as a result of not properly investigating the cumulative benefits of the combinations of technologies that could be employed to meet the proposed requirements as outlined in the staff report. It appears that none of the commenters have actually modeled the technology combinations provided in the staff report so that they could properly assess their emission reduction benefits. Instead, potentially with an eye toward litigation, industry falsely concludes with little support that relatively expensive full hybrids or vehicles with aluminum frames would be needed to meet the requirements. There would be no need to resort to mix shifting to meet the proposed requirements since one of the goals of the staff assessment and one of the directives of AB 1493, subject to legislative review, was that model availability not be impacted and that costs to the consumer be affordable. We believe the proposed regulations fully meet these requirements.

268. Comment: Equally important, once the proposed standard would be fully implemented, vehicle manufacturers will generally not attempt to sell “California” vehicles in jurisdictions where the proposed rules would not apply. This means that the cost analysis contained in the Sierra Research study understates the likely costs of vehicles meeting the new standards, because there will be no nationwide production economies of scale once the rules took full effect. (Alliance of Automobile Manufacturers, from Declaration of Thomas C. Austin, included in Appendix C)

Agency Response: Staff disagrees with the comment. Toyota has announced that their new Camry full hybrid vehicle to be introduced in 2007 would be produced along the same assembly line as the conventional Camry. There is no reason why with today’s flexible manufacturing techniques that technologies destined for California couldn’t be built along the same assembly lines as vehicles destined for non-California program states. As indicated earlier, staff expects that the volumes of the technologies needed to meet the proposed requirements will be sufficiently high due to demand for them from other countries planning on meeting existing voluntary or regulatory commitments. Therefore the technologies themselves should be relatively inexpensive as outlined in the staff report, and producing California specific models can be accomplished on the same assembly line as conventional vehicles (should other states’ consumers not prefer the California vehicles, which is unlikely), thereby keeping costs low.

269. Comment: Each of the Board's external reviewers whose views were made available just prior to the hearing, and who commented on the compliance issues, concurs that strategies like mix-shifting and other approaches different from the use of new technologies must be considered in a complete analysis of the impacts of the proposed rule. (Alliance of Automobile Manufacturers, referencing "Peer Review Comments and Responses" (Sept. 2004), pages 71-75, posted on ARB's website.)

Agency Response: In order for a strategy such as mix shifting to be effective, a manufacturer would probably need to discontinue its largest vehicles and try to focus sales on smaller ones with lower CO₂ emissions. However, their largest vehicles are also their most profitable ones, so that ceding market share in those segments to competitors would be unlikely. Since staff cost estimates for complying with the proposed requirements are much less than the profit manufacturers make on these vehicles, it seems more likely that manufacturers would not abandon the larger segments of the market. GM, for example, has said they will implement a full hybrid powertrain option on their larger SUVs in the 2008 timeframe, which is a more costly approach than staff is suggesting is needed in order to meet the proposed requirements. Consistent with the directive in AB 1493 that the regulation not affect vehicle model availability and consumer choice, staff continues to maintain that all vehicle segments can comply with the requirements cost effectively. Thus, mix shifting would not be a likely compliance path for any manufacturer.

270. Comment: The cost of compliance would likely be lower if ARB were to limit the scope of the rule so as not to include commercial vehicles. I am informed by one of the largest members of the Alliance that commercial vehicles are a significant proportion of its sales in California, slightly more than 10% of 2004 year-to-date sales, excluding rental car fleets. The rental car sales exceeded 25% of total 2004 year-to-date California sales, which means that a significant portion of this manufacturer's California sales are fairly described as commercial sales. However, because ARB staff makes no provision for identifying and removing commercial vehicles from the proposed regulation, I have not undertaken to quantify the costs of compliance if commercial vehicles were not subject to the emission standards. (Declaration of Thomas C. Austin, Appendix C to the letter from the Alliance of Automobile Manufacturers)

Agency Response: AB 1493 is very specific in defining which vehicles are exempt from the regulations and did not provide a blanket exemption for all vehicles used by commercial enterprises. Section 3 of AB 1493 (Health and Safety Code section 43018.5 (e)) states "The regulations adopted by the state board pursuant to subdivision (a) shall provide an exemption for those vehicles subject to the optional low-emission vehicle standard for oxides of nitrogen (NO_x) for exhaust emission standards described in paragraph (9) of subdivision (a) of Section 1961 of Title 13 of the California Code of Regulations." The optional NO_x emission standard referred to by AB 1493 is provided to vehicles that are capable of carrying heavy loads and that most likely would be used for commercial purposes such as farming. Subdivision (a) of Section 1961 of Title 13 of the California Code of Regulations specifically provides an exemption from the greenhouse gas requirements for vehicles meeting this criterion. Furthermore, section 3 of AB 1493

(Health and Safety Code section 43018.5 (i)(3)) defines a vehicle subject to the regulation as "... a passenger vehicle, light-duty truck, or any other vehicle determined by the state board to be a vehicle whose primary use is noncommercial personal transportation." Clearly, AB 1493 did not intend that all vehicles sold to commercial enterprises such as rental agencies to be exempt from the regulations. See also the response to comment 572.

271. Comment: Manufacturers who are members of the Alliance, including manufacturers' experiences with the constraints of federal CAFÉ upon their fleet mix, indicate that they do not intend to comply with the proposed standards on a nationwide basis. Because the technologies required to achieve compliance are not cost-effective from a customer's perspective, the lowest cost approach to compliance involves restricting model availability in California and producing certain vehicles for sale in California only. One vehicle category that will be restricted severely, or discontinued entirely, is what ARB staff classifies as the "medium-duty passenger vehicle." (Declaration of Thomas C. Austin, Appendix C to the letter from the Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. Staff demonstrated for five vehicle classes spanning the full range of manufacturers' vehicle offerings, including the larger pickup trucks and SUVs, that the greenhouse gas requirements were both technically feasible and cost-effective (see previous responses). Therefore, restricting model availability in a highly competitive market when cost-effective approaches are available doesn't make economic sense. Concerning medium-duty passenger vehicles (MDPVs), these vehicles are used primarily for personal transportation and are subject to stricter emission requirements than other vehicles in their weight class under both the LEV program and the federal Tier 2 program. Therefore, it is appropriate that they be included in the greenhouse gas requirements. Since MDPVs are essentially SUVs in the 8,500-10,000 lbs. weight class, manufacturers can use the same technologies demonstrated for large trucks and SUVs to achieve comparable greenhouse gas emission reductions. In addition, these vehicles represent a very small percentage of manufacturers' LDT2 fleets and their higher greenhouse gas emissions can be offset by lower emitting vehicles to achieve compliance with the fleet average emission standards. Regarding model unavailability, see response to comments 267, 269, 272 and 278.

272. Comment: Implicit in CARB's analysis is the assumption that manufacturers will respond to increased CAFÉ requirements by reducing vehicle weight from what it otherwise would have been, which underscores the importance of the CARB staff's error in failing to consider weight reduction as a consequence of the proposed rule. (Appendix C to letter from Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. As noted in comment 164, staff demonstrated technical feasibility without reducing vehicle weight. Therefore, weight reduction is not implicit in staff's analysis. Since manufacturers can comply with the requirements without reducing vehicle weight, it was not incumbent on staff to consider the consequences of vehicle weight reduction. What manufacturers choose to use to meet CAFÉ requirements and what combinations of technologies they may choose to employ to

meet these greenhouse gas emission standards (including reductions from direct air conditioning emissions of HFCs) are entirely separate matters.

273. Comment: The Alliance request for a new staff report and a postponement of the public hearing was denied in a letter from the Executive Officer dated August 23, 2004. The letter from the Executive Officer stated that the mistakes identified by the Alliance and its consultants in the August 6, 2004, final Staff Report had resulted in “modifications” to the estimated costs of the proposed rule and the relevant technologies. The letter also stated that the “modifications...have been communicated to your consultants and to other interested parties on an ongoing basis.” If taken to mean that the ARB staff’s modified costs had been communicated to the Alliance consultants or to the Alliance, or to any of its members in regular contact with me on these issues, the quoted statement is not correct. Some of the “modifications” were communicated to the Alliance and its consultants on August 24, 2004 (none were provided prior to that time), and some were not released for another two and a half weeks. (Declaration of Steven P. Douglas, Appendix D to the letter from the Alliance of Automobile Manufacturers)

Agency Response: The comment is incorrect. Shortly after publication of the draft Staff Report staff began a dialogue with Sierra Research and provided the data spreadsheets used to compute the emission standards and costs for the greenhouse gas requirements. Subsequent to publication of the ISOR on August 6th, staff provided files containing the final revised technology cost figures to industry’s consultant Sierra Research on August 16th 2005 (see email correspondence with subject heading “RE: Revised Cost Spreadsheet” in the second 15-day notice). Staff continued to maintain an open dialogue with Sierra Research throughout the process as the Addendum to the ISOR was being developed, responding to Sierra Research’s questions on the data and providing revised data spreadsheets as they became available through subsequent email correspondence. See for example emails dated August 10th, August 20th, August 24th, and August 27^t in the second 15-day notice.

274. Comment: The estimated costs depicted in the August 2004 “final” staff report were riddled with errors and incorrect calculations. The most recent changes in the staff’s cost and benefit analysis for the proposed rules were released in an “Addendum” to the Staff Report after the close of normal business on Friday, September 10, 2004. That date is less than 15 days prior to public hearing scheduled for this matter. In the time since September 10, and indeed in the time since June 2004, it has not been possible for the Alliance and its members or consultants to develop complete technical analyses of the staff’s engineering cost and benefit estimates, though the analyses we have prepared do demonstrate that the staff’s claim that the proposed rules will be cost effective are not supported by sufficient evidence or analysis. (Declaration of Steven P. Douglas, Appendix D to the letter from the Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. As noted in other responses, the Alliance did not actively participate in the rulemaking process despite repeated invitations. Nonetheless, staff provided the spreadsheets from which the data reported in the “Addendum” were derived to Mr. Thomas Austin at Sierra Research shortly after

publication of the ISOR (see previous response). Since Mr. Austin was commissioned by the Alliance to provide a technical analysis of the staff's engineering cost and benefits, the statement that such data was not available to the Alliance or its consultants is unsupportable.

275. Comment: My independent analysis of the proposed standards, in which I correct the errors made by ARB staff, assumes nationwide deployment of the technologies required for compliance. Since these technologies are not cost-effective, nationwide deployment cannot be expected to occur. Without nationwide deployment, the cost of the proposed standards would be substantially higher. (Declaration of Thomas C. Austin, Appendix C to the letter from the Alliance of Automobile Manufacturers)

Agency Response: See responses to comments 231 and 232.

276. Comment: Some manufacturers deem the risk of customer resistance to some of the key technologies identified in the staff report to be too large to permit deployment of those technologies at the level assumed in the ARB staff's analysis. (conclusion from Appendix B to letter from Alliance of Automobile Manufacturers)

Agency Response: There are a number of alternatives to meeting the proposed requirements. If a manufacturer deems one technology path too risky, then other alternatives exist. None of the alternatives suggested by staff were considered too risky by the experts at AVL or by staff. In fact, many vehicles are already being sold that incorporate the technologies outlined by staff as options for meeting the proposed requirements.

277. Comment: Even if all of the technical concerns could be overcome, and if the engineering resources were available for the industry to make such sweeping changes to its product line in such a short time frame (given we are committing to 2009 MY tooling now), and if the capital were available to support such investments, California consumers would pay far more for their new cars and trucks than they would ever recoup in future fuel savings, and product choice would be limited for California and Northeast consumers. (DaimlerChrysler)

Agency Response: Staff disagrees with the comment. Staff has evaluated the costs projections provided by Sierra, and have concluded they are based on an incomplete analysis of the alternatives provided by ARB staff. The ARB assessment utilized extensive state of the art modeling techniques employed by AVL to properly characterize the emission benefits of the example combinations of technologies that could be employed to meet the proposed requirements. The cost projections were also made by experts in the field. By comparison, the analysis conducted by Sierra was incomplete since it did not duplicate the technologies listed as ways to meet the proposed requirements. Instead, apparently lacking the needed modeling tools, Sierra resorted to modeling the use of expensive aluminum frames or full hybrids to make up the shortfall in meeting the proposed requirements. While such an exercise will yield excessive costs, it is far from credible as an analysis that can be relied on to predict the most economical means of

meeting the proposed requirements. The staff analysis showed that consumers will recover the additional costs of the near term standards in less than 3 years, while assuming a fuel cost far below today's levels.

278. Comment: If consumers are unwilling to swallow the estimated price increases, auto manufacturers will be forced to limit the distribution of lower mpg vehicles in California in order to comply with the proposed carbon dioxide gram per mile fleet averages. A California restriction in the availability of vehicle models (such as large SUVs, mini vans, and pickup trucks) that are offered for sale in other parts of the country will cause consumers to buy out-of-state. Such a restriction will also cause havoc in the dealer body because dealers will fight among themselves for vehicle inventory allocation of popular lower mpg models that would be diverted by auto manufacturers to other parts of the country. (Peter K. Welch, California Motor Car Dealers Association)

Agency Response: Staff disagrees with the comment. ARB demonstrated technical feasibility for all vehicle classes, including large SUVs, minivan, and pickup trucks. Every study that has examined the impact of price increases has found that sales reductions are proportional to the relative price increase. This is commonly called price elasticity. Since many of the cited vehicle types typically carry a higher retail price than smaller vehicles that typically emit lower greenhouse gas emissions, the relative impact on vehicles sales should be smaller. Accordingly, dealers and consumers in California should not experience any restriction on model availability.

279. Comment: The regulations will not only reduce GHGs but will benefit consumers given the significant savings that can be achieved in operating costs as outlined by the staff. (Coralie Cooper, NESCAUM)

Agency Response: Staff agrees with the comment.

280. Comment: Staff ran all their cost estimates using only a dollar seventy-four per gallon of gasoline. And there were some run at two thirty. But a buck seventy-four is the basis for everything. We believe those values, which are really based upon earlier findings by the CEC, are substantially underestimated, especially because the CEC numbers were generated at a time when we certainly didn't have political instability in the Middle East.

And for that reason, we would like to see those numbers run again at some point using values that are far higher than that, perhaps even up to \$5 or \$7 a gallon. We think that's actually justified from the standpoint that there's a number of petroleum geologists today, top geologists around the world who are indicating that we could be seeing the price of a barrel of oil by the end of this century reaching as high as a hundred dollars a barrel or even higher, considering that we're now getting very close to peak oil demand where production and demand are more or less commensurate and we cannot produce any more than we are today.

So if that turns out to be true, at 82 million barrels a day, then that is certainly going to drive oil prices up in the future. We need to be cognizant of that. We should probably take a look at those numbers again to make sure that we've done them right, because there are a lot of arguments to be made for much higher oil prices in the very near future. (Dr. Russell Long, Executive Director, Bluewater Network)

Agency Response: In response to a directive from the Board at the September hearing, staff evaluated the cost effectiveness of the regulation using an assumed fuel price of \$5 per gallon. This analysis, presented on the second day of the Board meeting, showed that for the PC/LDT1 category the average monthly savings to the consumer for the near term standards increased from \$11 to \$45, and the average monthly savings to the consumer for the mid term standards increased from \$3 to \$46.

281. Comment: It's also likely that the \$27 per barrel cost used in the cost-effectiveness analysis is actually quite conservative given the current and expected future gasoline prices out there. Given those distinctions, there are even greater economic benefits associated with the lower greenhouse gas emissions targets than have been assumed in the staff report. So your Board could choose to set more stringent goals and still be within the bounds of the cost effectiveness intended by the staff. (Larry Allen, Air Pollution Control Officer for San Luis Obispo County, representing the California Air Pollution Control Officers Association)

Agency Response: In performing its economic analysis staff used the California Energy Commission's long term estimated fuel price forecast. Staff agrees that in light of recent trends this results in a conservative estimate of potential operating cost savings. Nevertheless staff believes that the proposed standards represent the maximum feasible application of available technology, which here as in most ARB regulatory actions, is the focus of staff's analysis.

282. Comment: The carbon dioxide emission reduction and fuel cost savings that result from design changes to improve motor vehicle fuel economy are a function of average lifetime vehicle miles traveled (VMT). As a result, an overestimation of average lifetime VMT will result in an overestimation of both the emissions and fuel economy benefits of a regulation forcing the production and sale of vehicles with lower CO₂ emissions and higher fuel economy. Failure by CARB staff to properly account for lower accumulated mileage of the remaining fleet as higher mileage vehicles are retired from service has resulted in a substantial overestimation of the benefits of its proposal.

CARB's analytical technique for estimating lifetime average VMT is mathematically incorrect. In addition, data from the Bureau of Automotive Repair's random roadside test program indicate that average total mileage accumulation for older vehicles is much lower than predicted by CARB's methodology. Furthermore, final odometer readings from about 1,000 vehicles that were retired under CARB's pilot scrappage program indicate that most vehicles had a useful life in the range of 125,000 to 185,000 miles, and only 10% of scrapped vehicles had final odometer readings greater than 200,000 miles. This result further confirms the veracity of Sierra's methodology and it contradicts CARB staff's

calculation of typical full-life mileage (and benefits) on the order of 202,000 miles for passenger cars, 219,000 miles for LDT1 category vehicles, and 224,000 miles for LDT2 category vehicles. Sierra estimates the lifetime average VMT of passenger cars and light duty trucks is 155,000 miles. (Sierra Research, Review of the August 2004 Proposed CARB Regulations to Control Greenhouse Gas Emissions from Motor Vehicles: Cost Effectiveness for the Vehicle Owner or Operator, page C3-1 and similar comment on page 28. Similar comments are also found in: Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, page 20, and page 4 of the declaration of Thomas C. Austin.)

Agency Response: Staff disagrees with the comment. Staff provided a thorough response to these comments in the document "Estimation of Average Lifetime Vehicle Miles of Travel" included in the Addendum to the Supplemental 15 Day Notice of Availability of Modified Text (available at <http://www.arb.ca.gov/regact/grnhsgas/vmt.doc>).

283. Comment: The lifetime benefits of the standards are based on the assumption that light-duty vehicles are traveling more than 200,000 miles on average in their lifetime. And we believe we can conclusively demonstrate that there is a math error associated with the approach that was used to come up with that number that results in an overstatement of the benefits by 40 percent just due to that factor alone.

The staff's benefit estimates for the improved fuel economy are based on the assumption that the average lifetime travel for passenger cars and light-duty trucks in California is 202,000 miles lifetime for cars and 224,000 miles lifetime for trucks, including all of the vehicles that end up being scrapped because they're involved in accidents.

We for a long time have been concerned about these numbers being so much higher than the national average and discovered that there is a math error in the way these numbers were calculated that's built into the way VMT is calculated by the staff. The problem exists in the way that the ARB staff has been accounting for the mileage accumulation by vehicles in California fleet by using odometer readings that come from your vehicle inspection and maintenance program.

One of the problems in taking odometer readings from the data that comes from that program is that sometimes the mechanics write down the number and they're off by one decimal point. And so if a vehicle comes in the door and it's got 90,000 miles on it, they might write down 9,000 miles. That happens frequently. Sometimes we have older vehicles where there's a rollover problem. The vehicle comes in with 20,000 miles on the odometer and maybe it's really got 120,000 miles. And so your staff came up with a good way of dealing with that kind of problem.

But what they end up doing is instead of looking at the average odometer of all cars coming through the smog check program, they look at cars coming through the program this year, specific cars, and then they trace the vehicle license plate number or the VIN of that car to the last time it was inspected and they look at what's the change in odometer.

And so if a car comes in this year and it's got 50,000 miles it and it came in two years ago and it had 30,000 miles on it, they conclude that it's been accumulating miles at a rate of 10,000 per year, and that's a reasonable number, it passes the lab test and so they accept it. No problem there. The problem comes in that when you actually do an example and look at what happens when you apply this approach in the real world, it turns out that you don't get the right answer when you have high mileage accumulation vehicles being retired from service at a relatively young life. If, for example, you've got fleet vehicles that are accumulating 40,000 miles per year, which I use in this example, after four years they have 160,000 miles on them. If you assume they're retired from service at this point and that the vehicles that remain in the fleet are only getting 10,000 miles per year, and they stay in the fleet for 16 years, both kinds of cars have a true lifetime vehicle mileage accumulation of 160,000 miles. But when you do the analysis the way your staff is doing it, you are led to the conclusion that the lifetime VMT for the fleet is 220,000 miles, because you're adding 10,000 miles per year for those cars that didn't get the real high rates of mileage accumulation when they were young and you're ignoring the cars that have been removed from the road, you're not incrementing their odometers by zero like you should be.

I know that superficially this may sound like, well, it can't be a very significant effect however it is a very significant effect and if the true lifetime VMT, the true period of time over which any fuel economy benefit is going to be realized by the consumer, is much closer to 150,000 miles than it is to 200 or 220,000 miles, it ends up having a big effect on the benefit you calculate to the regulation. (Tom Austin, Sierra Research – transcript of public comments given at the September Board hearing)

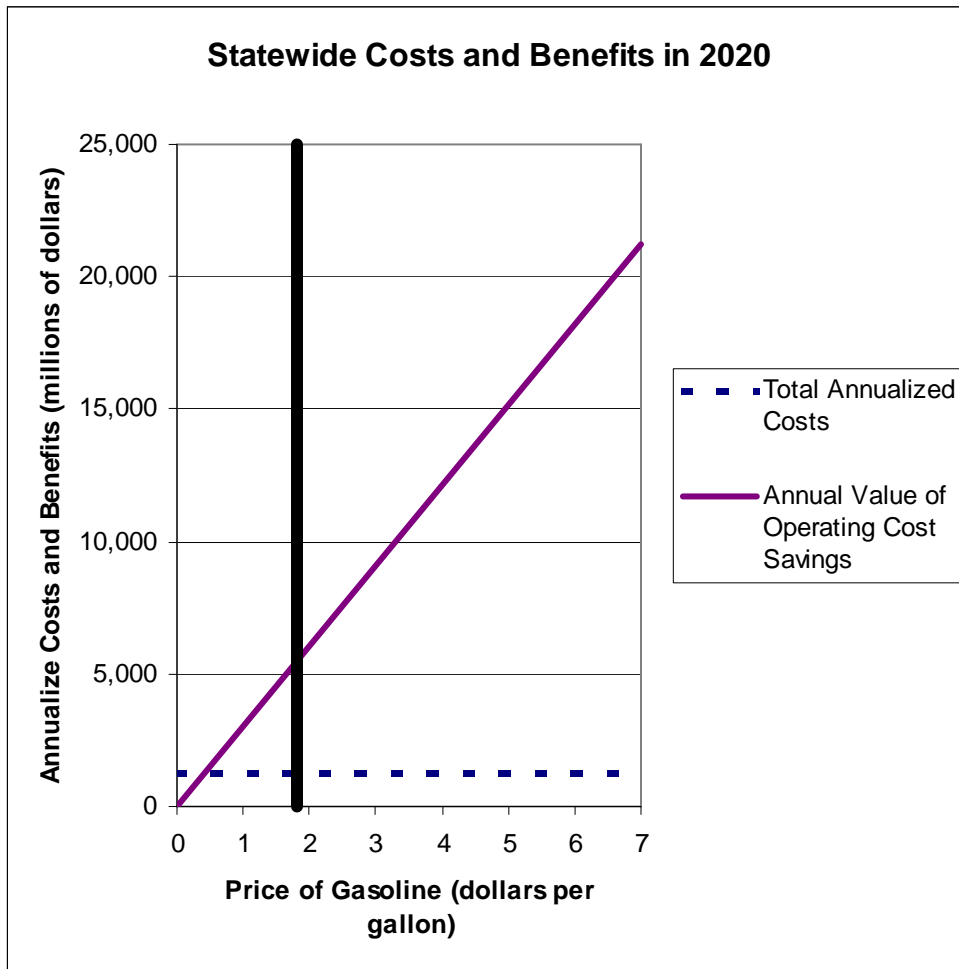
Agency Response: Staff disagrees with the comment. See the response to comment 282.

284. Comment: Part of our work is to speak on behalf of the consumers with regard to the costs to the consumers. Of course these numbers are subject to debate, and we're certainly interested in what happens in the future with regard to the cost to the consumers.

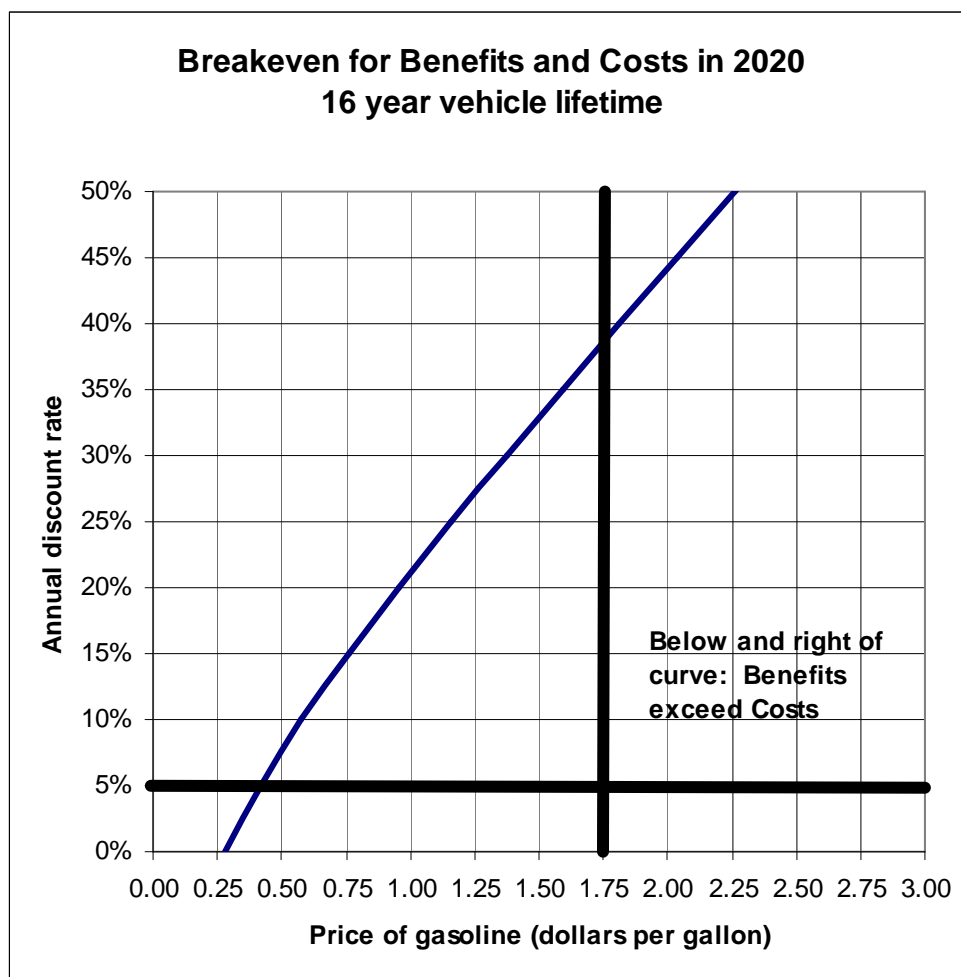
There is some work that we've been looking at relating to this question of payback period. And I would say at this point that it's really not clear from the consumer's perspective what the rate payback period is in terms of what a consumer will choose to purchase a vehicle. There's some discussion about payback period over the life of the vehicle. But the best information seems to suggest that consumers don't make their choices about purchasing vehicles over the life of the vehicle but rather thinking in a much shorter time period. So this does affect the question of whether there's a net benefit in terms of the cost for operation of vehicle or not. At this point though, it's really not clear what the consumers' payback period really is. This is certainly a question I think that we'd like to have more information on as we go forward. (Lewis Lem, Northern California Triple A)

Agency Response: A response to this comment must look at both the price of fuel and the length of the assumed payback period. With regard to the price of fuel, ARB acknowledges that any "point estimate" of the future gasoline price is likely to prove wrong.

The chart below shows the statewide costs and benefits for a range of possible gasoline prices. These costs and benefits are the same as shown in Revised Figure 10-1 of the Addendum, but only for one year, 2020. The costs are the annualized cost of price increases on new vehicles through 2020, using a discount rate of 5 percent and lifetime of 16 years. The benefits are the reduced operating costs occurring in 2020. (The vertical line represents \$1.74 per gallon, the price assumed by ARB.)

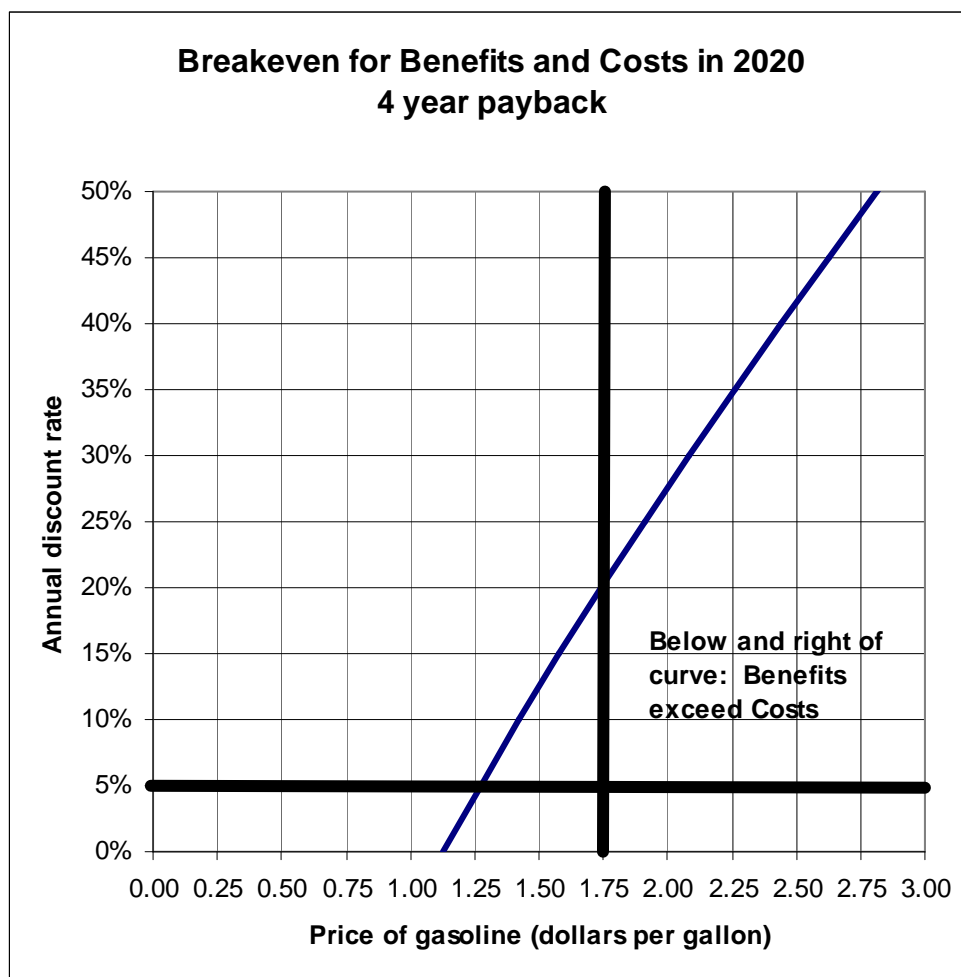


The height of the cost curve depends on the discount rate assumed. The chart below shows the sensitivity to discount rate. The breakeven curve shows the combinations of discount rate and gasoline price such that the costs and the benefits are equal. For combinations to the right or under the curve, the benefits are larger than the cost. In particular, the point representing a 5 percent discount rate and \$1.74 gasoline price (shown by heavy lines) falls in this region. The curve assumes a 16 year lifetime of the vehicles.



For a gasoline price of \$1.74 per gallon and any discount rate below 38 percent, the benefits will exceed the costs. Also, for a discount rate of 5 percent and any gasoline price above \$0.41 per gallon, the benefits will exceed the cost.

With regard to the assumed payback period, some experts contend that consumers want a payback on the order of three to five years. Perhaps that is because new vehicle buyers tend to own the new vehicle for three to five years, then replace it with another new vehicle. The chart below shows the breakeven curve for a payback period of four years.



Thus for a gasoline price of \$1.74 per gallon and any discount rate below 20 percent, over a four year period the benefits will exceed the costs. Also, for a discount rate of 5 percent and any gasoline price above \$1.27 per gallon, the benefits will exceed the cost. Thus the cost effectiveness of the regulation to the consumer is sustained under a wide variety of assumptions.

Moreover, staff notes again that whether or not each individual consumer actually makes the calculation over the full life of the vehicle is unnecessary to meet the statutory directives (see response to comment 244,) and the payback applies to both new and used vehicle purchases (see ISOR section 11.4 and related updates in the September Addendum).

d. ISOR Section 6—Climate Change Emission Standards

(1). Section 6.1—Determination of Maximum Feasible Emission Reduction Standard

285. Comment: I am writing to urge you to set the strongest possible standards to reduce greenhouse gas pollution from new passenger vehicles.

The regulations proposed for AB 1493 by the Air Resources Board—which cut greenhouse gas emission 30 percent by 2016 are a good start but don't go far enough. This regulation is relatively weak; it won't lead to any absolute reduction in pollution from the state's fleet of passenger cars. Why? Because even though vehicles will be cleaner, by 2030 there will be even more cars on the road, annually driving more miles. Since each gallon of gasoline burned puts 20 pounds of carbon dioxide into our atmosphere, this adds up fast.

Deeper cuts would be more in line with the vision of the hundreds of environmental and public health groups, unions, businesses, cities, water and air districts, religious organizations, and dozens of political leaders who fought so valiantly to pass this legislation in 2002, not to mention the bill language itself. After all, the legislation's text calls for "maximum feasible, cost-effective reductions," a far cry from the zero net reductions that are now being proposed. (Doris Murphy; about 2,600 similar letters received).

Agency Response: ARB staff agrees that even with the reductions achieved under the approved standards, total emissions from the light duty vehicle fleet will eventually grow due to increased travel. Staff does not agree, however, that this means that the regulation is "relatively weak" or that more stringent reductions are appropriate. Rather, staff believes that the standards established by the approved regulations are challenging and achieve the maximum feasible and cost effective reductions as required by AB 1493. The proposed standards make full use of those technologies that the staff analysis determined to be feasible for widespread adoption across the fleet in the 2009-2016 timeframe. More aggressive reductions would not be feasible for some manufacturers. Additional discussion of technical feasibility issues is provided in Section 2.d (4).

286. Comment: It is understood that the proposed standards are not as aggressive as past programs such as LEV II or the ZEV program. The structure of the regulations has been designed to accommodate U.S. auto manufacturers with the highest GHG emission levels; this will generally result in less aggressive controls needed for fleets with lower GHG emissions, such as those of Japanese and other foreign manufacturers. ARB should consider future strengthening to ensure that there are no incentives to increase the manufacture of the heaviest of SUV-class vehicles. (Larry F. Greene, California Air Pollution Control Officers' Association, Larry Allen, Air Pollution Control Officer for San Luis Obispo County, representing the California Air Pollution Control Officers Association)

Agency Response: We disagree that the regulations are not as aggressive as past programs. The regulations require the rapid implementation of conventional technologies by all manufacturers across their vehicle model lines. While the emission standards were structured to accommodate the full line manufacturers to assure compliance was achievable for all manufacturers, the Japanese and foreign manufacturers will also be required to substantially reduce their vehicle greenhouse gas emissions. It is because these manufacturers are already incorporating some greenhouse gas reduction technologies on their vehicles and because their vehicles are generally significantly lighter and smaller than the U.S. fleet that their baseline greenhouse gas emission are lower. The structure of the regulations also provides no incentive for manufacturers to increase the number of heavy trucks or SUVs. Since the emission standards for the LDT2 category are fleet average standards, the emissions from any increased production of heavy trucks or SUVs would need to be offset by lower emitting vehicles.

While the Board did not choose to do so at the hearing, it may later request staff to provide an update on progress in implementing the regulation.

287. Comment: I am in general accord with the Staff Proposals for the “one manufacturer fleet average emission standards” for PC and LDT1 vehicles and for LDT2 vehicles. However, the gravity of the effects of vehicle emissions on climate change (global warming) causes me to recommend that these proposed standards be augmented (“phased in”) at the earliest possible dates rather than five to fifteen years from now. ...I believe that near-term and mid-term emission standards should be phased in as early as possible, for example, by 2005-2008 for near-term (PC and LDT1 vehicles) and 2009-2013 for mid term (LDT2). (Margaret Steele)

Agency Response: Manufacturers need several years lead time to design and test vehicles, develop a supply chain for parts, obtain tooling, and configure the necessary manufacturing facilities. Thus it is not feasible to require manufacturers to achieve reductions in their 2005-2008 fleets. That is why AB 1493 specifically stated that the regulations could apply only to 2009 and later model year vehicles. Staff believes that the regulations as approved by the Board achieve the maximum feasible and cost effective reductions possible in a reasonable timeframe.

288. Comment: The California Clean Cars Campaign, a coalition of health, environmental and public interest groups, supports the adoption of the California Air Resources Board staff proposal to implement California’s vehicle global warming pollution reduction law pursuant to AB 1493.

The staff recommendation, while conservative, responds effectively to the directions set forth in the original legislation. ARB’s adoption of the proposed vehicle emission standards represents an important step forward in the state’s efforts to protect public health and reduce harmful global warming pollution from cars. Our coalition believes the ARB’s analysis over the past two years has resulted in a proposed rule that fairly complies with the law and that will deliver affordable clean car choices for California consumers.

The rule being considered by the Board today is technically justified by the thorough analysis conducted by staff. However, the coalition of organizations involved with the California Clean Cars Campaign believes that the conservative analysis has resulted in a proposed regulation that should be strengthened. We believe that the regulation could be more effective in a number of ways, for example, by increasing the stringency of the standard and/or shortening the implementation timeframe. Individual organizations involved with the campaign will offer specific proposals for strengthening the recommendation in their direct testimony. (American Lung Association of California, Bluewater Network, California League of Conservation Voters, Center for Energy Efficiency and Renewable Technologies, Coalition for Clean Air, Environment California, Environmental Defense, Natural Resources Defense Council, Planning and Conservation League, Physicians for Social Responsibility, Sierra Club, Steven and Michele Kirsch Foundation, Union of Concerned Scientists).

Agency Response: See responses to comment 3 and comments 285 through 287.

289. Comment: Overall, we feel that the regulation has a very sound technical base. The modeling agrees well with modeling results developed by the Union of Concerned Scientists in a study completed this spring.

Despite the strong technical foundation for the proposed regulation, we feel that there are three areas where the regulation could be stronger.

Phase in period. While staff has proposed two four-year periods for the phase-in of the standards we feel it is more appropriate to consider the introduction of technologies along a continuum over the full eight years of the program. An eight-year period to achieve a 30% reduction in GHG emissions is more than generous to automakers.

Hybrid electric vehicles. The current standard does not include any penetration of hybrid electric vehicles (HEV) by 2016. Given the current popularity of HEVs and the additional HEV models that have been announced by automakers, this assumption clearly underestimates the actual penetration of HEVs that will be part of the new vehicle fleet by 2016. While it is not clear what GHG emissions value to assign to HEVs, they almost certainly will result in additional GHG emission reductions. Using CARB's modeled emission reductions for HEVs in the five vehicle categories and estimated ZEV penetration levels, GHG emission reductions could be 31% lower than 2002 levels by 2016 rather than the 30% projected using the current technology assumptions in the ISOR. Not including these vehicles in the stringency of the standard leaves potential emission reductions unrealized.

Inclusion of minivans. In the ISOR, the modeling results for minivans are not included in determining the stringency of the standard. Minivans are generally lower emitting than other T2's and make up approximately 2-0% of the T2 category. In addition, because they are unibody construction, minivans are likely to be more representative of the emission reduction potential associate with crossover utility vehicles (CUV). CUVs are an increasingly large share of light truck sales, making up approximately 16% of light truck

sales in 2003. This share is projected to grow over the coming years. Because minivans and CUVs tend, on average to be lower emitting than pickup trucks, not including the reductions potential for these vehicles in the standard setting process underestimates the reduction potential for the T2 category. (Louise Bedsworth, Union of Concerned Scientists)

There is a potential for strengthening the regulation. In the current proposed standard, hybrid electric vehicles have not been factored in. And we feel that in the 2016 standard this is a missed opportunity. According to announcements by auto makers at least 13 models of hybrids will be available by 2010. This is across all vehicle classes. Currently about 25 percent of hybrid vehicle sales occur in California. And given current waiting lists and interest in the available vehicles, this does not seem likely to abate in the future.

In addition, hybrids are likely to be a primary compliance pathway employed by automakers in the ZEV Program. Under the ZEV Program approximately 12 percent of new vehicle sales in California could be hybrids by 2016. Depending on the emission reductions achieved with these vehicles, this could be an additional -- up to an additional 2 percent reduction. And it seems at this time that it would be wasteful to leave those potential reductions on the table given the cumulative nature of greenhouse gas emissions. (Louise Bedsworth, Union of Concerned Scientists)

Agency Response: Staff has proposed the maximum feasible reductions of greenhouse gas emissions taking into consideration technical feasibility and the economic impact to consumers. In reality, although the standards are phased-in over two four-year periods, in order to comply with the requirements manufacturers will need to rollout new technologies beginning in 2009 and then incorporate near and mid term technologies in a continuum across their fleets as the standards increase in stringency.

Concerning the exclusion of minivans from determination of the LDT2 emission standards, staff acknowledges that the requirements for LDT2 would be more stringent if minivans had been included. However, as noted in the comment they comprise a very small portion of the LDT2 category, therefore, including minivans in the calculation would result in only a minor increase in the stringency of the emission standards. In addition, since they were included in the 2002 California vehicle baseline used to determine the LDT2 emission standards, the impact on the LDT2 emission standard is further reduced. The comment also notes that CUVs also emit at lower levels than pickup trucks and that they are becoming increasingly popular. Since these vehicles were classified as light trucks in the NESCCAF study, they were included in the determination of the class average statistics for model years 2002 and 2009. While their numbers may increase in the future, staff relied on Martec's prediction of the 2009 fleet rather than include an arbitrary growth factor.

While hybrids are beginning to emerge in the market place, staff does not expect they will be mainstream vehicles in the 2010 to 2016 timeframe. World events could alter this expectation, however, staff wanted to be conservative in its forecasting. The comment is correct that hybrids will receive credit in the ZEV program. To the extent they are

introduced, manufacturers would be able to use the credit to provide additional flexibility in meeting the proposed fleet average requirements, thereby making them even more achievable.

290. Comment: There are a few opportunities for additional emission reductions as we go forward, particularly with respect to looking at reductions below levels that exist currently in the 2004 base year. The staff assumes that hybrid technology will not be a mainstream technology option until after 2016. Now, we appreciate the conservative rationale underlying that judgment. And we also think that there are strong market signals which indicate a surging demand pull, if you will, for electric hybrid technologies today. There are already 9,000 back orders for the 2006 model year Lexus hybrid SUV, the Ford Escape is getting similar consumer reaction. Virtually all the OEM's are accelerating their programs in electric drive train development. And, as I mentioned, rising gasoline prices are also very much changing and propelling consumer interests in their valuation of that kind of technology. So we think that it would be useful perhaps to consider at the earliest feasible date to take full advantage of those market trends. (Paul Wuebben, Clean Fuels Officer, South Coast Air Quality Management District)

Agency Response: While mild and aggressive HEVs were modeled in each of the vehicle classes in the NESCCAF study, staff does not believe that the technology can be applied to a broad range of vehicle types within the time frame of the greenhouse gas regulations. HEVs have only recently been introduced into the commercial market and, while demand for HEVs is currently outstripping supply, the complexity of these vehicles and the resources required to develop them across a broad range of vehicle classes suggest that their roll out may occur at a slower pace than more conventional greenhouse gas reduction technologies. Thus HEVs were not used as a basis for setting the standards. As a result, manufacturers that include HEVs in their fleet will be able to smooth the rate at which they incorporate other more conventional technologies on their vehicles in order to meet the requirements of the greenhouse gas regulations. However, should HEV technology penetrate the market at a faster pace than anticipated by staff, ARB will reevaluate the potential for greater reductions of vehicle greenhouse gas emissions.

291. Comment: Bluewater Network believes the measures being considered are quite conservative, allowing substantially more greenhouse gas emissions than could have been achieved under more vigorous interpretation of the legislation. The result: The regulations will only slow the increase in greenhouse gas emissions from California's expanding fleet of passenger vehicles, not stop them. To reiterate this, the regulation reduces emissions about 30 percents from what they would otherwise be from new vehicles in 2016. But the bad news is in 25 years greenhouse emissions from passenger cars will increase 9 percent from today's levels due to increasing numbers of cars on the road driving further every year. So in absolute terms the regulation doesn't reduce emissions. It merely slows down the huge increases that we're guaranteed to have in the next two and a half decades. And the Air Board has not really focused on that problem yet. In recognition of that, the Air Board must, at some point consider instituting a program that would ultimately create absolute reductions in greenhouse emissions from cars. And that means also, it requires the regulation of greenhouse gases from all other source

categories as well and all other greenhouse gases, for example, black carbon and tropospheric ozone. Clearly there's no intention here to pick on a single industry. Progress is being made on all fronts as fast as we can. And we need to continue to put the pressure on, not just the auto industry, but other industries as well and other pollutants as well. (Dr. Russell Long, Executive Director, Bluewater Network)

Agency Response: The regulations meet the requirements of AB 1493 to achieve the maximum feasible and cost effective reductions of greenhouse gas emissions that are economical to the consumer. They require manufacturers to aggressively refine current technologies and apply new engine and drivetrain technologies in a short, but reasonable timeframe. More aggressive reductions could only be achieved at substantially higher cost resulting in a significant increase in vehicle costs for the consumer.

292. Comment: Based on its technical and legal soundness, NRDC strongly urges the Board to adopt the staff's proposal. However, we respectfully recommend that the Board consider the following amendments to strengthen the program:

- (1) Reduce the phase-in time by one year (2015 versus 2016 for full implementation of the mid-term package);
- (2) Increase the stringency of the mid-term standard by considering higher numbers of hybrid vehicles;
- (3) Increase the weight break point for T1s from 3750 lbs. in order to prevent gaming by manufacturers in classifying car-based "crossover" vehicles as light trucks; and
- (4) Reduce the period from four to two years over which the automakers can accrue GHG debits before being assessed penalties.

(Roland Hwang and David Doniger, Natural Resources Defense Council)

Agency Response: All of the recommendations suggested by the commenters were considered by staff when drafting the greenhouse gas regulations. However, staff believes that the phase in schedule is appropriate given the resource and lead-time constraints facing manufacturers when incorporating advanced technologies across their vehicle fleets. Regarding an increase in the weight break point for T1s, staff chose to retain the criteria for vehicle categories used by the LEV program in order to be consistent with current emission control programs. Nonetheless, to prevent gaming of the greenhouse gas requirements ARB will closely monitor how manufacturers classify their "crossover" vehicles. In addition, debit accrual requirements are also consistent with the requirements for other emission control programs such as the LEV program whereby manufacturers are allowed to defer offsetting any accrued debits until the end of the phase-in period.

Concerning the suggestion to increase the stringency of the mid term standards by including more hybrids, see response to comment 291.

293. Comment: The proposed regulation is technically sound and supported by excellent economic and technical analysis. We applaud the work of ARB staff, which

involved a very thorough evaluation of all available technologies to reduce greenhouse gas emissions from new passenger vehicles.

That said, we do believe the measures being considered are only a first step. The staff proposal is conservative, allowing substantial greenhouse gas emissions which a more aggressive regulation could have controlled. In fact, the regulation will not even result in the absolute decrease in emissions which are necessary if California is going to do its part to protect future generations from a variety of climate catastrophes related to the increasing number of cars on the road, driving further every single year. Although the full-phased-in greenhouse gas standard will mean approximately 30 percent less emissions from the average new vehicles, by 2030, total sector emissions will be nearly nine percent higher than today's emissions.

One area where we believe the staff could have gone further to achieve more substantial greenhouse gas reductions is more stringent standards for minivans and cross-over vehicles. The proposed regulation sets a stronger emissions standard for passenger cars and light trucks than for large trucks and SUVs. If minivans, with their car-like construction, and the growing "crossover" utility vehicle category were subject to the stricter standard, greater overall reductions would be achieved.

Another way to push emissions lower would be to include hybrid-electric vehicle technology. Hybrid technology is cost-effective and in high demand today, as evidenced by the long waiting list for a Toyota Prius. Even though nearly every automaker will have a hybrid vehicle on the market within the next several years, the standards in this regulation could be met without any increase in hybrid introductions beyond current automaker plans. We believe this is overly lenient, as it leaves easily-achievable greenhouse gas reductions on the table.

The economics of this proposal are also very conservative. Within a very short time period, consumers will save money through reduced operating costs. While this is great news for the public, it's not enough in the face of an escalating climate crisis. We believe a standard based on a break-even scenario, or even a slight increase in consumer cost, combined with gasoline prices that better reflect today's oil prices, would allow much more sizeable emissions reductions and still be consistent with the statutory mandate of AB 1493. (Elisa Lynch; Bluewater Network).

Agency Response: See responses to comments 289 through 292.

294. Comment: In developing the 2009 baseline forecast, CARB followed the assumption in the NESCCAF interim draft report that there would be no significant increase in weight for light-duty trucks, despite a clear trend. The 2009 baseline forecast also assumes increased use of variable valve lift and timing and transmissions with a greater number of gears. These future baseline assumptions predict that manufacturers will deliberately switch to more expensive transmissions and engine technology, instead of using less expensive alternatives that would simultaneously improve fuel economy. (Sierra

Research Report No. SR2004-09-04, Appendix C to the letter from Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. The assumptions on variable valve lift and transmission technology deployment are based on expectations about market trends that include factors other than the consideration of fuel economy. As also commented on in response to comment 210, greenhouse gas and fuel economy regulations are not the only constraints that would dictate the schedule and level of deployment of new technologies in vehicles. The trends in other vehicle attributes like consumer-demanded power, acceleration, and vehicle weight also impact the technologies offered by competing manufacturers in vehicle models. Therefore it is not at all unreasonable to find that, in a competitive auto market, future technologies with significant costs will continue to enter the new vehicle market even in the absence of the proposed greenhouse gas regulation.

295. Comment: The fuel economy level (40.0 mpg) needed to comply with the proposed 2016 standard for passenger cars is at least 47% higher than the federal CAFÉ standard. The 332 g/mi standard for LDT2/MDPV vehicles is equivalent to 26.8 mpg for a vehicle with a conventional air conditioning system. This is 21% higher than the recently adopted 2007 federal CAFÉ standard for light-duty trucks of 22.2 mpg. With an alternative air conditioning system (earning an 18.5 g/mi credit), the required level of fuel economy drops to 25.4 mpg. Due to consumer preference in California, the fuel economy of passenger cars and light trucks is lower than the national average for some manufacturers. As a result, the percentage improvement in fuel economy required to comply with the proposed standards is even greater than estimated herein. (Sierra Research Report No. SR2004-09-04, Appendix C to the letter from Alliance of Automobile Manufacturers)

Agency Response: The proposed greenhouse gas regulations do not require a percentage improvement in fuel economy. In their comments manufacturers have provided conversions like this to indicate the potential impact that meeting these greenhouse gas regulations could have on fuel economy.

It should be noted that the light-duty vehicle classification systems of the U.S. and California differ slightly, making simple direct comparisons invalid. The California vehicle classification system incorporates both passenger cars and the lightest light trucks into the smaller regulatory category, "PC/LDT1," thereby including more vehicles than the federal classifications would for their "passenger car" designation. According to ARB data, the average baseline California PC/LDT1 vehicle emits 310 grams CO₂ per mile – approximately the same as for average U.S. passenger cars for model year 2004. For the California LDT2 category (which does not include the smallest light trucks), the average carbon dioxide emission rate is about 425 grams per mile; the U.S. baseline light truck emission rate is about 441 gram per mile. Though the data does not allow for direct comparison, it is possible that, if the same classification system was employed, the California baseline average emission rates for both categories would show slight improvements over the U.S. averages. However, because these regulations set

greenhouse gas emission reduction levels using the different classifications above and including greenhouse gases other than CO₂, there was and remains no need to evaluate the conversions provided. See also response to comment 591.

296. Comment: Since the largest SUVs rated above 8,500 pounds emit higher levels of carbon dioxide, their inclusion increases the stringency of the regulation. CARB completely ignored this factor and we (Sierra Research) did not have access to the sales projections that would be necessary to account for the impact of Medium-Duty Passenger Vehicles (MDPVs) on the cost and feasibility of compliance. (Sierra Research Report No. SR2004-09-04, Appendix C to letter from Alliance of Automobile Manufacturers)

Agency Response: ARB concurs that including SUVs over 8,500 pounds increases the stringency of the regulations. However, since these vehicles meet the federal criteria for medium-duty *passenger vehicles* (MDPV), emphasis on passenger vehicles, they were included in order to meet the mandate in AB 1493 to reduce greenhouse gas emissions of "...a vehicle whose primary use is noncommercial transportation." As noted previously, the manufacturers did not participate in the regulatory process and, since they are the only data source for CO₂ emissions of these vehicles, staff was unable to incorporate their emissions into the baseline. However, sales of these vehicles constituted less than 0.1% of vehicle sales in California in 2004. Therefore, the impact of their inclusion in the greenhouse gas regulations is minimal.

297. Comment: ARB staff estimates necessary lead-time of 36 months for manufacturers to comply with the 2009 standard. That estimate is unrealistic given that many of the technologies the ARB staff relies upon involve fundamental changes to engines and transmissions. The lead-time for the development, tooling, production, and validation of the required new engines and transmissions is far longer than 36 months. For the type of engine and transmission changes recommended by ARB, I would estimate necessary lead-time of 60 months. Investment must begin immediately, and significant capital investment in the automotive supplier community normally must include direct investment by OEMs at or near the start of a project. (Declaration of Thomas C. Austin, Appendix C to the letter from the Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. As noted in the response to comment 238, Thomas Stephens of GM provided an example of how manufacturers are already designing engines to incorporate many of the new technologies outlined by staff as being capable of meeting the proposed requirements. This is particularly true for those technologies that would be utilized in the near term (e.g., more sophisticated valve trains, turbocharging, direct injection, etc.). GM and Ford already have newly designed 6 speed automatic transmissions in the pipeline (which we indicated would achieve all the emission benefits ascribed to the AMT transmission in the study). Manufacturers are thus already poised to implement the technologies even before the operative 2009 date of the regulation.

298. Comment: We have some concerns about staff estimates of the time frames necessary for companies to integrate the new technology into their systems. I do recall

the testimony that was given at the workshops in July, and I think we just heard some more of it today, that once a new technology is adopted, it does take companies time to properly design it, research, test it, perfect it. These items can't just be picked off the shelf and put into an integrated unit without a lot of other work being done to be sure that they're going to function properly and that you can actually hold up a warranty with them and expect that they'll fulfill their promise.

The industry representatives that came forward earlier today and raised concerns in the context of the transmissions are points that resonate within the business community and are very valid concerns. So, there could be some issues in this rule with regard to the practicality of the implementation dates because of issues associated with actual acquisition and the integration of this new technology into the vehicles that they manufacture. (Bob Lucas, California Council for Environmental and Economic Balance)

Agency Response: Staff disagrees with the comment. See response to comments 238, 297, and 302 through 304.

299. Comment: In all cases, ARB staff has made unrealistic assumptions about the ability of manufacturers to implement technologies in a timeframe that does not respect the normal product development and life cycle planning crucial to the financial health of the automobile industry and the affordability of our products for consumers. (DaimlerChrysler)

Agency Response: Staff disagrees with the comment. See responses to Comments 267, 269, 271, 297, and 356.

300. Comment: There is no guarantee that implementing the technology assumed by ARB staff will lead to compliance with the proposed rule. Many of the posited fuel-economy/CO₂ reduction changes may not be achievable with the technologies identified by the staff. For example, one manufacturer has noted potential compliance by way of advanced diesel technology, but I am doubtful that compliance by such means is a genuine option in light of applicable LEV II emission standards. (Declaration of Thomas C. Austin, Appendix C to the letter from the Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. Concerning technical feasibility, see response to comment 179 and detailed responses on specific issues. As to the use of advanced diesel technology to meet the greenhouse gas requirements, see response to comments 173 and 174.

301. Comment: The technique used by ARB for determining the appropriate value of the standards renders meaningless the weight adjustment that was supposed to have been made to the projected 2009 baseline for small cars. (Sierra Research Report No. SR2004-09-04, Appendix C to the letter from Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. The weight increase in small cars was incorporated in an appropriate manner. The method employed and in particular the

selection of baseline technologies significantly and accurately accounted for future vehicle attribute trends of weight, power, and acceleration for each vehicle class. In the case of the small car vehicle type, the average annual estimated weight increase was determined to be 22 pounds per year. Over the same time, small cars were estimated to see improvements in 0-60 mph acceleration of about 0.11 seconds each year. Therefore, from 2002 to 2009 the average baseline changes for the small car class were to reduce 0-60 mph acceleration time by about a second and *at the same time* have a 150-lb average increase in vehicle weight. These are significant simultaneous changes, considering that increased vehicle weight, all else being equal, works against acceleration improvement. These changes are appropriately accounted for in the ARB methodology since all of the future technologies that were ultimately deemed feasible had to (at a minimum) provide for these baseline acceleration improvements for heavier cars.

302. Comment: As the ARB added technologies to the manufacturers' product plans, lead-time and manufacturers' cycle time should have been considered. Technologies cannot be incorporated in every vehicle at the same time, due to capital costs, differing vehicle and powertrain planning cycles, and engineering resource constraints both at the manufacturer and supplier level. The incorporation of production intent technologies is dependent on the business case, consumer acceptance, and cost effectiveness. The pull ahead of technologies is not always an option for manufacturers to meet the ISOR standards. (DaimlerChrysler)

Agency Response: Staff disagrees with the comment. More than a decade exists before the phase-in of technologies would need to be completed. Given that many of the technologies are already incorporated into numerous vehicles and that there is still sufficient time to develop some of the mid-term approaches, staff believes that with good planning, there is sufficient time to produce the needed vehicles.

Ford, DaimlerChrysler, and General Motors included confidential comments on the leadtime and product cadence needed to introduce new technologies across their vehicle lines, maintaining that the leadtime and implementation schedule provided by the greenhouse gas requirements were insufficient to accomplish the task. Again, none of the confidential submittals included sufficient data to establish the merit of their arguments.

303. Comment: The suggestion by ARB that manufacturers can simply add new "off the shelf" technologies not currently in their product plans is faulty. When technology is said to be "on the shelf" it is available to be considered for integration into complete control systems, but it is not simply "bolted on" to an existing vehicle. Integrating any technology into the "whole vehicle" package is a complex task that must consider what a manufacturer is going to build and when and how it is going to build it. Manufacturers must make sure that the design is optimized not just for assembly but also for serviceability and consumer satisfaction in use. Once this level of confidence is achieved in the design, manufacturers give the go-ahead to build the long lead-time manufacturing tools to keep the product on schedule. Suppliers may also have some of the same lead-time constraints for the components they are going to provide to manufacturers. (DaimlerChrysler)

Agency Response: Staff disagrees with the comment. Staff is well aware of the fact that many of the technologies shown to be feasible are not just “bolted on,” and that engineering is required to incorporate new technologies seamlessly into new products. That is why staff allocated increased costs in the form of the 1.4 multiplier to the supplied component costs, to account for the integration costs. Staff agrees that the task can be complex, but as noted in the response to comment 238, Thomas Stephens of GM has clearly outlined that with planning, these tasks can be much less costly and resource intensive..

304. Comment: Engineering and manpower resource constraints dictate that new technologies be introduced into a single product for system integration and refinement before being used on other products where it may be suitable. Incorporation of these technologies into a complete product ranges in time from several months to several years depending on complexity. (DaimlerChrysler)

Agency Response: Staff agrees with the need to introduce new technologies carefully and systematically, and has accounted for this in the leadtime provided in the regulation. For example, the Chrysler group has introduced cylinder deactivation in their 5.7liter Hemi engine first in the passenger cars and then a year later in the SUV and truck applications. Notably, the 5.7 liter engine was designed from its inception to eventually incorporate cylinder deactivation, which made the roll out smooth and gradual, but still substantially within 2 years in this example. Staff is confident that the engineering capability exists in the Chrysler group to accomplish the proposed requirements if the approach taken to implement cylinder deactivation is taken for other technologies. Also, it should be noted that most of the potential technologies eventually projected in the August 2004 ISOR had been under discussion in pre-regulatory workshops and meetings (and under development by manufacturers) consistently for nearly two years beforehand.

305. Comment: In addition to basic lead times for program execution and integration, there are two sets of constraints that are at odds with the timetable for change described in ARB’s regulations: 1) the cadence at which a manufacturer’s technical staffs can redesign their entire product line and 2) the economic lifetime of a product necessary to earn an adequate return on investment. Not everything can be changed at the same time. For this reason, product planners maintain a cadence of change so that technical and financial resources can be applied evenly from year-to-year, avoiding disruptive, wild swings in staffing and funding levels. It imagines changing virtually all powertrain components in near-term, mid-term and presumably long-term waves coming at four-year intervals. Given the expertise necessary to properly execute these programs, it would be impossible to assemble the technical resources to maintain the pace and scale of change outlined in ARB’s analysis. (General Motors)

Agency Response: Staff disagrees with the comment. See response to Comment 223.

306. Comment: Capital-intensive products such as engines and transmissions typically need useful economic lifetimes of ten or more years to justify an adequate return on investment. The pace of change described by ARB, moving within a few years from

one technology to the next, is not consistent with providing an adequate useful economic life for these major investments. (General Motors)

Agency Response: Staff disagrees with the comment. See response to comments 206 and 223.

307. Comment: Technical discussions of mobile air conditioning (MAC) within the ISOR and the technical support documentation reflect the complexity of MAC issues and the newness of MAC issues for ARB. There is limited data available on many aspects such as consumer MAC usage patterns in various climates. In view of the complexity and data limitations in this area, it is unwise and inappropriate for CARB to have incorporated possible MAC improvements to increase the stringency of the greenhouse gas standard.

A superior approach for ARB would be to incorporate MACs as a purely extra credit feature into any regulatory program while additional understanding and experience with MAC issues is achieved, without using anticipated improvements to increase the stringency of the standard. Further, the MAC crediting program should be approached with a view towards maximum flexibility in granting credits in view of the large number of design approaches that may be applied towards MAC improvements. (General Motors)

Agency Response: Staff disagrees with the comment. Mobile air conditioning systems are a significant contributor to vehicle climate change emissions and there are considerable efforts underway both in the United States and Europe to reduce the greenhouse gas emissions associated with their use. As noted in the response to comment 18, staff believes the air conditioning factor for California drivers derived from the NREL study and used to adjust the greenhouse gas emission standards appropriately accounts for air conditioning use in California. In addition, the regulations already provide manufacturers considerable flexibility when certifying their air conditioning systems and accommodates any design improvements they may choose to implement.

308. Comment: MAC issues would need to be explored much more extensively and ARB's analysis refined considerably, before MACs could be included directly into the calculation of technical feasibility for the greenhouse gas standards or included directly into a vehicle test procedure. As outlined in General Motors' presentation to the March 2003 CARB AB 1493 technical workshop, there are prohibitive barriers to a full vehicle MAC efficiency test that is simultaneously practical, effective and fair. There are simply too many factors affecting occupant comfort (e.g., humidity), the outdoor conditions that produce MAC loads (e.g., solar load), and the vehicle features that impact MAC load (e.g., vehicle interior and exterior color, window tints and design). It does not appear possible to establish full vehicle laboratory test procedures that give, in a reasonable number of tests, accurate, repeatable results for the energy consumption of various systems at equivalent levels of occupant comfort in various climates. With so much uncertainty about actual MAC energy consumption and refrigerant leakage, and no standardized test procedures for accurately measuring these factors, it is inappropriate to have used anticipated improvements in setting greenhouse gas standards. (General Motors)

Agency Response: Staff disagrees with the comment. This comment is inconsistent with General Motor's support of U.S. EPA's I-MAC 30/50 Initiative, which was recently announced publicly in A^Ction Magazine, a publication of the Mobile Air Conditioning Society Worldwide.

One of the core objectives of the partnership is to advance the development of improvements in technology and of the test protocols necessary to rigorously quantify such benefits. As stated previously, at present the evidence for incorporation of MAC emissions into the calculation of overall greenhouse gas emissions is robust and defensible. ARB is actively working with industry stakeholders as represented by SAE and MACS Worldwide to advance the metrology of MAC improvements.

Test procedures are expected to be developed in a staggered manner with a mini-SHED test for the integrated MAC components (for testing outside of the vehicle) and then the evolution to full vehicle testing. SAE has publicly acknowledged its commitment to advance this issue and to target the development of a practical and representative test. Thus, these challenges are fully acknowledged in the regulation documents. ARB and U.S. EPA will continue to work collaboratively with SAE and MACS Worldwide on these issues. One example of this collaborative progress, as stated previously, is the new I-MAC 50/30 Initiative, as well as the SAE Alternative Refrigerant Collaborative Research Program.

309. Comment: There is a continuous trend of mobile air conditioner refrigerant charge size reduction in comparisons of models of comparable size, and warranty data indicate that refrigerant leak reduction design targets are producing a significant reduction in refrigerant leakage. Further enhancements to R-134a systems in efficiency and refrigerant leakage have been outlined and are being engineered and implemented, including through cooperative programs with USEPA. Our evaluations of Lifecycle Climate Change Performance (LCCP) for enhanced R-134a systems indicate there is no compelling environmental case for a costly move to an alternative refrigerant, especially in a warm climate such as prevails in much of California, where R-134a's high efficiency in hot conditions gives it an advantage over some of the alternatives. In these environmental evaluations, capture and recycling of refrigerants during vehicle servicing and end of life disposal are important variables, and California government can play a helpful role in ensuring responsible capture and recycling practices. (General Motors)

Agency Response: We agree with the statement that some methods of evaluation (i.e. Life Cycle Climate Performance) suggest that improved R-134a systems may be advantageous to other alternative systems. However, in the ISOR, ARB staff outlined multiple options for improvement and for each option, staff discussed the pros and cons. The decision to choose an alternative will rest with the automaker based on its analysis of the market and its business plan goals and priorities. While it is highly desirable to switch to R-152a and CO₂ for mobile refrigerant, we recognized and believe in the benefits of improved R-134a.

For this reason, CARB became a partner in the I-MAC 30/50 Initiative. We continue to work to gain a better understanding of other relevant factors in the lifetime refrigerant emissions equation, such as servicing and end-of-life releases. To the extent possible, ARB staff will continue to work with stakeholders such as the Japanese and Australians who have implemented innovative refrigerant recovery structures. However, enough is known now (see response to comments 170 through 172) to incorporate such credits into the greenhouse gas standard.

310. Comment: Although a change to an alternative refrigerant is not currently warranted, General Motors has been a leader in exploring alternative refrigerants through the Society of Automotive Engineers Alternative Refrigerant Cooperative Research Program as well as independent research with our suppliers. This experience differs from ARB's characterization of R-152a. It is not yet clear if R-152a will be judged acceptable, and it certainly is not a simple drop-in replacement for R-134a (contradicting the NESCCAF analysis Appendix D-20, which appears to have been based on an obsolete understanding of R-152a). (General Motors)

Agency Response: We recognize General Motor's leadership in this area as ARB is also a member of the Society of Automotive Engineers' Alternative Refrigerant Collaborative Research Program (SAE ARCRP) Phase II. The most recent technical research literature still contains references to the potential for R-152a to be a drop-in substitute. (JSAE Next Generation Refrigerant Symposium, January 2005, Tokyo, Japan, presentation by Sanden Corporation). It is also acknowledged that the optimization of some system components (i.e., evaporator) may be warranted and could lead to further improvements. As stated by the SAE ARCRP expert team, a tradeoff between requirements is the likely result in the optimization process. In addition, this discussion is hampered by the need for a "real world" test to determine emission improvements.

311. Comment: The assumption that manufacturers "will be converting to HFC 152a systems in the mid term" (ISOR, p. 107) is unwarranted and unduly speculative for a technology that is still at R-152a's stage of development. ARB should not rely on technologies that have never been commercially implemented anywhere, in this case not even demonstrated to any significant degree in test fleets, as the basis for setting regulatory standards. Conversion to R-152a should not have been assumed in setting mid-term standards, and it should not have been modeled for this purpose as having superior energy efficiency. (General Motors)

Agency Response: ARB agrees with GM's assertion that conversion to R-152a and a resultant decrease in non CO₂ greenhouse gas emissions was assumed for the mid-term greenhouse gas emission standard. This is one reason why a direct conversion or comparison between federal CAFÉ mpg levels and the greenhouse gas emission levels set here is impossible.

Due to efforts by the European Commission to phase out HFCs from mobile air conditioning, intense efforts for the development of alternative refrigerant technology have taken place for some time. As suggested by the SAE ARCRP Phase II efforts, HFC-152a

has received equal attention to other alternatives, such as improved HFC-134a and CO₂. In addition, HFC-152a emerges as a potential drop-in substitution. With these considerations in mind and taking into account the feedback from U.S. suppliers who are working arduously to generate new market ventures, ARB staff believed that it was prudent to assign a mid-term entry point to HFC-152a.

At present, the most current information available to staff suggest that the potential for significant development of all three leading options (improved HFC-134a, HFC-152a, and CO₂) is still real.

312. Comment: One alternative that could have been considered would be to set the emission standard for each test weight according to an estimate of the maximum feasible cost-effective emissions reduction for that weight. This alternative would, by definition, satisfy the 1493 mandate.

Another option that I think some people have brought up in previous workshops would be to set a single uniform standard that applies to all weights. I think there are good reasons that the staff rejected a weight-neutral standard, although the staff report does not state those reasons. The emission level that's attainable within the limitations of feasibility and cost effectiveness generally depends on vehicle weight. So it's not possible to define a single standard that makes sense for all vehicles. And a weight-neutral standard would only satisfy 1493 on a sales average basis and then only for a particular assumed vehicle weight distribution. This is also true of the proposed two-level LEV-type standard.

1493 requires maximum feasible cost-effective reduction of GHG emissions for motor vehicles. The proposed standard does not comply with this mandate. For example, according to staff analysis, the smallest truck in an NESCCAF study, which has a 4250 pound test weight, could in 2016 achieve emissions of 284 grams per mile within the limits of feasibility and cost effectiveness. Whereas a standard only requires an emissions of 332 grams per mile.

So the only sense in which the proposed standard can be construed as achieving the objective of 1493 is on a sales average basis and only for a fleet weight distribution matching General Motors 2002 California sales. These conditions are too limiting to meet the requirements of 1493 in part because the standard is not self-consistent. The calculations underlying the standard are premised on a specific fleet weight distribution and yet the two-level formula standard would itself induce the industry to change vehicle weights either by upweighting or downweighting so that the assumed weight distribution no longer applies.

For example, the 2002 market had 20 models, including 8 GM models with test weights of 3750 pounds, which is at the upper limit of the T1 weight range. The calculations underlying the proposed standards assume that these vehicles are in the T1 category. But the standard creates a compelling incentive to upweight these vehicles so that they are -- so they would be subject to the less stringent T2 standard, 332 versus 205 gram per mile.

So by adding about 100 pounds to each of these vehicles a manufacturer effectively gets 120 gram per mile emission credits, which would have a value of probably about \$1500 in terms of compliance costs reduction.

If all manufacturers were to upweight their 3750 pound vehicles to move them up into the T2 category, the effect on California emissions in 2030 would amount to about 15,000 tons CO₂ per day, which is about 10 percent of the projected reduction under the proposed regulation.

And that's a reduction that is not accounted for and neglected in the staff analysis. If the manufacturers were to also equate their 3625 pound vehicles, that would add another 20,000 tons CO₂ per day. And if you extrapolate that to the national level that could probably be another factor of 10 increase.

The standard would also induce downweighting due to the weight stratified disparities in compliance costs. For example, in the NESCCAF study -- well, let me just skip over this quickly, because I don't want to take too much of your time.

But the downside of the incentive would provide no environmental benefit because emission standards are flat within each class. And while downsizing reduces emissions, it also reduces a need for overcompliance credits so small trucks could be designed to a less stringent emissions standard. So the downsizing incentive only functions to incentivize industry to substitute downsizing for technology contrary to the technology forcing nature of the regulation.

Upweighting and downweighting will shift the vehicle weight distribution away from the assumed California 2002 market conditions so that the standard no longer satisfies the 1493 mandate even on a sales-average basis.

And even if there were no upweighting or downweighting, and if the vehicle weight mix in 2016 matched 2002 California conditions, the proposed standard would still not comply with the mandate because, with the exception of GM, none of the six manufacturers is actually required under this standard to achieve maximum feasible and cost-effective emission reductions. GM is the only company that's actually required to achieve that standard. (testimony of Kenneth Johnson)

Agency Response: Staff endeavored to achieve the maximum feasible reduction in greenhouse gas emissions with the structure of the standard that was proposed. While the weight-based approach suggested could possibly yield additional reductions, there are other considerations that staff had to address. Some were concerned that manufacturers might add weight to vehicles to move them to a higher weight class in order to achieve a less stringent standard, thereby encouraging heavier vehicles. Staff also concluded that its proposed standards needed to be set relative to the worst case manufacturer in order to satisfy the directive to continue to have full model availability and to ensure competitiveness of all manufacturers. Mr. Johnson's comments have technical merit, but they ignore some of the other practical and competitive issues the staff had to wrestle with

in making its decision on the form of the standard and its stringency. Staff believes that the staff proposal provides the best balance among the various competing concerns.

313. Comment: The Initial Statement of Reasons (ISOR) specifies a maximum feasible and cost-effective emissions reduction level, and yet the proposed emission standards do not conform to this specification as required by AB 1493, paragraph 3(a).

Figures 6-1 and 6-2 in the ISOR illustrate regression lines that are described as representing the “maximum feasible reduction levels” of CO₂ as a function of vehicle test weight (ISOR, page 112), and the regression model is also constructed to satisfy the cost-effectiveness criterion (ISOR, Section 6.1.A and Tables 6.1-2, 6.1-3, and 5.3-8). According to this characterization, a weight-indexed emission standard based on the regression model would achieve “maximum feasible and cost-effective” emissions reduction, as required by AB 1493. But the proposed LEV-based, bilevel standard differs substantially from the regression model and does not comply with the requirements of paragraph 3(a).

The bilevel standard comprises two emission limits, one for each LEV weight category. As stated in the ISOR, page 105, “The proposed emission standards for each category were... based on the manufacturer with the highest average weight vehicles to ensure all manufacturers can comply with the standards (i.e., not simply according to the average of all manufacturers).” This prescription is intended to ensure cost-effectiveness for all manufacturers, but at the cost of increasing the aggregate emissions allowed by the standard in relation to the “maximum feasible and cost effective” standard. This loss of environmental effectiveness is incurred by the restrictive bilevel form of the standard, and not by any requirement or limitations of AB 1493, and hence represents a violation of the maximality requirement of paragraph 3(a).

The bilevel standard’s environmental effectiveness can be quantified in terms of its “excess emissions allowance,” which is defined for each manufacturer (and for the aggregation of all manufacturers) as the difference between the sales-averaged emissions allowed by the standard and that of the “maximum feasible and cost effective” standard. Table 1 lists these values for the proposed mid-term standard under the column heading “Proposed standard.” (The values in Table 1 represent sales averages over both weight categories, and hence take into account any allowance trading between categories.) The 12 g/mi value in the bottom row (“All”) is a measure of the degree by which the maximality requirement is violated.

Table 1

Excess mid-term emissions allowance (CO₂e g/mi) relative to “maximum feasible and cost effective” standard (regression model).

	Proposed standard	GM-based bilevel	Optimum bilevel	Perverse bilevel	Weight-based
DaimlerChrysler	15	11	11	25	10
Ford	11	7	7	14	9
General Motors	4	0	0	9	10
Honda	12	9	0	9	12
Nissan	19	15	11	11	10
Toyota	18	14	11	30	10
All	12	8	6	17	10

(Kenneth Johnson)

Agency Response: ARB staff disagrees with the assertions above. The commenter contends that the step in the ARB standard-setting method which involved setting the standard according to the manufacturer with the highest average vehicle weight was unwarranted by any requirement or limitation of AB 1493. We agree that this “heaviest-weight” constraint is employed at the expense of forgoing potential emission reductions from manufacturers with lighter average vehicle weights. However, this is a necessary constraint to ensure that the regulation is *feasible to all manufacturers*. Setting the standards to a more stringent standard would disadvantage the heaviest manufacturer by forcing more aggressive adoption of technologies or forcing the purchasing of excess credits by other manufacturers (assuming that others over-comply and are willing to sell the credits).

314. Comment: The methodology by which the standard was determined is overly complex and error-prone. In particular, the standard was apparently erroneously calculated on the basis of an incorrect LEV weight cutoff; it is based on a regression model of dubious validity; and an incorrect optimality criterion was applied in establishing the emission limits.

The proposed standard is intended to achieve zero excess emissions allowance for General Motors within each weight category; hence the excess allowance over both categories should also be zero, and not 4 g/mi as indicated in Table 1. This discrepancy is due to an error that was apparently made in computing the emission standard. The CARB analysis apparently used a 4000 lb. weight ceiling for the PC/LDT1 category, rather than 3750 lb. LEV weight cutoff. (This error is corrected for the following analysis.)

Table 7

CO₂-equivalent Emission Standards, recomputed from CARB data with correct weight cutoff (3750 lbs.)

	Emission standard (g/mi)	
	PC/LDT1	LDT2
Near-term	229	355
Mid-term	202	327

(Kenneth Johnson)

Agency Response: Staff disagrees with the comment. The statement that the ARB standard determination is “erroneously calculated” is based on a misunderstanding of the vehicle class categories. The commenter asserts that the “CARB analysis apparently used a 4000 lb. weight ceiling for the PC/LDT1 category.” This is incorrect. The PC/LDT1 category is the combination of passenger cars (“PC”) and category 1 light trucks (“LDT1”). The PC subcategory is independent of a weight cut-off (i.e. a 4500-lb passenger car such as a Lincoln Town Car is classified “PC”). It is only the light trucks that are affected by the vehicle test weight cut-off of 3750 lbs. Therefore it is only the LDT1 portion of the PC/LDT1 category that is affected by the cut-off. (These vehicle categories are defined in the “California Exhaust Emission Standards and Test Procedures for 2001 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles.”) The ARB staff on review has found that it has properly applied these vehicle classifications to its analysis and, therefore, disagrees with the related “corrections” of the commenter in comments and tables both above and below.

315. Comment: The GM-based bilevel standard for the PC/LDT1 category was determined by matching it to the “maximum feasible and cost effective” standard (as defined by the regression model) for a vehicle weight equal to General Motors’ sales-averaged test weight within PC/LDT1 (i.e., 3384 lbs.); and the LDT2 standard was similarly matched to the “maximum feasible and cost effective” standard for General Motors’ sales-averaged test weight in LDT2 (5021 lbs.). The rationale for this methodology is discussed in Section 6.1.C of the ISOR; however, this is not the correct methodology for determining the standard.

Cost-effectiveness (with trading) requires that the emission limits be constrained so that each manufacturer’s excess emissions allowance is non-negative. There are six such constraints, and subject to these constraints, the maximality condition of AB 1493 requires that aggregate emissions be minimized. This objective translates into a linear programming problem, which can be solved graphically by the method outlined in the Appendix following this Commentary. The following table shows the resulting emission limits (identified as “Optimal bilevel”) in comparison to the GM-based emission limits. As indicated in Table 1, the aggregate mid-term emissions allowance with the optimal bilevel standard is 6 g/mi, which is marginally better than the 8 g/mi of the GM-based bilevel standard and a factor of two better than the proposed standard.

Table 8
CO₂ – Equivalent Emission Standards

	Emission standard (g/mi)			
	GM-based bilevel (corrected)		Optimal bilevel	
	PC/LDT1	LDT2	PC/LDT1	LDT2
Near-term	229	355	212	364
Mid-term	202	327	190	334

(Kenneth Johnson)

Agency Response: The ARB method of standard determination was chosen to meet the requirements of AB 1493 and ensure that each manufacturer could comply with the standards by employing the technologies discussed. The linear programming optimization method employed by the commenter results in standards that could not feasibly be achieved by the heaviest overall manufacturer, General Motors. According to ARB analysis, GM's average vehicle weight corresponds to the maximum feasible (mid-term) emission reduction lines at CO₂-equivalent emission levels of 205 g/mi for PC/LDT1 and 332 g/mi for LDT2 vehicles (See Addendum Figures 6-1 and 6-2, <http://www.arb.ca.gov/regact/grnhsgas/addendum.pdf>). The hypothetical emission standards of 190 g/mi (PC/LDT1) and 334 g/mi (LDT2) would require GM to some extent to either (1) restrict their product availability, (2) reduce the weight of their fleet, or (3) purchase credits from other manufacturers to make up for their own shortfall. The ARB method specifically sought to set the standards for light duty vehicles that were achievable strictly via technology deployment, i.e. without requiring manufacturers to alter product availability or trade with other manufacturers. Therefore, we find that the linear programming method utilized by the commenter gives a resulting standard level that is not feasible to every manufacturer.

316. Comment: The proposed emission standard is specifically based on year-2002 market data, and could hence violate either the maximality or cost-effectiveness requirements of AB 1493, paragraph 3(a), as market conditions change in future years.

Table 1 indicates that with allowance trading, the bilevel standard would be cost-effective for all six manufacturers. However, this is only true under the assumed year-2002 market conditions. In particular, cost-effectiveness might not be maintained for General Motors and Honda, who have zero emissions allowances under the optimal bilevel standard. If these manufacturers were to design their vehicles to the “maximum feasible and cost effective” standard, they would have exactly the right amount of emission credits from over-compliant vehicles to cover under-compliant vehicles. But if they lose market share in the over-compliant category in future years, they would have to also restrict sales in the under-compliant category due to loss of emission credits. On the other hand, if sales were to increase in the over-compliant category while diminishing in the under-compliant category, they would be incurring excess costs associated with unnecessary over-compliance.

Unless the emissions reduction required of a manufacturer is significantly less than the “maximum feasible and cost effective” reduction level, the manufacturer would only be

able to use trading to optimize compliance costs if the weight distribution of its fleet remains close to the 2002 distribution that was assumed in setting the emission standard. Due to uncertainty in future market conditions, the manufacturer may be compelled to make each vehicle fully compliant with the bilevel standard without trading. However, compliance with the bilevel standard may be considerably more expensive than complying with the “maximum feasible and cost effective” standard. As noted in the ISOR (Section 12.7), even if the assumes fuel price were increased from \$1.74/gal to \$2.30/gal, further emissions reduction beyond the “maximum feasible and cost effective” level would not be cost-effective; hence making the under-compliant vehicles fully compliant with the bilevel standard could be very expensive and in some cases may not even be feasible. (Kenneth Johnson)

Agency Response: The ARB staff does estimate the 2009 California baseline CO₂ equivalent emissions levels and average vehicle weights as equivalent to the 2002 California baselines. Predicting, with any accuracy, the extent to which automaker-specific average weight, sales-average CO₂ emissions, and market share will change would be nearly impossible. Moreover, predicting each of these changes specifically for the California market, for which there is less data available than for the US market, would be even more difficult. Because of these uncertainties it was deemed more prudent to assume no change in these characteristics.

317. Comment: The proposed emission standard is specifically based on California market data, and could hence deter adoption of the standard by other states, or could violate maximality or cost-effectiveness if adopted by others.

The standard is not only premised on the year-2002 sales mix; it also assumes sales data specific to California. A standard that is cost-effective in the California market may not be so in other states or in a national or global context. (Conversely, even if it is cost-effective in other contexts it may not have maximal environmental effectiveness.) The environmental benefits of AB 1493 will be insignificant unless the regulations are adopted by other states and other countries; yet a standard that is custom-fit for the California market might deter adoption by others. (Kenneth Johnson)

Agency Response: The proposed CO₂ regulation is based on the regulation of new vehicle sales in California and does rely on California-specific data on vehicle sales mix, vehicle usage, and fuel prices. However, the extent to which the relevant California-specific data differs from national data is unlikely to significantly affect the generality of the results of the cost-effectiveness analysis conducted by ARB. For example, the fuel price used in the analysis was \$1.74 per gallon of gasoline; this is lower than the previous year’s average retail gasoline price in the US, suggesting that any new analysis would yield *more* cost-effective results than the current ARB analysis. New vehicle sales by vehicle class and by average emissions levels are also quite similar for sales within and outside of California. For both California and the US as a whole, just over half of new light-duty vehicle sales are light trucks. Also, the average CO₂ emissions characteristics for the new California and new US vehicle fleets are very similar for passenger cars and light trucks,

suggesting that the results of the feasibility and cost-effectiveness assessment for the regulation in California and in other states would have approximately the same results.

318. Comment: Although the regulation may be cost-effective on a sales-averages basis, the LEV-type structure of the emission standard may motivate inequitable price increases, with some vehicle weights incurring price increases significantly in excess of cost-effective limits.

Although a manufacturer might be able to optimize its aggregate compliance costs by trading between over-compliant and under-compliant vehicles, the bilevel standard could nevertheless induce large disparities in vehicle prices or profitability between different vehicle weights, with some weights greatly exceeding the cost-effectiveness threshold. Trading would not necessarily even out these disparities.

For example, a manufacturer who puts a 5500-lb. vehicle on the market in California would have a degree of flexibility in how the compliance costs for that vehicle are distributed. The vehicle could fully comply with the standard; or it could comply partially, with the balance being made up for by other over-compliant vehicles. But irrespective of how the costs are distributed, the full compliance costs represent costs that would be incurred by putting a 5500-lb. vehicle on the market in California, and would not be incurred if the vehicle is not put on the market. Hence the full compliance costs will be accounted for in that vehicle's profit margin, and in order to maintain profitability the manufacturer will likely pass the full compliance costs to the consumer. (Kenneth Johnson)

Agency Response: Whether and to what extent auto manufacturers use alternative pricing to maximize profitability is not of chief concern to the AB 1493, so long as the automakers are compliant with the regulation. The technology and cost assessment conducted by ARB assumes that technology is deployed across the fleet of various vehicle classes and that the associated technology costs are passed on to vehicle purchasers. The ARB assessment verified that the level of emission reductions proposed is cost-effective according to the guidelines set forth by AB 1493 according to this method of passing costs on to consumers. Manufacturers could alter their pricing to increase vehicle prices by more (or less) than the actual incremental cost of the additional emission-reducing technologies and do so differentially based on consumers' willingness to pay in the different markets for various vehicle types. We can assume such an approach would only be chosen if it was deemed more cost-effective to each automaker than uniformly passing on the additional marginal costs.

319. Comment: The LEV-type standard would tend to destabilize the existing competitive balance between manufacturers and between different vehicle weights.

As noted above, trading could help a manufacturer minimize its aggregate compliance costs (at least under year-2002 California market conditions), but it would probably not be effective at eliminating the weight-stratified profitability loss or price increase induced by the bilevel emission standard. Even with trading, the bilevel standard would destabilize the existing competitive balance between different vehicle weights, and could have

substantial market impact. Furthermore, there would be no compensating environmental advantage because weight disparities would motivate manufacturers to concentrate their fleet weight distributions at weights where the bilevel standard is less stringent than the “maximum feasible and cost effective” standard.

The weight disparities would also disrupt the existing competitive balance between manufacturers, due to their varying degrees of specialization in different weight categories. As indicated in Table 1, the optimal bilevel standard would put General Motors and Honda at a disadvantage relative to other manufacturers who have excess emissions allowances over the “maximum feasible and cost effective” level. (Kenneth Johnson)

Agency Response: It is acknowledged that each manufacturer begins from a different average baseline emission level, and, therefore, the effort needed to achieve compliance with the new standard is somewhat different for each automaker. However, this is a necessary consequence of moving from an unregulated industry characteristic toward regulation. While developing the regulation staff thoroughly analyzed the various potential forms of the standard, and ultimately the chosen two-category LEV II form of the standard was determined to best manage the criteria of automaker competitiveness, consumer choice, and total climate change emission reductions over time. We disagree that the proposed regulation unduly disadvantages the competitive position of General Motors and Honda. More generally, the notions that the proposed bilevel standard “would destabilize the existing competitive balance between different vehicle weights” and “also disrupt the existing competitive balance between manufacturers” are flawed for two reasons: (1) The current auto market is already accustomed to a two category system of regulation, and (2) Competition, here between automakers and within weight classes, is by nature dynamic, i.e. it is neither stable nor balanced, regardless of the proposed regulation.

320. Comment: The standard would create perverse incentives to increase vehicle weight in order to take advantage of the much less stringent LDT2 standard relative to the PC/LDT1 standard. (Kenneth Johnson)

Agency Response: As mentioned in the response above, there was much analysis into the question of the form of the standard. Ultimately, the chosen LEV II form of the standard was determined to best manage the competing tradeoffs relating to the criteria of automaker competitiveness, consumer choice, and total climate change emission reductions over time. In reality, the extent to which the LEV II form creates a “perverse incentive” to increase vehicle weight is overstated here by the commenter, especially when this form of the standard is compared against the weight-based form of the standard that the commenter proposes. The commenter falsely assumes passenger cars (PCs) to be subject to the weight cut-off (see response to comment 314, above), when actually only the “LDT1” portion of the PC/LDT1 category is prone to weight increase-induced category jumps. Furthermore, most LDT1 classified light trucks (e.g. Toyota RAV4) are much lighter than the 3750-lb vehicle test weight cut-off, and are therefore unlikely to be intentionally upweighted for the purpose of reclassifying the vehicles as LDT2.

321. Comment: The weaknesses of the bilevel standard outlined above undermine the standard's practicality and could make it vulnerable to legal challenges. In principle, these deficiencies could be overcome by using an emission standard based on the regression model. The above analysis assumes that the regression model represents the "maximum feasible and cost effective" emission reduction level, as characterized by the ISOR; but there are a couple of discrepancies in the model that raise questions about its reliability. Unless these discrepancies can be resolved or rationalized, the regression model should not be relied on as a "maximum feasible and cost effective" standard.

The regression model uses two-point linear regression within each weight category, under the premise that the "maximum feasible and cost effective" emission level is an approximately linear function of sales weight. But the regression data is not consistent with this premise, as evidenced by the model's discontinuity at the 3750 lb. transition point and by the misfit of the model to the representative minivan data point.

Since the regression model is an explicit function of weight, it is not clear why separate functions are needed for the two weight classes. There may be a natural division of vehicles into two categories with different "maximum feasible and cost effective" emission limits, but if so, the 3750-lb. weight cutoff apparently does not adequately characterize the distinction between these categories. As noted in the ISOR, page 105, minivans are better aligned with passenger cars, although the weight criterion puts them in the LDT2 category. Furthermore, trucks in the LDT1 category would probably have "maximum feasible and cost effective" emission characteristics more similar to LDT2 trucks than to passenger cars.

There is also a discrepancy in how the regression data points were selected. The points are based on the five representative vehicles characterized in the NESCCAF study. For each representative vehicle, two or three best-option technology packages were chosen based on emissions performance and cost-effectiveness. Quoting from the ISOR, page 110, "The average CO₂ gram-per-mile values of the selected technology packages were then used to determine the maximum feasible CO₂-equivalent reduction for each of the two LEV II vehicle classes." The policy rationale for choosing the average is unclear. If the objective is "maximum feasible CO₂ reduction," then the standard should be based on the lowest gram-per-mile value. If cost-effectiveness considerations require that manufacturers be given multiple technology options, then the highest value should be used. In any case, the "average" is not among the options available to manufacturers. (Kenneth Johnson)

Agency Response: Because the agency could not reasonably model all vehicles with all of the potential climate change emission reduction technologies that consumers could potentially purchase, certain representative vehicle classes were chosen for the assessment. By choosing a representative "small car" and representative "large car," each which have the average or representative characteristics of the vehicles in those passenger car classes, we were able to successfully incorporate the different ways that various technologies affect emission rates for the full spectrum of passenger cars. In order to bridge the gap between these two vehicle subclasses to determine a standard for

average passenger cars, a weight-based regression was the most obvious and reasonable analytical tool due to the fact that vehicle test weight is the strongest statistical predictor of baseline CO₂ emissions. The option to choose the best two or three technology packages was conducted both to demonstrate that several packages of technologies are viable options to comply with the proposed emission standards and because certainty in any one data point is not perfect.

322. Comment: An alternative that would circumvent the above limitations is a simple weight-based standard of approximately 140 g/mi/ton near-term (2012) and 132 g/mi/ton mid-term (2016), based on vehicle test weight (compared to the 2002 aggregate emissions of 181 g/mi/ton). This alternative would represent a radical departure from the proposed LEV-type standard; but it is radical in the direction of simplification and would therefore not require significant rework by ARB staff. The alternative serves industry interests (by better preserving the existing competitive balance between manufacturers and between different vehicle weights), and also serves environmental interests (by improving environmental effectiveness); so it should be more acceptable to all stakeholders. And most importantly, the alternative would bring the regulation into conformity with the requirements of AB 1493.

The definition criterion for these weight-based standards is that for every one of the five NESCCAF representative vehicles, at least one of the associated best-option technology packages should be capable of reducing emissions to the compliance level. In actuality, many of the representative vehicles would have two or three options well within the compliance limit, and with trading, it is possible that all would. (Kenneth Johnson)

Agency Response: A weight-based standard was studied by ARB staff in the development of the proposed emissions standard, but ultimately was not chosen, for several reasons. As the commenter states, the weight-based alternative would equate to a “radical departure” from existing ARB vehicle emission regulation programs. Efforts were made in the selection of the form of the standard to have a standard that is simple to monitor and administer for regulators and automakers alike, and maintaining the LEV II vehicle classification system is indeed the simplest and most familiar regulatory framework. In addition, any weight-based regulation form is most susceptible to what the commenter above (comment 320) refers to as “the perverse incentives to increase vehicle weight.” That is, a weight-based standard, instead of simply encouraging the addition of emission-reduction technology to achieve compliance, allows a mixed strategy of both adding some emission-reduction technology and adding weight. This weight-based standard therefore increases the possibility of a long-term gradual weight increase that could undermine the objective of the proposed regulation to achieve climate change emission reductions.

323. Comment: In looking at the proposal, the staff made some concessions to the industry in the structure, in the two-part fleet, the passenger car and then the heavier vehicles. And also their approach of working from the manufacturer with the highest baseline emissions levels. There’s an inherent caution in this work that I think contributes to its robustness. (John DeCicco, Senior Fellow with Environmental Defense)

Agency Response: Staff agrees that the approach chosen is conservative with respect to its potential impact on manufacturers.

324. Comment: Touching on the lead-time issue, ED believes the staff's proposal is very generous. ED looked at historical adoption rates of engine technology refinements and design refinements in transmissions and so on, what the historical adoption rates are in the industry. This proposal is very consistent with that. ED looked at the issue of product redesign cycle, how long it takes the automakers to redesign products. In fact, competitive pressures have compressed their cycle. You can't keep old product on the street competitively. This proposal was very much in line with the competitive redesign of vehicles that is driven by market forces. Because this is a technology-based proposal it will not limit consumer choice in any way. (John DeCicco, Senior Fellow with Environmental Defense)

Agency Response: Staff agrees with the comment.

325. Comment: We note that a three year phase-in period is consistent with past automotive standards, which typically ranges from three to four years. For example, EPA's Tier 1 rule, Cold CO, and ORVR (onboard refueling vapor recovery) were all implemented on a three year phase-in schedule. Therefore, we believe it is consistent with past pollution standards to require a 3 year phase-in for the mid-term package. (Roland Hwang and David Doniger, National Resources Defense Council)

Agency Response: Staff disagrees with the comment. Staff believes that four-year phase in periods are necessary in order to accommodate manufacturer lead time requirements. See also the response to comment 292.

326. Comment: New York believes that staff's proposal provides auto manufacturers with the flexibility necessary to bring compliant vehicles to the market. This is accomplished through the use of phase in periods to reach both the near and midterm standards as well as a vast array of existing and emerging technologies that are expected to be widely available within the next decade. The proposal provides additional flexibility by allowing manufacturers to participate in an alternative compliance program. (David Shaw, Director of the Air Resources Program at the New York State Department of Environmental Conservation)

Agency Response: Staff agrees with the comment.

327. Comment: The NESCAFF study found that cost-effective technologies exist to reduce motor vehicle greenhouse gases for a range of reductions of up to 47 percent. NESCAUM and NESCAF believe the standards proposed by the ARB staff make sure that that significant greenhouse gas reductions for motor vehicles will be achieved expeditiously, while at the same time provide an adequate lead time for manufacturers to meet the standards. (Coralie Cooper, NESCAUM)

Agency Response: Staff agrees with the comment.

328. Comment: The Santa Clara County Medical Association supports California's efforts to address global warming through the implementation of a strong regulation to reduce greenhouse gas emissions from vehicles, as set forth in AB 1493 (Pavley), and urges the Air Resources Board to adopt a greenhouse gas standard for fuels. (Stephen H. Jackson, MD)

Bluewater Network hopes to work with the Air Resources Board in the coming year to establish a greenhouse gas standard, at least to consider one, for motor fuels themselves, as Chairman Lloyd had mentioned previously. And this is very important because they're the other half of the vehicle global warming problem. Consider of course that all four fuels that vehicles use have a cleaner greenhouse gas version. Gasoline obviously has cellulosic ethanol. Natural gas vehicles can operate on biogas from the sewage treatment plants as well as landfills. And this is being done in Sweden today, with Volvo involved in that. Diesel can be replaced or supplemented with biodiesel. And hydrogen can be made not just from fossil fuels but from wind and solar. And we all know that's an important distinction. The Board has the authority to move the state in the direction of cleaner fuels, just like the Governor is now attempting to do with this hydrogen highway. It would only be natural for us to take his lead and to target cleaner fuels for all of our cars. It's the right thing to do and it will further enhance the excellent start being made with this regulation today. (Dr. Russell Long, Executive Director, Bluewater Network)

Agency Response: During the workshop process several commenters suggested that ARB should incorporate revisions to its fuel standards into the AB 1493 rulemaking process. Staff considered the issue and determined that under the current circumstances mandated use of low greenhouse gas fuels would not pass the cost-effectiveness test imposed by AB 1493, which requires that the reductions must be "economical to the consumer over the lifecycle of the vehicle". Staff therefore excluded consideration of fuels from this rulemaking. However the ARB and the State of California have a longstanding interest in alternative fuels and staff will continue to explore opportunities to encourage use of low greenhouse gas fuels throughout its other programs.

(2). Section 6.2—Determination of Effect of Standard on the Fleet

329. Comment: The proposed rule will result in the overall down-weighting of the California motor vehicle fleet in order to comply with the proposed standards, as well as weight reductions in some vehicles in order to reduce fuel consumption. This issue is completely ignored by the staff report, which simply assumes for purposes of its analysis that the fleet will not lose weight (while conceding that it may). Appendix C explains why weight reductions are inevitable. (Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. The proposed requirements were developed in accordance with the directive to not require down-weighting. As such, the technologies identified by staff would be capable of meeting the proposed requirements without down-weighting. Also, as was demonstrated by the Sierra Research analysis,

down-weighting may not be a cost effective means of complying with the proposed requirements. That analysis relied heavily on down-weighting to achieve the proposed standards, thereby greatly inflating the cost of compliance. Also, we note the commenter's understanding that complying with the proposed standards and reducing fuel consumption are separate issues subject to separate standards with separate considerations. See also response to comment 254.

330. Comment: There has been no concrete recognition of how the effects of the technologies assumed in CARB's analysis will affect noise, vibration, and harshness or drivability, or how adverse impacts on these attributes will be mitigated. This is a significant issue with respect to several of the technologies. For example, significant benefits are assigned to the use of automatically shifted manual transmissions (AMTs). However, NESCCAF subcontractor AVL has advised that its modeling of ATM did not address the drivability problem associated with a loss of torque transmission during gear changes with this technology. (Sierra Research Report No. SR2004-09-04, Appendix C to the letter from Alliance of Automobile Manufacturers)

Agency Response: This is incorrect. As staff indicated previously (see responses to comments 159, 162 and 195) noise, vibration, and harshness (NVH) concerns were considered, with additional measures included for cylinder deactivation as one example. Staff also mentioned its assessment that a 5 cylinder turbocharged engine might be a better replacement for a V-6 engine than a turbocharged 4 cylinder engine. Further, staff drove a dual wet clutch automated manual transmission and concluded that the quality of the gear shifts was second to none. Clearly, staff considered NVH issues and adjusted its scenarios accordingly and included added costs to address them where needed.

331. Comment: Fuel economy levels in the ISOR cannot be achieved, within the time periods provided, by adding technology, even including technologies beyond those identified in the ISOR. Therefore full line manufacturers such as DaimlerChrysler will need to limit consumer choice of new vehicles in California and other states adopting California's LEV II Regulations. Manufacturers whose market mix is focused towards larger vehicles are most negatively impacted by the ISOR's regulatory structure. (DaimlerChrysler)

Agency Response: Staff disagrees with the comment. There is no evidence that industry has properly considered the technology improvement paths identified by ARB staff as means to achieve the proposed requirements. Industry has not performed the necessary modeling of the technology combinations to be able to conclude that the approaches outlined by ARB staff would not work. Instead they have resorted to modeling draconian measures that incur excessive costs to accomplish the pollutant reductions. Such an analysis is not useful or credible.

332. Comment: According to the US EPA, the average vehicle weight of Passenger Cars has been increased around 0.7% per year for over ten years. This trend is due to strengthening safety regulations and customer demands and has a direct negative impact on vehicle fuel economy.

During this same period, fuel efficiency technology developments have provided an average of 1% improvement annually. (Annual improvement of 1% is derived from actual vehicle test data and is the benchmark for our powertrain design goals.) Despite fuel efficiency technology improvements, overall CAFÉ has not improved because increased vehicle weight cancels the effects of technology improvement. (Ellen J. Gleberman, Mitsubishi Motors North America, Inc.)

Agency Response: The conclusion reached by ARB staff, working in consultation with NESCCAF and AVL/Martec, was that weight will not continue to increase in new vehicles except for small cars. This conclusion was based on information relating to weight trends, taking into account federal fuel economy provisions being implemented for trucks.

333. Comment: Mitsubishi's current CAFÉ fuel economy goal is 27.5 mpg for the 2007 MY. Mitsubishi, as an Independent Intermediate Volume Manufacturer, would be required to meet a fuel economy goal of 38.4 mpg for the 2016 MY. This is a 40% net increase over a period of 9 years or 4.5% per year.

To meet this goal, we plan to utilize the proven 1% technology-based annual fuel efficiency increase for improvement in vehicle fuel economy. The remaining 3.5% annual improvement in fuel economy will be made through reduction in vehicle weight. This level of weight reduction is not possible in all our vehicle offerings. Therefore, we will be required to change our product offerings for the State of California specially to meet these requirements. This line up change would reduce the quantity or eliminate sales of larger, heavier vehicles to lower the overall fleet average weight.

Based on the conclusions of this study, MMC finds that the proposed regulation is too aggressive to satisfy, and MMNA and MMC request the ARB reconsider the regulation. (Ellen J. Gleberman, Mitsubishi Motors North America, Inc.)

Agency Response: Staff disagrees with the comment. Mitsubishi has not demonstrated that staff modeling efforts are incorrect or that the technologies outlined by staff could not be successfully implemented in its full product line in the timeframe that would be required. Weight reduction was not needed to meet the proposed greenhouse gas reductions based on our modeling results.

334. Comment: Total light duty truck sales (i.e., the sum of LDT1, LDT2, and MDV vehicle classes) are estimated by EMFAC2002 to decrease between the 2000 and 2006 model years. This is counter-intuitive, and it is unlikely to track reality. In addition, the EMFAC2002 estimates are inconsistent with the car/truck split that the ARB staff has used for a number of its economic analyses. For example, Table 6.1-4 of the August 6, 2004, staff report lists the PC/LDT1 versus LDT2 (which includes the EMFAC2002 LDT2 and MDV classes) split as 53 percent versus 47 percent for the six major auto manufacturers in 2002. However, the EMFAC2002 model estimates the split to be 72 percent versus 28 percent in 2002, and the discrepancy grows to 78 percent PC/LDT1 versus 22 percent LDT2 in 2010. (NERA Economic Consulting and Sierra Research, Environmental and

Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, page B4-23)

Agency Response: The car/truck splits shown in Table 6.1-4 are derived from California Department of Motor Vehicles (DMV) records for registered 2002 model year vehicles. The car and truck population data in EMFAC2002 are based on 1999 DMV records, which were the most current data available when the model was developed. Projections of future model year car and truck populations are based on historical trends up through 1999. It is acknowledged that EMFAC2002 may not reflect all changes in the car/truck sales mix occurring in calendar year 2000 and later. This is why staff chose to use the latest data available, in this case 2002 model year data from DMV, in assessing costs and benefits for the regulation.

(3). Section 6.4—Treatment of Upstream Emissions

335. Comment: In Table 6.4-1 itself, the ratio of 0.31 for upstream CO₂ divided by exhaust CO₂ for RFG is too high. A more realistic value, supported by widely accepted and credible estimates in the literature is about 0.25. Note that this is consistent with the 20% value mentioned above for the upstream divided by total (upstream plus exhaust) CO₂ emissions. For diesel, the ratio of upstream CO₂ divided by exhaust CO₂ would be about 0.20 (and consistent with the 15% of total CO₂ for diesel mentioned above). (WSPA, API)

Agency Response: The 0.31 ratio is based on a vehicle CO assumption consistent with existing vehicles and is consistent with other studies and reflects the use of California reformulated gasoline. The estimates contained in the ISOR are somewhat greater as they are derived using the marginal rather than average transportation energy inputs used by the U.S. Energy Information Administration. Modifying the estimates to account for California specific emissions increases the estimates by roughly 15 percent as noted in the comment.

336. Comment: It also appears that the fuel economy assumed for the HEV20, when it is using gasoline, is nearly twice that assumed for the conventional car, despite its added battery weight. In addition, its assumed electricity consumption, and that of the full electric vehicle, is more in line with electricity use by the small, 2-seat EV1 than by larger vehicles truly comparable in size and utility with a conventional car. (WSPA, API)

Agency Response: To estimate fuel usage as an impact of reducing greenhouse gas emissions for HEV20's as contained in Table 5.4-1, ARB staff used the results from an EPRI study entitled "Comparing the Benefits and Impacts of Hybrid Electric Vehicle Options." This study brought together representatives from the utility and automotive industries, the Department of Energy, regulatory agencies and academia to assess the performance and costs of a variety of HEVs, including HEV20s. There are several reasons for the improved fuel usage rate noted in the comment. The most significant include: consistent vehicle operation at the engine's peak efficiency, a reduction in engine size and weight due to the electric motor, and recovery of energy through regenerative

braking. The study projects that these benefits would result in a range of fuel usage rates. The rate used in the ISOR falls within the results of the study.

337. Comment: There also are some serious inconsistencies with Table 6.4-1 and the related discussion on page 125. At the top of page 125, the statement that “approximately 31% of the total CO₂ emissions associated with conventional gasoline-fueled vehicles are a result of upstream emissions” is in error. As noted above, it overstates the upstream contribution by more than 50%. It is further stated at the top of page 125 that “diesel fueled vehicles result in approximately the same upstream emissions fraction as gasoline vehicles.” This statement also is in error: the fraction is closer to 15%, so in this case the assumed 31% fraction is mistaken by about a factor of two. (WSPA, API)

Agency Response: ARB staff agrees that the statement on page 125 is inconsistent with the results in Table 6.4-1. The statement identified in the comment should read “Fuel cycle emissions represent approximately 31% of the direct CO₂ emissions from conventional gasoline-fueled vehicles.” While the statement is confusing, the results in Table 6.4-1 are accurate based on the methodologies used by TIAX. These results were used to establish the adjustment factors contained in the regulation. Correcting the statement as noted above would also address the comment regarding diesel-fueled vehicles.

338. Comment: Table 6.4-1 lists another set of “upstream adjustment factor[s] for alternative fuel vehicles” that are in certain cases inconsistent with Table 5.2-13. For example, following the format of Table 6.4-1, the CO₂ adjustment factor is 1.03 for compressed natural gas in Table 6.4-1, but a comparable calculation (ratio of upstream emissions to exhaust emissions) yields a factor of 0.96 in Table 5.2-13. (WSPA, API)

Agency Response: The emissions data used to determine the adjustment factors reflect new information developed during the regulatory process subsequent to the initial estimates of the emissions from alternative fuels. Where differences occur, ARB staff has relied on the estimates contained in 6.4-1 to establish the adjustment factors.

339. Comment: The adjustment factor for “electricity” in Table 6.4-1 is 115 g/mi but the factor in Table 5.2-13 is 150 g/mi as upstream CO₂ emissions for electricity. The text of the ISOR does not explain why these differences exist, which set is more accurate, and it is not clear which set of adjustment factors would be used if the proposed regulations are implemented. (WSPA, API)

Agency Response: The adjustment factor in Table 6.4-1 is consistent with the vehicle data presented in Table 5.2-13. An explanation for this difference is contained in footnote 2 of Table 6.4-1. The footnote indicates that the emissions for those fuels with no direct emissions have been reduced by 31 percent to be consistent with the adjustment factors for vehicles with direct emissions (150 g/mile divided by 1.31 = 115 g/mile).

340. Comment: Of particular significance is that the single “default” CO₂ adjustment factors for electric and hydrogen vehicles do not reflect actual fuel economy or electricity

use of the range of these types of vehicles. The default values are based on optimistic energy efficiency assumptions for small vehicles that are unlikely to be representative of most actual vehicles of this type that would be placed into service. An actual fuel economy value, in miles per kg for hydrogen or kWh per mile of electricity use, should be incorporated to accurately credit these vehicles for actual CO₂ reduction. (WSPA, API)

Agency Response: Several vehicle technologies required special consideration in calculating their overall climate change emissions. For vehicles using hydrogen or electricity, an adjustment factor based on information from DOE was used to adequately assess the vehicles' emissions impact. The fuel usage rate of 32 miles per kilogram for hydrogen combustion vehicles and 45 miles per kilogram for hydrogen fuel cell reflect existing technology in small to mid-sized sedans. ARB staff expects that improvements in technology by 2009 justify the moderately lower estimates found in Table 6.4-1. In addition, the regulation provides an opportunity for the EO to adjust these values in the future should changes in vehicle performance or hydrogen production so warrant.

(4). Section 6.5—Early Reduction Credits

341. Comment: Early reduction credits are an important mechanism that creates positive incentives for research into and development and commercialization of new technologies. The proposal strikes an appropriate balance by establishing incentives for early reductions without undercutting the standard by providing excessive credits for past actions or a business-as-usual trajectory. While the proposal does not anticipate that any manufacturer would earn early reduction credits based on current plans, the value of an early reduction credit program is that it will provide incentives for manufacturers to alter their current plans in favor of earlier reductions in motor vehicle GHG emissions as a means of accumulating credits. (John M. DeCicco, Ph.D., and Kate M. Larsen, Environmental Defense; letters of support also received from Natural Resources Defense Council, Bluewater Network, Environment California, Communities for a Better Environment, Union of Concerned Scientists, Sierra Club, Coalition for Clean Air, Conservation Law Foundation, Alliance for a Clean Waterfront, As You Sow, The David Brower Fund, Clean Water Action, Coalition of Concerned National Park Retirees, Community Clean Water Institute, National Parks Conservation Council, Neighborhood Parks Council, Rainforest Action Network, San Francisco Bicycle Coalition, San Francisco Tomorrow, Santa Barbara Channelkeeper, Vote Solar Initiative, Community Action to Fight Asthma)

Agency Response: Staff agrees with the comment.

(5). Section 6.6—Alternative Compliance Strategies

342. Comment: Although AB 1493 requires CARB to adopt regulations that allow manufacturers to use “alternative” compliance methods, the ISOR describes restrictions on the allowable alternatives that would eliminate all alternatives except for emissions

reductions from vehicles subject to the statute in California. (Sierra Research Report No. SR2004-09-04, Appendix C to the letter from Alliance of Automobile Manufacturers)

Agency Response: AB 1493 directed that the regulations must provide flexibility, to the maximum extent feasible consistent with the overall requirements of the bill, in the means by which a person subject to the regulation may comply. That flexibility shall include, but is not limited to, authorization for a person to use alternative methods of compliance with the regulation. The Board must ensure that any alternative methods for compliance achieve the equivalent, or greater, reduction in emissions of greenhouse gases as the emission standards contained in the regulation. In providing compliance flexibility, the Board may not impose any mandatory trip reduction measure or land use restriction.

As required by the legislation, the regulation allows manufacturers significant flexibility in complying with the proposed emission standards. Specifically, the regulation allows manufacturers to average emissions across their vehicle models, aggregate the different climate change pollutants, bank excess credits for later use, and trade credits in order to meet the climate change emission standards.

With regard to alternative compliance, the statutory language clearly states that the use of alternative compliance strategies must not undercut the primary purpose of the regulation, which is to achieve greenhouse gas reductions from motor vehicles. Accordingly, the alternative compliance program applies to vehicles that are regulated through AB 1493, and their fuels. This ensures that the program does not dilute the technology-forcing nature of the regulation, since the goal is to improve the vehicles themselves. The major features of the alternative compliance mechanism are:

- Projects must be located in California to be eligible,
- Companies regulated by AB 1493 (automakers) are eligible to apply,
- Vehicles regulated under AB 1493 (model year 2009 and later passenger vehicles, light-duty trucks and other vehicles used for noncommercial personal transportation in California) are eligible for alternative compliance credits, and
- Eligible projects are limited to those that achieve greenhouse gas reductions through documented increased use of alternative fuels in eligible vehicles.

See also agency response to comment 574.

343. Comment: We agree that the proposal's approach for allowing automakers flexibility in meeting the standards is an effective way to ensure compliance and reduce costs. The primary flexibility mechanisms (aggregating, averaging, banking and trading) will provide automakers with the ability to tailor their own most efficient compliance route, allowing for innovation and creative solutions to achieve emissions reductions.

Alternative compliance projects are an important way of ensuring that reductions are achieved in the most cost-effective and efficient manner. To guarantee that actual reductions take place, such projects must fulfill the principles applicable to pollution credits under the Clean Air Act. They must be real, quantifiable, surplus, enforceable, and

permanent. Furthermore, they must not jeopardize other environmental objectives of the State. The proposal's restriction of alternative compliance projects to sources that fall within its sphere of regulatory authority, namely, MY2009 and later vehicles, meets these principles and ensures administrative convenience as CARB and regulated entities transition into compliance. (John M. DeCicco, Ph.D., and Kate M. Larsen, Environmental Defense; letters of support also received from Natural Resources Defense Council, Bluewater Network, Environment California, Communities for a Better Environment, Union of Concerned Scientists, Sierra Club, Coalition for Clean Air, Conservation Law Foundation, Alliance for a Clean Waterfront, As You Sow, The David Brower Fund, Clean Water Action, Coalition of Concerned National Park Retirees, Community Clean Water Institute, National Parks Conservation Council, Neighborhood Parks Council, Rainforest Action Network, San Francisco Bicycle Coalition, San Francisco Tomorrow, Santa Barbara Channelkeeper, Vote Solar Initiative, Community Action to Fight Asthma)

Agency Response: Staff generally agrees with the comment. Staff notes that California is not required to meet the stated federal principles, but rather ARB's practice is to apply those principles.

344. Comment: We support early compliance and alternative compliance measures that are in this rule and they're in your other rules, and hope you continue that practice. (Bob Lucas, California Council for Environmental and Economic Balance)

Agency Response: As suggested by the comment and as required by AB 1493, the regulation includes early compliance and alternative compliance provisions. No other response needed.

e. ISOR Section 8—Environmental Impacts

(1). Section 8.2—Emissions Benefits of Proposed Regulation

345. Comment: The fleet-wide CO₂ reductions expected to be achieved in Europe cannot be realized in the California market when the same technology measures are applied. (BMW Group)

Agency Response: ARB does not expect that the fleet-wide CO₂ reductions being realized in Europe would be duplicated in California. Staff's evaluation consisted of the application of appropriate greenhouse gas emission reduction technologies to the California fleet, not the European fleet.

346. Comment: Absent a standard or other public health goal applicable to California, the number of tons per day of CO₂ reductions (86 tpd in phase I) stands devoid of a context of its meaning. Context is necessary to support the allocation of resources to this effort as opposed to other expenditures to attain public health goals. (Bob Lucas, California Council for Environmental and Economic Balance)

Agency Response: Context for the magnitude of this emission reduction is provided by the statewide inventory information presented in the Initial Statement of Reasons. The emission reduction achieved by this regulation (86,000 tons per day, not 86) represents one of the most significant measures that California can take to reduce its greenhouse gas emissions. Greenhouse gas emissions from light duty motor vehicles are a significant fraction of the statewide total.

(2). Section 8.3—Emission Impact of the Staff Proposal in a Broader Context

347. Comment: Many people are asking if what California doing meaningful? There are many unilateral actions, as Supervisor Roberts said. There are many people making decisions, both multinational companies and countries in Europe, that are already making decisions to make cuts of the scale that California's proposing unilaterally.

And so is it meaningful and is it being done elsewhere? For perspective, the scale of California is the scale of Kyoto almost, per nation, okay, the percentage reductions. If California's reductions in emissions apply to the rest of the U.S. for transportation alone, it would be the scale of what the U.S. would take to meet Kyoto. That won't happen. But at least that's the scale of the argument. So is it meaningful? Yes. These are large numbers. They do have a large impact. And we're seeing similar multinational high quality -- you know, high cost efforts being made by countries, by basically companies and others. (Michael Prather, University of California at Irvine)

Agency Response: Staff agrees with the comment and notes that the reductions here are comparable to those required of many Kyoto parties. No further response needed.

348. Comment: The other point I'd like to make is the -- the impact of California action cannot be overstated. My colleague, David Doniger, mentioned three ways for which this is going to impact pollution outside the state. And what I would like to reinforce is a consistent track record again of California action on air pollution being emulated nationally and by other states.

Starting in the early '60's California was the first ever state or government agency to regulate pollution for motor vehicles, positive crankcase ventilation, emulated later federally and in other areas. 1966 California adopted the first ever pollution tailpipe standard for carbon dioxide and hydrocarbons, adopted federally in 1968. And in 1970's a huge success story. First ever requirement for catalytic converter here in California. California stood up the automakers when they claimed economic calamity and high cost. And of course the catalytic converter is a huge clean air success story.

This story continues. 1990, first unleaded gasoline or for made gasoline, coming across the U.S. and now internationally. 1994 LEV program. Four northeast states adopted that. Eventually became the model for the national LEV program.

California's LEV II program, which is a current criteria pollutant -- smog-forming pollutant control program. That has been adopted by seven northeast states and has served as a model for the current federal program -- Tier 2 program.

2009 when these California CO₂ standards take effect, we believe -- if you look at the past history and you look at the intentions from New York State, Canada and elsewhere, have indicated interest in adopting these standards.

I think that this is the most important air pollution standard since the adoption of the catalytic converter in the 1970's. In the 70's smog was a big problem for California. Still is a big problem. These big problems require big solutions. And I think that California's standards today is a meaningful solution to a big problem. (Roland Hwang, Natural Resources Defense Council)

Agency Response: Staff agrees with the comment. No further response needed.

349. Comment: Climate change has to be debated and it has to be addressed at the global level. (Fred Webber, The Auto Alliance)

Agency Response: The passage of Assembly Bill 1493 in 2002 directed the California Air Resources Board to develop greenhouse gas emission standards for passenger vehicles. The legislation explicitly discussed the rationale for the direction to develop regulations (i.e., concerns over the impacts of climate change on California). Thus the commenter is questioning the merits of the enabling legislation, not the Board's implementation of its directives. The regulations that the Air Resources Board staff developed in close coordination with a broad spectrum of stakeholders through a series of workshops and public comment periods are consistent with the direction given by the Legislature.

It is true that the contribution to a reduction in global warming from the actions of California alone will be small. This is true of any individual contribution. The point here is that human-induced climate change is a truly global problem – one that will eventually require actions by all countries. By assuming a leadership role, California will show the way for other states and countries, and eventually reap the benefits of more widespread emission reductions. Just as the Kyoto Protocol is only a first step towards solving the climate change problem, so, too, is California's proposed action a first step towards more geographically comprehensive actions. Without this first step, California, the U.S., and all countries will be subjected to the consequences of unmitigated climate change.

350. Comment: As the ARB Governing Board meets to consider the adoption of these regulations, the following issues deserve the Board's most diligent consideration:

- Greenhouse gases need to be addressed on a global level. The effect of greenhouse gasses is transnational.
- No state, including California, has the authority to regulate CO₂ emissions or fuel economy.
- Additionally, Toyota is unable to support state-specific regulation of CO₂ from motor vehicles—notwithstanding preemption—because doing so may require us to (1) design unique vehicles for the state, and/or (2) restrict vehicle choice in the state. (Dave Baxter, Toyota Technical Center USA)

Agency Response: See response to comments 349, and 587 through 593.

351. Comment: CCEEB does not object to sensible greenhouse gas rules, particularly if they're implemented at the national or the international level. But we do have concerns of unanticipated impacts of unilateral state action. (Bob Lucas, California Council for Environmental and Economic Balance)

Agency Response: See response to comment 349.

352. Comment: Efforts to address climate change at the state level are doomed to be ineffective as they ignore the vast differences between air pollution and climate change. Congress properly recognized these differences when they've preserved federal authority over such regulations. AIM urges ARB to work with other states to build consensus for a national climate protection program and a national energy policy. AIM also urges ARB to work the National Highway Traffic Safety Administration to develop an improved national motor vehicle fuel economy program. AIM is prepared to work with ARB to pursue other measures to address climate change. (John Cabaniss, Director of Environment Energy, Association of International Automobile Manufacturers)

Climate change gases cannot be effectively be regulated state by state, because they are fundamentally different from criteria air pollutants. Throughout the entire Staff Report, ARB treats climate change gases the same way it treats criteria air pollutants. This is a fundamental error that distorts all of ARB's analyses. (Statement of John Cabaniss, 9/23,04).

Air pollution is primarily a local problem. Climate change is truly a worldwide phenomenon, as it makes no difference where the carbon dioxide or other greenhouse gas emissions occur. (Statement of John Cabaniss, 9/23/04).

Agency Response: Note that criteria air pollutants – which are regulated state-by-state as noted – are clearly known to have inter-state and international impacts on air quality. These impacts are far outside the urban region in which they are emitted. The same is true of CO₂. All of these pollutants are transboundary.

To the extent that the commenter implies that Congress preserved exclusive federal authority over climate change regulation the ARB disagrees; this is one issue in the current D.C Circuit case No. 03-1361 et. al. (consolidated).

353. Comment: California's air quality needs are special in many respects, but California does not have a special or unique situation with respect to global climate change. (Statement of John Cabaniss, 9/23/04).

Agency Response: See response to comment 349.

354. Comment: A global climate program can only be effective if it is a coordinated national effort. While global climate change cannot be effectively addressed at the state level, California, working with Western and other interested states, can and should have an important role in helping develop the U.S. climate change policy. AIAM urges California to focus its efforts on working at the national level to have a truly effective U.S. global climate change policy. Additionally, with respect to fuel economy regulations, the National Highway Traffic Safety Administration (NHTSA) has just begun a process for improving the CAFÉ program. NHTSA's rulemaking is one appropriate venue for addressing vehicle fuel economy (and consequently carbon dioxide emissions). (Statement of John Cabaniss, 9/23/04).

Agency Response: See response to comment 349.

355. Comment: There are other things that California can do as well. I mean there are many fuel-efficient cars that are already being manufactured and that are available. If we could get consumers to buy those and use them, then we would be better off as well in terms of climate change emissions. Things like purchase incentives, better education of consumers. There's any number of things that California and local governments can do that they don't do to help educate consumers about what they're purchasing -- the impacts of the vehicles they're purchasing.

And, another thing that California can continue to do, which they've had a very strong record in doing, is supporting good fuel quality programs, low sulfur diesel fuel, low sulfur gasoline that enable fuel-efficient technologies to be brought to market. So there are any number of things that California can do. We just do not support you setting standards for fuel efficiency. (John Cabaniss, Director of Environment Energy, Association of International Automobile Manufacturers)

Agency Response: Since ARB is setting a greenhouse gas standard, and not a fuel efficiency standard, this comment is arguably irrelevant.

The ARB and other agencies have, and continue to promote reductions in both criteria pollutant and climate change emissions. The regulation developed per AB 1493 is but one piece of the state's strategy to reduce these emissions. There are other regulations, incentive programs and education efforts that promote the use of clean vehicle technologies and fuels. The ARB will continue to promote these activities in parallel with program implementation.

356. Comment: The market also plays a key role. The low fuel prices and customer demand for other features, such as comfort, power, utility, and safety, make it very difficult to promote GHG reductions in the U.S. Market drivers need to be part of the solution. Honda would be happy to assist ARB in the development of incentives and education to promote lower greenhouse gases. We also urge California to work with other states to build consensus for a national climate protection program and to develop an improved national motor vehicle fuel economy program. (American Honda Motor Co.)

Agency Response: The comment presumes that technologies staff has identified for reducing greenhouse gas emissions would also affect consumer preferences. Staff has endeavored to ensure that consumer preferences would not be affected. Model availability would not be affected, vehicles would have slightly improved performance compared to today, effects on noise, vibration and harshness have been considered, operating costs will be reduced and other factors that could affect consumer choices have been evaluated to ensure that consumers would still find the vehicles attractive. We do appreciate the commenter's apparent understanding that climate protection and fuel economy are separate programs.

357. Comment: To the extent that ARB is able to reduce the local greenhouse gas inventory, any positive benefits for the state will only occur if other sources of greenhouse gases, most notably those of developing countries in the world -- and I think here of China and India -- if they're taking steps to regulate greenhouse gas emissions, and you and I know so far that is not the case. Controlling greenhouse gas emissions is indeed an energy-related issue that is being debated internationally and, in our opinion, can only be effectively addressed on a global basis.

According to the ARB staff report, California light-duty vehicles subject to this regulation account for about 2 percent of the total U.S. greenhouse gas emissions. The U.S. produces about 25 percent of worldwide greenhouse gas emissions. Thus California light-duty vehicles subject to this regulation account for about one half of one percent, .5 percent of the global greenhouse gas inventory. According to the staff report, the proposed regulations reduce emissions by an average of 27 percent. The ARB staff estimate that these regulations would reduce global greenhouse gas emissions by about one-tenth of one percent is documented in their report.

Let me put that in perspective. Even if ARB eliminated every -- say you had the power to eliminate every light-duty vehicle on the road, take it off the road, the global greenhouse gas inventory would not measurably change. And there would certainly be no identifiable changes in climate in the state of California. In fact, the regulations being proposed here will have no impact on the climate in California and, by extension, no impact on global climate. Indeed, the staff report does not claim any significant air quality benefit and does not attempt to quantify a single health benefit, as we learned earlier during the Q and A session.

California regulators have chosen to single out California drivers to pay that \$3,000 surcharge, which amounts to in the aggregate \$6 billion a year, with no health or environmental benefits to its citizens.

And despite the absence of any demonstrable environmental or health improvement in California, Californians will be paying more, \$6 billion more each year for their vehicles as a result of this proposal. You know, I'm from Washington, but I still think \$6 billion is a lot of money. (Fred Webber, The Auto Alliance)

Agency Response: See response to comment 349. The same comment could be directed at Kyoto parties with greenhouse gas emission reduction requirements similar to those adopted here, but we would hope that the commenter would avoid similarly maligning those countries.

In addition, staff disagrees with the commenter's assessment of the costs and benefits of the regulation for California citizens. Detailed responses to comments on these issues are contained in section III.A.2.c.

358. Comment: The staff report discusses the potential adverse environmental impacts associated with the global climate change, citing possible impacts on public health, air and water quality and agricultural productivity. However, neither the staff report nor the cited supporting materials provide any evidence that such impacts would be mitigated in any way by the proposed regulation. In fact the staff report states the opposite view, pointing out that California's greenhouse gas emissions are only a tiny fraction of worldwide emissions. (John Cabaniss, Director of Environment Energy, Association of International Automobile Manufacturers)

Agency Response: It is true that the contribution to a reduction in global warming from the actions of California alone will be small. This is true of any individual contribution. The point here is that human-induced climate change is a truly global problem – one that will eventually require actions by all countries. By assuming a leadership role, California will show the way for other states and countries, and eventually reap the benefits of more widespread emission reductions. Just as the Kyoto Protocol is only a first step towards solving the climate change problem, so, too, is California's proposed action a first step towards more geographically comprehensive actions. Without this first step, California, the U.S., and all countries will be subjected to the consequences of unmitigated climate change.

359. Comment: Climate change gases are fundamentally different from criteria air pollutants. Vehicles are designed, built, distributed, and marketed for the entire U.S. market, not just for California. While development of ultra-efficient catalysts and improved combustion chamber design made it feasible to design a different emission system for California, the ARB greenhouse gas proposal would require changes to every aspect of the vehicle and powertrain. This is fundamentally different from emission control and just does not work at the state level. Climate Change is a global issue and it is appropriate to

handle GHG/FE policy and regulations at the national and international level. (American Honda Motor Co.)

Agency Response: See response to comment 268.

360. Comment: Although the section of the August 6 ISOR dealing with the environmental and human health impacts of climate change is designed to create the impression that the regulation of greenhouse gas emissions from vehicles sold in California will be beneficial, there has been no attempt to quantify the benefits. Neither is there any analysis showing that the proposed regulation would actually result in a net reduction in greenhouse gas emissions on a global basis. (This is a significant issue given the flexibility manufacturers have under the federal CAFÉ standards to offset the sale of vehicles with higher fuel economy in other states.) (Sierra Research Report No. SR2004-09-04, Appendix C to the letter from Alliance of Automobile Manufacturers)

Agency Response: Throughout the rulemaking process, some commenters questioned the value of California action, stating that measures adopted in California will have no discernable effect on global climate change and thus no effect on the potential public health and environmental consequences of climate change in California. Staff has acknowledged that greenhouse gas emissions from California light duty vehicles are a small fraction of the global total. It does not necessarily follow, however, that California should do nothing. Rather, there are several compelling reasons to move forward with state regulation, even while recognizing that by itself it will not solve the climate change problem. First of all, the approved regulation is a “no regrets” policy that reduces climate change emissions but at the same time provides economic benefits to the state. Second, California is not acting in isolation. Other states in the United States, and other countries internationally, have already taken or are contemplating steps to reduce greenhouse gas emissions from a variety of sectors and sources. Finally, the longstanding technology-forcing role of California regulation should not be understated. There have been many instances where other jurisdictions have adopted motor vehicle controls that were pioneered in California. Thus there is potential for the new regulation to spread to other jurisdictions and add momentum to the already existing measures that are underway around the globe. The approved regulation represents California’s contribution to the solution to this global problem, and as part of ongoing, broader efforts will help to protect the public health of California’s citizens.

Staff is unable to speculate about any potential strategies manufacturers may use to meet future CAFE requirements and any such debate is extraneous to the purpose of this regulation, which is to reduce greenhouse gas emissions from the California fleet in accordance with the requirements of AB 1493. Nonetheless, staff believes that vehicles designed to meet California's greenhouse gas requirements will be attractive to consumers outside California due to their lower impact on global warming, lower operating cost, and cost effectiveness to the consumer (see responses to Comments 249, 284, and 356.) Furthermore, there is a strong indication that states that have already adopted California's Low-Emission Vehicle Program will also adopt California's greenhouse gas regulations (see Comment 19). To the extent that this occurs it will make it more cost effective for

automakers to manufacturer vehicles that can be sold in all 50 states rather than manufacturer multiple versions of the same vehicle.

361. Comment: The regulation will have no measurable impact on ambient CO₂ levels. (DaimlerChrysler)

Agency Response: The regulation assuredly will have a measurable impact on tailpipe CO₂ and other vehicular greenhouse gas emission levels, and will be part of broader efforts in combination with numerous climate change emission reduction and energy conservation measures undertaken worldwide by governments, regulatory agencies, and industry. See also the response to comment 360.

362. Comment: In the unlikely event of nationwide compliance with the proposed standards, my analysis indicates that the long-term change in greenhouse gas emissions will reduce ambient temperatures in California by less than 0.001°C. Using EPA's Empirical Kinetic Modeling Approach (EKMA), my analysis indicates that the reduction in ambient ozone concentrations associated with that change in temperature would be less than 0.02%, which is not measurable. (Declaration of Thomas C. Austin, Appendix C to the letter from the Alliance of Automobile Manufacturers)

Agency Response: See response to comments 79 through 91 and 109 through 137.

363. Comment: Because the national CAFÉ standard is binding, a mandatory reduction in the fuel consumption of California vehicles results in a deterioration of the fuel economy of vehicles sold outside of California and this will lead to an increase in fuel usage in those other states. Mandating more stringent CO₂ standards in California would free up manufacturers to offer the larger, safer, and more powerful vehicles that consumers prefer in the other states, thus at least partially offsetting the fuel savings in California. (General Motors)

Agency Response: This comment is misleading in several respects. First, the commenter implies that California is setting vehicle fuel economy standards rather than greenhouse gas emissions standards. While a side benefit of these standards may be reduced fuel usage in California, the primary purpose of these regulations is to reduce the impact of California's vehicle fleet on global warming. Second, the national CAFÉ standard is the minimum corporate average fuel economy level that a manufacturer must meet. It does not prohibit a manufacturer from selling vehicles with greater fuel economy than the CAFÉ standard. Therefore, a reduction in the fuel consumption of California vehicles does not necessarily cause a "deterioration of the fuel economy of vehicles sold outside of California." If it does, it is entirely the result of manufacturers choosing to sell more efficient vehicles in California and less efficient vehicles elsewhere. Third, the commenter implies that because of the greenhouse gas regulations, manufacturers will be severely limited in the types of vehicles they can sell in California. To the contrary, the greenhouse gas regulations were crafted specifically to ensure that this would not be the case. ARB evaluated the technological feasibility of the proposed standards on several different vehicle classes, including large cars, trucks, and sport utility vehicles. Then a fleet

average emissions approach was used to reduce greenhouse gas emissions, which allows a manufacturer to sell vehicles with higher emissions than the “standard” provided those emissions are offset by vehicles with lower emissions. In addition, the commenter seems to ignore recent surveys, in which over 80 percent of Californians polled indicate their support for reducing greenhouse gases from motor vehicles. Other states that have already adopted California’s LEV II program, such as New York, have also indicated their interest in adopting California’s greenhouse gas regulations. This demonstrates that concerns about global warming extend beyond California and vehicles with lower greenhouse gas emissions will be attractive to consumers in other states. See also the response to comment 360.

364. Comment: The National Research Council in its 2002 study of CAFÉ, concluded, “The CAFÉ program has been particularly effective in keeping fuel economy above the levels to which it might have fallen when real gasoline prices began their long decline in the early 1980s,” (NRC, page 3). A published and refereed study by Professor Andrew Kleit, then of the Pennsylvania State University, concludes that CAFÉ is binding by about 1.5 mpg for both cars and trucks. (“Impacts of Long-Range Increases in the Fuel Economy (CAFÉ) Standard,” *Economic Inquiry* (April 2004), pages 279-294) These studies imply that leakage caused by this regulation could be significant and the environmental benefits stated in the ISOR considerably overstated. California consumers could be negatively impacted by this regulation in return for little or no fuel reduction. This issue deserves analysis by ARB. (General Motors)

Agency Response: See response to comment 363.

365. Comment: In Sections 2.6 and 8.3 of the August Staff Report, the ARB Staff infers that one of the benefits of the proposed regulations would be a reduction in tropospheric ozone concentrations. The ARB Staff notes that there is a positive correlation between tropospheric ozone concentrations and higher temperatures, and suggests that because the proposed regulations will mitigate the temperature rise associated with global warming, they will also lead to lower ozone levels. In section 8.3, the ARB Staff also justifies California’s adoption of the regulation by noting that it could be a catalyst for the adoption of similar regulations in other states and perhaps nationwide, which would lead to even greater reductions in climate change gas emissions. However, the ARB Staff has made no effort to demonstrate that ozone levels would in fact be affected, nor has the agency quantified the degree to which the proposed regulations adopted either in California alone or in additional states could affect either temperature or ozone. (NERA Economic Consulting and Sierra Research, Inc., Attachment B-5, The Potential Effect of the Proposed Regulations on Ambient Temperature and Ozone Concentrations, September 2004).

Agency Response: ARB staff has identified an association between higher temperatures and ozone formation, but has not claimed specific ozone reductions from that mechanism as a result of this regulation. See response to comment 113. This is not surprising, as no ARB-adopted control measure—for example those focusing on criteria pollutants--projects specific ozone reductions or specific differences in ozone levels by a date certain. Rather,

such ARB control measures project reductions in ozone precursor emissions. Numerous state, federal and local control measures reduce ozone precursors that then ultimately lead to lower ozone levels. Likewise, here numerous state, local, international and hopefully U.S. control measures will reduce greenhouse gases and the resultant global warming that increases ozone formation, among other impacts.

In addition, staff identifies criteria pollutant emission reductions as a result of lower upstream emissions due to reduced fuel use. Specifically, ARB staff quantified the emission reduction in criteria pollutants for 2020 and 2030. The analysis calculated the reductions in criteria pollutant emissions using marginal fuel cycle emission factors based on an average vehicle. Staff estimates that the regulation will reduce “upstream” smog-forming emissions of hydrocarbons and oxides of nitrogen by approximately 6 tons per day in 2020 and 10 tons per day in 2030.

Manufacturers have argued that the regulation will actually significantly increase criteria pollutant emissions. This argument relies on the assumption that consumers will postpone the purchase of cleaner new vehicles due to the higher initial cost, and will increase their driving due to the reduced cost of operating the vehicles. As part of its comprehensive analysis of the potential effects of the regulation, staff retained experts at the University of California to evaluate each of these issues. In both cases the new studies found that the effect on emissions is small. These issues are further discussed in section III.A.2.i.

366. Comment: As outlined below, we have performed an analysis of this issue with the very optimistic assumption that the proposed regulations are adopted nationwide. Even with this optimistic assumption, our analysis indicates that the potential reduction in temperature in California will be on the order of 0.01°C and that the impact on peak ambient ozone levels in California will be on the order of 0.02 percent. The effect of adoption on the proposed regulations only in California on temperature and temperature driven changes in ozone levels would be substantially less. Our results demonstrate that the proposed regulations will have no discernable impact on temperature and that the very small increase in ambient temperature that would occur without their adoption will have no measurable impacts on peak ozone concentrations. Therefore, the ARB Staff cannot claim either reductions in ambient temperatures or temperature driven ozone levels as a benefit of the proposed regulations. However, as documented extensively elsewhere in this report, the proposed regulations will lead to significantly higher ozone levels as the direct result of an increase in emissions of ozone precursors. (NERA Economic Consulting and Sierra Research, Inc., Attachment B-5, The Potential Effect of the Proposed Regulations on Ambient Temperature and Ozone Concentrations, September 2004).

Agency Response: See response to comment 366.

367. Comment: Not only is this calculated temperature change exaggerated by assuming that all temperature change occurring during the last century was caused by anthropogenic carbon dioxide, it also assumes that measures taken to improve motor vehicle fuel economy in the U.S. would not affect carbon dioxide emissions elsewhere. In fact, reduced demand for petroleum in the U.S. would suppress petroleum prices

worldwide. This would be expected to lead to higher consumption and increased carbon dioxide emissions in other parts of the world. (NERA Economic Consulting and Sierra Research, Inc., Attachment B-5, The Potential Effect of the Proposed Regulations on Ambient Temperature and Ozone Concentrations, September 2004).

Agency Response: Most other jurisdictions with large current or emerging transportation based greenhouse gas emissions (Europe, Canada, Japan, China, Australia) already have in place voluntary or regulatory measures that directly or indirectly constrain greenhouse gas emissions from their fleet. Any potential increases elsewhere in the world due to California's regulation will be mitigated by such measures.

368. Comment: For reasons summarized above, the suggestion in the August Staff Report that the proposed regulations will yield meaningful reductions in temperature and ozone concentrations as the result of reduced global warming is baseless. No measurable change in temperatures or ozone concentrations would be expected even using pessimistic projections of the relationship between carbon dioxide emissions and ambient temperature. (Comments by NERA Economic Consulting and Sierra Research, Inc.)

Agency Response: See response to comment 366.

369. Comment: Although the section of the August 6 ISOR dealing with the environmental and human health impacts of climate change is designed to create the impression that the regulation of greenhouse gas emissions from vehicles sold in California will be beneficial, there has been no attempt to quantify the benefits. Neither is there any analysis showing that the proposed regulations would actually result in a net reduction in greenhouse gas emissions on a global basis. (This is a significant issue given the flexibility manufacturers have under the federal CAFÉ standards to offset the sale of vehicles with higher fuel economy in California with the sale of vehicles with lower fuel economy in other states.) This issue is being addressed in more detail in other studies. (Declaration of Thomas C. Austin)

Agency Response: See response to comment 349.

(3). Section 8.4—Fuel Cycle Emissions

370. Comment: On September 13, 2004, Alliance consultants requested the analysis that supported the new "upstream" emissions benefits numbers inserted into the Addendum. Although some information was provided, there are still omissions that prevent complete review of the new upstream estimates. For example, neither the data nor the source of the data used to generate the new upstream emission factors has been disclosed. In addition, no information has been provided that allows one to establish the relative contribution of each type of upstream emissions source (such as gasoline product tankers and tank trucks) to total upstream emissions. (Alliance)

Agency Response: Staff disagrees with the comment. As explained in the Addendum to the Initial Statement of Reasons, dated September 10, 2004, the estimates in Table 8.4-2

were adjusted to correctly report fuel cycle emissions in tons per day instead of tons per year. The estimates were also modified to reflect updates to the emission factors provided by TIAX as part of a contract with the ARB. The initial emission factors provided by TIAX and used by ARB staff to estimate the long-term fuel cycle emission impacts were modified to reflect new trucking and shipping estimates for 2020. As noted in the Comment, ARB staff provided the revised emission factors obtained from TIAX and explained the rationale for adjusting the factors. However, the emissions model used by TIAX is proprietary and has not been released to the ARB or the general public.

371. Comment: The only method by which the proposed rule can be suggested to not have adverse effects on smog-forming pollution levels is by accepting at face value the September 10 Addendum's claims that the proposed rules might indirectly reduce "upstream" emissions. Because the staff did not present those claims and their basis in its August 6 publications, it would be improper for the Board to accept those claims without allowing proper public review, in the manner outlined elsewhere in these documents. To the extent that those claimed indirect upstream emissions estimates can be understood, however, they appear to be inconsistent with the studies on which they are supposedly based. When partially corrected to conform with the prior studies, the upstream emissions benefits are minor, compared to the excess emissions from the vehicle fleet itself. In fact, even if the Addendum's estimated upstream emission benefits are taken at face value, the net effect of the proposed regulation will still be an increase in smog-forming emissions. (Alliance)

Agency Response: Staff disagrees with the comment. As explained in the response to comment 370 above, the fuel cycle estimates were revised to address a mistake and to take into consideration updated emission factors. The most significant change in estimates resulted from correcting the estimates from "tons per year" to "tons per day." The new fuel cycle estimates were included in the Addendum to allow interested parties the opportunity to comment on changes made subsequent to the ISOR.

The revised fuel cycle emission estimates were combined with the potential effects of rebound and fleet turnover to provide a supplemental estimate of the overall criteria pollutant impacts of the regulation. ARB staff estimates that the rebound and fleet turnover impacts are essentially offset by the benefits from reduced fuel cycle emissions. See also the response to comment 554.

372. Comment: Section 8.4 addresses the impacts that a reduction in gasoline consumption as a result of the proposed regulations would have on emissions related to the distribution and marketing of gasoline in California. Nowhere in either the Report or the Addendum are the emission factors or the data and methodology used to compute these emission impacts documented or referenced. In response to our requests for detailed information regarding the emission factors, methodology and data used to arrive at these estimates, the ARB Staff has released the emission factors and provided two references for the methodology used.

The primary reference cited by ARB staff is a report by TIAX under contract to the ARB. This report was used by the ARB and the California Energy Commission to estimate the emission benefits associated with reducing petroleum usage in California pursuant to AB 2076. Problems with the ROG emission factor in the TIAX report have been documented previously and the corrections made to properly account for ARB EVR regulations described previously are used here. In addition, the ARB has noted that emission factors used by TIAX had been modified to account for longer travel distances by marine vessels bringing gasoline into California and to more accurately account for tanker truck emissions. No additional details explaining those changes have been provided. The emission factors used by the ARB staff for NOx and PM are far higher than those published previously. (Alliance)

Agency Response: Staff disagrees with the comment. ARB staff relied on TIAX to develop the emission factors to determine fuel cycle emissions. As such, TIAX maintains the detailed data and models used to develop these factors. ARB staff made available the information and data in its possession as requested. Models used by TIAX and other entities that predict emissions 20 to 30 years in the future typically undergo changes to reflect the latest data and information. The emission factors for marine vessels were modified based on input from stakeholders involved with these emissions. The tanker truck emissions factor was revised to reflect the latest modeling of those emissions in the 2020 timeframe. The changes made to the emission factors do not fundamentally alter the overall estimated emissions impact on criteria pollutants from the regulation in 2020 and 2030.

373. Comment: The emission reductions associated with the reductions in gasoline consumption were estimated by multiplying those consumption values by the TIAX emission factors present. The estimated emission reductions for NOx, PM and ROG are lower in all scenarios than those reported by the ARB staff. (Alliance)

Agency Response: ARB staff estimated the criteria pollutant emission impacts from the regulation by combining the emissions from fleet turnover, rebound and fuel cycle emissions. The emission impacts on fuel cycle emissions estimated for 2020 and 2030 represent the latest data and emission factors. Analyses by others using different emission factors and models will result in different estimates. ARB staff disagrees with the estimates noted in the comment because staff believes that the emission factors and models used in the staff analysis best represent likely fuel cycle emissions in the 2020 and 2030 timeframe.

374. Comment: Under the proposal, the criteria pollutant increases reported due to reduced fleet turnover and increased VMT due to reduced operating costs would be partially offset by a reduction of “upstream” emissions associated with the distribution and marketing of gasoline resulting from reduced gasoline consumption. Reduced gasoline consumption has an insubstantial effect on all of the criteria pollutants except ROG. After taking into account the estimated change in gasoline consumption calculated using the same method employed by ARB with NERA/Sierra inputs, the estimates of the change in

2020 emissions in California of the ozone precursors ranges from about 2.3 tons per day to about 41.2 tons per day. (Alliance)

Agency Response: Staff disagrees with the comment. The extremely wide range of estimates provided in the Comment reflects the inherent uncertainty in developing long-term emission estimates. ARB staff stands by the estimates for the impacts from rebound, fleet turnover and fuel cycle emissions. For further detail regarding the rebound and fleet turnover issues see the discussion in section III.A.2.i.

375. Comment: The report alludes to a couple of tons per year of criteria pollutant reduction, is this in addition to that which will be achieved through current emission standard regulations? (Bob Lucas, CCEEB)

Agency Response: The criteria pollutant emission reductions achieved by this regulation, due to reduced fuel cycle emissions, are in addition to any reductions achieved by other regulations.

(4). Section 8.5—Energy Cost and Demand

376. Comment: The ISOR says the proposed standards will reduce California's vehicle fuel consumption and thus reduce fuel prices. If true, the reduced fuel prices would mean greater demand for gasoline and other uses of oil in California's other energy-consuming residential, commercial, agricultural, recreational, and manufacturing sectors, not to mention for used cars, which consumers will retain longer as a result of not being able to get the performance, weight, and safety they want in their new vehicles. There would be yet other offsets or leakage for the rest of the nation and for the world in response to a reduction in fuel prices. (General Motors)

Agency Response: Staff agrees that a reduction in fuel prices would result in greater demand in other oil-using sectors. However there are a variety of energy efficiency programs in place, particularly in the residential, commercial and manufacturing sectors, that will serve to mitigate demand growth.

As noted elsewhere, staff has not claimed that this regulation alone will solve the climate change problem; rather, it is a first step and provides leadership that will help ensure progress in other jurisdictions.

f. ISOR Section 9—Cost Effectiveness

377. Comment: The proposed regulations developed by the staff are cost effective and they clearly meet the economic test that's laid out, set forth in AB 1493. The proposal is economically well justified. It easily meets the statutory cost effectiveness criterion. And the conclusions are robust and they rely on reasonable economic assumptions and thorough analysis. (Eric Haxthausen, Environmental Defense)

Agency Response: Staff agrees with the comment.

378. Comment: In terms of cost-effectiveness to consumers, CARB has also taken a conservative approach. The technology combinations on which the proposed standards rely all entail conventional technologies or refinements of conventional technologies. The cost values estimated are consistent with the engineering literature. Moreover, CARB's choice of packages that yield net consumer savings over a vehicle's lifecycle goes beyond the cost-effectiveness mandate which would only require that emissions reductions are cost-effective. This would not require either a net savings or zero net cost, but would require that reductions be achieved at a reasonable cost. This indicates that even greater improvements would be cost-effective to consumers. This approach provides a margin of safety in CARB's estimates; arguably, CARB could set significantly more stringent targets while still meeting reasonable tests of cost-effectiveness.

The cost of technology to meet the standards falls below the trend of increasing real prices in the motor vehicle market. Extension of that trend implies average new vehicle real price increasing by \$1,600 from a 2002 baseline year through 2009, the first year of standards phase-in, and by \$3,200 through 2016, when the mid-term standards would be fully phased-in. Because the estimated technology costs of up to \$1,064 are well below this trend, the market can readily absorb the costs of improved technology while continuing to provide other vehicle enhancements, whether for criteria pollution control, safety, or other amenities. (John M. DeCicco, Ph.D., and Kate M. Larsen, Environmental Defense; letters of support also received from Natural Resources Defense Council, Bluewater Network, Environment California, Communities for a Better Environment, Union of Concerned Scientists, Sierra Club, Coalition for Clean Air, Conservation Law Foundation, Alliance for a Clean Waterfront, As You Sow, The David Brower Fund, Clean Water Action, Coalition of Concerned National Park Retirees, Community Clean Water Institute, National Parks Conservation Council, Neighborhood Parks Council, Rainforest Action Network, San Francisco Bicycle Coalition, San Francisco Tomorrow, Santa Barbara Channelkeeper, Vote Solar Initiative, Community Action to Fight Asthma)

Agency Response: Staff agrees with the comment.

379. Comment: On cost effectiveness, ED thinks those numbers are also robust, certainly in line with our own review of work that's been done on the issue. Again, one of the important things to keep in mind is these are not exotic technologies to achieve these reductions. And, therefore, it's very much in line with the current capability of automotive engineering. And, in fact, if you look historically -- and I know we've even used Air Board staff's own documentation of past costs of other emission regulations. I think it's well known that the Board makes very cautious costs. And the costs we hear from industry I think without exception have historically been overstated, often many-fold. And so, again, I think that's another reason for robustness in these estimates. Bottom line is this proposal is cost effective for the consumer. (testimony of John DeCicco, Senior Fellow with Environmental Defense)

Agency Response: Staff agrees with the comment.

380. Comment: There's been trend in increasing car prices averaging about \$230 a year marketwide in this country for many years. If you project that trend out over the time periods of this proposal, both the midterm targets and the 2016 -- or the near-term targets and the 2016 midterm target, and look at the implied cost just under market conditions, this proposal comes in under that. What that means is that this cost analysis is really in a sense examining, as it should, the opportunity cost. It is very likely that these changes can be made without a noticeable effect on the prices that consumers will actually see. We know it's already been very close to that experience in other areas of regulation. So in many ways for the actual consumer in terms of gasoline prices, this is likely to be even more cost effective to the individuals than is even documented in the regulation. (John DeCicco, Senior Fellow with Environmental Defense)

Agency Response: The comment is supportive of the staff analysis. No further response needed.

381. Comment: So it is especially significant that the Legislature in California required ARB to develop a plan that is cost effective. Clearly in our mind this plan is not cost effective, either in terms of the Legislature's definition of the term "cost effective" in AB 1493, or in terms of any reasonable conventional definition of that term. Simply put, this plan violates the legislative mandate. (Fred Webber, The Auto Alliance)

Agency Response: ARB fully demonstrated that the regulations are cost-effective to the consumer over the lifetime of the vehicles as defined in AB 1493. See also responses to comment 254 and comments 568 through 570.

382. Comment: The proposal does not meet the cost-effective standard as outlined by the California legislature in AB1493. These regulations are not intended to reduce pollution or any adverse health effects related to air pollution. ARB's traditional role of adopting standards that improve air quality in California does not come into play here, because these regulations focus predominantly on controlling carbon dioxide. Greenhouse gas is quickly dispersed throughout the global atmosphere. And reductions in California will have no preferential impact on California. (Fred Webber, The Auto Alliance)

Agency Response: Staff disagrees with the comment. ARB fully demonstrated that the regulations are cost-effective to the consumer over the lifetime of the vehicles as defined in AB 1493. See also response to comment 381.

383. Comment: I think that we should be reluctant to impose any increased costs on manufacturers. We ought to have a very high burden of proof whenever we want to impose higher costs. If this is regulation is not cost effective -- and the legislation requires it to be cost effective, that legislation says maximum feasible reductions that are cost effective. So if we can't do the reductions in a cost-effective way, we have to back up and do less reductions in order to make them cost effective.

The Governor says that the economy is the number one issue. It's jobs, jobs, jobs. And we agree. We need revenues out of this economy in order to rebuild the infrastructure, rebuild the transportation systems that are going to allow our vehicles to move faster, idle less, and get people where they're going quicker. (Dorothy Rothrock, California Manufacturers and Technology Association)

Agency Response: Contrary to the view expressed by the commenter, the staff economic analysis clearly shows that the climate change regulations are cost-effective on their merits. The staff analysis shows that average consumers will be able to recoup the initial increase in a vehicle price by about three times over from operating cost savings over a vehicle life. The staff analysis also shows that the proposed regulations will increase employment by about 3,000 jobs in 2010, 53,000 in 2020, and 77,000 in 2030.

g. ISOR Section 10—Economic Impacts

(1). Section 10.2—Potential Impacts on Business Creation, Elimination, or Expansion

384. Comment: CALSTART, an organization with more than 115 participating companies and agencies working to develop commercially viable clean transportation technologies, strongly urges the Air Resources board to adopt the proposed regulations in their entirety. CALSTART believes that the proposed standard is technically feasible and cost-effective. Furthermore, the proposed standard has potential to spur the growth of California-based advanced transportation technology companies, create high quality jobs, and increase investments in the state.

A recently completed CALSTART study, *California's Clean Vehicle Industry, How the Drive to Reduce Automotive Global Warming Pollution Can Benefit the California Economy*, demonstrates the potential that the proposed greenhouse gas emission standards have along these same lines. Specifically, this report found the following:

1. California has key competitive advantages in clean vehicle technologies
2. 124 clean vehicle technology companies and supporting institutions already exist
3. California's clean car cluster is poised for growth

The results of California's Clean Vehicle Industry are important because AB 1493 requires the Air Resources Board to evaluate the bill's environmental and economic impacts, including the creation of jobs within the state, the creation of new businesses within the state, and the expansion of businesses currently operating within the state. Combined with the facts that nationally adopted California automotive emission requirements (which in the case of the proposed greenhouse gas standards would create an annual automotive pollution control market of about \$20 billion) and regulatory trends around the world are both expanding global markets for greenhouse gas reducing automotive technologies. CALSTART's work makes it clear that the state's clean car cluster is well positioned to add high quality jobs and investments in response to the implementation of AB 1493 and thereby provide significant positive economic impacts to the state.

To summarize, CALSTART supports the staff's proposal and is dedicated to constructively pursuing its goals, for this bill has a strong potential to spur significant employment and investment growth in California. (John Boesel, CALSTART)

Agency Response: Staff agrees with the comment.

385. Comment: 1493 is a good fit for industry and skills that California already has. It will provide significant benefits for this California industry as well as create jobs and investments within the state. (Matt Peak, Project Manager, CALSTART)

Agency Response: The ARB staff agrees with the commenters that the proposed regulations will have a positive direct impact on California companies that are engaged in the development of greenhouse gas reducing technologies. In addition to its direct impact, the climate change regulations will also have a positive indirect impact on many California industries. As described in the staff report, consumer's purchasing power from reduced fuel consumption is projected to increase from approximately \$131 million in 2010, to about \$5.3 billion in 2020, and \$9.4 billion in 2030 assuming an average fuel price of \$1.74 per gallon. Accounting for indirect impacts of these changes, the proposed regulations would be expected to increase personal income by roughly \$160 million in 2010, \$4.8 billion in 2020, and \$7.3 billion in 2030. As a result, the proposed regulations are projected to boost employment by about 3,000 jobs in 2010, 53,000 in 2020, and 77,000 in 2030.

386. Comment: We are worried that in the next 30-70 years the ski industry may be out of business. So, we support ARB's climate change regulations. (Bob Roberts, Executive Director CA Ski Industry Association)

Agency Response: The comment is supportive of the staff analysis. No further response needed.

387. Comment: By raising vehicle ownership costs above the value of any fuel savings, the proposed regulations would lead to almost 100,000 fewer jobs in 2016. The cumulative effect would mean that by 2016, more than 300,000 person-years of employment would have been sacrificed over an 8-year period. (See Appendix B at 33-35) (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, page 25)

Agency Response: Staff disagrees with the comment. The staff analysis shows that 53,000 jobs would be created in California as a result of the climate change regulations in 2020. The difference in the employment effect estimates is mainly due to the fact that the NERA/Sierra lifecycle cost estimate of a new vehicle differs significantly from the ARB estimate. The NERA/Sierra estimates an ownership cost increase of \$3,000 per vehicle, which is three times more than the ARB's estimate, and a lifetime benefit of \$1,000 per vehicle, which is about 1/3 of the ARB's estimate. The NERA/Sierra analysis is based on

the assumptions and inputs that are significantly different from those that the ARB Staff used. The ARB economic analysis was peer-reviewed by three independent researchers. They unanimously confirmed the validity of its results. ARB disagrees with the results of the NERA/Sierra analysis, which was not peer-reviewed, because it is based on unrealistic assumptions and selective data sources (see FSOR section III.A.2.c).

388. Comment: The California Gross Regional Product would be reduced by more than \$11.6 billion in 2016, with a cumulative loss from 2009 to 2016 of more than \$36 billion (in 2003 dollars). Disposable personal income losses would be similar, peaking at \$7.9 billion in 2016 with a cumulative total of more than \$25 billion by 2016. (See Appendix B at 31-32.) (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, page 25)

Agency Response: Staff disagrees with the comment. The staff analysis shows that the California Gross State Product would be reduced by about \$2.8 billion while personal income would increase by about \$4.8 billion in 2020. As stated in the agency response to Comment 387, the NERA/Sierra analysis is based on assumptions and inputs that significantly differ from those that the ARB Staff used. As a result, the NERA/Sierra estimate of the lifecycle cost of a new vehicle differs significantly from the ARB estimate. This difference mainly explains the divergence in the Gross State Product estimates between the NERA/Sierra and ARB. As noted before, the ARB estimates were extensively peer-reviewed while the NERA/Sierra's estimates were not.

389. Comment: Table 8 of the NERA/Sierra report summarizes the impacts of the Staff Greenhouse Gas Proposal on the California economy. The table shows both the annual changes in the economy and the cumulative effect over time in these impacts. In 2016, the Staff Greenhouse Gas Proposal would lead to almost 100,000 fewer jobs. The cumulative effects mean that by 2016 more than 300,000 person-years of employment would be lost over the eight-year period. The California Gross Regional Product ("GRP") would be reduced by roughly \$11.5 billion in 2016, with a cumulative loss from 2009-2016 of more than \$36 billion. Disposable personal income losses are similar, reaching \$8 billion in 2016 with a cumulative total of more than \$25 billion. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, page 32)

Agency Response: Staff disagrees with the comment. Contrary to the NERA/Sierra analysis, the ARB staff analysis shows significant gains in personal income and employment in 2020 and 2030. The ARB staff stands by its own analysis which used assumptions and inputs that are significantly different from those used by the NERA/Sierra. Please also see our response to the comment 387.

390. Comment: The California Travel Park Association represents the interests of several thousand operators of RV parks and campgrounds and hundreds of thousands of RV enthusiasts who visit and recreate in California every year. ...RV Parks and campgrounds are just one set of small businesses in California that serve and cater to

vacationing enthusiasts throughout the state. This combination of businesses brings in billions of tourism dollars to the California coffers annually.

Accordingly, we are very concerned about your rule implementing Assembly Bill No. 1493 because of its eventual impact on SUVs and light trucks, vehicles that millions depend on to tow trailers and campers. In order to meet the legislative mandate of “the maximum degree of emission reductions possible from vehicular and other mobile sources” by vehicles “whose primary use is noncommercial personal transportation,” our members and their customers--RV owners--will be affected disproportionately.

While it is good news that the Assembly specifically prohibited the “imposition of additional fees and taxes on any motor vehicle, fuel or vehicle mile traveled; a ban on the sale of any vehicle category; or reduction of vehicle weight,” etc., the only remaining way to achieve what is required under AB 1493 is to directly or indirectly force vehicles to burn less fuel. What the public is not being told is the flip side of the coin—that this will require vehicles substantially different than what is available on the market today, with less capacity and torque to tow campers, boats and other trailers.

We find the law to be in fundamental conflict with market reality. It contains popular language to give the impression that nobody loses; but the vehicles that will be forced by this mandate will not meet the needs of recreational vehicle enthusiasts unless there are technological breakthroughs of epic proportion. And the experts do not expect that to be the case.

Say what you will about “cutting edge technology,” but it is just not available for the applications needed by RV enthusiasts and to predicate this rule on it is unrealistic. We hope in the years ahead that it will be, and that there can be a phasing in of new means of propulsion that improve fuel economy and reduce emissions even more, while also providing consumers with the hauling and towing capacity they need for family, business and recreational transportation needs. But that day is not here. And your rulemaking needs to both acknowledge this honestly and see that it does no harm to California’s thriving recreational and tourism industry. (Deborah M. Sipe, Executive Director)

Agency Response: The staff evaluation demonstrated that the standards can be met while maintaining current and projected product availability, and also specifically concluded that the standard could be met by large trucks and SUVs (see the response to comment 271). Thus there is no basis for concern that the regulation will have an impact on California’s recreation and tourism industry.

391. Comment: The precise inputs and assumptions used in the Executive Officer’s E-DRAM analysis concerning new vehicles sales are not clear. If she did not include the results of her latest CARBITS and price-elasticity model results that predict a reduction in new vehicle sales, then the results from her macroeconomic analysis will not be accurate, nor will they represent the best analysis of economic impact from the proposed rules available to the Board or the Executive Officer. Her results will understate the economic impact on the California economy. The best evidence on this issue, and the only fully

documented analysis, is contained in Appendix B of the Alliance comments, which estimates losses in employment in the California automobile industry. (Declaration of Steven P. Douglas, page 3)

Agency Response: The inputs and assumptions used in the Executive Officer's E-DRAM analysis were based on the results of the ARB's assessment of the costs of the regulation as presented in Chapter 6 of the Staff Report standard analysis. ARB also conducted a supplemental analysis (See Section 12 of the Staff Report) using the latest CARBITS and price-elasticity model. E-DRAM contains its own embedded price-elasticity model. So E-DRAM takes consumer response into account, in an aggregate way. If staff had used CARBITS output to modify the input to E-DRAM, then the results would have double-counted the effect of consumer response. In addition, the supplemental analysis results did not differ significantly from the standard analysis report.

ARB thus had good reason to not repeat the E-DRAM analysis using the supplemental analysis results. In addition E-DRAM has a proven record analyzing impacts of statewide regulations both at ARB and at other state agencies. CARBITS, while a good model for providing a "reality-check" on the potential impact of consumer behavior, is not at the same level of development to warrant relying on its outputs for economic or environmental impacts.

392. Comment: The impact of increased prices on households is modeled in REMI as a general price increase. It is put into variable number 960 (Consumer Expenditure Price Index). This welfare effect is modeled as a general price increase to avoid overestimating the substitution effect, which is modeled separately. The substitution away from new vehicles and towards other products is modeled separately because the New Vehicle Market Model and Fleet Population Model provide a more detailed representation of new vehicle demand than is available in the REMI model. The price increase is thus modeled solely as a loss of income to households who purchase vehicles covered under the Staff Greenhouse Gas Proposal. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B7-5)

Agency Response: Staff used a different regional economic model called E-DRAM to perform the economic impact analysis of the climate change regulations. E-DRAM is a modified version of the California Department of Finance's Dynamic Revenue Analysis Model (DRAM) that has been used extensively for dynamic analysis of State tax and spending policies. E-DRAM describes the relationships among California producers, California consumers, government, and the rest of the world. E-DRAM have been used extensively by the ARB for the economic impact assessment of large-scale environmental regulations such as the economic impacts of Phase III regulations for reformulated gasoline, economic impacts of state implementation plan, and economic impacts of transportation fuel policies (AB 2076). Although both REMI and E-DRAM are reliable models, there are significant differences between them. In modeling with REMI, the commenter's assumption that the price effect (income loss) of new vehicle purchases occurs in the year in which a vehicle is bought may not be realistic. This is because most

new vehicle purchasers borrow money to pay for their vehicle purchases although the price increase associated with the proposed regulations require a lump sum payment. Thus, the income loss to households should also occur over a vehicle finance period, usually five years. Otherwise, the income loss may have been overestimated in the year in which a vehicle is purchased.

393. Comment: Because REMI does not have a policy variable for the increase of production cost due to the increased price of a good, the regional input-output (“I/O”) table is used to determine how this welfare effect will be shared across industries. The proportion of the welfare loss borne by each industry is estimated by first determining the percentage of production accounted for by each industry (from the I/O table). This number is then multiplied by total annual output to estimate the number of dollars spent on motor vehicles annually by each industry. For each industry, this value can be used to determine the proportion of annual motor vehicle demand that each industry is responsible for. The proportion is used to approximate each industry’s share of the total welfare impact on business. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B7-6)

Agency Response: NERA/Sierra conducted their own modeling of the climate change regulations which significantly differ from the ARB modeling. In addition to using an alternative model, one of the key reasons for the differences can be attributed to the reliance on inputs such as the cost of the regulation that significantly overstate the estimates provided in the Staff Report. See our response to the comment 392.

394. Comment: The overall effect on gasoline expenditures is calculated by multiplying the net change in gasoline consumption by the average fuel price. For this calculation, we relied on data from the Energy Information Administration (“EIA”), which provides forecasts of motor fuel prices through 2025. For California, these prices were adjusted to reflect the standard “mark-up” (i.e., the historical difference between California and U.S. fuel prices). (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B7- 9 & 10)

Agency Response: The average fuel price used in the Staff Report’s main analysis was \$1.74 per gallon (2004 dollars) based on the California Energy Commission’s Integrated Energy Policy Report (CEC 2004). The Staff also conducted a sensitivity analysis to assess the impact of the higher average fuel price of \$2.30 per gallon on the results of the Staff’s economic impact analysis.

395. Comment: Because repair costs are correlated with both VMT and the age of the fleet, we estimate repair costs under the Staff Greenhouse Gas Proposal as one plus the percentage increase in the fleet composed of used vehicles multiplied by the baseline cost per mile. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B7-10)

Agency Response: The Staff Report's supplemental analysis (Section 12.5) shows that the climate change regulations would have only a minor impact on new vehicle sales and VMT. Thus, the staff does not expect a significant change in repair costs as a result of the regulations. To the extent that the NERA/Sierra analysis overestimated repair costs, the economic benefits of the climate change regulations are underestimated in their analysis.

396. Comment: One of the automobile finance services affiliated with one of the largest manufacturers in the California retail market has reported that adjusted for inflation, its real discount rate for new vehicles over the last five years was 8.11 percent, and for used vehicles was 9.72 percent. The Staff Report's analysis is deficient because it does not account for that significant difference between new and used vehicle loan rates. (Declaration of Steven P. Douglas, pages 4-5)

Agency Response: Staff disagrees with the comment. The 5% real discount rate used for the analysis is based on ten-year averages of car loans at auto finance companies as reported by the Federal Reserve Bank and adjusted by the consumer price index (CPI) as reported by the Bureau of Labor Statistics. The commenters have not questioned the validity of this estimate. Staff believes that the 5% real interest rate more accurately represents the cost of auto loan to an average car buyer because it is based on the real interest rates offered by all automobile finance companies rather than only one company. For the used vehicle loan rate, staff used a 10% real interest rate that is slightly higher than the rate mentioned above. For example, the staff analysis of the impact of the climate change regulations on low-income households assumes a 10% real rate of interest rate for a 3-year car loan.

397. Comment: ARB staff has overestimated the present value of fuel cost savings associated with the proposed regulation by using a discount rate of only 5%. Since the unsubsidized interest rate on vehicle loans significantly exceeds 5%, the ARB analysis is based on the assumption that consumers are willing to borrow money at an interest rate higher than 5% in order to achieve a 5% return on their investment in fuel economy technology. (Declaration of Thomas C. Austin, page 4)

Agency Response: This comment is not supported by historical data. The 5% real interest rate is based on ten-year averages of automotive interest rates and the consumer price index. The commenter also misinterpreted the ARB analysis. The analysis actually assumes the reverse of what is stated above. The analysis implicitly assumes that consumers are willing to borrow money at a 5% real interest rate in order to achieve a higher than 5% return on their investment through reduced operating costs, an indirect benefit of the greenhouse gas regulations.

398. Comment: The discount rate assumed in the staff report, which is five percent, has no support in any independent empirical analysis. ARB's designated external reviewer considers this issue to be "key" to the economic analysis in the staff report and recommends that it be re-examined. The peer-reviewed literature – some of which the Board's external reviewer considered, but all of which staff documents ignore – indicates

that the private discount rate applied in the market for personal-use vehicles is far above five percent. One of the most detailed empirical studies indicates that “only 35 percent of the present-value cost savings provided by improved energy efficiency is capitalized in the purchase price of vehicles.” The rate used in some of the fuel economy benefit calculations in the National Research Council study published in 2002, which was 12%, is more than twice that used in August 6 staff report. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, page 14)

Agency Response: Staff disagrees with the comment. As stated in our response to comment 396, the 5% real discount rate used for the analysis is based on ten-year averages of car loans at auto finance companies as reported by the Federal Reserve Bank and adjusted by the consumer price index (CPI) as reported by the Bureau of Labor Statistics. The 5% real discount is certainly based the actual cost of car loans in the past 10 years. Staff also raised this issue in its response to the comment by the external peer reviewer. In addition, staff conducted a number of sensitivity analyses using higher discount rates. The results showed that the regulations would be cost-effective to consumers even if we double the discount rate. The National Research Council in its 2002 study provided two case studies, one using 12% discount rate and the other using zero percent discount rate. It is clearly stated in the study that the 12% discount rate was based on a subjective assumption. This rate was used to provide an upper bound of the rate of return consumers expect to earn from the money spent on fuel savings. The study also uses zero percent discount rate in the case that consumers expect a vehicle payback period of 3 years.

For a sensitivity analysis of the effect of discount rate on the calculated lifecycle savings, see the response to comment 284.

399. Comment: Current unsubsidized new car loan real interest rates in the non-commercial market are in the range of eight percent. Even if consumers valued fuel economy savings over the full service life assumed by the ARB staff’s analysis, no rational consumer would borrow money at eight percent in order to obtain a return on investment of five percent. Indeed, the five percent rate is not consistent with other discount rates used by ARB staff in other recent rulemaking in which it was necessary to select a discount rate, and its realism has been questioned in ARB’s extramural review of the staff report. In the extramural review document, one reviewer properly recognizes this as a “crucial consideration.” and the ARB staff agrees with him that “real interest rates will be higher over the next 5-10 years than they were over the past 5-10 years.” A discount rate that is too low will, in an analysis like that performed in the staff report, overstate the benefits of future fuel savings; that is why selection of discount rates is “crucial.” The Board cannot adopt a rule based on a cost-effectiveness assessment when a “crucial” input like discount rate has been conceded by the ARB staff to be incorrect. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, pages 16-17)

Agency Response: Staff disagrees with the comment. The 8% interest rate on car loans represents the rate offered by only one of the automobile finance services in California while the 5% interest rate is based on ten-year averages of new car loans at auto finance companies. For the purpose of this analysis, it is certainly more appropriate to use an interest rate that is representative of the cost of a car loan to average consumers rather than a rate that is offered by only one of the automotive service companies. Thus, the commenter's conclusion that no rational consumer would borrow money at eight percent in order to obtain a return on investment of five percent is based on an erroneous assumption. The commenter also states that the 5% interest rate is not consistent with the rate used for other recent rulemakings. However, the commenter is not specific to which rule he/she is referring. Generally speaking, the opportunity cost of capital varies for different industries or economic sectors depending upon the level of risk and uncertainty associated with the industry. In assessing the economic impact of the ARB regulations, staff tries to use a discount rate that closely reflects the opportunity cost of capital for the regulated industry. Thus, it is not uncommon to use different discount rates in our assessment of the economic impacts for different industries.

400. Comment: If it considers the use of loan discount rates to be an appropriate method for estimating cost-effectiveness, the Board should direct the staff to identify a range of realistic discount rates, based on the published literature or some other sources that can be fully examined by the public, and then should invite public comment on the new staff analysis. Only at that point would it be appropriate for ARB to determine what levels of control might be appropriate, based on the value of future cost savings to the consumer. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, page 17)

Agency Response: The 5% interest rate used in the staff analysis represents the real discount rate based on ten-year averages of car loans at auto finance companies. That is, the nominal automobile loan rates were adjusted for the inflation rates. In the past 10 years, the nominal automobile loan rates varied from a high of 11.2% in 1995 to a low of 3.4% in 2003. During the same period, the inflation rates also varied from a high of 3.4% in 2000 to a low of 1.6% in 1998. The commenter's comment that the ARB staff used loan discount rates to estimate cost-effectiveness ignores the fact that the staff has adjusted those rates for inflation. In addition, staff conducted a number of sensitivity analyses using higher discount rates. The results showed that the regulations would be cost-effective to consumers even if we double the discount rate.

401. Comment: In addition, the staff report does not take proper account of the fact that very few individuals who purchase a new vehicle plan to retain it for the vehicle's full service life. For example, the staff report suggests that a new-vehicle owner who obtained financing would find the cost of interest and principal for the additional technology required by the proposed rule would be far less than her monthly "decreases in operating costs." But now that is not how a rational consumer would value future fuel savings. Particularly in the used-vehicle market, "many automobile purchasers are liquidity constrained, and therefore face implicit discount rates higher than the market level." This has

consequences not just for someone buying a used vehicle, but for the purchaser of a new vehicle who does not plan to keep the vehicle for its full service life. Assuming she considers loan rates in valuing future fuel savings, the new-vehicle purchaser will not apply the relatively low loan rate that she can command for the new vehicle when valuing the entire future stream of fuel economy savings that a vehicle will provide. In the used vehicle market, the value of future fuel economy savings will be discounted at higher rates than in the new-vehicle market, due to the liquidity constraints recognized in the literature and greater uncertainty about the value of the collateral. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, pages 15-16)

Agency Response: Staff disagrees with the comment. It is certainly true that the cost of borrowing for the purchase a new or used car varies among consumers. Consumers constrained by liquidity are likely to face higher discount rates than the market level. However, these consumers only account for a small fraction of the purchasers of new or used vehicles. The staff analysis used the 10-year average market interest rate to represent the cost of borrowing to average consumers rather than those on fringes. The staff analysis also assumed higher discount rate for the purchasers of used vehicles. In fact, staff performed two analyses of loan payments: one for average automobile purchasers assuming a payback period of 5 years and 5% discount rate and the other for low-income households (usually purchasers of used vehicles) assuming a payback period of 3 years and 10% discount rate. The staff analysis shows that new and used vehicle purchasers would benefit from the regulations in both cases.

402. Comment: The present value of fuel cost savings is based on the unrealistic combination of a 5% discount rate and a 16-19 year payback period, which substantially overstates the value to new vehicle purchasers. (Sierra Research, Review of the August 2004 Proposed CARB Regulations to Control Greenhouse Gas Emissions from Motor Vehicles: Cost Effectiveness for the Vehicle Owner or Operator, page 22)

Agency Response: Staff disagrees with the comment. Staff used historical data to estimate discount rate and payback period. The 5% discount rate is based on ten-year averages of new car loans at auto finance companies as reported by the Federal Reserve Bank and adjusted by the consumer price index (CPI) as reported by the Bureau of Labor Statistics. The 16-19 year payback period is based on vehicle lifetime obtained from the California Department of Motor Vehicles and the ARB's EMFAC emission model. Staff believes these data are realistic and do not overstate the present value of fuel cost savings to new vehicle purchasers. As stated in our response to comment 401, staff also performed two analyses of loan payments: one for average automobile purchasers assuming a payback period of 5 years and 5% discount rate and the other for low-income households (usually purchasers of used vehicles) assuming a payback period of 3 years and 10% discount rate. The staff analysis shows that the climate change regulations would bring about net benefit to both new and used vehicle purchasers.

403. Comment: CARB staff has assumed that new vehicle purchasers will value the future savings associated with improved fuel economy using a discount rate of only 5%.

The discount rate is essentially the opportunity cost of capital. A 5% discount rate implies that the average new car buyer is willing to spend or borrow money in order to obtain a 5% return over time. Current unsubsidized new car loan rates have averaged somewhat over 8% over a recent five-year period. Even if consumers valued fuel economy savings over the 16-19 year period assumed by CARB, no rational consumer would borrow at 8% in order to obtain a return on investment of 5%. The implied discount rate new car buyers assign to fuel economy improvement is likely to be substantially in excess of 8%. For purposes of this review, Sierra uses an extremely conservative 8% discount rate. (Sierra Research, Review of the August 2004 Proposed CARB Regulations to Control Greenhouse Gas Emissions from Motor Vehicles: Cost Effectiveness for the Vehicle Owner or Operator, page 29)

Agency Response: Staff disagrees with the comment. The 8% interest rate on car loans represents the rate offered by only one of the automobile finance services in California and is not representative of the prevailing market rate for new car loans. The 5% interest rate used in the staff report, however, is based on ten-year averages of new car loans at all auto finance companies and is more representative of the actual cost of car loans to new vehicle purchasers. Staff certainly agrees with the commenter that new car buyers expect substantially higher implied discount rate. Based on the estimates of operating cost savings in the staff report, new purchasers of PC/T1 would earn over 25% return on their investment over 16 years while new purchasers of T2 would earn over 30% return on their investment over 19 years. Even over a 5-year payback period, the staff analysis shows that operating cost savings from new vehicles substantially exceed the increase in their initial purchase prices.

404. Comment: The Staff Report claims that it is appropriate to use a “real discount rate” of five percent, based on part on average automobile interest rates, to determine the value of CO₂ control hardware or systems to the consumer. No evidence is offered to support the specific interest rate assumed in the Staff Report. In addition, the Staff Report’s analysis assumes that the interest rates for new and used vehicles are the same. The latter assumption is unrealistic and makes the Staff Report’s valuation of CO₂ control systems incorrect. (Declaration of Steven P. Douglas, page 4)

Agency Response: Staff disagrees with the comment. The appendix D, page VII of the Draft Technology and Cost Assessment for Proposed Regulations to Reduce Vehicle Climate Change Emissions Pursuant to Assembly Bill 1493 published on April 1, 2004 provides both data and sources to support the 5% real interest rate used in the Staff Report. It is true that the Staff Report’s analysis is based on the use of a 5% average real interest rate for both new and used vehicles. However, staff also conducted a number of sensitivity analyses using higher discount rates. The results showed that the regulations would be cost-effective to consumers even if we double the discount rate. In addition, staff used a 10% real interest rate to assess the impact of the regulations on the purchasers of used vehicles in low-income and minority communities. Assuming a payback period of 3 years and a 10% discount rate, staff also shows that the regulations would be cost-effectiveness to low-income purchasers of used vehicles.

405. Comment: First, it is well-known that very few new vehicle purchasers plan on retaining or actually retain a new vehicle for the entire service life of the vehicle. Instead, most new vehicle purchasers plan on selling the vehicle after they have owned it for a while. In addition, new vehicle purchasers typically understand that when they sell a used vehicle, they may not be able to obtain what they would theoretically consider to be the full value of the vehicle in the resale. In the used vehicle market, financing is often necessary. Buyers in the used vehicle market may have less liquidity than those in the new vehicle market. In addition, the secured property will have a less-certain value than when new, in part because its maintenance costs will be less predictable as the vehicle ages, and particularly after the warranty period is over. (Declaration of Steven P. Douglas, page 4)

Agency Response: Staff agrees with the commenter's comment and there is nothing in the Staff Report that contradicts this comment. Staff recognizes that the cost of borrowing may be higher for used car purchasers. That is why staff used a 10% real interest rate to assess the impact of the regulations on the purchasers of used vehicles in low-income and minority communities. The staff analysis shows that the impact on low-income and minority communities would be minor. Staff also conducted an analysis of the cost-effectiveness to low-income purchasers of used vehicles using a 10% discount rate and a payback period of 3 years. Staff found that the purchasers of used vehicles would benefit from the proposed climate change regulations.

406. Comment: While a new vehicle purchaser may not account with precision for the impact of a higher loan rate in the used-car market when deciding how much to spend for a new vehicle, the typical new vehicle purchaser will certainly not assign the same value of gasoline savings from the vehicle for its full service life. Any retail customer with experience in selling a used car, either to a dealer or to another retail customer, is likely to assume that the vehicle will have less value once it enters the used-vehicle market. If a customer will apply a loan-rate-based discount factor for future gasoline savings, then the customer must also be assumed to apply more than one loan-rate-based discount rate in valuing the CO₂ control technology: one based on the new-vehicle loan rate, and at least one other based on the loan rate in the used vehicle market. (Declaration of Steven P. Douglas, page 4)

Agency Response: Exactly for the reasons the commenter identified, staff conducted different analyses to show the cost-effectiveness of the regulations to consumers. In addition to demonstrating the cost-effectiveness of new vehicles to consumers over the vehicle lifetime, staff also shows the cost-effectiveness of new vehicles to consumers assuming a payback period of 5 years and 5% discount rate. In addition, staff performed the cost-effectiveness of used vehicles to consumers assuming a payback period of 3 years and 10% discount rate. The staff analyses show that the proposed climate change regulations are cost-effective to the purchasers of both new and used vehicles.

407. Comment: CARB failed to account for California's average 8% sales tax in doing its calculations of net lifetime costs of technology changes. (Sierra Research, Review of the August 2004 Proposed CARB Regulations to Control Greenhouse Gas Emissions from Motor Vehicles: Cost Effectiveness for the Vehicle Owner or Operator, page 22)

CARB's analysis of the consumer benefit of improved fuel economy does not account for the sales tax. This has a significant effect on the results. Our independent analysis accounts for an 8% tax on the price increase associated with the technology changes needed to comply with the proposed standards. (Sierra Research, Review of the August 2004 Proposed CARB Regulations to Control Greenhouse Gas Emissions from Motor Vehicles: Cost Effectiveness for the Vehicle Owner or Operator, page 27)

Agency Response: Inclusion of sales tax in the analysis does not change the conclusion that the regulation is cost effective to the owner or operator. The following table is a revision to Table 10.5-1 of the Addendum, modified to show the effect of sales tax on the owner of a new vehicle.

Description	PC/LDT1	LDT2
<i>Without sales tax:</i>		
Average Increase in New Car Price	\$1,064	\$1,029
Increase in Monthly Loan Payment	\$20.08	\$19.42
Monthly Operating Savings	\$23.46	\$26.16
Net Monthly Savings	\$3.38	\$6.74
<i>With sales tax:</i>		
Average Increase in New Car Price	\$1,064	\$1,029
Increase in Monthly Loan Payment	\$21.69	\$20.97
Monthly Operating Savings	\$23.46	\$26.16
Net Monthly Savings	\$1.77	\$5.19

Here is a revision to Table 11.4-2 of the Addendum, modified to show the effect of sales tax on the owner of a used vehicle.

Description	PC/LDT1	LDT2
<i>Without sales tax:</i>		
Average Increase in New Car Price	\$245	\$329
Increase in Monthly Loan Payment	\$7.91	\$10.62
Monthly Operating Savings	\$14.02	\$15.21
Net Monthly Savings	\$6.11	\$4.59
<i>With sales tax:</i>		
Average Increase in New Car Price	\$265	\$355
Increase in Monthly Loan Payment	\$8.54	\$11.47
Monthly Operating Savings	\$14.02	\$15.21
Net Monthly Savings	\$5.48	\$3.74

(2). Section 10.4—Potential Costs to Local and State Agencies

408. Comment: Tax revenues in 2016 would be almost \$1 billion less in California, with a cumulative loss of more than \$3.2 billion from 2009 to 2016 (See Appendix B at 36.) (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, page 25)

Sales tax revenues would be about \$600 million lower in 2016, with a cumulative reduction of almost \$2 billion over the eight-year period from 2009 to 2016. Income tax revenues would be roughly \$400 million lower, with a cumulative loss of nearly \$1.3 billion. Overall state sales and income tax revenues in 2016 would be almost \$1 billion less in California as a result of the Staff Greenhouse Gas Proposal, with a cumulative loss of more than \$3.2 billion from 2009 to 2016. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, page 35)

Agency Response: Both the August 6, 2004 Initial Statement of Reasons, (section 10.4), and the September 10, 2004 Addendum to the ISOR, (p.25), estimate potential revenue losses to local and state agencies. The relevant tax revenues come from two sources: (1) excise tax and sales tax on gasoline sales; and (2) sales tax on purchase of new vehicles.

Our revised estimate, which appears in the Addendum, projects that, if tax rates remain the same, gasoline excise and sales tax revenues to state and local agencies would decline by \$1.3 billion in 2020, compared to a no-regulation scenario. We also estimate that \$131 million of this revenue loss would be offset by increased vehicle sales tax revenues, for a net potential revenue loss of approximately \$1.1 billion in the year 2020.

However, as we also state in both the ISOR and the Addendum, these potential net losses may be further offset as buyers of regulated vehicles spend some percentage of their increased personal income on goods subject to local sales tax.

409. Comment: Government purchases constitute roughly three percent of passenger car sales. Because we assume that the government has a balanced budget constraint, the increased expenditure on new covered vehicles must be offset by either an increase in taxes or a decrease in other expenditures. For this analysis, we assume that the government pays for its share of increased vehicle prices by increasing taxes to households. The amount of this increase is equal to the total consumer welfare effect multiplied by the proportion of total vehicle purchases by the government (0.03). (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B7-6)

Agency Response: Staff disagrees with the commenter's assumption that the government pays for its share of increased vehicle prices by increasing taxes to households. This assumption tends to exaggerate the adverse impacts of the proposed regulations on the government and households. The government, like households, would experience

significant savings from reduced vehicle operating costs. The government would also experience increased tax revenue associated with increased vehicle prices. Reduced vehicle operating costs tend to induce the overall economic performance, as a result increasing the government tax revenues. These savings would significantly offset increased vehicle prices in any year, thus reducing the government need to increase taxes to consumers. Staff believes that savings from vehicle operating costs would more than offset increased vehicle prices to government over time.

410. Comment: These consumer welfare gains due to fuel efficiency are divided among households, businesses and governments using the same approach as described above for the price increases. For households, these effects increase consumer surplus and thus have the opposite sign of the price effects described in the previous section. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B7-7)

Agency Response: ARB Staff agrees with the commenter that a decline in vehicle operating costs would increase consumer surplus. Other purchasers of vehicles such as governments and businesses would also benefit.

(3). Section 10.5—Potential Impact on Individual Consumers

411. Comment: Nothing in the text of AB 1493 permits the Board to ignore any category of costs. The statute's requirement to consider what is "economical" to the consumer must be understood as a mandate to consider *all* relevant costs to the consumer, not just the costs of additional hardware. Consumers who buy a vehicle to meet standards that they would not otherwise prefer, incur costs that are real and quantifiable, as demonstrated by the literature reviewed above. In view of the staff report's failure to consider all the relevant types of costs of the proposed regulation to vehicle purchasers, the Board lacks sufficient analysis, and the public has not been properly advised of the total estimated costs of the proposed rule. On such a record ARB cannot adopt the proposed rule. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, pages 12-13)

Agency Response: Staff disagrees with the comment. In determining what regulations would be economical to the consumer, staff considered all relevant potential costs to the consumer.

Staff did not ignore the possibility that manufacturers could choose to comply with the regulation by compromising vehicle drivability or performance. The ISOR identifies, in detail, a variety of technology-based approaches to compliance which conserve for consumers not only current levels of vehicle performance and drivability, but *anticipated* levels of vehicle performance and drivability.

While it is *possible* that automakers might choose to achieve compliance by making drastic pricing adjustments or reducing existing levels of vehicle performance or drivability, such approaches are highly unlikely. It is more likely, in staff's view, that competitive imperatives will motivate auto manufacturers to achieve compliance by integrating improved technologies, while maintaining or improving upon vehicle performance.

Staff's estimate of 2009 vehicle attributes incorporates vehicle performance improvements that are expected to occur whether or not the proposed regulation is approved. Hence, compliance need not be achieved at the expense of existing or anticipated performance attributes historically demanded by consumers. Moreover, the regulation is specifically designed to ensure that the full range of vehicle sizes and styles now available will continue to be available to California's next generation of new-car buyers. Sierra-NERA's prediction that consumers will incur "real and quantifiable" costs due to compliance-related vehicle attribute changes relies on speculation about both the automakers' approach to compliance and consumer preferences from the year 2009 forward.

CARBITS consumer response modeling, on the other hand, indicates that from 2009-2013, Californians will buy more, not fewer, new compliant vehicles despite retail price increases. By 2009, consumers may well prefer the attributes of regulated vehicles to those of unregulated vehicles. Such a response could result from a preference for lower vehicle operating costs. Other factors not included in the model, such as heightened awareness of the costs of climate change and dependence on foreign oil, could increase consumer preference for the attributes of compliant vehicles. See also the response to comment 568.

412. Comment: The economic analysis in the staff report ignores opportunity costs, which are important in mainstream economic analysis of measures like that proposed in this rulemaking. These opportunity costs include the value of the foregone opportunity to purchase a vehicle which may be less fuel efficient but has other features that a consumer desires more than enhanced fuel efficiency, such as vehicle performance, safety, capacity, comfort, and aesthetics. (Alliance of Automobile Manufacturers)

Agency Response: See response to comment 411.

413. Comment: The economic analysis in the August 2004 staff report and its supporting materials assume that the major cost that would be incurred by a consumer who purchases a vehicle certified to the proposed CO₂ requirements would be the cost of the hardware needed to meet those requirements. The staff ignores opportunity costs, which are important in mainstream economic analysis of measures like that proposed in this rulemaking. The total costs of a rule like that proposed in the staff report include, for example, the value of the foregone opportunity to purchase a vehicle which may be less fuel-efficient but has other features that a consumer desires more than enhanced fuel efficiency. Such features obviously include vehicle performance, safety, capacity, comfort and aesthetics. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, page 8)

Agency Response: The ARB's staff technical evaluation of technologies and fuels that can reduce climate change emissions in passenger vehicles shows that automotive manufacturers have a number of technological options to meet the requirements of the climate change regulations. Most of these technologies are currently available or would be available in the 2009 timeframe. The application of these technologies is not expected to alter other vehicle features that a consumer desires. Some vehicle models are currently equipped with these technologies. The ARB staff believes that a more widespread use of these technologies would not come at the expense of compromising other vehicle features that a consumer desires such as vehicle performance, safety, capacity, comfort and aesthetics. In other words, the staff expects no loss of value to consumers due to the foregone opportunity. On the contrary, the staff believes that the use of climate change emissions reducing technologies in new vehicles would enhance their marketability, and that these technologies pay for themselves.

In determining what regulations would be economical to the consumer, staff considered all relevant potential costs to the consumer. Staff analyzed at great length the opportunity cost that consumers might incur under the proposed regulation. The findings of that analysis are shown in Tables 12.1-6 and 12.1-7 and discussed on page 179 of the ISOR.

Consumer response modeling results indicate that, in the early years of the regulation, consumers will value the attributes of regulated vehicles as much or more than those of unregulated vehicles. Despite increased prices, new car sales during the period from 2009 to 2013 are expected to be higher in the regulated scenario than in the unregulated (baseline) scenario.

In later years, (2013-2020), as per-vehicle compliance costs climb, the regulation scenario projects slightly slower new-car sales. But the projected decline in 2013-2020 sales is in line with normal consumer response to price increases in the absence of product attribute changes. This implies that, in general, consumers will be as satisfied with the attributes of regulated vehicles as with unregulated alternatives. Therefore the cost of any frustrated demand for higher operating cost vehicles, as evoked by the commenter, is considered negligible.

h. ISOR Section 11—Impacts on Minority and Low Income Communities

(1). Section 11.1—ARB Environmental Justice Policy

414. Comment: We want to recognize that this is only a first step in our commitment for just climate policies, and there is a long way to go. We applaud the efforts of ARB staff and the leadership of the Board and we strongly support the recommendations. (Bahram Fazeli, Communities for a Better Environment)

Agency Response: ARB staff agrees with this comment, and the regulations approved by the Board will achieve the maximum feasible and cost effective reductions. No further response needed.

415. Comment: This regulation is a major step forward for EJ Communities and for California and I hope other States follow. (Dr. Clark, West County Toxics Coalition)

It is important for the Board to continue in its leadership role by looking at this in a very serious manner, adopting this role, working within the communities that would be impacted to find mutual solutions and working with all stakeholders to make sure that we can move forward and gain progress on this. It's very important. (Carlos Porras, private citizen)

Agency Response: Staff agrees with the comments.

(2). Section 11.3—Potential Environmental Impacts

416. Comment: Increases in heat waves would most affect people of color and the urban poor. Increases in air pollution are likely to exacerbate existing health problems and raise health exposure. Unhealthy exposures occur unequally among vulnerable communities and low-income people. Low-income and people of color are disproportionately employed in industries most sensitive to climate change; thus leading us to conclude that the economic impacts are also likely to be quite disparate. (Michel Gelobter, Executive Director of Redefining Progress)

Agency Response: The comment is supportive of the staff analysis and the proposed regulation. No further response needed.

(3). Section 11.4—Potential Economic Impacts

417. Comment: The proposal also provides strong evidence that the regulations would benefit disadvantaged communities and low-income and minority residents of California, and would allow the state to continue to attract businesses to these and other communities throughout the state. As discussed in our July 6, 2004, comments on the draft staff proposal that preceded the ISOR, the other aspects of the economic analysis developed by CARB staff are sound and amply demonstrate that the proposed regulations meet all of the economic stipulations of the authorizing legislation. (John M. DeCicco, Ph.D., and Kate M. Larsen, Environmental Defense; letters of support also received from Natural Resources Defense Council, Bluewater Network, Environment California, Communities for a Better Environment, Union of Concerned Scientists, Sierra Club, Coalition for Clean Air, Conservation Law Foundation, Alliance for a Clean Waterfront, As You Sow, The David Brower Fund, Clean Water Action, Coalition of Concerned National Park Retirees, Community Clean Water Institute, National Parks Conservation Council, Neighborhood Parks Council, Rainforest Action Network, San Francisco Bicycle Coalition, San Francisco Tomorrow, Santa Barbara Channelkeeper, Vote Solar Initiative, Community Action to Fight Asthma)

Agency Response: The comment is supportive of the staff analysis and the proposed regulation. No further response needed.

i. ISOR Section 12—Other Considerations

(1). Section 12.1—Consumer Response Effects on Emissions and State Economy

(a). General Effect

418. Comment: Thus, the design changes made in response to CARB's proposed GHG standards will be transparent to consumers, in terms of vehicle functionality, and the price impacts will most likely be unobservable. In other words, the technology improvements induced by the GHG standards will play out very similarly to what has occurred in response to past air pollution emissions control standards, and we can expect to see the benefits of reduced GHG emissions even as cars and light trucks continue to improve in other ways, without any appreciable impacts on either consumer acceptance or overall sales. (John M. DeCicco, Ph.D., and Kate M. Larsen, Environmental Defense; letters of support also received from Natural Resources Defense Council, Bluewater Network, Environment California, Communities for a Better Environment, Union of Concerned Scientists, Sierra Club, Coalition for Clean Air, Conservation Law Foundation, Alliance for a Clean Waterfront, As You Sow, The David Brower Fund, Clean Water Action, Coalition of Concerned National Park Retirees, Community Clean Water Institute, National Parks Conservation Council, Neighborhood Parks Council, Rainforest Action Network, San Francisco Bicycle Coalition, San Francisco Tomorrow, Santa Barbara Channelkeeper, Vote Solar Initiative, Community Action to Fight Asthma)

Agency Response: Staff agrees with the comment.

419. Comment: My concern with this regulation is the direct and harmful effect it will have on my business and the businesses of other automobile dealers in California. Based on the cost estimates in the ARB staff's latest review, it is clear that the proposed regulations are very expensive. By model year 2012, the estimated costs of the first phase of the regulation are between \$280 per vehicle (larger light-duty trucks) and \$370 per vehicle (passenger cars and small light-duty trucks). The estimated costs then skyrocket and reach levels of \$1030 per vehicle (larger light-duty trucks) and \$1060 per vehicle (passenger cars and smaller light-duty trucks) by model year 2016.

The estimated costs by the staff represent huge cost increases. The cost increases will result in much higher vehicle prices for my customers. Cost increases of this magnitude will immediately lead to lower vehicle sales. Automobile sales are highly dependent on price—if the price of automobiles increases—the number of automobiles will decrease. This is simply a result of the decreased market for a more expensive product. This result is not idle speculation, it is based on my 30 years of experience selling vehicles. Whenever the cost of automobiles has increased faster than the income available to purchase vehicles, the result is less vehicles sold.

Reduced vehicle sales will directly reduce the income from my dealership and its economic value as a continuing enterprise. I was therefore startled to see that the staff's assessment of the impact on automobile dealerships assumes that there will be no net impact. The staff claims that the "dealers' loss of sales volume was roughly compensated by the increase in vehicle prices". This assumption is directly contrary to my 30 years of experience selling automobiles.

The higher vehicle prices will result in lower sales, and the overall effect will be a drop in total revenue. Further, because the costs of all vehicles increase, people will not be able to purchase either the same type of vehicle they previously purchased or will not be able to purchase the same trim level that they previously purchased. My customers will have to settle for a vehicle with less options, a smaller engine, or a smaller vehicle. All of these changes will result in lower net revenue for my dealership.

I do not usually comment on emission regulations that are issued by the Air Resources Board. However, because the costs estimated by the ARB staff are so high, I feel compelled to urge you to consider the actual economic impact on independent California automobile dealers. The only prudent thing to do in the face of the extremely high costs estimated by the ARB staff is to not implement such extreme measures. I cannot believe that the people of California envisioned such costly and extreme measures would ever be promulgated. (John W. Gardner, Central Valley Automotive; similar letters received from Sturgeon and Beck Inc. Buick Pontiac GMC, Hansel Toyota, Galpin Motors, 3 Way Chevrolet, George Chevrolet, Toyota of San Bernardino, Turlock Auto Plaza, Hoblit Motors, Courtesy Automotive Center, Steves Chevrolet-Buick, Fireside Dodge, Hemborg Ford, Pearson Ford, Bob Williams Chevrolet Geo , Hendrick's Hallowell Chevrolet, Surroz Motors Inc.).

Agency Response: Staff disagrees with the comment. Vehicles meeting the greenhouse gas standards will have lower operating costs, which offsets the up-front purchase price increase. Staff used the CARBITS model to quantify the consumer response to this combination of price increase and lower operating cost. In 2009-2012, during the phase-in of near-term technologies to reduce climate change emissions, the modeling projected that sales of new vehicles increase due to the regulation. This increase comes about because consumers are willing to pay for the lower operating cost. During the phase-in of the mid-term technology, sales growth of new vehicles drops modestly due to the regulation, but the lower operating cost is a mitigating factor that blunts the effect of the price increase. Furthermore, manufacturers have historically used marketing strategies to soften the impacts of any price increase and are likely to do so for this regulation to maintain market share and sales. Their efforts will mitigate any potential impact on their dealers.

(b). CARBITS Modeling Issues

420. Comment: If the model were to receive a review that would be typical in deciding whether to use the model to evaluate the potential impacts of a regulation, the following additional information would be required:

1. The survey data and computer programs that were used to derive the data on which basis the Sheng model was estimated;
2. The computer program(s) used to estimate the Sheng model;
3. The computer program(s) used to simulate household demographic changes;
4. The computer program(s) used to run the CARBITS micro simulations; and
5. Any other computer program(s) or data that are necessary to fully replicate CARBITS. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, page 8).

ARB staff apparently has justified not providing the full set of CARBITS information on the basis that CARBITS has already been peer reviewed. The fact that two published papers cited by ARB Staff have been peer reviewed, however, does not mean that CARBITS itself has been subject to peer review or that peer review would imply that the underlying data and methodologies are valid. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, page 8).

Agency Response: Staff disagrees with the comment. ARB provided NERA with all the information about CARBITS in our possession, in July and August 2004. ARB does not have the information listed above nor did we try to gather it at any time while UC Davis ITS was developing CARBITS.

ARB has posted on its web site, for the public including NERA to view, these peer-reviewed articles:

- David Brownstone, David S. Bunch, Kenneth Train, Joint mixed logit models of stated and revealed preferences for alternative-fuel vehicles, *Transportation Research Part B*, volume 34, pages 315-338.
- David Brownstone, David S. Bunch, Thomas F. Golob, and Weiping Ren, A Transactions Choice Model for Forecasting Demand for Alternative-Fuel Vehicles, *Research in Transportation Economics*, Volume 4, pages 87-129, 1996.

ARB has provided NERA with this peer-reviewed article:

- David S. Bunch, David Brownstone, and Thomas F. Golob, A Dynamic Forecasting System for Vehicle Markets With Clean-Fuel Vehicles, *Seventh World Conference on Transport Research*, 1995.

ARB also provided two dissertations of graduate students who performed some of the original work. Each student had a committee of professors who rigorously reviewed the dissertations.

- Hongyan Sheng, *A Dynamic Household Alternative-fuel Vehicle Demand Model Using Stated and Revealed Transaction Information*, 1999.
- Camilla Kazimi, *A Microsimulation Model for Evaluating the Environmental Impact of Alternative-Fuel Vehicles*, 1995.

ARB's description of peer-reviewed papers produced by University of California researchers relates to the fact that multiple researchers have done a substantial amount of

work in this area covering a multi- year period. Clearly, the methodology has been thoroughly and rigorously peer-reviewed. CARBITS development rested on both the substance of the previous work and on the experience and insights gained while working in this area.

During the development of CARBITS, ITS would send a preliminary version of CARBITS to ARB. ARB staff would test the model and have issues with it. ARB would report the issues and ITS would make improvements. ARB and ITS continued this iterative process until ARB had a version of CARBITS that worked properly. ARB compared CARBITS results with EMFAC and with vehicle data obtained from CALTRANS. ARB insisted on consistency with sales counts, vehicle population, and vehicle age distribution. ARB also insisted on internal consistency of consumer response to changes in vehicle attributes. ARB is satisfied that CARBITS works as it should. ARB staff did not consider it necessary to obtain the FORTRAN source code and look through it searching for bugs. This would be equivalent to asking Microsoft for the source code underlying the software used to compose this document.

ITS calibrated CARBITS, at ARB's request, to be consistent with EMFAC. (EMFAC is ARB's model for mobile source emissions, approved by U.S. EPA.) That is, the household weights were set such that for the base year, 1995, the vehicle age distribution of the CARBITS baseline scenario matched that of EMFAC for 1995. CARBITS output for 2000, after five simulated years of household vehicle transactions, still shows excellent agreement with EMFAC, in the vehicle age distribution. Because of the good agreement between the two models in spite of their very dissimilar methods of calculating vehicle populations, we have confidence that CARBITS is a useful tool for the Staff Report's supplemental analysis.

421. Comment: The Sheng dissertation model uses a multinomial logit (MNL) specification for the revealed preference (RP) portion of the model. The MNL specification imposes what is known as the "independence of irrelevant alternatives" (IIA) assumption. This assumption substantially lessens the computational complexity and burden of estimating the vehicle choice model. However, as is well established in the economics literature, the IIA assumption also imposes restrictions on households' patterns of substitution between choices.

Under the IIA assumption, for example, the cross-price elasticities of demand with respect to a particular product's price are forced to be equal to each other. In the current context, IIA would force the cross price elasticity of minivans with respect to sports cars to be equal to the cross price elasticity of luxury cars with respect to sports cars. These restrictions imposed by IIA are often unrealistic – the cross price elasticity between luxury cars and sports cars might be expected to be larger than the cross price elasticity between minivans and sports cars as purchasers of sports cars would view luxury cars as closer substitutes for sports cars than minivans.

The Sheng model uses an MNL specification and thus it imposes the IIA assumption. However, the Sheng dissertation does not indicate that any test of the validity of the IIA

assumption was conducted. This raises the question of whether the Sheng model has incorrectly imposed the IIA assumption and its restrictive substitution patterns. If IIA has been incorrectly imposed, the model (and thus CARBITS) would be biased and unreliable.

Brownstone, et al. estimates a vehicle choice model using data from the same underlying survey as that used in the Sheng dissertation. They determine that the MNL model with its IIA assumption is appropriate in their context. However, the Brownstone, et al. model differs in a significant respect from the Sheng model. The Brownstone, et al. model addresses a household's choice among vehicles, conditional on having purchased a vehicle. The Sheng model, in contrast, addresses both the household's decision as to whether to purchase a vehicle at all as well as the choice among vehicles for those households who choose to purchase. In the context of the Sheng model, IIA is imposed over all choices, including the "no purchase" option. Thus, even if the IIA assumption is valid within the vehicle choice "branch" of the decision tree (as Brownstone, et al. appears to show), there is no reason to believe that IIA applies over the whole decision tree. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, pages 10-11).

Agency Response: Staff disagrees with the comment. The IIA issue is primarily relevant for aggregate level models estimated on aggregate level data. Specifically, when using disaggregate data it is possible to include many economic and demographic factors in the utility function that drive household decision-making. Aggregate data, by its nature, does not capture detailed effects that distinguish one household from another.

For an aggregate level model, as NERA points out, it would indeed be unrealistic to force the cross price elasticity of minivans with respect to sports cars to be equal to the cross price elasticity of luxury cars with respect to sports cars. On the other hand, in a disaggregate model that takes household characteristics into account, the choice of vehicle depends on the size of the household, the age of the drivers, and household income. By taking these economic and demographic factors into account, each household makes a decision that makes sense for itself.

In other words, MNL can be a reasonable approximation for individual level behavior when a more complex utility function is estimated. CARBITS is a household-level model using disaggregate data, with many household-level factors in the MNL utility function. Therefore the IIA issue associated with aggregate level models is insignificant. NERA even acknowledges that IIA is appropriate for the Brownstone et al. model, which is very similar to the Sheng model underlying CARBITS.

422. Comment: The TSD states that the Sheng model was estimated on a sample of households, which were selected in part on the basis of having "three or fewer vehicles after transacting". Under this definition, the sample used to estimate the Sheng model was selected in part on the outcome being studied.

For example, consider two households that are otherwise identical in terms of their observed characteristics. Both households have three vehicles during the first wave of the

survey. Between waves, one household chooses to add a fourth vehicle, while the second household undertakes no transactions. The first household would be excluded from the estimation sample because it would have four vehicles after the transaction. The second household would be included because it would have only three vehicles. Thus, the only reason the second household appears in the sample while the first does not is the difference in respective outcomes of the two households' purchase decisions.

This type of endogenous sample selection leads to bias in the estimated coefficients if uncorrected. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, pages 11-12).

Agency Response: Staff disagrees with the comment. Of the 749 households with valid information on replacement or addition, only 84 (11%) had four or more vehicles. This sub-sample size is statistically too small given the number of estimated parameters and decision points for an accurate estimation of transitions for a four-vehicle decision tree that models such transactions. Likewise, whatever bias results from leaving out the 84 households would be small. Therefore the exclusion has no meaningful impact on the results."

423. Comment: The TSD describes the data on which CARBITS is based. These data sets are seven to ten years old, in which period much has changed in both the Californian and national vehicle markets. For example, CARBITS uses the National Personal Transportation Survey data to calibrate benchmarks of the overall transactions and sales rates, and sales rates as a function of vintage. Insofar as these parameters have changed over the past decade, CARBITS simulations will not be a good description of the current vehicle market. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, page 12).

Agency Response: The CARBITS approach is based on theoretical principles that are widely accepted in the travel demand field. ARB wanted to take advantage of the previous work done by ITS. Model development takes a long time. Data collection is expensive and slow. Model construction and calibration and peer review takes time. The effort to make CARBITS useful to ARB took another two years.

ITS calibrated CARBITS, to be consistent with EMFAC. CARBITS output for 2000, after five simulated years of household vehicle transactions, still shows excellent agreement with EMFAC in the vehicle age distribution. This shows that despite using the seven to ten year old data the model correlates well with current conditions. Because of the good agreement between the two models in spite of their very dissimilar methods of calculating vehicle populations, we have confidence that CARBITS is a useful tool for the Staff Report's supplemental analysis.

424. Comment: An important consequence of using these outdated data, as well as the weighting procedure used to incorporate them into CARBITS, is that CARBITS contains too many cars relative to other vehicle groups, as compared with more recent data. As Table 6.1-4 in the August Staff Report shows, 53 percent of vehicles sold by the largest

car manufacturers in California in 2002 were in classes PC and LDT1. However, in CARBITS baseline output, the corresponding figure is 83 percent. CARBITS therefore misrepresent the structure of the vehicle market. Insofar as owners of vehicles in different categories have different preferences and characteristics, consumer responses forecast by CARBITS will be similarly inaccurate. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, pages 12-13).

Agency Response: Staff disagrees with the comment. The distribution of market shares is due to the weighting procedure, not to the age of the data. CARBITS calculates vehicle stock, including new vehicle sales, for 14 vehicle types. Of these, seven correspond to EMFAC class Light Duty Auto, also known as PC (for "Passenger Car"). The other seven classes consist of various pickups, vans, and SUVs. There is no obvious way to translate from these vehicle classes to EMFAC classes LDT1, LDT2 and MDV. ARB and ITS chose a weighting procedure to allow CARBITS output to be consistent with EMFAC output. Thus, both CARBITS and EMFAC show an 83% to 17% distribution of PC/LDT1 LDT2/MDV. In the 2002 CalTrans Travel Survey of households, the share of 2002 household vehicles that are cars is 63%, and this figure does not include any light-duty trucks. In any case, as previously noted, CARBITS performed well in validation tests based on an "apples to apples" comparison using available household survey data.

425. Comment: The Sheng model includes variables taking account of the interaction between fuel operating cost and transaction-type, but these were eliminated from CARBITS. In other words, the coefficients on these fuel operating cost variables were set to zero in CARBITS. This was done based on "expert judgment" that their inclusion constituted a specification error. Dropping the variables that indicate a specification problem without re-estimating the model does not solve the specification problem; it simply hides the fact that a specification problem exists. Thus, the specification problem to which the TSD alludes is still present in the vehicle choice model in CARBITS. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, page 13).

Agency Response: Staff disagrees with the comment. The modifications to the Sheng model were made on the basis of knowledge and insight obtained through intensive calibration, testing, and evaluation efforts. The implications of the two original coefficients were rather subtle. However, it became clear that finding a reasonable way to drop the coefficients would lead to an improvement based on theoretical considerations. It was also clear that the recalibration of the model compensated for the excluded effects. Continued testing and calibration of the model demonstrated that its behavior was an improvement over the previous version.

426. Comment: The second exception to CARBITS' use of the Sheng RP coefficient estimates is that CARBITS employs the "SP," or stated preference, coefficient estimate for the tailpipe emissions variable rather than the RP coefficient because the RP coefficient estimate was positive rather than negative. There are several methodological problems with this procedure. First, the RP coefficient estimate is the best estimate of the effect of

the emissions variable in the RP model; no econometric justification exists to change it. Second, as with the fuel cost interaction variable coefficients, if it was determined that the RP emissions coefficient should be constrained to a certain value, the Sheng model should have been re-estimated with this constraint imposed so that the rest of the coefficients in the model could be re-estimated optimally. Because this was not done, the coefficient estimates as used in CARBITS are likely to be biased. (NERA Economic Consulting, *Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California*, pages 14-15).

Agency Response: For the consumer response scenarios presented in the ISOR and the Addendum, ARB staff changed only the vehicle price and fuel economy. ARB staff did not alter the emissions variable. Whatever effect the emissions variable may have, it is the same effect for the regulation scenario as it is for the baseline scenario. Thus, in terms of the scenario analysis, the issue is moot. As previously noted, CARBITS produced results that matched historical patterns up through 2000 and beyond.

427. Comment: The SP coefficient estimate is based on respondents' answers to hypothetical survey questions, whereas the RP coefficient is based on the respondents' actual transactions. SP survey responses are well known to be subject to bias. The problem arises because surveys ask respondents hypothetical questions. Respondents are not forced to make any real economic decisions as a consequence of their answers. Thus, the survey process cannot be said to require them to take the exercise as seriously as they would take an actual purchase opportunity where they would be paying many thousands of dollars. In addition, respondents may have incentives to give "strategic" answers designed to support a policy outcome they think is "right" rather than answers that describe their true economic preferences for the good in question. (NERA Economic Consulting, *Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California*, page 15).

Agency Response: Stated preference approaches provide a valuable source of information for developing models used in policy analysis. The questionnaire methodologies used in the survey take the concerns stated above into account. In addition, there are major problems with using revealed preference data alone. The modeling project mitigated these problems by using conjoint data – combining revealed preference data with stated preference data – as mentioned on page 36 of the Technical Support Document on Other Considerations. Prof. Dan McFadden (the 2000 Nobel Prize winner in Economics, for his development of theory and methods for analyzing discrete choice) has stated that carefully collected conjoint analysis data are on the whole measuring the same preferences as revealed preference data. Specifically he states (Daniel McFadden, *Disaggregate Behavioral Travel Demand's RUM Side*, July 2000, page 25):

A second innovation in data has had a major impact on travel demand analysis, and probably receives more attention than any other topic in travel demand research. This is the use of *stated preference* (SP) data, a shorthand for a variety of data that can be collected from individuals by offering them

hypothetical choice tasks, eliciting attitudes and perceptions, and collecting subjective reports on preferences. Most of these variables and the methods used to measure them come from psychology via market research. In particular, conjoint analysis has proven that it can give a much more rounded view of the preferences of an individual than the one-dimension picture provided by revealed preference data.

428. Comment: CARBITS does not include any modeling of the supply-side of the vehicle market. Yet, understanding the supply-side is crucial to understanding the extent to which the cost changes mandated by the proposed regulation would be passed through to purchasers of new vehicles. It is well established in the economics literature that the amount of cost pass-through depends on the shape of the demand curve, the form of competition between manufacturers, and the degree to which the cost increase falls on each manufacturer. Instead of appropriately modeling the supply-side in addition to the demand-side, which would allow a determination of the extent of cost pass-through, CARBITS simply assumes that pass-through would be 100 percent.

Another important supply-side consideration is the extent to which used vehicle prices would increase in response to an increase in new vehicle prices. ARB Staff's failure to model the supply-side of the market and to incorporate the supply-side into the simulations is tantamount to assuming that vehicle prices (both new and used) are exogenous. This assumption is not supported by the economics literature generally and is rejected specifically in studies of the automobile industry. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, page 16).

Agency Response: Models used for policy analysis in the public sector and market analysis in the private sector almost always focus on the demand side rather than on the supply side. ARB's objective was to look at consumer response. For that, it is appropriate to consider the demand side alone. CARBITS provides the right kind of information for its role in the Staff Report's supplemental analysis.

It is clear that ARB staff was making a conservative assumption in using a 100 percent pass-through. It was a perfectly sensible approach to set this value to 100 percent as part of a long list of assumptions required to provide a basic framework for the analysis. The cost-effectiveness calculations show that the vehicles affected by the greenhouse gas regulation are economical to the owner, even assuming that all of the cost increase gets passed through as a price increase. The vehicles pass the test with this assumption in place. If it turns out that, because of supply side considerations, the price increase is somewhat less than the cost increase, then the consumer is even better off.

429. Comment: We have focused on the patterns of scrappage of vehicles implied by CARBITS, since scrappage results figure prominently in the ARB Staff's use of CARBITS. Scrappage patterns are a key determinant of the age structure of the vehicle fleet population, which in turn is a key influence on the level of emissions from vehicles. The reasonableness of the CARBITS model's predictions of scrappage effects is therefore

clearly crucial to its usefulness for policy evaluation. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, page 17).

Given the inconsistency between the CARBITS scappage rates and the actual historical scappage rates, the reliability of the CARBITS scappage rates is called into question. Scappage patterns are a key determinant of the age structure of the vehicle fleet population, which in turn is a key influence on the level of emissions from vehicles. Because the scappage rates produced by CARBITS were unreliable, the conclusions of the ARB Staff Report would have no reliable basis. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, page 23).

Agency Response: Staff disagrees with the comment. It is in fact the age distribution of the vehicle population, not scappage rates, that figures prominently in the ARB's use of CARBITS. The age distribution is important to ARB, because older vehicles emit more criteria pollutant emissions. The age distributions produced by CARBITS are both sensible and reasonable. The baseline age distribution agrees well with the age distribution of vehicles in EMFAC. The *difference* in CARBITS age distribution caused by a regulation has qualitatively the same shape as the difference in age distribution resulting from the NERA/Sierra New Vehicle Market Model.

430. Comment: ARB staff has understated the cost of compliance with the proposed standards by ignoring the average 8% sales tax that applies in California. (Declaration of Thomas C. Austin, page 3)

Agency Response: The appropriateness of including sales tax in the ARB compliance cost estimates is addressed in comment 243. The treatment of sales tax with respect to net consumer benefit is addressed in the response to comment 407. This response addresses the relevance of sales tax to the CARBITS modeling.

The prices in the CARBITS vehicle attribute database do not include sales tax. Consumers make comparisons between vehicles based on price, not price plus sales tax. Thus CARBITS, as a consumer response model, uses price excluding sales tax. CARBITS was calibrated using baseline prices that do not include sales tax. Therefore it would be inappropriate to include sales tax in the regulation scenario.

If the vehicle prices used in the E-DRAM scenario included sales tax, the impact would not be significantly different than the E-DRAM results reported in Revised Tables 10.2-4 and 10.2-5 of the Addendum.

(c). NERA Consumer Response Model

431. Comment: NERA has developed a New Vehicle Market Model to determine the effects of the Staff Greenhouse Gas Proposal on the vehicle market in California and the rest of the United States. The model uses a nested logit demand framework based on

historical transaction price, sales data, and vehicle characteristics for both regions. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B-1.1)

Logit discrete choice analysis provides a method for predicting consumer choices, and therefore demand, based on previously observed consumer behavior and other assumptions about demand. The most basic logit framework, also referred to as the “simple” logit framework, groups all product alternatives together and therefore allows only very limited patterns of own-price and cross-price elasticity between different alternatives. This limitation is often referred to as the “Independence of Irrelevant Alternatives” (“IIA”) problem. The nested logit framework builds on this simple framework, but provides for a much richer pattern of cross-elasticity between different alternatives through the nesting structure. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B-1.1)

We assume each vehicle’s alternative-specific parameter depends upon the vehicle’s type and attributes according to the following model:

$$\alpha = X\beta + D_{nest} \gamma_{nest} + \delta_{year} D_{year} + \phi_{make} D_{make} + \varepsilon ,$$

where

α is the alternative-specific coefficient,

X are vehicle characteristics,

D_{nest} are dummy variables corresponding to vehicle nests,

D_{year} are dummy variables corresponding to vehicle model years,

D_{make} are dummy variables corresponding to the vehicle make (manufacturer)

ε is an error term capturing unobserved characteristics, and

β , γ_{nest} , and ϕ_{make} are estimated parameters

(NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B1-7-8)

We use national and California-specific sales data from JD Power and Associates to determine the market share for each vehicle model, aggregated across trim levels, for the years 2001-2003. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B1-8).

We use data on transaction prices for each model from JD Power and Associates for both California and the rest of the United States. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B1-9).

We use data from EPA's Fuel Economy statistics to reflect the fuel efficiency of each vehicle model. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B1-9).

We rely on data from Ward's for information about other vehicle attributes, including engine size, number of cylinders, curb or test weight, horsepower, length, and height. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B1-9).

Consistent with various literature sources, we assume an aggregate elasticity for the new vehicle market of -1.0 . We set the own-price elasticity of the "normalized" vehicle model to be -4.0 , which is consistent with various other literature estimates of individual model own-price elasticities. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B1-10).

The nesting parameters for nested logit models represent the similarity between choices for vehicles falling within the same nest. For the "Buy" nest we use a nesting parameter equal to 0.9, for vehicle types we use a nesting parameter equal to 0.6 and for vehicle classes we use nesting parameters equal to 0.3. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B1-10).

In general, the model uses vehicle prices and assumptions about consumer response to changes in those prices to calculate marginal costs that are consistent with both profit-maximizing behavior and the observed market share. Marginal costs for each vehicle are calculated based on each vehicle's calculated elasticity. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B1-10).

Agency Response: The approach taken by NERA is to estimate an aggregate level nested logit model that focuses solely on new vehicle sales, totally ignoring the used vehicle market. Such models are not typically used in policy analysis involving long time horizons. They do not include enough detail on fundamental behavior and preferences to reasonably capture potential dynamic effects. They completely ignore important effects associated with used vehicle holdings that occurred as a result of decision making in previous periods. Moreover, all of these decisions will be affected by decisions they have made in previous periods; these previous decisions are missing in NERA's model. In addition, it is obvious that other important effects related to demographic trends, changes in household structure, etc., are not captured by this approach.

The NERA New Vehicle Market Model differs from CARBITS in fundamental ways:

- The NERA model uses aggregate sales data, whereas CARBITS is a household-level microsimulation. That is, CARBITS simulates consumer decision-making at the household level, where vehicle purchase decisions actually get made. The NERA model uses sales totals that aggregate away any information about individual decisions.
- The NERA model is completely devoid of any demographic information. CARBITS simulates the behavior of more than 40,000 households, modeling the number of individuals, their ages, and household income. CARBITS simulates births, deaths, marriages, divorces, and grown children leaving home from 1995 to 2020.

Furthermore, NERA has not indicated whether the New Vehicle Market Model has been peer-reviewed at any level, nor whether its baseline outputs agree with any dataset or output from any other model.

In conclusion, ARB continues to regard CARBITS as a wholly appropriate model of consumer response for the Staff Report's supplemental analysis.

432. Comment: In 2020, new vehicle sales of PC/LDT1's and LDT2's combined are about 176,000 lower as a result of the Staff Greenhouse Gas Proposal. In contrast, the number of vehicles in the fleet with model years before the regulations would take effect (i.e., pre-2009 model year vehicles) is more than 1 million greater in 2020 as a result of the Staff Greenhouse Gas Proposal. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, page ES – 3)

Agency Response: These results rest on these considerations, developed in detail in the appendices submitted by NERA-Sierra:

- The costs of compliance are about three times as high as ARB estimates
- The fuel savings are about a third as much as ARB estimates
- The rebound effect is about six times as high as ARB estimates
- NERA-Sierra use an aggregate-level model to calculate the fleet turnover effect.

Other responses in this document (see section III.A.2.c(4)) explain that the cost increases and rebound effect assumed by NERA-Sierra are significantly overstated. Likewise, the operating cost savings assumed by NERA-Sierra are understated (see section III.A.2.c(5)).

NERA-Sierra developed its own vehicle holdings model to calculate fleet turnover effect. The model uses market-level aggregate data to estimate the coefficients used in the model. By contrast, ARB uses CARBITS, a household-level transactions model. Modeling at the level of households is more realistic than modeling with aggregate data. Also, a transactions model is better than a holdings model for measuring consumer response to changes in vehicle attributes. Thus, the basic conclusion of the AAM/NERA/Sierra documents – that the regulation results in harm to the California economy and environment – does not hold.

The analysis upon which the regulation is based as presented and documented in the Staff Report was subjected to external peer review by UC scientists. To our knowledge the NERA model and its results were not.

433. Comment: The estimated number of reduced new vehicle sales in 2020 ranges from about 53,000 to more than 300,000. The estimated number of increased pre-2009 vehicles in 2020 ranges from about 64,000 motor vehicles to more than 1 million motor vehicles.

[NERA/Sierra] Table ES-1. Summary of the Changes in Statewide 2020 Vehicle Population Estimates as a Result of the Staff Greenhouse Gas Proposal Scenarios

	New Vehicle Sales in 2020	Pre-2009 Vehicles in 2020 Stock
NERA/Sierra methodology With NERA/Sierra inputs	-176,176	1,068,444
NERA/Sierra methodology With ARB staff inputs	-50,916	388,634
CARBITS methodology With NERA/Sierra inputs	-309,243	905,371
CARBITS methodology With ARB staff inputs	-72,472	64,244

(NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, pages ES – 4-5)

Note--The discrepancy between “53,000” in the text and “-50,916” in the table is in the original NERA/Sierra document.

Agency Response: NERA/Sierra provide results from four scenarios, three of which differ from the analysis performed by ARB staff. The scenarios as well as an explanation for the differences are as follows:

- *NERA/Sierra methodology with NERA/Sierra inputs.* The NERA/Sierra new vehicle sales estimate is much lower than ARB’s estimate. The NERA/Sierra pre-2009 vehicle stock is much higher than ARB’s estimate. The differences in outputs are due mainly to NERA/Sierra overestimates of cost increases and underestimates of fuel savings. See response to Comment 432.
- *NERA/Sierra methodology with ARB staff inputs.* The NERA/Sierra pre-2009 vehicle stock is much higher than ARB’s estimate. The differences in outputs are due to differences between the NERA/Sierra model and CARBITS. See response to Comment 431.
- *CARBITS methodology with NERA/Sierra inputs.* The NERA/Sierra new vehicle sales estimate is much lower than ARB’s estimate. The NERA/Sierra pre-2009 vehicle stock is much higher than ARB’s estimate. The NERA/Sierra document describes how NERA/Sierra prepared their input, but does not provide any numbers. The ARB staff

could not find, on the CD-ROMs provided by NERA/Sierra, any files that contained vehicle attributes for use in CARBITS. ARB staff therefore does not have sufficient basis for evaluating this scenario.

- *CARBITS methodology with ARB staff inputs.* The NERA/Sierra numbers reported here agree with ARB results within the uncertainty of the CARBITS output.

434. Comment In 2016, California motor vehicle purchasers would experience a welfare loss of more than \$4 billion dollars. (All values are in 2003 dollars.) The cumulative welfare loss over the period from 2009 to 2016 would be more than \$12.8 billion. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, page ES-7)

Agency Response: The NERA/Sierra analysis is based on data and modeling that are significantly different from those used by ARB. Contrary to the NERA/Sierra analysis, the ARB analysis as presented in the Staff Report and subjected to UC peer review shows that California vehicle purchasers would experience a welfare gain of about \$1 billion in 2016. The cumulative welfare gain from 2009 to 2016 would be about \$7.3 billion.

435. Comment: The Staff Greenhouse Gas Proposal has the effect of changing the age distribution of the vehicle population in both categories. In 2020 the number of older vintage vehicles-including vehicles sold before 2009 and those sold between 2009 and 2012-is higher than in the base case because consumers opt to retain their existing vehicles for longer, rather than replacing them with more expensive newer vehicles. In 2020, sales of new PC/LDT1's and LDT2's combined are lower by about 176,000 vehicles in California as a result of the Staff Greenhouse Gas Proposal. In contrast, the number of vehicles in the *fleet* with model years before the regulations would take effect (i.e., pre-2009 model year vehicles) is more than 1 million greater in 2020 as a result of the Staff Proposal. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, page 17)

Agency Response: NERA/Sierra significantly overestimate the cost increase and underestimate the operating cost savings associated with the proposed regulations. Thus their estimates of the impact of the regulation on vehicle sales are likewise overstated. See response to Comment 432.

436. Comment: We determine the impacts of the Greenhouse Gas Proposal on consumer welfare using the New Vehicle Market Model. The model enables us to calculate the change in consumer welfare due to the proposed regulation and to value it in dollar terms. (Attachment B-8 describes the concept of the consumers' surplus due to the Staff Greenhouse Gas Proposal.) In 2016, California motor vehicle purchasers would experience a welfare loss of more than \$4 billion dollars. (All values are in 2003 dollars.) The cumulative welfare loss over the period from 2009 to 2016 would be more than \$12.8 billion. (NERA Economic Consulting and Sierra Research, Environmental and Economic

Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, page 30)

Agency Response: NERA/Sierra provide an apt description of the concept of consumer surplus, but nowhere do they describe the model they used to calculate the loss of consumer surplus. Section B-1.1.5 on page B1-7 discusses “each vehicle’s alternative-specific parameter,” but NERA/Sierra do not say whether they use this parameter to calculate consumer surplus. See also response to Comment 432.

437. Comment: The estimates provided by NERA indicate that if vehicles meeting the California CO₂ rules or very similar vehicles were sold nationwide, new motor vehicle sales in the United States would decline by more than 1.8 million vehicles per year by 2016. That reduction represents, for purposes of a comparison, more than 12 percent of current U.S. production of the types of vehicles included in the California greenhouse gas proposal. A typical motor vehicle assembly plant in the United States produces between 200,000 and 240,000 vehicles per year. The proposed rule could therefore cause a reduction in sales that could close eight or more vehicle assembly plants in this country, with attendant direct job losses of 2,500 to 3,500 workers at each assembly plant. It could also cause the equivalent of four engine plants and four transmission plant closures, and the loss of the jobs for tens of thousands of other workers at other plants in the United States that supply parts to those assembly, engine, and transmission plants. (Declaration of Steven P. Douglas, page 2)

Agency Response: This comment is outside the scope of ARB’s analysis, which focused on California impact. However, as discussed in the Staff Report, the vehicles produced in response to the regulation will lead to significantly lower operating costs. The resulting savings will translate into a substantial increase in jobs primarily due to consumers being able to spend more on discretionary items. Also see response to Comment 432 above.

(d). Potential Impact on Businesses

438. Comment: It is suggested that even if dealers lose “sales volume” in California, this would be “roughly compensated by the increase in vehicle prices.” This conjecture would be true only if (among other assumptions) dealer profits were the same on all vehicles, or if the profits on the vehicles that would still be sold were sufficient to offset the lost profits from foregone sales. Either assumption is unlikely, and neither is discussed explicitly in the staff documents, much less supported with information or analysis. For most dealers the lost profits from foregone sales will be larger than any increased profits from the sale of a smaller number of higher-priced vehicles. (Declaration of Steven P. Douglas, page 3)

Agency Response: Staff has assumed an aggregate elasticity of –1 for the entire vehicle market. This assumption is consistent with numerous literature sources and is even used by the industry in its own analysis of the Zero Emission Vehicle Regulations. Again, we agree with the commenter that there are variations in the price elasticity for each vehicle model but our analysis is conducted for the entire vehicle market in California and our assumption regarding the aggregate price elasticity is consistent with the literature.

439. Comment: In order to evaluate the impact of the proposed rules on the State's automotive workers and affiliated businesses, the Staff Report recounts an evaluation of the potential impacts on automotive workers and affiliated businesses in San Diego. In this regard the Staff Report makes three assumptions: (i) gasoline consumption drops by 25 percent, (ii) automotive service increases by one percent, and (iii) automobile dealers' profitability is unaffected by the regulation. With the exception of the first assumption, which is based on the Staff Report's calculated reduction in fuel consumption, there is no documentation to support those three assumptions. The available documentation developed by ARB staff from CARBITS and the price-elasticity demand model indicates that there will be a substantial impact on new vehicle sales and consequently on automobile dealers.

To justify the second assumption, concerning increased demand for automotive service, the Staff Report states that because new vehicle prices increase, people will tend to maintain their vehicles longer – which is another internal contradiction in the Staff Report. As noted above, the Staff Report assumes elsewhere that new vehicle sales will not be affected by the proposed regulation. If vehicles are retained longer in service, there is less demand for new vehicles. In addition, it must be noted that for typical privately held vehicles, independent repair shops perform 75 percent of vehicle service after the warranty expires. Thus, even if the second assumption were true, vehicle service at franchised new car dealers would decrease, adding to the negative impact of reduced vehicle sales. (Declaration of Steven P. Douglas, pages 3-4)

Agency Response: As the commenter correctly states, the Staff Report's main analysis assumes that the proposed regulations would not affect new vehicle sales. However, this assumption was probed in the supplemental analysis as presented in Chapter 12 "Other Considerations" to show that the results of this analysis would not be significantly different from the main analysis.

In the analysis of the impact on businesses in low income and minority communities, the Staff assumes a modest change in new vehicle sales as a result of the proposed regulations. This assumption is consistent with the Staff's supplemental analysis and contrary to the commenter's view does not represent an internal contradiction in the Staff Report. Given a modest change in new vehicle sales due to the regulations, Staff assumed a 1% increase in demand for automotive service and repair businesses if some vehicle buyers delay the purchase of new vehicles and hold onto their old vehicles longer. This assumption was made for the illustration purpose and has no significant bearing on the results of the analysis. The NERA/Sierra also assumed an increase in repair costs in its analysis of the proposed regulations (Attachment B7-10). The assumption regarding automotive dealer's profitability is consistent with the assumption regarding the aggregate elasticity of -1 for the entire vehicle market. As stated in comment 431 and the agency response to Comment 438, this assumption is consistent with the literature.

(2). Section 12.3—Effects of Regulation on Vehicle Miles Traveled

(a). General Effect

440. Comment: ARB staff has overestimated the fuel savings associated with the proposed standards by ignoring the “rebound effect,” which is the well-documented increase in travel associated with reductions in vehicle fuel cost. (Declaration of Thomas C. Austin, page 4)

Agency Response: The commenter is correct that ARB staff did not consider the “rebound effect” in its main analysis. The reason was that ARB staff was very conservative in their assumptions. The inclusion of the “rebound effect” would have increased the staff estimate of the fuel cost savings. In other words, ARB staff has underestimated the fuel cost savings contrary to the claim of the commenter. Chapter 11 of the ARB staff analysis provides a supplemental analysis. In that analysis, staff included the “rebound effect”. The inclusion of the “rebound effect” in the supplemental analysis did not change the results significantly from those of the main analysis.

It should also be noted here that the commenter appears to imply that increased consumer expenditures on fuel that may occur as a result of the “rebound effect” would potentially reduce the fuel cost savings associated with the proposed standards. The estimated fuel cost savings provided in the main analysis are based on the assumption that the consumers’ vehicle miles traveled (VMT) would not be changed after the regulation becomes effective. The question now is what consumers will do with their savings from reduced fuel consumption. Consumers certainly have the choice to spend their savings on any goods or services they desire or save their money. It is likely that some consumers spend some of their fuel cost savings on the purchase of additional fuel to drive more. For their additional expenditures on fuel, consumers would be able to drive more. In other words, consumers would receive additional benefits (or utilities) from driving more. Contrary to the commenter’s statement, staff believes this consumer action should not be represented as a reduction in the fuel cost savings associated with the proposed standards.

441. Comment: Estimated fuel cost savings ignore the “rebound effect” which is the well-documented increase in travel associated with reductions in vehicle fuel cost. (Sierra Research, Review of the August 2004 Proposed CARB Regulations to Control Greenhouse Gas Emissions from Motor Vehicles: Cost Effectiveness for the Vehicle Owner or Operator, page 23)

Agency Response: See the agency response to Comment 440.

442. Comment: Table 15 shows the same analysis accounting for a 17% rebound effect. The net cost increase associated with the proposed standards rises from \$3,129 to \$3,357. (Sierra Research, Review of the August 2004 Proposed CARB Regulations to Control Greenhouse Gas Emissions from Motor Vehicles: Cost Effectiveness for the Vehicle Owner or Operator, page C1-26)

Agency Response: A 17% rebound effect estimate is based on the NERA revision of the rebound effect estimate by the University of California, Irvine that the ARB staff used in their analysis. This revision is based on a misinterpretation of the data and misunderstanding of the assumptions used in the UC Irvine study. Please see our subsequent responses to the comments on the rebound effect in this section. ARB staff has a great confidence in the rebound effect results generated by the UC Irvine study because the study was extensively peer-reviewed while the NERA analysis was not.

443. Comment: Attachment C-4 presents our independent analysis showing that the rebound effect in California is approximately 16% (i.e., -0.16), which is consistent with the literature for the nationwide rebound effect. A separate analysis by NERA reaches the conclusion that the rebound effect is 17%. By ignoring the rebound effect, CARB has overstated the fuel savings by approximately 17%. (Sierra Research, Review of the August 2004 Proposed CARB Regulations to Control Greenhouse Gas Emissions from Motor Vehicles: Cost Effectiveness for the Vehicle Owner or Operator, page 30)

Agency Response: The Sierra analysis provides a rough estimate of the rebound effect for 2003 based on Smog Check data. In its analysis, Sierra associates the entire change in the 2003 VMT to three changes in the fuel price in that year. In other words, Sierra only uses three data points in 2003 to estimate the rebound effect while the UC Irvine study uses over 1,800 data points (i.e., a data set for 1966 to 2001 on a cross-section of U.S. states and District of Columbia). In addition, it is a well-known fact that changes in the fuel price cannot solely explain the entire change in VMT. In addition to fuel price changes, VMT changes due to a host of other factors such as time costs, travel congestion, income, income level, etc. It was due to this complexity that the ARB decided to commission an exploratory study by the UC Irvine on the rebound effect. ARB staff believes that the rebound effect estimation approach developed by the UC Irvine is more credible and realistic than the simplistic approach used by Sierra Research. This is because the UC Irvine study uses a significantly more complex approach and data points to estimate the rebound effect. In addition, it was extensively peer-reviewed.

(b). UC Irvine Study Methodological Issues

444. Comment: As documented in reports prepared by NERA and Robert Crawford, the results of the UCI study are inaccurate because of mistakes made in formulating the models used in the study – when those mistakes are corrected, the magnitude of the rebound effect calculated using the UCI methodology is essentially the same as that found elsewhere in the literature. The ISOR also states that the travel demand models used by the Southern California Association of Governments and the Bay Area Metropolitan Transportation Commission show no significant rebound effect. The following section of this report contains an explanation of why travel demand models are not capable of estimating the rebound effect. (Sierra Research, Review of the August 2004 Proposed CARB Regulations to Control Greenhouse Gas Emissions from Motor Vehicles: Cost Effectiveness for the Vehicle Owner or Operator, page 21)

Agency Response: Staff disagrees with the comment. The commenter makes three main assertions about the UC Irvine study of the rebound effect. These comments are summarized as follows:

(1) The interaction variable, cost per mile times income, is said to be very highly correlated with cost per mile, making it impossible to measure their effects separately. This would be important because it is the coefficient of the interaction variable that measures how the rebound effect changes with real per capita income, and this has a major effect on the projected results in California in 2009 and beyond.

(2) The problem noted in (1) is said to manifest itself in an unrealistic estimate of the income elasticity, i.e. the parameter measuring how much VMT increase with income. Mr. Crawford asserts that our income elasticity is negative, whereas theory and other studies would lead one to expect it is positive.

(3) California's high per capita income is said to be increasingly offset by higher living cost. Mr. Crawford prefers a model where income is measured as disposable income (which is after-tax) divided by a cost of living adjustment that he computes using data from ACCRA.

The first point is based on a misunderstanding of how correlations affect statistical results. The second is based on a mistake that the commenter makes in computing the income effect from our results. The third is a dubious use of cost-of-living figures that apply only to metropolitan areas. We elaborate on each below.

(1) Correlation between variables

As long as a statistical model includes a constant term, as ours does, the effect of variables on statistical results depends on their variation within the sample, not their absolute values. For example, a common practice is to "normalize" a variable by subtracting from its values the average value in the entire sample. Doing so in a typical linear model changes neither its correlation with other variables nor any results except the constant term.

When two variables are multiplied together to create an interacted variable, such as is done in the UC Irvine model, each of them can be similarly normalized by subtracting its mean. (In its interaction variables, UCI did this for income but not for the variables it is interacted with.) In a model that is linear in the interaction variable, as is the UCI model discussed in the Staff Report, this affects the constant term and also the coefficients of each of the component variables. It does not affect the coefficient of the interaction variable itself, nor does it alter the model's predictions in any way if those predictions are computed correctly using the modified definition of the variable. The choice as to whether to normalize a variable or not is made solely on the basis of convenience in presentation.

In the UC Irvine report, researchers normalized the variable *inc* (logarithm of per capita real income) when interacting it with *pm* for exactly this reason: they wanted the coefficient

of *pm* itself to measure the rebound effect at the average value of *inc*. Because *pm* occurs in two places in the model— by itself (variable *pm*) and as part of the interaction variable, which we labeled as $pm^*(inc-meaninc)$ — a full calculation of the rebound effect requires using both coefficients. Specifically the short-run rebound effect is the coefficient of *pm* plus $(inc-meaninc)$ times the coefficient of the interaction variable. This is how they compute the rebound effect in their projections. When *inc* equals its mean value, the second part of the calculation is zero, so that the coefficient of *pm* alone gives the rebound effect at the mean value of *inc* in the sample.

The UCI researchers could have similarly normalized *pm*, and in retrospect it would have made their presentation clearer. Because the model includes a variable formed by interacting *pm* with *inc*, this normalization would change the coefficient of *inc*— specifically, that coefficient would then measure the income elasticity at the average value of *pm*. No other results would change, no predictions would change, and the statistical confidence surrounding the estimates would not change. However, the apparent high correlation between *pm* and $pm^*(inc-meaninc)$ would be revealed to be an artifact of the fact that *pm* is not normalized.

To clarify their presentation in response to this comment, the UCI researchers have shown the calculations with *pm* normalized. Calling this new variable *pmnorm*, its correlation with $pmnorm^*(inc-meaninc)$ is only 0.0455. This is the correlation that determines how well the separate effects of the two variables can be measured, and it is very low, indicating there is no problem of excessive correlation. For the same reason of convenience in interpretation, the UCI researchers also normalized the variable *Urban* because it also is interacted with *pm* in the model. The re-estimated equations are identical to those in Tables 1-3 of our report (to within numerical calculation error in the last digit) except for the coefficients of *inc*, *Urban*, and *constant*. They show these three coefficients below for the Usage Equation, Estimated Using Three-Stage Least Squares (corresponding to the first two columns of Table 1 of our report).

Variable	Coefficient	Standard Error
<i>incnorm</i>	0.0917	0.0145
<i>Urbannorm</i>	-0.0454	0.0206
<i>constant</i>	2.0715	0.1265

The predictions of effects of *pm*, *income*, and *Urban* on VMT from this re-estimated model are identical to those presented in the Staff Report and the UCI report.

(2) Income Elasticity

Mr. Crawford’s assertion about the income elasticity of VMT in the UC Irvine model is due to a mistaken calculation. Specifically, he uses only the coefficient of *inc* (which is the logarithm of real per capita income), and neglects to account for the effect of income through the coefficient of $pm^*(inc-meaninc)$. Denoting these two coefficients by β_{inc} and β_{pminc} , respectively, the full calculation of income elasticity is:

$$\varepsilon_{inc} \equiv \frac{d \ln(VMT)}{d \ln(Income)} \equiv \frac{d(vma)}{d(inc)} = \beta_{inc} + pm * \beta_{pminc} .$$

This varies with the value of pm ; at the mean value of pm in the sample (1.8599), this equation applied to the coefficients β_{inc} and β_{pminc} in Table 1 in our report (first column) gives the income elasticity as:

$$\varepsilon_{inc} = -0.0740 + 1.8599 * 0.0890 = 0.0915.$$

This is identical to the coefficient of $inc-norm$ shown in the table above, within numerical error of 0.0002, as it should be according to the statements above. Thus, the UC Irvine model does generate a positive income elasticity. Although it is somewhat lower than the income elasticities shown for four other studies in Table 5 of Crawford's comment, those studies include the effects of income through increased vehicle holdings, which are held constant in the calculation above because "vehicle stock" is included as a variable in the UC Irvine usage model.

(3) Cost of Living Adjustment

The UC Irvine monetary numbers, including income and fuel costs, are all stated in real terms, deflated by a cost of living index. This index is the US nationwide consumer price index. Ideally UCI researchers would have liked to include variations across states in cost of living, but no state-wide cost of living indices are available. Instead, Mr. Crawford uses indices computed every five years for each metropolitan area, and attributes to each state a weighted average of the cost of living for its metropolitan areas. UCI researchers consider this use of cost of living data questionable because it creates an error that varies in unknown ways according to how urbanized a state is. Real income would be misstated in mostly rural states relative to mostly urban states, potentially confounding the effects of other variables.

Furthermore, if such a cost of living index is to be applied to income, it should be applied to fuel price (and hence the cost per mile variable) as well.

Crawford's proposal to use disposable income is a reasonable alternative to UCI's use of personal income. However it is not at all obvious that this is a better measure of how large fuel costs loom in people's budgets. If disposable income is lower in California because of higher taxes, this in part reflects a high level of provision of public services, which people in other states may have to provide privately or do without. Thus, it does not necessarily mean the Californians' standard of living is correspondingly less, or that driving costs are correspondingly more salient in Californians' travel decisions.

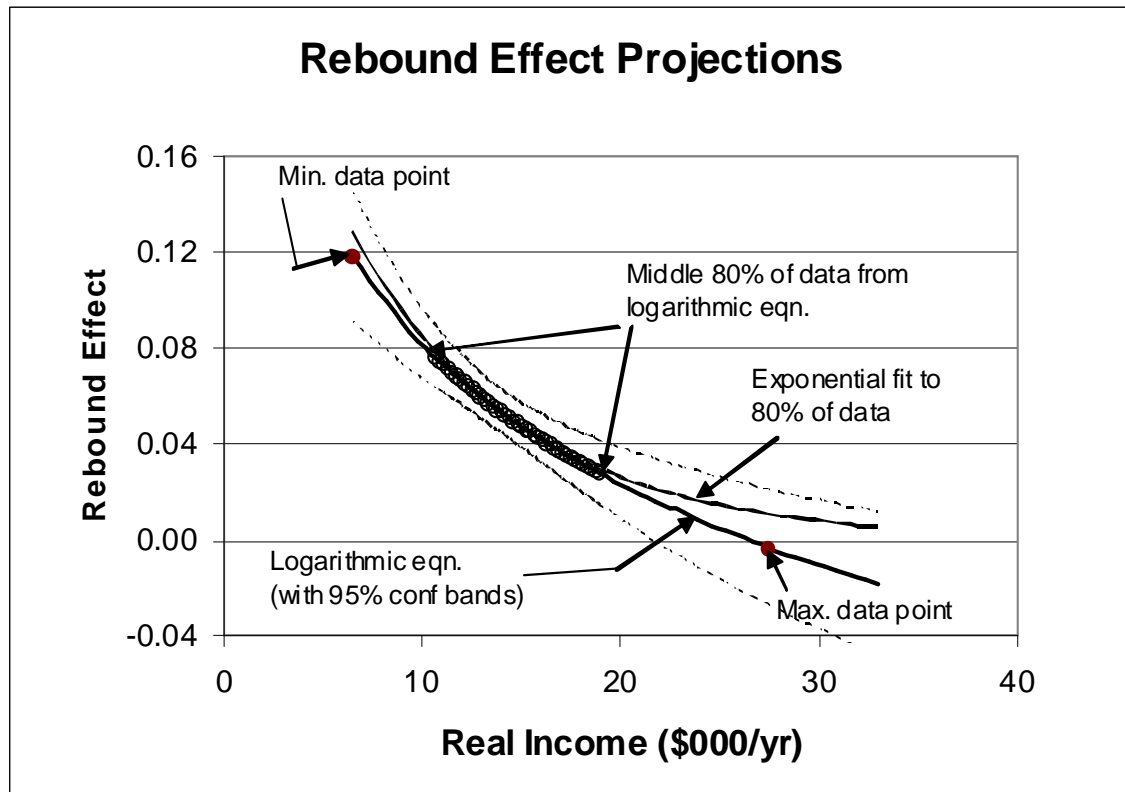
If UCI researchers find that disposable income performs well in their equation, in terms of statistical significance and goodness of fit, then using it to project the rebound effect would make a good alternative scenario to present. The UCI researchers do not think that such a scenario will differ much from the one they presented in their report because the relationship between disposable and personal income in California differs only slightly from that for the US as a whole. Specifically, in 2002, the ratio of disposable to personal income

was 86.0% in California and 87.5% for the US (*Statistical Abstract of the United States: 2003*, Tables 666, 671, 672).

In addition, Crawford advocates the use of gross state product instead of personal income to measure growth in earning power as it influences vehicle usage. UCI researchers initially tried this approach, but discovered that it leads to serious anomalies because certain cities have a lot of jobs that are filled by out-of-state residents. Thus, dividing gross state product by state population, as Crawford apparently does, is unwarranted. As the most visible example of these anomalies, per capita gross state product for Washington, DC, is 2.8 times that of its two neighboring states (averaged from 1966-2001).

445. Comment: The procedure to deal with uncomfortable results of negative rebound rates is strange and calls into question the validity of the study. For each year and state in their sample, the authors use the coefficients for price and the price-income interaction term (but not the price-urbanization term) to generate estimates of both short-run and long-run rebound effects. They then throw out “the lowest 5 percent and the highest 5 percent” of their predicted values, thereby eliminating the negative rebound estimates (although this feature is not noted). Next, they regressed the natural logarithm of the predicted rebound effect (truncated to eliminate the negative effects) on income alone. Finally, they used the predicted values from this equation to forecast the rebound effect in California in future years. The net effect of this procedure (not acknowledged by the authors of the study) is to eliminate the uncomfortable results but also to introduce inherent biases in the projected rebound effects. (NERA Economic Consulting, *Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California*, page 27).

Agency Response: Staff disagrees with the comment. Every statistical study implies a margin of error around any specific predictions. The fact that *point estimates* of rebound effects for a small minority of states and years are negative does not invalidate the statistical predictions. The question is, does the UC Irvine model make strong predictions of rebound effects that are theoretically implausible? The answer is no. The graph below shows a 95 percent confidence interval around the projected rebound effect as a function of income. Using the linear equation (between logarithms of variables) estimated in the UCI model, the highest-income observation in the sample has a point estimate that is negative, but a 95 percent confidence interval that includes positive values. Therefore, it is theoretically plausible that the true values are within the 95 percent confidence. The procedure that UCI employed is designed to restrict the projections from the model to this more plausible range, as indicated by the line marked “exponential fit to 80% of data”. Note that this line remains within the confidence interval of the projected rebound effect, even beyond the range of the data all the way to the value of income used to project California rebound effect to 2020. As noted in the report, such projections are tenuous because they go beyond the reach of the data; but UCI researchers believe they are the best one can do given that we do not actually observe any states with incomes that high.



446. Comment: The rebound effect results for some states are not plausible. The results of the Irvine study suggest that some states have negative rebound effects—i.e., that drivers there are actually likely to drive less if the cost of driving falls. These results are clearly not sensible, suggesting problems with the underlying model. Moreover, this problem apparently led the authors to develop an ad hoc (and flawed) method to modify their projections of rebound effects in California rather than use estimates from their model. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, page 29).

Agency Response: Staff disagrees with the comment. Please see our response to Comment 445.

447. Comment: Key data on income and gasoline price do not reflect state differences in the cost of living. Several of the key data and variables in the Irvine study are unreliable, with ramifications for model estimation. In particular, the income and price variables are not appropriately deflated to take into account differences across states in the cost of living. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, page 29).

Agency Response: Staff disagrees with the comment. Please see our response to Comment 444.

448. Comment: The specification of the trend variables is arbitrary, and alternative specifications are superior. There is no clear conceptual rationale for the authors' choice

of trend variables. Alternative specifications are superior. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, page 29).

Agency Response: Staff disagrees with the comment. There is no theoretical rationale for having three trend variables in the usage and vehicle stock equations. We therefore chose the model with one trend, partly for purpose of parsimony, believing that we should not try to estimate too many parameters with no theoretical rationale. In its early experiments the UCI researchers did not find any important differences that result from allowing three separate trends. Although the NERA commentary indicates a statistical rejection of equality of the hypothesized three trend variables they propose, it does not state whether the resulting coefficients portray a sensible pattern. In any event, the UCI researchers found generally that the time trend variables played very little role in the analysis, presumably because the most important trends were captured in the variables used.

449. Comment: Errors in variables and equation specification call the estimation procedure into question. Errors in the data underlying the licad variable and in the construction of the cafe variable suggest that three-stage least squares is not the best estimator for obtaining estimates of the rebound effect. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, page 29).

Agency Response: Staff disagrees with the comment. The UCI report shows two-stage least squares results, as well as three-stage least squares, precisely because of the possibility of data or specification errors spreading through the system, as noted in the report. It is easy to see in the UCI report tables that the results of interest from two-stage least squares and three-stage least squares are very similar, so it really doesn't matter which one is used.

The ARB staff agree that the data on licensed drivers contain errors as is common for such large datasets, but is unaware of any reason why they should bias the results one way or another. The UCI researchers share this assessment. Further, the UCI researchers do not believe that the cafe variable contains systematic errors, although NERA is correct that it contains statistical uncertainty that increases over time.

450. Comment: The VMT equation should be estimated using two-stage least squares rather than three-stage least squares. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, page 40).

Agency Response: Staff disagrees with the comment. Please see our response to Comment 449.

451. Comment: The income and gasoline price data should be deflated using appropriate state-specific price indices that account for state differences in the cost of living and changes over time. (NERA Economic Consulting, Reviews of Studies

Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, page 40).

Agency Response: Staff disagrees with the comment. Please see our response to Comment 444.

452. Comment: Given the arbitrariness of the trend variables, the specification should be modified to reflect the most appropriate set of trend variables. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, page 40).

Agency Response: Staff disagrees with the comment. Please see our response to Comment 448.

453. Comment: We used data from the American Chamber of Commerce Research Association to develop state-specific cost of living indices.

Relying on city and regional CPI data from the BLS, we developed state-specific CPIs for the period from 1996-2001.

The Irvine study uses Trend rather than the Trend1, Trend2, and Trend3 to explain both the VMT equation and the vehicle stock equation. Also the two dummy variables D74 and D79 are theoretically superior replacements for the single dummy variable D7479 in the VMT and fuel efficiency equations. We have adjusted the Irvine study estimation to incorporate both of these improvements.

These modifications cause the long-run rebound effect for California to nearly triple from 9.3 percent in the Irvine Study to 24 percent or 25 percent under the two revised models. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, pages 41-42).

Agency Response: As described in response to Comment 444, UCI researchers do not believe that using local cost-of-living data based only on metropolitan areas would improve the accuracy of state-level data on prices and incomes. On the contrary, they think that doing so would introduce systematic errors worse than any errors that they eliminate. Deflating a mostly rural state like Montana by an index constructed from its metropolitan areas will substantially overstate the cost of living there, compared to an urban state like New Jersey. Thus, the effects of such deflated price and income variables will be confounded with variables related to urbanization.

When UCI researchers allowed dummy variables D74 and D79 to be estimated with separate coefficients, they were virtually identical to results for the combined variable. In short, this change makes no difference to the results.

454. Comment: The authors adopt an ad hoc approach to projecting income in order to prevent the projected rebound effects from becoming negative in California in the future,

as the model implies already happens for several states. This ad hoc approach is not defensible and thus we do not present corrected results using this procedure. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, page 43).

Agency Response: Staff disagrees with the comment. Please see our response to Comment 445.

455. Comment: We have reviewed the data and modeling approach of the Irvine study. Our review identified the following four primary concerns with the Irvine study model:

- The rebound effect results for some states are not plausible, casting doubts on the model.
- Key data on income and gasoline price do not reflect state differences in the cost of living.
- The specification of the trend variables is arbitrary and alternative specifications are superior.
- Errors in equation specification and key variables call the specific estimation procedure used into question.

The first of these concerns suggests an underlying problem with the modeling approach, because it generates results that are not plausible. The other three concerns concern specific issues with data and estimation that can be corrected.

As a result of these concerns, we developed three major modifications to the modeling:

- We re-estimate the model using two-stage least squares rather than three-stage least squares.
- We deflate the income and gasoline price data using appropriate state-specific price indices that account for state differences in the cost of living and changes over time.
- We modify the specification to reflect the most appropriate set of trend variables.

These modifications lead to revised estimates of the California rebound effect of 5.3 percent in the short run and 24 percent in the long run, substantially greater than the rebound effect estimates developed in the Irvine study. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, pages 43-44).

Agency Response: Staff disagrees with the comment. Although UCI researchers have not replicated NERA's revised results exactly, the many experiments they carried out with alternative specifications makes them believe that only one of the NERA revisions has any substantial effect on the results: the use of metropolitan-area cost-of-living indices to apply to entire states. However, NERA presents no evidence supporting its implied conclusions that other revisions are important; such evidence would consist of applying each revision separately to see its effect on results. As explained in response comment 444 above, UCI

researchers do not believe that using local cost-of-living data based only on metropolitan areas would improve the accuracy of state-level data on prices and incomes.

456. Comment: The August Staff Report ultimately relies on a value of 3.08 for the “dynamic rebound effect”. Although the description of the calculation of this effect is so vague that we cannot reproduce it, it does seem clear that a “dynamic rebound effect” calculated using the correct estimates would be substantially larger than the value used by ARB staff. (NERA Economic Consulting, Reviews of Studies Evaluating the Impacts of Motor Vehicle Greenhouse Gas Emissions Regulations in California, pages 44).

Agency Response: Staff disagrees with the comment. ARB staff adapted a spreadsheet provided by Professor Ken Small of UC Irvine to calculate the dynamic rebound effect. The spreadsheet, which is presented in the Staff Report, provides VMT-weighted averages of the short-term and long-term rebound effect for model years 2009-2020. Thus the magnitude of the dynamic rebound effect is related to the magnitudes of the annual rebound effect numbers entering the calculation, as the commenter points out.

457. Comment: ARB staff assumed the percent change in operating cost to be 25 percent for all 2009 to 2020 model year vehicles. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B4-20)

Agency Response: The commenter is correct. Staff assumed a 25 percent average reduction in operating cost in its evaluation of the impact of the proposed climate change regulations on the State’s affiliated businesses. This assumption was based on the Staff Report’s estimated average reduction in operating cost for vehicles subject to the regulation.

(c). NERA/Sierra Rebound Analysis

458. Comment: Figure 4 shows the results of our analysis based on an underlying annual VMT/vehicle growth rate of 1.38%/year. The fuel price elasticity can be estimated by comparing the actual annual VMT/year to the expected annual VMT/year and then dividing the difference by the percent change in gasoline price. (Sierra Research, Review of the August 2004 Proposed CARB Regulations to Control Greenhouse Gas Emissions from Motor Vehicles: Cost Effectiveness for the Vehicle Owner or Operator, page C4-8)

Agency Response: The Sierra approach in estimating the fuel price elasticity (rebound effect) is not robust. The approach is based on the assumption that all changes in VMT can be explained by changes in fuel prices. This assumption fundamentally biases the results. As described in our response to Comment 443, not all changes in VMT are associated with changes in fuel price. In addition to fuel price changes, VMT changes by a host of other factors such as time costs, travel congestion, income, income level, etc. Furthermore, Sierra selectively chooses three time periods to compare changes in VMT to changes in fuel price. This approach which is based on selective choice of data points is

not scientific but rather anecdotal. In summary, the analysis presented in the Staff Report is a more robust approach for estimating the rebound effect.

459. Comment: Since price elasticity is the proportional change in demand over the proportional change in price, it was calculated as follows:

$$-7.30 / 45.7 = -0.16$$

(Sierra Research, Review of the August 2004 Proposed CARB Regulations to Control Greenhouse Gas Emissions from Motor Vehicles: Cost Effectiveness for the Vehicle Owner or Operator, page C4-8)

Agency Response: Please see our response to Comment 458.

460. Comment: The economic impact estimates were developed for this study using a Regional Economic Models, Inc. ("REMI") model. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, page 14).

Agency Response: ARB used E-DRAM, a California regional economic model developed by UC Berkeley, to develop its economic impact estimates. Both E-DRAM and REMI are widely used for the economic impact assessment.

461. Comment: We have estimated a 17 percent effect for California between 1998 and 2003. However, rather than assume that this rebound effect will remain constant through 2020, we have assumed that the relationship between VMT and cost-per-mile is described by a linear demand curve, so that the elasticity of VMT with respect to cost-per-mile will vary with cost-per-mile. We used the results of the VMT model to determine initial parameters (the constant and the coefficient of cost-per-mile) for the linear demand curve. Then, using forecasted cost-per-mile data from the EIA 2004 Annual Energy Outlook, we adjusted the parameters for each year so that the EMFAC2002 base-case VMT and the cost-per-mile fit the demand curve described by the two parameters. The parameters and the cost-per-mile determine the elasticity of VMT with respect to cost-per-mile. By this procedure, our estimated rebound effect for California in 2020 is 16 percent. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B3-6)

Agency Response: The NERA approach in projecting the rebound effect is considerably less robust than the approach presented in the Staff Report. In its approach, NERA assumes that the entire change in VMT is caused by changes in cost-per-mile. However, it is a well-known fact that changes in the cost-per-mile cannot solely explain the entire change in VMT. As described in the agency response to Comment 443, changes in VMT are caused by a host of factors other than cost-per-mile such as time costs, travel congestion, income, income level, etc. To ignore the other explanatory factors in explaining the changes in VMT would bias the projection of the rebound effect. In

addition, NERA use of a linear demand curve to explain the relationship between VMT and cost-per-mile is hard to justify because it implies that VMT could decline to zero, even at some finite costs, in regions of high cost-per-mile.

462. Comment: Also as noted elsewhere in this report, a secondary outcome of the improved fuel economy required by the Staff Greenhouse Gas Proposal regulations is additional VMT being accumulated by those vehicles subject to the regulations (i.e., the “rebound” effect). As the cost of travel decreases, total VMT increases. An example of this effect is illustrated in Figure B4-3, which shows that VMT accrual is estimated to increase from the 2009 model year (the first year of the regulation) to the 2016 model year (when the regulation is fully phased in). (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B4-6)

Agency Response: The focus of the regulation presented in the Staff Report concerns the reduction of greenhouse gas emissions from motor vehicles. A reduction in operating costs is a secondary benefit resulting from compliance with the standards. Staff agrees with the commenter that total VMT increases as the cost of travel decreases. However, staff disagrees on the question of how big the rebound effect is likely to be in California when the climate change regulations become effective. NERA estimates the rebound effect of 17 percent. This estimate fails to consider the effects of income and urbanization in California. Accounting for these factors, the UC Irvine study estimates the short-run rebound effect of 2% and the long-run effect of 9.3%. These estimates which were developed from a study by UCI researchers and are fully documented focused on providing a rebound effect applicable to California (e.g., demographics). The results of this study are the basis for the estimates used in the Staff Report.

463. Comment: Figure 3 shows how the 1987-1999 annual VMT/year trend lines compare to year-to-year VMT data for both California vehicles and U.S. vehicles. ... Both the California and U.S. data show a decrease in annual average VMT/vehicle once gasoline prices jumped in 2000. With both the California and US data showing similar annual VMT/vehicle trends through 1999, annual VMT/year data was expected to continue increasing in 2000, 2001, and 2002, absent some other factor. (Sierra Research, Review of the August 2004 Proposed CARB Regulations to Control Greenhouse Gas Emissions from Motor Vehicles: Cost Effectiveness for the Vehicle Owner or Operator, page C4-7)

Agency Response: Staff have reviewed the Sierra analysis, Evidence of the “Rebound Effect” in California Data, which is based on data from the Bureau of Automotive Repair Smog Check program and the CalTrans Motor Vehicle Stock, Travel and Fuel Forecast. The figure cited indeed shows a drop in VMT per vehicle in California in the year 2000, when gas prices increased 20 percent or more. Despite even higher jumps in gasoline costs nationally, however, U.S. VMT is shown to continue its increase in Calendar Year 2000. And both urban California and U.S. VMT increased at rates similar to the long-term trend in 1999, despite fuel price increases of 14 and 10 percent, respectively.⁷ The inconsistencies in these comparisons only illustrate the key phrase concluding the

⁷ Consumer price index data, Table D-18 at http://www.dof.ca.gov/html/fs_data/stat-abs/sec_D.htm.

comment above, “absent some other factor.” It is apparent that other factors caused or contributed to the unusual turndowns in VMT for both California and the U.S. as a whole. The economic recession that occurred during this period would certainly have influenced VMT growth, in the same way recession interrupted VMT growth in the early 1990s, as can also be seen in Figure 3.

Though it is likely that fuel prices will someday climb to a threshold that significantly restrains VMT, we cannot conclude from the analysis provided by Sierra that this threshold was reached in 2000 -- or that decreases in relative fuel cost for vehicles affected by the regulation will effect a significant increase in miles traveled.

464. Comment: As shown above, the mileage accumulation is significantly higher for vehicles with better fuel economy. (Sierra Research, Review of the August 2004 Proposed CARB Regulations to Control Greenhouse Gas Emissions from Motor Vehicles: Cost Effectiveness for the Vehicle Owner or Operator, page C4-12)

Agency Response: The commenter has failed to show that lower costs due to fuel economy differences are the cause of additional driving. Indeed the reverse is the case for consumers who, because of their need to drive more miles, buy vehicles with better fuel economy. Personal travel demand influences the vehicle purchase decision, and thus personal fuel economy, prior to any interaction between fuel price and travel in that vehicle.

465. Comment: Many components contribute to the cost of travel, including maintenance and time costs, but the major out-of-pocket cost is the cost of gasoline. Fuel efficiency and the price of gasoline together provide a direct measure of the fuel-related cost-per-mile of travel. For a given motor vehicle, cost-per-mile can be approximated as the price of gasoline divided by fuel efficiency (price per gallon/miles per gallon = price per mile). The VMT model estimates the rebound effect by relating changes in VMT to changes in the price of gasoline. The result applies equally well to the effects of the Staff Greenhouse Gas Proposal, since a decrease in MPG has the same impact on the price per mile as does an increase in the price per gallon.

The VMT model is based on observations that track the behavior of individual vehicles over time. Each observation incorporates two data measurements for a single vehicle, separated by several months. The model estimates the following equation:

$$VMT_d = \alpha + \beta P + \gamma X + \varepsilon,$$

Where VMT_d is the average VMT per day between two measurements; P is the average price of gasoline between two measurements; X includes population density, month indicators, county indicators, and vehicle make, model, and model year indicators; and ε is the unobserved error term. Population density is included as a measure of urbanization, which we expect to influence VMT. The rest of the variables included in X are dummy variables that capture fixed effects for seasons, locations, and vehicle types.

Other things equal, a percentage change in the price of gas implies the same percentage change in the fuel cost-per-mile of travel. Thus, the elasticity VMT with respect to fuel cost-per-mile is the percent change in VMT divided by the percent change in the price of gas (that is, $\Delta\text{VMT}/\text{VMT}$ divided by $\Delta P/P$). Since the estimated coefficient β in our model describes the behavior of $\Delta\text{VMT}/\Delta P$, we can estimate the elasticity of VMT with respect to fuel cost-per-mile as follows:

$$E = (\text{Mean } P \div \text{Mean VMT}_d) \times \beta,$$

where the mean values are taken over all observations. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, VMT Model, pages B3-1, 2, and 3)

Agency Response: Staff has reviewed the alternative estimates of the rebound effect provided by NERA, including the conceptual VMT model tied to fuel cost. We find that NERA's model oversimplifies the relationship between miles traveled and the complex and dynamic series of costs that affect it. We disagree with the assertions that the cost of gasoline dominates out-of-pocket costs, and that travel decisions are primarily controlled by out-of-pocket costs. NERA's model ignores additional critical costs, both out-of-pocket (e.g., changes in the housing market and personal income that affect location choices) and outside the pocket (e.g., changes in time costs due to altered traffic conditions during economic recession). NERA acknowledges that fuel cost impacts on VMT can be quantified when other things are equal, but this analysis fails to equalize the full series of other important impacts on miles traveled.

466. Comment: In section 12.3.C. of the ISOR, CARB staff presents what is purported to be an analysis of the VMT rebound effect in Southern California that was performed using the Southern California Association of Government's (SCAG) travel demand model for southern California. The results of this analysis in terms of changes in VMT and emissions are presented in table 12.3-3 of the ISOR. Based on the results, CARB staff claims that the elasticity of VMT rebound with respect to changes in fuel cost is about -0.04. However, CARB staff's decision to use SCAG's travel demand model to assess the travel-inducing effect of reduced vehicle operating expenses is inherently flawed as the model is wholly unsuitable for estimating the VMT rebound effect.

Since SCAG's model accounts only for the effect of fuel price and vehicle operating expenses on travel in a very indirect manner (by shifting person trips from single occupant vehicles to transit and carpools), the response to changes in operating expenses is limited to at most a second-order effect. As a result, the analysis presented in Section 12.3.C is meaningless with respect to the estimation of the magnitude of a VMT rebound effect in California, as are the conclusions drawn by CARB staff from the results of the analysis. (Sierra Research, Review of the August 2004 Proposed CARB Regulations to Control Greenhouse Gas Emissions from Motor Vehicles: Cost Effectiveness for the Vehicle Owner or Operator," pages 29-30.)

Agency Response: Predicting consumer response to lower relative fuel cost is complex, particularly for California's congested urban areas. To augment the econometric analysis developed at UC Irvine with an estimate of what may happen on an urban travel network, staff consulted with transportation modeling experts in the southern California, Bay Area, and Sacramento regions. We pursued the use of a travel demand model because of its capability to account for VMT rebound within the context of the many additional variables that affect the demand for motor vehicle use, including the accessibility of the transportation network. California's regional travel demand models are subject to continuous improvement and peer review. They are operated by experts at the agencies specifically empowered under federal and state law to make air quality and transportation planning decisions based on the results of such modeling.

It is incorrect to assert that contemporary travel models, including the models operated by Southern California Association of Governments, consider transportation costs only as a mechanism for mode choice. Though these costs serve as a direct input to mode choice, their effect is reflected through subsequent steps of the modeling system, as well as to previous steps through the recursion of travel times back to transit accessibility and auto ownership. Travel costs are reflected in the distributions of population and employment (through transportation system level of service), the generation of person trips (as a factor in real income), the relative attractiveness of destinations within the region (as a function of travel time) and the assignment of travel on the network (derived in part from the distribution of travel as affected by costs).

The analyst must consider that travel time, as a critical cost of travel that affects personal transportation decisions, can be profoundly affected by additional travel generated in the congested conditions that will prevail in California's urbanized areas in 2009 and beyond. Thus, while travel demand models predict that lower relative fuel costs will tend to generate additional VMT, that travel imposes a time cost on all travelers that will for some trips undermine the incentive to travel by personal vehicle. The reduced auto accessibility from increased delay hours will in turn affect travel time choice, peak and off-peak speeds, and even auto ownership. There are emissions implications from all of these effects. A serious examination of VMT rebound must therefore consider all types of travel cost among the full range of often countervailing factors that affect travel demand. Because a regional travel demand model provides this more complete context, staff believes its use is fully appropriate in the study of the rebound effect.

(3). Section 12.4—Combined Effect on Criteria Pollutant Emissions

467. Comment: The emissions impacts of changes to the vehicle fleet population as a result of the proposed regulations were modeled by the ARB staff by inputting alternative vehicle population by age and vehicle type into the EMFAC2002 model. In general, this is a valid approach to estimating the emissions impacts of fleet-turnover scenario. However, in the analysis performed by the ARB staff for calendar year 2020, the overall fleet VMT decreased by 5.47 million miles per day statewide. Assuming that VMT should be held constant across the baseline and fleet-turnover scenarios, the emissions inventory estimates under the fleet-turnover scenario must be increased to account for the VMT

“lost.” By multiplying the revised inventory by the ratio of VMT under the baseline and control cases, the inventory is increased such that the lost VMT is assumed to be made up by a fleet-average vehicle.

The results of this adjustment are summarized in Table B4-7.

Table B4-7. Summary of ROG, NO_x, and PM₁₀ Emissions Estimates, from Fleet Turnover

Scenario	ROG	NO _x	PM ₁₀
Original ARB Staff Estimate	+ 1.52	+ 0.95	-0.04
Corrected ARB Staff Estimate	+ 2.77	+1.98	+ 0.19

Source: August Staff Report and NERA/Sierra Calculations

(NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, page B4-20)

Agency Response: EMFAC assumes that the accrual rate, that is, the VMT per vehicle by year, for any class depends solely on the age and class of the vehicle. If the fleet ages because of the regulation, then the overall fleet VMT decreases. NERA/Sierra apparently assume that the accrual rate depends solely on the characteristics of the driver, resulting in overall fleet VMT independent of age. A more realistic modeling assumption would recognize that the accrual rate varies according to both the characteristics of the driver and also the age of the vehicle. So some VMT is “lost,” but the correction is not as large as NERA/Sierra claim. It would take a sophisticated vehicle use model to provide a quantitative estimate of the net VMT change. In any case NERA/Sierra overcorrect the fleet VMT.

468. Comment: The methodology used by ARB staff to estimate the rebound effect has a curious impact on evaporative ROG emissions. The model predicts an overall decrease in evaporative ROG emissions from an increase in mileage accrual rates for 2009 and newer vehicles. (In fact, the decrease in evaporative ROG is greater than the increase in exhaust ROG, resulting in a net decrease in total ROG emissions.) Further, this decrease in evaporative emissions only occurs for 1997 and older model years, while there is no change to evaporative emissions from vehicles that are covered by the regulation (where one would expect an increase, at least for running loss emissions). It is unclear why this occurs, but it is likely a result of how the Smog Check program is modeled by EMFAC2002. When the model is configured to turn off the Smog Check program, there is no change in evaporative ROG emissions as a result of modifications to the mileage accrual rates. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, page B4-21)

Agency Response: Staff agrees that a decrease in ROG emissions with an increase in mileage accumulation is counterintuitive. Staff has investigated this and found that it is the result of how the gas cap testing component of Smog Check is modeled in EMFAC. The model uses an algorithm in which the gas cap failure rate is a function of odometer; hence, an increase in accrual rates results in an increase in gas cap failures, which when repaired result in an emissions benefit credited to the Smog Check program. For evaporative losses, this emissions benefit is slightly larger than the increase in emissions from higher mileage accumulation. See also the response to comment 469 below.

469. Comment: The ARB staff modified the baseline annual mileage accrual rates in EMFAC2002 for the first 12 model years considered by the model. This approach has the intended effect of increasing the VMT from the 2009 to 2020 model years. However, a secondary effect of this methodology is to increase emissions deterioration for all model year vehicles. This occurs because the average mileage at a given age is calculated in the model by summing the annual mileage accrual rates. Thus, although a 2008 model year vehicle is not subject to the Staff Greenhouse Gas Proposal regulations (and therefore would not be expected to have increased VMT relative to the baseline case) the average mileage of a passenger car of this vintage (in 2020) increases from 171,828 to 173,070 miles. Because of this increase in accumulated mileage, the model predicts that a 2008 model year vehicle under the rebound case will have a slightly higher emission rate than in the baseline case. As a result, about half of the exhaust ROG, CO, and NO_x emissions increase associated with the rebound effect calculated by ARB staff is from vehicles older than 2009 model year and not subject to the regulation. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, page B4-20 and 21)

Agency Response: ARB staff agrees that changing the accrual rates in the EMFAC model for the first 12 model years does impact vehicles older than 12 model years by increasing their cumulative mileage and therefore increasing their emissions deterioration. Staff also agrees that the impacts of rebound presented in Table 12.3-2 in the August 6, 2004, ISOR incorrectly include the impact of the accrual rate changes on 2008 and older model year vehicles.

ARB staff conducted additional EMFAC runs to limit the impact of the accrual rate changes (rebound effect) to model year 2009 and newer vehicles. These impacts on model year 2009 and newer vehicles were then expressed as a percentage change for the entire light duty fleet (including all model years). The results are presented here as a revised version of Table 12.3-2.

Revised Table 12.3-2. Impacts of Rebound Effect, Total Light Duty Fleet ≤ 8500 lbs. GVWR VMT and Emissions (tons per day)

	CY2020		
	Baseline	Adjusted	% Difference
VMT	1,020,478	1,025,760	0.52%
ROG	230.95	231.03	0.03%
NOx	190.20	190.42	0.12%
PM10	42.74	42.98	0.56%
CO	2096.98	2,101.39	0.21%
CO₂	485,150	487,540	0.49%

Relative to Table 12.3-2 in the ISOR, the table above shows a net decrease in statewide ROG + NOx emissions of 0.03 tons per day. NOx, PM10, and CO emissions increases are less than originally estimated. ROG emissions go from a net decrease to a very slight increase. The original ROG decrease is due to how the Smog Check program is modeled in EMFAC, as explained in the response to comment 468 above. For 1996 and newer vehicles, the impact of Smog Check on evaporative failures is smaller, because these vehicles are equipped with on-board diagnostics systems (OBD II) that identify evaporative failures. Thus, for the 2009 and newer vehicles, the impact of the Smog Check algorithm does not outweigh the ROG emissions increase from higher mileage accumulation.

The impacts of the rebound effect as presented in the revised Table 12.3-2 do not alter staff’s conclusion that the combined effect of the regulation is a net decrease in ROG and NOx and a de minimis increase in PM10.

470. Comment: The values in Table B4-8, “Summary of ROG, NOx, and PM10 Emissions Estimates, from Rebound,” show that the ARB staff methodology substantially underestimates the impact of the rebound effect on ROG emissions, while it overestimates the impact on CO, NOx, and PM10 emissions. (NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, page B4-22)

Agency Response: Staff disagrees with the comment. Underestimating the impact of the rebound effect on ROG emissions, and overestimating the impact on CO, NOx and PM10 emissions, are addressed in the responses to comments 468 and 469 above.

471. Comment: Once the staff’s estimated rebound and fleet turnover effects are included, the proposed rule will under the staff’s own estimates result in increases in overall smog-forming pollutants from the regulated vehicle fleet, as vehicles are driven more and the age of the fleet increases. The staff’s estimates appear in Table 12.4-1 of the September 10 Addendum, and are discussed in detail in Appendix B of these comments. The staff’s estimates were based on unrealistic estimates of the engineering costs and fuel savings benefits of the proposed rule, as noted above and explained in detail in Appendix C, but even those estimates show pollution increases. (Comments of the Alliance of Automobile Manufacturers on the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, page 27)

Agency Response: Table 12.4-1 of the September 10 Addendum shows the estimated emissions impact due to three contributors: rebound effect, fleet turnover changes, and fuel cycle changes. ARB staff agrees that if only the rebound and fleet turnover effects are included, the proposed rule will result in slight increases in overall smog-forming pollutants from the regulated fleet. However, these increases are offset by the decrease in fuel cycle emissions such that the net result is a decrease in smog forming pollutants and a de minimis increase in PM10.

472. Comment: Using the spreadsheet model developed by Sierra, ARB staff estimates of the fleet-turnover effects on vehicle populations and the rebound effects on VMT per vehicle for 2009 and newer model years were evaluated. The combined effects reported by the ARB staff in the September Staff Addendum are compared to the estimates that have been corrected to conserve VMT for pre-2009 model year vehicles and to only include rebound effects for 2009 and newer vehicles. These results are shown in Table B4-9.

Table B4-9. Summary of ROG, NO_x, and PM₁₀ Emissions Estimates, from Fleet Turnover and Rebound

Scenario	ROG	NO _x	PM ₁₀
Original ARB Staff Estimate	+ 1.61	+ 1.17	+ 0.20
Corrected ARB Staff Estimate	+ 3.09	+ 2.32	+ 0.40

Source: August Staff Report and NERA/Sierra Calculations

(NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, attachment B4-22)

Agency Response: Staff disagrees with the comment. The table provided with the comment presents incomplete information and overestimated impacts. See the responses to comments 467 through 470.

473. Comment: Table ES-3 summarizes the emissions effects in 2020 under all four scenarios. All four scenarios would lead to increases in criteria pollutants in 2020. For the ozone precursor emissions, the increases range from about 6.3 tons per day to about 44.7 tons per day.

Table ES-3. Summary of the Statewide 2020 Emissions Impacts of the Staff Greenhouse Gas Proposal

Criteria Pollutant Increases,
Accounting for Turnover and Rebound
(tons per day)

Scenarios	ROG	NOx	CO	PM₁₀
NERA/Sierra methodology With NERA/Sierra inputs	17.16	13.23	146.95	1.58
NERA/Sierra methodology With ARB staff inputs	5.56	4.36	46.55	0.50
CARBITS methodology With NERA/Sierra inputs	25.23	19.44	202.25	1.95
CARBITS methodology With ARB staff inputs	3.56	2.77	29.45	0.41

(NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor Vehicles, page ES – 6. A related comment is also found on page 25 of the same document.)

Agency Response: NERA/Sierra provide results from four scenarios, each of which differs from the analysis performed by ARB staff.

- NERA/Sierra methodology with NERA/Sierra inputs. The differences in results are due mainly to NERA/Sierra overestimates of cost increases and underestimates of fuel savings. See response to Comment 432.
- NERA/Sierra methodology with ARB staff inputs. The differences in results are due to differences between the NERA/Sierra model and CARBITS. See response to Comment 431.
- CARBITS methodology with NERA/Sierra inputs. The NERA/Sierra document describes how NERA/Sierra prepared their input, but does not provide any numbers. Nor could ARB staff find any files that contained vehicle attributes for use in CARBITS. ARB staff therefore does not have sufficient basis for evaluating this scenario.
- CARBITS methodology with ARB staff inputs. NERA/Sierra modified CARBITS methodology to correct for “lost VMT”. See response to comment 467 above. NERA/Sierra overcorrect the emissions, so the numbers presented in Table ES-3 overestimate the emissions impact.

474. Comment: When more realistic estimates are used (estimates which still understate the total costs of the proposed rules), the excess smog-forming emissions in 2020 could surpass 30 tons per day in California, depending on the predictive models used in the analysis, as demonstrated in Appendix B. (Comments of the Alliance of Automobile Manufacturers on the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, page 27. Similar comments are found in NERA Economic Consulting and Sierra Research, Environmental and Economic Impacts of the ARB Staff Proposal to Control Greenhouse Gas Emissions from Motor

Vehicles, page ES – 5 and page 21, which is attached to the Alliance comments as Appendix B.)

Agency Response: Staff disagrees with the comment. The reported emission increases are overstated due to overestimated technology costs, underestimated operating cost savings, and methodological problems. See also the response to Comment 473 above.

475. Comment: Because of other factors, the rebound effect that you've heard about being one of them, we believe that the net effect of this regulation will be an increase in ozone precursors, which will be more than enough to offset the essentially unmeasurable change in temperature that would result from the regulations, and so you're going to end up with a net adverse environmental impact. (Tom Austin, Sierra Research)

Agency Response: Staff disagrees with the comment. See the response to Comment 473 above.

476. Comment: The regulation will increase smog forming pollutants in the State's non-attainment areas – in conflict with ARB's responsibility under CEQA to ensure clean air for Californians. (DaimlerChrysler)

Agency Response: Staff disagrees with the comment. See the response to Comment 473 above.

477. Comment: Regulations already on the books ensure that most smog-forming pollution will be eliminated over the next 20 years. Such policies include EPA's NO_x SIP Call regulation (requiring a 60 percent reduction in NO_x emissions from power plants and industrial boilers during the May-September ozone season), EPA's Tier II emission standards for cars (under which the average vehicle on the road in 15 to 20 years will be 90 percent cleaner than today's average vehicle, EPA's diesel truck rule (requiring a 90 percent reduction in NO_x and soot emissions from trucks beginning in 2007), and EPA's non-road diesel rule (requiring similar reductions in emissions from construction equipment farm machinery, and marine engines). U.S. air quality will improve substantially over the next two decades, whether global warming occurs or not. (Competitive Enterprise Institute, 9/21/04).

Agency Response: Staff agrees that regulations already in place will significantly reduce smog-forming emissions over the next 20 years.

(4). Section 12.5—Manufacturer Response

478. Comment: Page 190 of the August 6 Staff Report states, “[s]taff reviewed consultant reports from ITS and the literature to assess the information available” on some of the economic impact issues addressed in the staff report. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.1)

Agency Response: Staff disagrees with the comment. The comment misunderstands and misrepresents the relationship between the ITS reports and the Staff Report. The p.190 quotation, so far as it goes, is accurate. However, the balance of the sentence appended by the commenter incorrectly asserts that the purpose of staff's review of ITS reports was to address economic impact issues covered elsewhere in the Staff Report. To the contrary, the qualitative insights staff extracted from the ITS reports, (and summarized on page 191 of the August 6, 2004 ISOR), address issues which are not fully covered by the rest of the Staff Report.

479. Comment: The staff report then presents a conclusion that "the increases in vehicle prices due to the regulation could well be less than the estimates provided" elsewhere in the staff report, and refers to the ARB's staff's "main findings" on the issues of regulatory costs and pricing that are apparently based on the ITS studies. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.1)

Agency Response: Staff disagrees with the comment. This comment again misunderstands and misrepresents the relationship between the ITS reports and the Staff Report's regulatory cost and pricing estimates by taking quotations from p.190 of the Staff Report out of their original context and juxtaposing them with the commenter's statements. The comment incorrectly suggests that ARB's estimates of regulatory costs and prices presented elsewhere in the Staff Report are "based on the ITS studies." On the contrary, the estimates of regulatory costs and prices provided in the Staff Report did not and do not draw on the ITS reports or their findings. The "main findings" referred to in section 12.5 of the Staff Report concern a qualitative assessment of the "strategies automobile manufacturers may employ to comply with regulatory requirements." These strategies are not addressed anywhere in the Staff Report other than in section 12.5. Again, the ITS reports did not have any bearing on the costs estimates presented in the Staff Report. Rather, the ITS reports were mentioned in the "Other Considerations" chapter of the Staff Report (Section 12.5) to provide the reader with some qualitative insights gained as part of the staff analysis.

480. Comment: The August 6 staff documents interpret the ITS studies to suggest that the ARB staff has conservatively overestimated the costs and adverse consumer and manufacturer impacts of its proposal to regulate fuel economy, and that a more realistic assessment would be that such costs and adverse impacts are minimal. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.2)

Agency Response: Staff disagrees with the comment. The comment misconstrues the regulation proposed in the Staff Report as a "proposal to regulate fuel economy." The August 6th 2004 Staff Report does not propose to regulate fuel economy. Rather, it proposes to regulate climate change emissions. Section 12.5 does not suggest that the costs or impacts of the proposed regulation will be "minimal," as the comment asserts. Chapter 5 of the Staff Report documents the costs of the various technological options considered as part of the staff analysis.

481. Comment: As indicated elsewhere in the Alliance's comments, the Alliance believes that any reliance on the ITS studies, in whatever form they were actually considered by the ARB staff, would be legally improper. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.1)

Agency Response: Staff disagrees with the comment. ARB staff did not rely on the ITS reports to develop its climate change regulation or to prepare its estimates of regulatory costs or pricing. The ITS reports are in the record purely in response to the inquiries by commenters.

482. Comment: The ITS studies advance three central conclusions: (1)The engineering costs of emissions and safety hardware mandated by federal and state governmental regulations between 1967 and 2001 have had little or no discernible effect on vehicle prices and sales and thus have had little or no adverse affect on the nation's auto manufactures and consumers. (2) Consumer responses to emissions and fuel economy technologies are poorly understood and the demand for "green technologies" is weak. (3) In the words of the Summary Report, or Report #1 as identified in Appendix I of this review, "the challenge for government regulators as they formulate regulatory initiatives is to understand shifting market dynamics, anticipate technological innovation, and forecast near- and long-term cost impacts," which is "easier said than done." (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.1)

Agency Response: ARB staff did not rely on the ITS reports to develop its AB1493 regulation or to prepare estimates of regulatory costs or pricing contained in the Staff Report. The ITS reports are in the record purely in response to inquiries by the commenters. With the exception of section 12.5 of the Staff Report, (pages 190-191), the findings of ITS case studies have no bearing on the Staff Reports' discussion of the regulation's economic impacts. In addition, the comment above misunderstands and misrepresents the ITS studies' findings. The ITS project's summary report (#1) lists eleven findings, not "three central conclusions" as described in the comment. Contrary to the comment's summary of ITS report findings, the ITS summary report's first finding confirms that, "[g]overnment regulations to improve the safety and reduce air pollutant emissions and oil use have added significant cost to vehicles." And Finding #3 of the same report concludes that the effect of emissions and safety regulations on overall vehicle sales is unknown.

483. Comment: Finally, it ["The ITS studies' first central conclusion" as outlined above] is contradicted by the ITS papers' reported statistical research and by the ITS papers' stated understanding of the relevant economic theory. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.2)

Agency Response: Staff disagrees with the comment. The “central conclusion” commented on doesn’t accurately represent the findings of the ITS Summary Report, (see response to Comment 481, above.) The only statistical analysis undertaken in the ITS papers occurs in an early draft, (of paper #3), and is omitted from later versions of the paper. It is therefore not appropriate either to comment on that statistical analysis or to respond to such comments. Further, as previously indicated, the ITS reports were not relied on for the development of the proposed regulations presented in the Staff Report.

484. Comment: If the ITS studies received any reliance from the Board, they could lead to erroneous conclusions about how environmental and fuel economy regulations affect consumer choice and vehicle demand. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.2)

Agency Response: ARB staff did not rely on the ITS reports to develop the climate change regulation or to prepare estimates of regulatory costs or pricing. The ITS reports are in the record purely to respond to inquires by the commenters.

485. Comment: Given a rational refusal by consumers to buy more fuel economy, the ARB staff’s proposal to increase the stringency of fuel economy regulations would necessarily impose welfare losses on consumers. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.3)

Agency Response: Staff disagrees with the comment. The comment incorrectly suggests that the ARB has fielded a proposal to increase the stringency of fuel economy regulations. The ARB’s proposed regulation addresses climate change emissions, not fuel economy standards. Moreover, the regulations provide a welfare gain to consumers and the California economy, as discussed in section ISOR section 10 and FSOR section III.A.2.g.

486. Comment: Numerous analyses in the case studies of Papers #2, #3, #4,¹ #5, and #6 directly contradict the above summary conclusions on which the ARB staff relies. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.5)

Agency Response: The “summary conclusions” as described above by the commenter are not consistent with the findings of the ITS summary report as written. It is logical, therefore, that such analyses in the accompanying ITS case studies may not support the “summary conclusions” listed by the commenter. To avoid further misunderstanding, it is important to reiterate here that ARB staff did not rely on the ITS reports to develop the climate change regulation or to prepare estimates of regulatory costs or pricing.

487. Comment: Paper #3 concluded, “The study of car sales during the period 1975-1986 indicated that gasoline price was the most important variable for the sales of both

domestic and imported vehicles... These trends continued during the second period (1986-2000) but to a reduced degree...These results seem to indicate that a significant fraction of vehicle buyers took into account gas price and thus fuel economy even in the later time period when gas prices had been relatively stable.” [3, pages 2 and 3, pages 57] Yet, Paper #7 concluded, “Higher fuel prices alone – at least those experienced over the past few years - do not appear to prompt the purchase of vehicles with higher fuel economy ratings.” [7, page 31] The reason that higher gasoline prices failed to stimulate increased sales of more fuel-efficient vehicles in the latter years of their study is that gasoline prices were below the levels in the earlier period. The fact that low and stable gasoline prices do not stimulate the purchase of fuel efficient vehicles with high and stable fuel prices do is itself proof of a strong influence of gasoline prices on vehicle demand as found in the ITS regression studies. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.18-19)

Agency Response: We agree that gasoline prices exert an influence on the demand for fuel efficient vehicles. However, the commenter asserts elsewhere, (p.22 of Appendix G), that the study of car sales cited above, “is not an analysis that would be entitled to credibility in the field of regulatory economics...” and is, “fraught with several errors including misspecification...” The studies appear in an early draft of one ITS paper, (paper #3), and are omitted from subsequent versions of the report. Given the commenter’s assessment of the ITS regression results’ credibility it is illogical for the commenter to cite the results as support for any comment. As indicated earlier, the ITS reports were not relied upon by staff in determining the costs of climate change reducing technologies or in setting the proposed emission standards.

488. Comment: Papers #3 and #4 conclude that in explaining auto sales, income dominates all the other variables, including vehicle prices, so that prices and all other variables are unimportant. [3, page 31: 4, pages 31-32] But the regressions in paper #3 indicate that in addition to vehicle price, vehicle weight, and fuel economy also dominate income as an explanatory variable. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.19)

Agency Response: The commenter asserts elsewhere, (p.22 of Appendix G), that the study of car sales cited above, “is not an analysis that would be entitled to credibility in the field of regulatory economics...” and is, “fraught with several errors including misspecification...” Given the commenter’s assessment of the ITS regression studies’ credibility, it is illogical to cite their results as support for any argument. More importantly, the results were not relied upon in the staff analysis.

489. Comment: The regression studies are based on flawed methodologies that underestimate the significance of regulatory costs. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 20)

Agency Response: The ITS regression studies appear only in Paper #3 and are omitted from later versions of the same paper (Paper #4). It is therefore inappropriate to comment on the regression studies cited above. In addition, none of the ITS reports were relied on to develop the Staff Report's estimates of compliance costs, pricing or potential sales impacts.

490. Comment: Papers #7 and #8 do not reflect a solid understanding of the principles of Herbert Simon's theory of bounded rationality and George Stigler's theory of costly information. These papers find, based on surveys that ITS is conducting, that new car buyers in the U.S. regard fuel economy as relatively unimportant, and conclude that this represents a lack of rational decision making. On the other hand they find that fuel economy is important to consumers in Europe and conclude that European consumers appear to be acting rationally. In fact, both examples are proof of consumer rationality, not the contrary. The price of gasoline was only about \$1.50 per gallon in the U.S. at the time of these studies, gasoline costs were only a small portion of total ownership costs, and improved fuel economy was strongly correlated with reduced size and acceleration. U.S. consumers thus rationally ranked it very low as an attribute to be considered in new vehicle purchases. Conversely, in Germany, gasoline was selling for \$5/gallon, diesel was selling for about \$4/gallon and modern diesels were available that reduced fuel bills without sacrificing performance or size. So German consumers rationally considered fuel economy as important in new vehicle purchase decisions and many consumers were willing to pay extra for diesels in order to save substantial operating costs. This is an extremely important point because a finding of consumer rationality necessarily implies that the private costs of the ARB proposal or any proposal for a binding constraint or lower bound on fuel economy necessarily exceed the private benefits, regardless of what any engineering study might purport to show. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 22-23)

Agency Response: None of the ITS reports were relied on to develop the Staff Report's estimates of vehicle price increases or vehicle sales impacts. The Staff Report compliance analysis assumes fully rational consumers who choose to purchase higher-priced vehicles because they offer substantially lower operating costs.

491. Comment: The conclusions that U.S. auto purchasers fail to rationally reflect on gasoline prices and vehicle operating costs are not only inconsistent with the ITS' studies' own research and that of the vast body of economic research; they ignore the fundamental principle of micro and public policy economics – the equal marginal principle. The equal marginal principle holds that consumers rationally maximize their well being by insuring the value of each dollar spent is the same for all attributes and goods. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 26)

Agency Response: None of the ITS reports were relied on to develop the Staff Report's estimates of vehicle price increases or vehicle sales impacts. The Staff Report

compliance analysis assumes fully rational consumers who choose to purchase higher-priced vehicles because they offer substantially lower operating costs.

492. Comment: In other words, the engineering or hardware costs of CAFE standards – the costs assessed in the ITS studies and in ARB’s proposal to set stringent fuel economy standards for California’s consumers – are just the tip of the proverbial iceberg. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 31)

Agency Response: The comment suggests that the purpose of the ITS case studies was to assess the economic impact of CAFE standards; this is incorrect. In addition, the comment incorrectly suggests that ARB has fielded a proposal to increase the stringency of fuel economy regulations. ARB’s proposed regulation, as discussed in the August 6th 2004 ISOR, addresses the establishment of climate change emission standards for motor vehicles, not fuel economy standards.

493. Comment: The Summary Paper also finds that the existing CAFE standards for cars and trucks are binding and that this has distorted the marketplace. In particular the Summary Paper finds: Summary Paper #1, Finding #7: “[I]n the late 1970s and early 1980s...CAFE standards played an important but controversial role in this shift to smaller cars, along with large fuel price increases (Greene, 1990)...CAFE standards played a role again, later in influencing product mix, this time encouraging the introduction of minivans, pickup trucks, and SUVs...Aggressive CAFE standards for cars, along with high fuel prices, played a central role in the demise of large station wagons in the late 1970s, while the more lenient CAFE standard for light trucks, along with dropping fuel prices, encouraged manufacturers to emphasize minivans in the 1980s, and then SUVs in the 1990s.” [1, Finding #7, pages 17-18] (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 32-33)

Agency Response: The findings of the ITS case studies regarding CAFE standards were not relied on to develop the Staff Report analysis of the compliance costs, pricing or sales impacts of the proposed regulation. ARB has fielded a proposal to regulate climate change emissions, not fuel economy standards. According to staff’s assessment of the proposed regulation’s impacts, automakers will be able to meet compliance standards at modest incremental cost using off-the-shelf technology, and without limiting the array vehicle choices available to consumers.

494. Comment: Paper #3 finds, “Vehicle weight and size (wheel base) were periodically a negative factor for all the manufacturers during the 1986-2001 time period, indicating some market resistance to downsizing by buyers of cars manufactured by the Big Three.” [3, page 53] This shows consumer harm from binding CAFE standards because the ITS regression studies agree with Crandall’s study that vehicle size dominates all other vehicle attributes, including fuel economy, in terms of the impact on vehicle sales. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt

Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 33)

Agency Response: Paper #3 is an early draft of Paper #4, which omits the regression study results referred to in the comment above. Elsewhere, the commenter asserts that, “[The ITS regression study] is not an analysis that would be entitled to credibility in the field of regulatory economics...” and is, “fraught with several errors including misspecification...” [See p.22 of Appendix G.] Here, the commenter uses the same regression study as support for an argument concerning the binding effects of CAFE regulation. Given the commenter’s assessment of the ITS regression’s credibility, and its omission from later drafts of the ITS paper, it is illogical and inappropriate to cite the study’s results as support for any comment. Further, the ITS reports were not used in the Staff Report as the basis for the proposed standards.

495. Comment: Finally Paper #3 finds that while there was market resistance to vehicle downsizing by domestic producers during 1986-2001, “the market accepted well the heavier Japanese car designs.” [3,page 53] This implies that during this period CAFE standards have disadvantaged full-line domestic producers relative to Japanese smaller vehicle producers. This loss of producer welfare is yet another cost that ARB ignores in its assessment of the impact of its proposal to mandate fuel economy increases. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 33)

Agency Response: Paper #3 is an early draft of Paper #4, which omits the regression study results referred to in the comment above. Elsewhere, the commenter asserts that, “[The ITS regression study] is not an analysis that would be entitled to credibility in the field of regulatory economics...” and is, “fraught with several errors including misspecification...” [See p.22 of Appendix G.] Here, the commenter adduces the same regression study as support for an argument concerning the binding effects of CAFE regulation. Given the commenter’s assessment of the ITS regression’s credibility, and its omission from later drafts of the ITS paper, it is illogical and inappropriate to cite the study’s results as support for any comment. Further, the ITS reports were not used in the Staff Report as the basis for the proposed standards.

496. Comment: ARB commissioned ITS to study the impacts of motor vehicle regulations on vehicle prices and on consumer behavior. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 38)

Agency Response: Staff agrees with this comment. The qualitative, retrospective part of that study was undertaken in the ITS case studies, which are commented on here. A quantitative, prospective assessment of the proposed climate change regulation was undertaken using the CARBITS consumer response model, and is not among the studies commented on here. The CARBITS study results are discussed in sections 12.1 and 12.2 of the August 6, 2004 ISOR.

497. Comment: The ITS studies' summary statements and assertions rely on faulty analytical, methodological, and statistical approaches – ignoring basic principles of economic theory and statistical research and relying on “proof by assertion.” (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 38)

The ITS studies' assessments are replete with internal contradictions. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 38)

Agency Response: ARB staff did not rely on the ITS reports to develop its climate change regulation or to prepare its estimates of regulatory costs or pricing. The ITS reports are in the record purely in response to inquiries from the commenters.

498. Comment: The papers ignore the administrative costs that its complex downstream program of carbon emissions trading would entail. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 38)

Agency Response: Issues involving the design of the regulation's alternative compliance provisions were not part of the scope of the ITS analyses. It is not clear why the commenter raises administrative issues in this context. In any event, the alternative compliance provisions of the regulation are limited in scope. Such banking and trading programs are already in practice for the affected manufacturers' fleets and should impose few administrative costs.

499. Comment: The ITS Studies and ARB do not address economic research that demonstrates that a carbon emissions trading program that includes auto manufacturers necessarily entails substantial administrative costs and creates a serious problem of double counting. ARB's proposal involves the trading of CAFE permits, which amounts to a downstream program of carbon emissions trading. This downstream – or midstream – emissions trading proposal includes, by ARB's own assessment, a complex set of eligibility considerations, application processes, issuance of alternative compliance credits, record keeping, auditing, inspection, and enforcement. ARB recognizes that these provisions must be designed in a way to minimize leakage – in a way that prevents credits from being earned that are “merely the result of shifting the same volume of fuel from one use to another.” (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 35)

Agency Response: Issues involving the design of the regulation's alternative compliance provisions were not part of the scope of the ITS analyses. With regard to those issues, however, the alternative compliance provisions of the regulation, which are limited to the demonstrated increased use of alternative fuel in vehicles subject to the regulation, are

designed to avoid leakage concerns. They do not constitute a “carbon emissions trading program that includes auto manufacturers”.

500. Comment: Finally, the ITS studies do not address a number of sources of leakage, or offsetting carbon emissions increases, that would be associated with any attempt to reduce carbon emissions by setting California-specific fuel economy standards. (Comments of the Alliance of Automobile Manufacturers on the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 36)

Agency Response: The ITS study scope of work, and indeed the entire staff analytical effort, was not directed toward setting fuel economy standards. Nor did the ITS scope of work include an evaluation the operation of the regulation and possible sources of leakage. Regarding manufacturer response, see also the response to comment 665.

As noted elsewhere, staff has not claimed that this regulation alone will solve the climate change problem; rather, it is a first step and provides leadership that will help ensure progress in other jurisdictions.

501. Comment: It is doubly surprising since it is likely that the cumulative effects of the different sources of leakage identified below could offset most or even all of the carbon emissions reductions that might be achieved by ARB’s proposal. In the absence of such economic analysis of consumer responses and how they might affect these different sources, of leakage it is impossible to know whether ARB’s proposal will achieve its intended results of reducing global carbon emissions. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 36)

Agency Response: See the response to comment 500.

502. Comment: The second most important source of leakage or offsetting carbon emissions increases derives from the “rebound effect” as purchasers of more fuel-efficient new vehicles increase their driving in response to reduced operating costs. Most economic researchers use a “rebound effect” of at least 20%, based on a survey by David Greene and colleagues. This means that the increased driving associated with higher fuel economy and thus lower vehicle operating costs would offset 20% or more of the fuel savings of any CAFE mandate. Paper #6, which is a case study of Europe’s experience with diesel-powered vehicles, finds a much higher rebound effect. Indeed, that study is unable to find a net reduction in fuel consumption associated with the increased diesel penetrations in Europe and this is in part because of a rebound effect that increases vehicle miles traveled on diesel powered vehicles. This rebound effect occurs in spite of Europe’s greater traffic congestion, which contradicts ARB’s assertion that California’s rebound effect must be smaller than for the rest of the U.S. because its highways are more congested than the rest of the nation. The ITS research does not reflect on the implications of this finding for the potential for leakage from a California-specific fuel economy program. Of course, if it is assumed that many other states or the nation will

adopt the California standard, as is sometimes argued by proponents of the program, the broader national estimate of 20% or more becomes the relevant assumption for ARB's analysis. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 36-37)

Agency Response: As discussed in section III.A.2.i(1), the staff supplemental analysis includes an economic evaluation of consumer response to the climate change regulations. ARB staff also evaluated the resulting effects of consumer responses including the rebound effect on the greenhouse gas emissions that would be achieved by the climate change regulations. In their evaluation of the impacts of the rebound effect, however, staff used California-specific estimates of the rebound effect that was developed by the UC Irvine study. Staff believes that the UCI estimates of the rebound effect are more reliable than other available estimates of the rebound effect. This is because the UCI study is based on a more comprehensive economic specification of the rebound effect definition than has been in the case in the literature. The UCI specification of the rebound effect accounts for factors other than cost-per-mile such as time costs, travel congestion, income, income level, etc. to explain the changes in VMT caused by the California climate change regulations.

503. Comment: Professor Small identified a third source of leakage in his study of the rebound effect. Professor Small found that lower fuel prices associated with reduced fuel consumption mandated by the ARB proposal would increase demand for fuel elsewhere, though he did not quantify the magnitude of the impact. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 37)

Agency Response: Professor Small measures the effect of the proposed climate change regulations on VMT holding fuel price constant. He did not estimate the effect that lower fuel consumption may have on fuel prices. He only points out the possibility of such an effect. However, since fuel prices are determined internationally, it is unlikely that regional changes in fuel consumption would have an impact on fuel prices. If there is an impact, staff doesn't expect the effect to last indefinitely.

504. Comment: Finally, the studies ignore several sources of leakage whose cumulative effects can be expected to offset much or all of any emissions reductions achieved by the ARB proposal. This failure to address leakage is surprising because ARB itself identified it as a significant issue and because many of the sources of leakage are the result of consumers' likely responses to the ARB proposal. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 38)

Agency Response: Please refer to previous responses concerning leakage issues, including Comments 500 and 502.

505. Comment: Forcing consumers to take any or all of the new technology in the form of fuel economy would impose real opportunity costs – costs that the ARB engineering methodology ignores. In that case, ARB’s engineering model would find that applying variable valve technology to yield fuel economy improvements is “cost-effective” even though the full “opportunity” or economic costs of that application would exceed the value of the fuel savings. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 27)

ARB regulations forcing consumers to buy more fuel economy rather than many other vehicle attributes they value more highly would severely reduce consumer welfare. The next section shows that this is the most costly aspect of these regulations. Yet the ITS Papers do not address any of the related opportunity costs – the costs of not using technology improvements for improvements in performance, size, and other more highly valued vehicle attributes. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 27-28)

Agency Response: The regulations do not force consumers to purchase any new technology in the form of fuel economy, but instead require new technologies to reduce greenhouse gas emissions.

In the Staff Report analysis of compliance costs and pricing, compliant vehicles in 2009 have all the performance and size attributes that non-regulated vehicles would be expected to have at that time. Customers do not bear an opportunity cost due to the proposed regulation because compliant vehicles are expected to have all the performance attributes of non-regulated vehicles, as well as lower climate change emissions and reduced operating costs.

ARB’s staff analysis shows that automotive manufacturers have numerous technological options to meet the requirements of the proposed climate change regulations. Most of these technologies are currently available or will be available in the 2009 timeframe. Some vehicle models are currently equipped with these technologies. ARB staff believes that more widespread use of these technologies would not come at the expense of compromising other vehicle features that consumers desire such as vehicle performance, safety, capacity, comfort or aesthetics. Thus staff expects no loss of value to consumers due to the foregone opportunity. On the contrary, the staff believes that the use of climate change emissions reducing technologies in new vehicles will enhance their marketability, and that these technologies will pay for themselves.

506. Comment: The ITS studies do not address the most costly aspects of ARB’s proposal to mandate increased CAFE levels – the adverse impacts on consumer welfare and on overall societal well-being. The failure to consider billions of dollars worth of annual consumer welfare losses from increases in federal CAFE constraints that are reported in recent published studies is particularly puzzling because AB 1493 requires that the “standard be economical to the owner or operator of the vehicle.” (Comments of the

Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 28)

Agency Response: The above comment misconstrues the regulation proposed in the Staff Report as a “proposal to mandate increased CAFE levels...” The August 6th 2004 ISOR does not propose to mandate changes in CAFE standards. Rather, it proposes to regulate climate change emissions from non-commercial motor vehicles.

The ITS case studies were not designed to evaluate the costs of the proposed climate change emission regulation presented in the Staff Report.

The ITS study scope of work did not include an evaluation of welfare effects. The ARB staff proposal is based on currently available technologies. The application of these technologies to all vehicle models is unlikely to compromise other vehicle features that a consumer desires. In other words, the staff expects no loss of value to consumers due to the foregone opportunity. On the contrary, the staff believes that the use of climate change emissions reducing technologies in new vehicles would enhance their marketability and that these technologies pay for themselves. The proposed standards are economical to the owner or operator as described in FSOR section III.A.2.c(5)

507. Comment: Several recent studies find that increased CAFE mandates would impose very substantial losses on consumers, producers and on society at large. Other studies find that the administrative costs of ARB’s downstream trading proposal would also be substantial. Neither the ITS papers nor ARB address any of these issues. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 28)

The ITS studies, and thus ARB, also do not reflect several recent studies that have found that increases in fuel economy standards would impose substantial costs on society – costs far in excess of any social benefits of the tightened standards. These are the increased costs of safety, congestion, and pollution associated with the rebound effect, caused by increased driving associated with reductions in vehicle operating cost. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.33)

Yet, neither this paper nor any other ITS paper draws any inferences from the case studies they perform or from several contemporaneous studies that find substantial offsetting, adverse effects on safety and congestion. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 33)

Agency Response: The ITS case studies were not designed to evaluate the costs of the proposed climate change emission regulation presented in the ISOR – either to consumers, producers or society at large. What recent studies may say about the

hypothetical impact of increased CAFE mandates on consumers is not applicable to the regulation proposed in the ISOR, which is a climate change emissions regulation.

508. Comment: The ITS studies do not consider several recent studies that confirm that increases in the corporate average fuel economy standards for new cars and light trucks would impose substantial welfare losses on the nation's consumers – losses that dwarf the benefits from reduced fuel consumption...This is important because the type of analysis of what is "economical" for a vehicle owner in the ARB staff report grossly underestimates the total costs that the proposed regulation would impose on vehicle owners and operators. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 28)

Agency Response: Please see the agency response to Comments 506 and 507.

509. Comment: It is important to note that CBO identifies two types of costs that must be compared with fuel economy savings flowing from a mandated increase in fuel economy levels. These are (1) the "higher prices paid by purchasers of new vehicles and [(2)] a loss in the well-being of consumers who would be discouraged from buying a new vehicle because of the higher prices."³² The ITS studies, like the ARB analyses, totally ignore the second type of cost.³³ (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 29)

Agency Response: Please see our response to Comments 506, 507 and 508.

510. Comment: The ITS studies ignore a large body of independent research that demonstrates the private and societal costs of fuel economy standards overwhelm any private and societal benefits. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.2)

The analysis in Summary Paper #1 mirrors the above conclusion by the nonpartisan Congressional Budget Office, thus confirming the significant welfare losses that would flow from an increase in fuel economy standards...The Summary Paper #1 notes that over the past 19 years consumers have chosen to use none of an estimated more than 30% increase in automotive fuel efficiency (gallons per ton mile) improvements to increase fuel economy (miles per gallon), instead spending the money on performance and other vehicle attributes of greater value. This overwhelming preference for other vehicle attributes over the past 19 years in the face of such a large increase in fuel efficiency implies that the ARB proposal to mandate a 40% increase in fuel economy over the next twelve years will impose substantial further welfare losses, denying California's consumers the opportunity to spend their money on these other attributes of much greater value to them than fuel economy. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 32)

The ITS studies do not cite the November 2003 CBO study that, utilizing the NRC engineering estimate of hardware costs and fuel savings benefits, found marginal welfare losses of 33 cent per gallon of a relatively small increase in the standards for cars and light trucks. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 33)

The ITS summary and background papers do not address the most important costs of binding fuel economy regulations – their adverse effects on consumer welfare, which is the central focus of AB 1493. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 38)

Agency Response: The ARB staff evaluation of existing technologies show that the required operating cost reduction could be achieved either with currently available technologies or with those that would be available in the 2009 timeframe. The application of these technologies is not expected to alter other vehicle features that a consumer desires such as vehicle performance, safety, capacity, comfort and aesthetics. In other words, the staff expects no loss of value to consumers due to the welfare loss. On the contrary, the staff believes that the use of climate change emissions reducing technologies in new vehicles would enhance their marketability and these technologies pay for themselves.

Cost-benefit analysis of fuel economy standards is outside the scope of the ITS studies. The ISOR's estimate of the costs of compliance with the proposed climate change regulation did not rely on the ITS case studies. It is therefore understandable that some literature comparing the costs and benefits of fuel economy standards should not have been discussed in the ITS studies. The comment refers to the findings of literature which, it claims, evaluates the costs and benefits of hypothetical fuel economy regulations

511. Comment: The ITS studies fail to understand that if a company reduces content by, say, \$200 to “pay” for a \$200 increase in emission control hardware, consumers suffer a full \$200 price increase, the value of that lost content. This misunderstanding appears to rest on the notion that vehicle manufacturers can somehow trick auto buyers into paying the same amount for a car whose content has been reduced – that auto buyers would be willing to pay the same for a 5 pound bag of sugar as for a 10 pound bag of sugar so long as no one tells them the difference. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.13)

Agency Response: Although a \$200 content reduction may be theoretically equivalent to a \$200 price increase, in practice it is not the same thing as a price increase. If de-contenting were the same as a price increase, auto manufacturers wouldn't bother to de-content, they'd simply increase prices. But de-contenting does not have the same impact on sales as a price increase because it is less evident to consumers. Automakers always

publish price information, but they rarely, if ever, advertise de-contenting. Many consumers simply do not notice de-contenting when it occurs. Because new car buyers generally do not compare successive years of the same vehicle from the same manufacturer, they are unlikely to recognize the year-on-year changes introduced by manufacturer de-contenting. New car shoppers are more likely to compare vehicles manufactured in the same year by different manufacturers. The commenter's sugar analogy doesn't apply to automobile purchasing decisions for several reasons: Vehicles are far more complex than sugar, which is a commodity product; consumers can easily discern the difference between a 5-pound and 10-pound bag of sugar through visual inspection, but de-contenting often cannot be detected by visual inspection; unlike sugar bags, we don't buy the same new cars every year. In the example given by the commenter, de-contenting pays for compliance improvements of comparable cost. But the economic impact of such a case would depend on the consumer's comparative evaluation of the content removed and the compliance equipment added. Consumers might value the added compliance equipment more highly than the omitted content, yielding an effective price decrease rather than the opposite. In any event, our analysis shows that manufacturers need not reduce content to meet the proposed greenhouse gas standards.

512. Comment: This failure to distinguish different consumer reactions to different types of regulatory costs leads the ITS studies to mistakenly conclude that manufacturers could market emissions control hardware if only they would try. The Summary Paper #1 expresses surprise at the fact, that "distinct environmental differences, such as emissions of criteria pollutants, were simply never marketed – even in the case of cars versus light trucks." [Summary Paper #1, Finding #11, page 23] Paper #5 mistakenly concludes, "just as automaker effectively marketed safety and airbags, they can market technologies that reduce greenhouse gas emissions." [5, page 53] This conclusion ignores not just the findings of the U.S. Bureau of Labor Statistics, it also ignores evidence in the various papers and that is listed in Section C, "Other Internal Contradictions." (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.16)

Agency Response: Staff recognizes and agrees that consumers react differently to different compliance-related vehicle improvements. But the comment mischaracterizes the summary report finding concerning auto industry marketing of environmental differences. The summary report's main finding is that consumer demand for environmental attributes is poorly understood because consumers have rarely been faced with choices between vehicles which differed only in terms of their performance on environmental measures. One oasis in this data desert, however, is the recent introduction of gas-electric hybrid vehicles by Toyota and Honda. As paper # 5 correctly observes, marketing campaigns for hybrid electric vehicles have emphasized the environmental qualities of these vehicles. While neither the ITS summary paper nor ITS paper #5 include any findings on the impact of Toyota's environmentally-oriented marketing campaign, the ramp-up of Prius sales and production as well as the waiting lists for other recently introduced similar technology vehicles suggest that it has been successful.

513. Comment: Indeed, as we shall see in section IV below, the weak demand for fuel economy technologies means that the ARB proposal to regulate fuel economy would impose very substantial welfare losses on California's consumers – costs that the ITS summary statements and ARB ignore in their assessments of consumer responses to and the costs of ARB's proposed regulations. [Emphasis in original.] (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.19-20)

Agency Response: The comment misconstrues the regulation proposed in the ISOR as a "proposal to regulate fuel economy." The August 6th 2004 ISOR does not propose to regulate fuel economy. Rather, it proposes to regulate climate change emissions. The ITS case studies were not designed to evaluate the costs of the proposed climate change emission regulation presented in the ISOR. In the ISOR's analysis of compliance costs and pricing, compliant vehicles in 2009 have all the performance and size attributes that non-regulated vehicles would be expected to have at that time. Customers do not suffer a welfare loss due to the proposed regulation because compliant vehicles are expected to have all the performance attributes of non-regulated vehicles, plus, lower climate change emissions AND, reduced operating costs.

514. Comment: The ITS studies also fail to cite the conclusions of the former head of the NRC CAFE study and his colleagues at Resource for the Future and at the United States Department of Energy, who, as noted, find: "When we account for the existing taxes on gasoline and the likelihood of a rebound effect, it appears that tightening CAFE could significantly reduce social welfare overall..."⁴⁰. Neither the Summary Paper #1, nor any of the background papers #2 through #9 refer to any of these recent studies concluding that the societal costs of increased CAFE standards greatly exceed the societal benefits and that such tightening would substantially reduce overall societal welfare. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 34)

Agency Response: Estimating the societal benefits or costs of increasing fuel economy standards is well beyond the scope of the ITS case studies. The ISOR's estimate of the costs of compliance with the proposed climate change regulation did not rely on the ITS case studies commented on here.

515. Comment: The papers totally ignore a large body of recent research that demonstrates even much more limited increases in the fuel economy standards will impose billions of dollars of annual costs on consumers, while creating offsetting, adverse societal effects on safety, congestion, and pollution – effects that dwarf any societal gains from reduced fuel consumption. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 38)

Agency Response: Estimating the societal costs of fuel economy standards is beyond the scope of the ITS case studies. The ISOR's estimate of the costs of compliance with the proposed climate change regulation did not rely on the ITS case studies.

516. Comment: The research in the ITS background papers does not support the first conclusion that auto manufacturers tend to fully absorb any costs of governmental emissions and safety regulations and that there is thus little or no impact on vehicle prices and sales. Specifically, the research in the body of the ITS studies contradicts the following findings in Paper #1, the Summary Paper, and in the summary sections of Papers #1 and #2: (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.3)

Agency Response: The comment misrepresents the findings of the ITS studies as presented in the ITS summary report. That report, (#1), lists eleven findings, not "three central conclusions" as explained above. Contrary to the commenter's view of ITS case study findings, the ITS summary report's first finding confirms that, "[g]overnment regulations have accounted for about 1/3 of overall vehicle price increases." And Finding #3 of the same report concludes that the effect of emissions and safety regulations on overall vehicle sales is unknown.

517. Comment: The regression results in the ITS studies as well as the ITS' CARBITS simulation model conclude that vehicle price increases result in substantial reductions in vehicle sales. These results directly contradict the assertions in the various summary papers that the costs of automotive regulations are not passed through to consumers and thus have no impact on vehicles sales. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.8)

Agency Response: The CARBITS consumer response model was used by ARB staff to estimate the potential impact of the proposed regulation on vehicle sales. Those estimates are presented in section 12.1.C of the ISOR. None of the ITS case studies were relied on to develop the ISOR's estimates of vehicle price increases or vehicle sales impacts. Regarding the "regression results" cited above, the commenter asserts elsewhere, (p.22 of Appendix G), that "[The ITS regression study] is not an analysis that would be entitled to credibility in the field of regulatory economics..." and is, "fraught with several errors including misspecification..." The regression studies appear only in one early draft of one ITS paper, (paper #3), and are omitted from subsequent versions of the report. Given the commenter's assessment of the ITS regression results' credibility it is illogical for the commenter to cite the results as support for any comment. In addition, the ITS Summary Report referred to, (There is only one such report.), does not find, as the comment claims, that the cost of automotive regulations are not passed through to consumers in the form of higher vehicle prices. On the contrary, finding #1 of the ITS summary report asserts that cost increases associated with government regulations account for approximately 1/3 (one third) of all vehicle price increases between 1975 and the present. Nor does the ITS summary report find that these price increases have no

impact on sales. Rather, the ITS summary report finds that the impact of increased regulatory costs on overall vehicle sales is unknown, (paper #1 p.12).

518. Comment: The ITS studies acknowledge that the standard assumption in economic policy analysis is that of a full pass through of all costs of doing business to consumers, including the costs of sales taxes and regulations. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.8)

Agency Response: Full pass-through of regulatory cost increases to consumers is indeed a standard economic assumption. But there are often substantial variations in the degree to which standard assumptions apply, in practice, to particular industries, companies and products. One purpose of the ITS studies was to investigate whether and to what extent standard theoretical assumptions could be applied in practice to the automobile industry, which, due to substantial obstacles to entry, is often considered imperfectly competitive. Empirical research reported in the literature has found that the extent of cost pass-through depends on the nature of demand and aspects of competition in particular markets.

519. Comment: The fact that other pricing and cost considerations might have been more important than the increase in hardware emissions control costs during some period of time says nothing about anything. The question is what is the impact of the increase in emissions hardware control costs on vehicle prices and thus sales, holding all other factors, including incomes and other “cost and pricing considerations” constant. This, of course, is the principle of *ceteris paribus*. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.10)

Agency Response: Staff understands the principle of *ceteris paribus*, which is essential in using statistical analysis to isolate the influence of individual independent variables on some dependent variable, such as the price of an automobile. We disagree with the commenter’s view regarding the significance of comparing the contributions of various factors to new vehicle pricing. For example, the finding that vehicle changes made by automakers for competitive purposes contributed twice as much to overall price increases as changes made for compliance purposes is useful in evaluating the relative impact of competitive and regulatory factors on new vehicle pricing. In addition, while it may be possible, in theory, to statistically disaggregate the influence of individual cost factors on pricing, in reality, new car buyers cannot always identify and respond separately to individual vehicle attribute changes which are ultimately combined into a single price.

520. Comment: Whether prices affect sales is ultimately an empirical question and the vast weight of the empirical evidence, including the research in Paper #3, in ITS’ CARBITS model, and in extensive marketing studies by auto companies and analysts, shows that increased prices, driven by increased regulatory costs, do in fact matter to consumers, and result in a significant reduction in sales. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.12)

Agency Response: Staff does not dispute that price increases influence consumer decision-making, and that, all other things being equal, price increases generally result in reduced sales. However, automobile price increases are often related to attribute changes, and, depending on how consumers respond to those new vehicle attributes, sales of a given vehicle model may either increase or decrease as a result. This point is covered in the ISOR in section 12.1.

521. Comment: Summary Paper #1 says that regulatory compliance costs are not immediately passed on to consumers. [Summary Paper #1, Finding #5, page 14] Once again, this says nothing about whether such costs are ultimately borne by consumers, which is the issue in an ARB proceeding that is based on projected costs and pricing impacts through 2020. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.17)

Agency Response: Here again, it is important to distinguish between the findings of the ITS case studies, and the ARB estimates of compliance costs and pricing impacts included in the ISOR. ARB estimates of compliance costs and pricing impacts presented in the August 6, 2004 ISOR and updated in the September 10, 2004 addendum do not rely in any way on the findings of the ITS case studies. In the estimates presented by ARB, 100 percent of compliance costs are assumed to be immediately passed on to consumers. Findings of the ITS case studies suggest that actual manufacturer response may differ: actual cost pass-through may be less than immediate and less than 100 percent of compliance costs may be passed along in the form of increased retail pricing.

522. Comment: Summary Paper #1 says, and ARB emphasized, “Manufacturers have used non-pricing strategies to overcome consumer resistance to price increases resulting from regulations.” [Summary Paper #1, Finding #8, page 19, boldface in original] This refers to advertising and to creative leasing and financing arrangements that manufacturers have increasingly resorted to in recent years in response to increased domestic and foreign competition. This has nothing to do with the issue of whether the cost of regulations is passed on to consumers. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.17)

Agency Response: We agree that ITS summary report finding #8 (cited above) does not speak to the issue of *whether* the cost of regulations is passed along to consumers. Rather, the finding relates to *how* automakers have passed along cost increases to consumers in ways that optimize sales. For example, automakers have used advertising to enhance the perceived value of required vehicle improvements such as airbags. The more highly consumers value compliance-related vehicle improvements, the less resistant they are to associated price increases. Other methods of minimizing the sales impact of cost pass-through may include adjusting the terms of vehicle financing or managing vehicle incentives.

523. Comment: Summary Paper #2 states, “Automaker response to new emissions regulations was not straightforward, uniform, nor transparent,” [2, page 23]. ARB staff says: “Automobile manufacturers that experience production cost increases as a result of new compliance requirements do not necessarily resort to new-car price increases to recover costs. The price sensitivity of new-car buyers (‘sticker shock’), is well known to automobile manufacturers, who can recover cost increases in ways that are less visible to consumers and therefore, less likely to impact purchase decisions...These more subtle approaches to cost recovery permit automobile manufacturers to recoup compliance costs without incurring the same revenue penalty as comparable changes to MSRP.” We have already addressed the allegedly “nontransparent” manufacturing responses to increases in regulatory costs, including vehicle de-contenting, and “creative” lease and financing programs. The Bureau of Labor Statistics scores all of these and other manufacturer marketing activities as either price reductions or price increases. None of these activities is missed by the watchful eyes of the nation’s auto buyers. None of them enables the automakers to avoid passing through the full costs of vehicle hardware regulations. No automaker can “fool” the extremely sophisticated automotive buyer in the Age of the Internet. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.18)

Agency Response: We agree that the Bureau of Labor Statistics take incentives, equipment de-contenting and vehicle quality changes into account in developing its producer price index (PPI) for automobiles. But the BLS PPI estimates the price received by manufacturers; it does not accurately measure the proportion of producer cost increases that are passed on to consumers. We also agree that much information about new vehicle quality, pricing and financing is available to the “extremely sophisticated automotive buyer in the Age of the Internet.” But the availability of product information says nothing about the consumer’s ability to accurately analyze such information. Moreover, some of the information that matters most to consumers is not readily available. Information about vehicle de-contenting is not easily accessed by consumers, and the true cost of new vehicles is often buried in the fine print of auto loan or leasing agreements. Many consumers do not have the skills, the knowledge or the inclination to calculate the true cost of new vehicles or thoroughly compare their attributes. With limited time available to make decisions, new car buyers may choose new vehicles on the basis of cash rebates or the amount of monthly loan payments rather than on the basis of a thorough comparative analysis.

524. Comment: The ITS studies fail to demonstrate that manufacturers absorb the hardware costs of emissions and safety regulations and that these regulations have little or no impact on vehicle sales and consumer and manufacturer welfare. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 38)

The ITS case studies, regressions, and citations to the referred literature strongly support a full pass through of the costs of all vehicle regulations to consumers and a

corresponding detrimental effect on vehicle sales, consumers, and manufacturers, depending on the type of regulation. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p. 38)

Agency Response: The ISOR's quantitative analyses of compliance cost, pricing and sales assume that 100 percent of compliance costs are immediately, (and perpetually), passed on to consumers in the form of increased prices. The ISOR's estimates of the cost and pricing impacts of the proposed climate-change emissions regulation did not rely on the findings of the ITS case studies.

The ITS historical case studies did, however, identify methods used by auto manufacturers to soften the sales impact of compliance cost increases. The ITS case studies found evidence indicating that average per-vehicle compliance costs:

- are not immediately passed on to consumers in the form of increased prices;
- often diminish with time as a result of design and production innovations;
- are recovered unevenly across product lines as automakers seek to capitalize on variations in price elasticity of demand; and,
- are recovered through methods other than price increases, such as incentive management, adjustment of financing terms, and vehicle de-contenting.

In addition much of the literature reporting on empirical research on the topic of cost pass-through in the automobile industry rejects the hypothesis that costs are fully passed through to prices. For these reasons, among others, section 12.5 of the ISOR asserts that the quantitative economic impact analyses of the proposed climate change regulation provides conservative estimates.

525. Comment: The ITS studies are self-contradictory on this point: they find, quite correctly, that there is only a weak demand for green technologies, but also conclude that vehicle manufacturers should be able to market those technologies.

Agency Response: Contrary to the view expressed by the commenter, the ITS study doesn't claim that there is only a weak demand for green technologies. The ITS Executive Summary, comment # 11 states that surveys show strong policy support for air pollution (Public Policy Institute, 2002), although there is little understanding about demand for environmental attributes of vehicles. The summary also states that preliminary results from a UC Davis study of the hybrid electric vehicle indicates that buyers of the Toyota Prius value low air pollutant emissions equally with the high gas mileage (Kurani and Turrentine, 2004b). Many Prius buyers would have otherwise purchased larger and more expensive vehicles, and have been willing to downsize to the Prius because of its progressive technology. Many buyers speak of wanting to be part of a change, a movement. These findings do not indicate a weak demand for green technologies. Consequently, it is incorrect to conclude that the ARB proposal results in substantial welfare losses on California's consumers. On the contrary, the Staff Report analysis shows that the proposed climate change regulations would bring about substantial gains to California's consumers.

526. Comment: Paper #1, the Summary Paper, correctly concludes that the demand for “green technology” is weak [1, page 23], as does Paper #6, when it concludes that only 3% of motorists in Britain, France, Germany, Italy, the Netherlands, and Spain rank “the effects of cars on the environment as their top concern,” [6, page 9, and as does Paper #5, which notes that the United States Bureau of Labor Statistics concludes that “a change in pollution control in no way changes the satisfaction derived from the vehicle derived by the individual consumer.”¹⁶ [5, page 42] Yet, other ITS case studies and commentaries in the background papers conclude that there is a strong demand for emissions reductions and manufacturers could market “green technologies” if only they would try. Paper #1, the Summary Paper, states, “Finally, the effect of emissions safety regulations on overall vehicle sales is speculative. Emissions and safety regulations clearly added cost to vehicles, but they also added value.” [1, page 12] and paper #5 states, “Just as automakers effectively marketed safety and airbags, they can market technologies and models that reduce greenhouse gas emissions.” [5, page 53] The ITS studies are self-contradictory on this point; they find, quite correctly, that there is only a weak demand for green technologies, but also conclude that vehicle manufacturers should be able to market those technologies. (Comments of the Alliance of Automobile Manufacturers On the Proposed Rulemaking to Adopt Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, Appendix G, p.19)

Agency Response: The ITS papers, as they should, comprehend a diversity of opinion regarding consumer preferences. Consumer preferences change in response to changing conditions and events. Much has changed since the 1999 survey of European motorists cited above, which has questionable relevance to the U.S. consumers of 2009. Changes such as growing public awareness of the causes and risks of climate change, costly U.S. military involvement in oil-producing nations, and dramatic spikes in world oil prices will impact consumer preferences. A July 21, 2004 U.S. Department of Energy survey found that 44% of prospective new car buyers consider themselves likely to buy hybrid electric vehicles – vehicles which have been marketed on the basis of their environmental attributes. Five years ago, few consumers had even heard of hybrid electric vehicles. Years before airbags became required equipment, automakers claimed they couldn’t be sold. After airbags became required equipment, automakers aggressively marketed airbags. Changing consumer preferences could very well result in more aggressive marketing of environmental vehicle attributes by 2009.

j. ISOR Appendix A: Regulatory Language and Test Procedures

527. Comment: The definition of an “intermediate volume manufacturer” in the greenhouse gas proposal contains new criteria governing when sales must be aggregated among companies with joint ownership. In the ARB greenhouse gas proposal the aggregation criteria are based on a “more than 10 percent” ownership criterion. This differs substantially from the recently adopted zero emission vehicle (ZEV) regulatory amendments which adopted a “more than 50 percent” ownership criterion. The Staff Report does not explain this departure from the ARB’s other regulatory position. (Statement of John Cabaniss, Association of International Automobile Manufacturers, and American Honda Motor Co.)

Agency Response: The LEV II regulations, on which the greenhouse gas regulations are based, currently provide less stringent emissions and certification requirements for two classifications of vehicle manufacturers, “small volume manufacturers” and “independent low volume manufacturers,” which are defined based on a manufacturer’s California vehicle sales. Each of these definitions requires that automobile manufacturers be grouped together for compliance purposes in cases where one company has at least a 10% equity ownership in the other, or in cases where a third party owns at least 10% of the equity in two or more automobile manufacturers. The definition of a “small volume manufacturer” used for the LEV II regulations is consistent with the federal definition. There is no federal equivalent of the “independent low volume manufacturer” definition. The category “intermediate volume manufacturer” is not currently applicable for the purpose of complying with LEV II regulations.

The zero-emission vehicle (ZEV) regulations incorporate both the “small volume manufacturer” and the “independent low volume manufacturer” classifications and added the category “intermediate volume manufacturer.” The ZEV regulations also increased the criterion above which a manufacturer must aggregate vehicle sales from 10 percent to 50 percent solely due to the unique technical nature of this program. Traditionally, regulations such as the LEV II program focus on reducing emissions from vehicles that are equipped with conventional gasoline and diesel-fueled internal combustion engines. The ZEV program, however, requires a manufacturer to develop, manufacture, and sell vehicles powered by entirely new power plants and propulsion designs (e.g., electric vehicles that use advanced batteries or fuel cells, or hybrid vehicles). Therefore, compliance with the ZEV program requires that a manufacturer expend considerably more research and development funding, developmental effort, and associated risk than is usually required. For this reason, ARB decided to provide latitude to intermediate volume manufacturers that fell into the 10 to 50 percent co-ownership category, and raise the aggregation criterion to 50 percent. This was purely a policy decision by ARB because of the unique nature of the ZEV program and was not intended to serve as a precedent for future rulemakings. Unlike the ZEV regulations, the greenhouse gas regulations were developed based on the emission reductions that are achievable using technology that is being used on vehicles today, although in limited applications. Therefore, the special circumstances that made it appropriate to apply a 50 percent ownership criterion within the context of the ZEV regulations do not apply to the greenhouse gas regulations. Consequently, it is more appropriate to retain the 10 percent aggregation provision used in the LEV II regulations than that applicable to the ZEV regulations.

528. Comment: The proposed regulation requires that automobile manufacturers be grouped together for compliance purposes in cases where one company has at least a 10% equity ownership in the other, or in cases where a third party owns at least 10% of the equity in two or more automobile manufacturers. The regulation also proposes to extend this provision beyond the greenhouse gas standards into other areas of emissions such as Non-Methane Organic gases (NMOG). Comprehensive coordination with these companies in some areas such as the numbers of vehicles offered for sale in California and product pricing could potentially be unlawful, yet comprehensive coordination would

be necessary to manage fleet average emission levels. Because publicly owned corporations have no control over investor trading in their own shares which could trigger the third party provisions, sudden unexpected situations could develop that put manufacturers out of compliance with the regulation through developments that are not within the control of the manufacturers. In view of these considerations, ARB should modify the proposed 10% equity ownership threshold to at least 50%, which is a level more commonly associated with management control the is required to manage integrated fleet emissions and is consistent with NHTSA's approach. (General Motors)

Agency Response: Staff disagrees with the comment. Action by an individual or individuals, such as investor trading of company stock, would not affect whether a manufacturer's sales should be aggregated with another. The requirement that automobile manufacturers be grouped together for compliance purposes in cases where one company has at least a 10% equity ownership in the other, or in cases where a third party owns at least 10% of the equity in two or more automobile manufacturers only applies to ownership of one company by another company. See response to Comment 527.

529. Comment: Under the proposed "more than 10 percent" criterion, nearly all manufacturers currently considered as intermediate volume manufacturers under the ZEV regulation would be required to meet the requirements for large manufacturers. However, generally these manufacturers do not derive any substantial technological or engineering expertise from their larger part-owner. Instead, the ownership relationship primarily represents a financial business interest. Thus, the small number of current intermediate volume manufacturers which could retain this classification under the ARB greenhouse gas proposal could gain a significant marketing advantage over the reclassified intermediate volume manufacturers by not having to comply until the 2016 MY. (Statement of John Cabaniss, Association of International Automobile Manufacturers, and American Honda Motor Co.)

Agency Response: As noted in the response to comment 527, the aggregation provisions of the ZEV program were designed to address the unique technical burden placed on manufacturers by the program, not to serve as a precedent for other, more conventional emission control programs. Since the technical requirements of the greenhouse gas regulations do not approach the magnitude of the ZEV regulation, staff believes that the 10% criterion is appropriate.

Of the manufacturers currently meeting the definition of "Intermediate Volume Manufacturer", staff is aware of only two that can be said to be "independent manufacturers", that is they are not partially or wholly owned by another manufacturer. Furthermore, even these manufacturers are expected to change their status to "Large Volume Manufacturer" before the greenhouse gas requirements are fully implemented. The remaining Intermediate Volume Manufacturers are in part owned by a "Large Volume Manufacturer" and share technologies such as engines and/or transmissions with their business partners. Accordingly, staff is unable to identify any manufacturer that may be disadvantaged by the 10% criterion.

530. Comment: The proposed regulation would apply stringent requirements on the six largest automakers beginning in 2009 model year (MY), but would delay any requirements on small and mid-sized manufacturers, with annual California sales under 60,000 vehicles, until seven years later, in 2016 MY. The companies that currently fall under the 60,000 vehicle threshold based on California sales include major global competitors such as Volkswagen, Hyundai, and BMW that have no inherent weakness that would justify this degree of regulatory preference. The significant competitive advantage provided by the less stringent requirements for these manufacturers can be expected to generate long-term adverse economic impacts on General Motors and on U.S. states with automobile production-related economic sector. This creates significant barrier to General Motors ability to create normal business alliances and collaborations worldwide, to the detriment of GM's ability to compete in states outside California as well as in other nations. ARB should delete the proposed Small, Low and Intermediate Volume Manufacturer requirements. (General Motors)

Agency Response: A small volume manufacturer is defined as one that sells fewer than 4,500 vehicles in California each year. An independent low volume manufacturer is one with annual California sales of less than 10,000 vehicles. Small and independent low volume manufacturers generally offer limited product lines, which makes it very difficult to reasonably meet an increasingly stringent fleet average greenhouse standard each year. For this reason, it is entirely appropriate to provide additional compliance flexibility to these size manufacturers. This practice is also consistent with other California vehicle regulations, such as LEV II.

Some of the same concerns that affect small and independent low volume manufacturers also apply to intermediate volume manufacturers (i.e., those manufacturers that sell fewer than 60,000 vehicles in California, other than small or independent low volume manufacturers) for the purpose of complying with the greenhouse gas regulations. For example, intermediate volume manufacturers generally offer limited product lines within California. This is a disadvantage for the manufacturer, since compliance with the greenhouse gas fleet average requirements requires that the manufacturer incorporate changes to the vehicle design. Since not all of the greenhouse gas-reducing technologies identified by staff can be applied to all engines and vehicle types, a manufacturer that does not offer a wide range of products is more limited than a larger manufacturer in terms of compliance choices. This problem becomes exacerbated if the intermediate volume manufacturer specialized in one specific type of vehicle, for example, high performance vehicles.

Finally, ARB does not believe that providing compliance flexibility to small volume, independent low volume, and intermediate volume manufacturers will “generate long-term adverse economic impacts on General Motors and on U.S. states with automobile production-related economic sector.” The fleet average emissions reduction approach used in the greenhouse gas regulations provides large manufacturers with the flexibility to sell vehicles with greenhouse gas emission levels that are higher than the fleet average, provided those emissions are offset by vehicles with lower greenhouse gas emissions.

This should provide sufficient flexibility to allow a large manufacturer (i.e., one that sells more than 60,000 vehicles in California each year) to both compete with the much smaller manufacturers and still be able meet its fleet average greenhouse gas obligations.

531. Comment: Given the multiple and conflicting emissions requirements presented by the ZEV mandate and these proposed greenhouse gas emissions standards and the additional lead time BMW would need to comply, we respectfully request that CARB modify the intermediate volume manufacturer definition as follows:

- If a manufacturer's average annual California sales exceed 60,000 units of new PCs, LDTs, MDVs, and heavy-duty engines based on the average number of vehicles sold for the previous consecutive model years (120,000 units if a manufacturer's annual worldwide production is less than 17 times its California's sales in each of the three previous consecutive model years), the manufacturer shall no longer be treated as an intermediate volume manufacturer and
- Shall comply with the fleet average requirements applicable to large volume manufacturers as specified in section 1961.1(a)(1) beginning with the sixth model year after the last of the three consecutive model years. This would make the criteria consistent with the requirements applicable to the ZEV mandate and provide the required lead time. (BMW Group)

Agency Response: Staff disagrees with the comment. The rationale for the commenters suggestion (allow a manufacturer with annual California sales volumes between 60,000 and 120,000 vehicles to qualify as an "intermediate volume manufacturer" based on whether or not "a manufacturer's annual worldwide production is less than 17 times its California's sales in each of the three previous consecutive model years.") is unclear. Rather, this proposal seems arbitrarily designed around the commenter's worldwide vehicle sales distribution, since there is no evidence to suggest why the criterion of "less than 17 times its California's sales" is appropriate in terms of impacting a manufacturer's ability to meet greenhouse gas requirements. Furthermore, the commenter provides no indication of how this proposed change could potentially affect other intermediate volume manufacturers in terms of economic competitiveness. Clearly, changing the definition of an intermediate volume manufacturer based on one manufacturer's sales with no regard to how the change would impact others would be entirely inappropriate. Finally, from an enforcement standpoint, since neither ARB nor the U.S. EPA has ever based vehicle emission standards on worldwide sales we do not have an accurate means to track a manufacturer's worldwide sales. It would, therefore, not be practical to add this criterion to the greenhouse gas regulations.

Regarding the second point made by the commenter, the proposed greenhouse gas regulations state that when an intermediate volume manufacturer's average California sales exceed 60,000 new vehicles based on the average number of vehicles sold for the three previous consecutive model years, the manufacturer shall no longer be treated as an intermediate volume manufacturer and shall comply with the fleet average requirements applicable to large volume manufacturers beginning with the fourth model year after the last of the three consecutive model years. The requirement that when a manufacturer exceeds the specified maximum sales, that manufacturer must comply with the

greenhouse gas requirements for a larger manufacturer beginning with the fourth model year after the last of the three consecutive model years also applies to small volume manufacturers and independent low volume manufacturers. These terms are consistent with the requirements of the LEV II regulations for small volume manufacturers and independent low volume manufacturers (the classification of “intermediate volume manufacturer” is not relevant for the purpose of complying with the LEV II regulations).

As discussed in the response to Comment 521, it was appropriate to provide added flexibility and relaxed requirements for all but the large volume manufacturers under the ZEV regulations based on the unique technical nature of these regulations (i.e., development of entirely new power plants and propulsion designs) and their associated costs. These concerns, however, do not apply to the greenhouse gas regulations. Rather, the greenhouse gas regulations were developed based on staff’s assessment of the emission reductions that are possible using technology that is available today. It is, therefore, more appropriate to apply the lead time requirements used in the LEV II regulations to the greenhouse gas regulations than to provide the longer lead times used in the ZEV regulations.

As discussed in the response to Comment 527, it was appropriate to provide added flexibility and relaxed requirements for all but the large volume manufacturers under the ZEV regulations based on the unique technical nature of these regulations (i.e., development of entirely new power plants and propulsion designs) and their associated costs. These concerns, however, do not apply to the greenhouse gas regulations. Rather, the greenhouse gas regulations were developed based on staff’s assessment of the emission reductions that are possible using technology that is available today. It is, therefore, more appropriate to apply the lead time requirements used in the LEV II regulations to the greenhouse gas regulations than to provide the longer lead times used in the ZEV regulations.

532. Comment: Greenhouse gas vehicle “groupings” should align with Federal CAFÉ groupings for “model type,” “vehicle configuration,” and “sub-configuration.” (Appendix A to letter from Alliance of Automobile Manufacturers)

Agency Response: The Board recognizes the inherent efficiencies of such alignment for manufacturers. However, ARB did not and need not consider CAFE groupings, which serve a different federal purpose, with greenhouse gas vehicle test groupings, which here serve the state’s purpose of testing for greenhouse gas emission reductions. See also the response to comment 588.

533. Comment: The Alliance recommends that ARB align the greenhouse gas vehicle groupings, test vehicle selection criteria, and data requirements with current Federal fuel economy data requirements such that the data generated under the Federal program may be utilized in meeting the California greenhouse gas compliance requirements. This change would: 1) dramatically reduce unnecessary manufacturer testing and certification requirements; 2) have no impact on greenhouse gas emissions in the state; and 3) provide

a more accurate estimate of fleet greenhouse gas emissions. (Appendix A to letter from Alliance of Automobile Manufacturers)

Agency Response: If and when there are federal greenhouse gas test procedures, the Board will more closely evaluate the extent to which the same test vehicle can be used to meet California and federal greenhouse gas emission standards. Further, we note that manufacturers have the flexibility to structure their test groups as they wish to reduce their overall testing burden.

534. Comment: Test vehicle selection criteria should be based on “high sales” instead of “worst case.” Because ARB set the standards based on NHTSA data that is representative of high-sales configurations – not worst case – this effectively requires manufacturers to test all configurations in order to comply. This equates to an incremental testing burden of 50-100% over the Federal CAFÉ program. (Appendix A to letter from Alliance of Automobile Manufacturers)

Agency Response: California’s greenhouse gas regulations are not synonymous with federal CAFÉ regulations. Comparisons to the federal program established by NHTSA are not relevant. Staff designed the program to minimize the testing burden on manufacturers while achieving the maximum feasible and cost effective greenhouse gas reduction.

When staff were deciding on vehicle selection criteria to be used for calculating a manufacturer’s fleet average greenhouse gas emissions, it was important to ensure that what ever methodology that was chosen did not under represent emissions from the fleet. The first approach considered, which is the most accurate way to calculate the fleet average greenhouse gas emissions from a manufacturer’s fleet, was to require that manufacturer to test every engine and vehicle configuration within that manufacturer’s fleet. However, the amount of testing required to accomplish this would be expensive and time consuming.

We then considered basing test vehicle selection on “highest sales,” as the commenter suggested. But, as shown in the following example, this approach does not necessarily work well for a manufacturer with multiple vehicle configurations. For example, assume a manufacturer has four possible vehicle configurations with the following sales percentages and CO₂-equivalent emission levels. Clearly in this example allowing this manufacturer to assign the CO₂-equivalent emissions from the highest sales volume configuration to the entire fleet would underestimate fleet emissions by almost 50 percent. Alternatively, the approach ultimately taken by ARB, whereby a manufacturer must test the “worst case” configuration but may also test other configurations as deemed appropriate, is more representative of the actual fleet emissions.

	CO₂-equivalent emissions (g/mi)	Percent of total vehicles
Configuration A	400	26%
Configuration B	350	24%
Configuration C	300	23%
Configuration D	150	27%
True Fleet Average	297.5	
“High Sales”	150	
“Worst Cast” testing 1 configuration	400	
“Worst Cast” testing 2 configurations (A, D)	332.5	
“Worst Cast” testing 3 configurations (A, C, D)	309.5	

Obviously these results will vary by manufacturer and vehicle fleet. However, since manufacturers have a lot of flexibility in deciding how to group vehicles into test groups for the purpose of certification, it is important to remove any incentive to “game the system,” by hiding vehicle configurations with high greenhouse gas emissions within test groups that also contain a low greenhouse gas configuration with a higher sales volume. Otherwise, we will not achieve the greenhouse gas emission reductions required from this regulation.

535. Comment: The proposed test procedures in Part 1 section G of the draft regulations in the ARB proposal do not parallel the current applicable EPA test procedures for fuel economy testing. The Staff Report does not explain why a different test procedure is appropriate. While AIAM understands ARB’s proposal is stated in terms of greenhouse gas emissions standards (i.e., carbon dioxide) rather than as fuel economy standards, from a practical testing perspective it is impossible to separate the two. While EPA’s fuel economy testing procedures have been in place for many years and all auto manufacturers are thoroughly familiar with them, the EPA procedures have evolved over the years to improve accuracy and prevent manufacturers from gaming the system. It would be burdensome on manufacturers and serve no environmental purpose for ARB to adopt a completely new testing approach. (Statement of John Cabaniss, Association of International Automobile Manufacturers, and American Honda Motor Co.)

Agency Response: The proposed test procedures in Part 1 section G of the draft regulations in the ARB proposal do not parallel the current applicable EPA test procedures for fuel economy testing because the greenhouse gas regulations are not fuel economy regulations. Rather the purpose of the greenhouse gas regulations is to reduce the impact of California’s vehicle fleet on global warming. Manufacturers may submit test data from programs such as the federal Tier 2 program or from CAFÉ testing. However, (as discussed in the response to comment 534) using the CAFÉ program as the basis for the greenhouse gas regulation would not achieve the emissions reductions of the California greenhouse gas program.

536. Comment: The ARB has proposed an approach for selecting test vehicles for determining the CO₂ equivalent emissions (CO₂E) fleet average that is based on testing worst-case vehicle configurations. As a result, a manufacturer's CO₂E fleet average will be over-estimated by a wide margin. To achieve a CO₂E fleet average representative of the true average, a manufacturer would need to test all vehicle configurations. ARB should use vehicles tested for CAFÉ to determine the CO₂E fleet average. The ARB should also allow analytical techniques, data substitutions and data equivalencies that are permitted under the CAFÉ program. These provisions help manufacturers to manage their test loads while maintaining focus on high volume, representative testing. This will result in fleet averages that are representative of the true average while keeping the test load at a reasonable level by focusing testing on the highest volume configurations. (General Motors)

Agency Response: See response to Comments 532 and 535.

537. Comment: Data generated via analytical techniques, data substitutions, and data equivalencies, as provided for under the Federal CAFÉ program, should be allowed under the greenhouse gas data requirements. (Appendix A to letter from Alliance of Automobile Manufacturers)

Agency Response: Unlike the federal CAFÉ program, the greenhouse gas regulations are an emission control program. Therefore, the certification procedures are structured to assure accurate reporting of all vehicular greenhouse gas emissions, including CO₂.

538. Comment: AB1493 only applies to vehicles "whose primary purpose is noncommercial personal transportation". In contradiction of this legal requirement, the ARB makes no provision in its standard setting analysis or in compliance provisions for identifying and removing commercial vehicles from the regulated fleets. The ARB justifies this omission with the claim that sales of commercial vehicles are "a small portion of the fleet". California's Department of Motor Vehicles defines commercial vehicles as including all vehicles for "transportation of property" as well as vehicles for "transportation of persons for hire, compensation or profit". These vehicles are registered as commercial vehicles and should be easily identifiable as such by California government agencies. ARB should adjust its calculation of the benefits of the proposed standards and should examine revisions to the standards based on removal of commercial vehicles. In addition, it should create compliance provisions that provide manufacturers with data on which vehicles are considered as commercial vehicles so that these vehicles can be removed from manufacturers' compliance reporting. (General Motors)

Agency Response: The greenhouse gas regulations comply with the requirement to exempt commercial vehicles as they are defined in AB 1493. See responses to comments 270 and 572.

539. Comment: The data used by the ARB for establishing baseline emission levels that were the basis for the proposed CO₂E fleet average standards were derived from the

NHTSA CAFÉ database. The data from this database were generated based on CAFÉ procedures that require manufacturers to focus testing on high volume configurations. Therefore, the ARB proposed “worst case” procedures are inconsistent with the approach used to set the standards, effectively increasing the stringency of the standards. Therefore, if the ARB maintains its “worst case” procedures, it must adjust the standards based on using these “worst case” procedures. (General Motors)

Agency Response: Since manufacturers chose not to participate in the regulatory process, the NHTSA CAFÉ database was the only source of vehicle CO₂ emissions available to staff. Accordingly, to establish the 2002 baseline greenhouse gas emissions for the California fleet, staff assigned the CO₂ emissions of specific vehicle models as reported in the NHTSA CAFÉ database to their California counterparts. Staff believes this to be an appropriate and accurate method to determine the baseline fleet CO₂ emissions for California. Concerning the certification of test groups using “worst case” emissions of the test group, see response to comments 532 and 535. The alleged inconsistency in approaches is not surprising given the different purposes of the federal CAFE test procedures and the ARB greenhouse gas emission standard setting process.

540. Comment: Exempt federal vehicles from the calculation of fleet average greenhouse gas emissions. Because these products are Federal products sold throughout the United States, ARB’s proposed regulations regulate CO₂E and fuel economy of Federal vehicles sold outside California, which is clearly beyond ARB’s authority. (Appendix A to letter from Alliance of Automobile Manufacturers)

Agency Response: The greenhouse gas regulations adopted by the ARB do not contain standards for individual vehicles or vehicle types. Rather they establish increasingly stringent fleet average emissions requirements each year, which each manufacturer must meet. As with the LEV II regulations, a manufacturer may sell vehicles with higher emission levels than the fleet average limits, provided emissions from the dirtier vehicle are offset by cleaner vehicles, with emission levels that are lower than the fleet average limits. A manufacturer will, therefore, not be required to make any changes to federal vehicle for the purpose of this regulation, but rather to offset those emissions with the sale of California certified vehicles. Consequently, the commenter’s claim that these regulations “regulate CO₂E and fuel economy of Federal vehicles sold outside California” is unfounded.

541. Comment: There are two provisions under which manufacturers sell federally certified vehicles in California. One is commonly referred to as the “Cleaner Federal Vehicle Program,” while the other is commonly referred to as the “Federal Offset Program”. The ARB proposed greenhouse gas regulations require that the CO₂E of vehicles produced and delivered for sale in California under both these programs be included in the CO₂E fleet average calculation and subject to the CO₂E fleet average requirements. Because these products are federal products that are sold throughout the United States, the ARB proposed regulations will have the effect of regulating CO₂E and fuel economy of Federal vehicles sold outside California. To avoid this type of extraterritorial impact, MDPVs and other vehicles sold under the Cleaner Federal Vehicle

Program as well as vehicles sold under the Federal Offset Program should be exempt from the greenhouse gas regulations. (General Motors)

Agency Response: See the response to Comment 540, above.

542. Comment: Allow five years for automakers to make-up debits and carry-over credits without penalty for debits or degradation of credits. (Appendix A to letter from Alliance of Automobile Manufacturers)

Agency Response: We agree with the commenter, and accordingly have extended the life of credits earned to five years and increased the number of years manufacturers are given to make up emission debits also to five years.

543. Comment: BMW believes incentives should be provided for air conditioner compressor downsizing. It should also be recognized that the refrigerant CO₂ requires less displacement in a relation of about 5:1 compared to HFC-134a. (BMW Group)

Agency Response: We agree with this statement. On October 19, 2004, ARB released for public comment proposed modifications to the text of the regulations. Included in the proposed modifications are revisions to the crediting structure that address expected compressor downsizing for CO₂ systems.

544. Comment: The global warming potential for HFC-152a is 140 per DIN EN 378-1 rather than 120. (BMW Group)

Agency Response: This comment is correct. However, the reference used by staff is from the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPPC). This source lists the GWP as 120.

545. Comment: The proposed calculation of CO₂-equivalent emissions for hydrogen vehicles, including both fuel cell and ICE, has been written such that these vehicles cannot meet the proposed greenhouse gas emissions standards when they are fully phased in by MY 2016. This oversight is counterproductive in terms of achieving the goals of California's Hydrogen Highway Initiative. (BMW Group)

Agency Response: Staff disagrees with the comment. The commenter is referring to the Upstream Emission Factors that were proposed for hydrogen internal combustion engine vehicles and hydrogen zero-emission vehicles (i.e., fuel cell vehicles), which are higher than the 2016 model year fleet average greenhouse gas requirements. In response these concerns, a provision has been added to the regulation to allow the Executive Officer to approve the use of a lower upstream emissions factor for hydrogen (and electric) vehicles, if a manufacturer demonstrates the appropriateness of the lower value. This provision will allow manufacturers to use the lower values based upon future increased use of renewable resources for the production of hydrogen (or electricity), per Governor Schwarzenegger's Executive Order S-7-04 initiating California's hydrogen highway effort.

546. Comment The proposed regulatory terms in Section 1961.1 pertaining to the noncompliance penalty should be modified as follows:

- (1) The penalty should be based on an emissions price per g/mi debt, rather than \$5,000 per noncompliant vehicle. (The proposed terms actually are based on an emissions price, but this is obfuscated by regulatory language that implicitly redefines “number of noncompliant vehicles” to mean an emissions-related quantity that is unrelated to the actual number of noncompliant vehicles.)
- (2) The emissions price should be the same for all vehicles. (Under the proposed terms, the emissions price would be \$24.39 per g/mi for PC/LDT1 and \$15.06 per g/mi for LDT2.)
- (3) The emissions price should be sufficient to adequately deter noncompliance. (It would ideally be indexed to vehicle and/or fuel prices to accommodate inflation.) (The noncompliance cost under the proposed terms would be fairly low and would not be inflation-indexed, so it may have little or no deterrent value, especially for LDT2.)
- (4) The proceeds from penalty charges levied on noncompliant manufacturers should be used to purchase excess emission credits from other manufacturers in order to offset the excess debits represented by noncompliance. (Under the proposed terms, the penalty charges would all go into the General Fund, and associated emission debits would be liquidated.)

(Kenneth Johnson)

Agency Response: The proposed regulatory language in Section 1961.1 pertaining to the noncompliance penalty is based on the language used to apply Section 43211 of the California Health and Safety Code to California’s LEV II program. Section 43211 of the California Health and Safety Code allows penalties to be imposed on new motor vehicles that do not meet applicable California emission standards. However, under the LEV II program a manufacturer may certify vehicles to a number of different emission standards, provided that each year a progressively more stringent fleet average NMOG requirement is met. Because there are multiple sets of emission standards to which a manufacturer may certify its vehicles, it was not practical to base noncompliance penalties on compliance with actual emission standards. Rather, it was more appropriate to base noncompliance penalties on manufacturers’ compliance with the fleet average requirement.

The greenhouse gas regulations are similar in structure to the LEV II regulations, in that each manufacturer must demonstrate compliance with a progressively more stringent fleet average requirement, rather than individual vehicle emission standards. Consequently, the methodology used to calculate noncompliance penalties for the greenhouse regulations is the same as that used for LEV II. In preliminary assessments of the possible penalties that could be assessed under the program, staff determined that the penalties faced by manufacturers could run into the millions of dollars.

While the commenter claims that this methodology is insufficient to deter noncompliance and that noncompliance penalties should “ideally be indexed to vehicle and/or fuel prices to accommodate inflation,” he did not suggest a practical alternative methodology that would address his concerns. It is, therefore, not possible to evaluate the appropriateness or feasibility of this suggestion.

Finally, as mentioned in the commenter’s letter, Section 43211 of the California Health and Safety Code stipulates, “Any penalty recovered pursuant to this section shall be deposited in the General Fund.” The specificity of this language clearly precludes the Air Resources Board from using these penalty charges for other purposes.

547. Comment: All the staff's work is based on the assumption that the fuel economy benefits result from people driving just like the CAFE test procedures. And your staff knows from work we've done for the staff in the past that is not the way people drive in California. They drive much more aggressively, much harder acceleration rates, much higher speeds. And the benefits of many of these technologies are much less in real driving.

There's another problem related to benefits that are calculated for the regulation that comes from the fact that all of the staff's calculations are based on modeling that was done using the official test procedures for the corporate average fuel economy testing, the EPA city cycle and the EPA highway cycle. The problem with using those cycles is that they no longer represent the way people are driving in California. They were developed, in the case of a city cycle, over 30 years ago, in the case of the highway cycle, 30 years ago. And that's not the way people are driving these days.

Average California driving is different. But more importantly, the fuel economy improvement associated with many of the technologies that the staff evaluated is different on the actual driving patterns than on these official test procedures.

The EPA city cycle or the LA-4 cycle by some people does not reflect the way people are really driving in California urban areas today. This is based on an enormous amount of data collection that we have done since the early 1990's. We developed cycles for your staff back in 1992 that better represents the way people were driving in the early 1990's. We've updated it with this analysis to represent the way people are driving now with a higher speed limit. The last time we did this it was before the change in the 55-mile an hour speed limit. And what it shows is that the speeds that people are driving at and the acceleration rates that they're using are substantially higher than on the official test procedure.

A policy decision was made back in 1974 when this test procedure was developed at EPA to only collect data on the way people were driving in areas where the 55-mile-an-hour speed limit was being vigorously enforced. And so all of the freeway driving came from the State of Ohio, which for the last 30 years has still been enforcing speed limits more aggressively than most other states. And as a result, we have a relatively low speed/highway cycle that's the basis for all the fuel economy testing. Looking at a

composite cycle developed from non-urban driving throughout California, for both northern California and southern California, using data that we've collected for ARB and CalTrans since 1997, there are dramatic differences between the way people are really driving and the kind of cycles that were used to model the benefits of the technologies that the staff looked at. The current cycles, the official cycles, they do a very good job of ranking vehicles in terms of their fuel economy, with few exceptions. If you go to the showroom and you see a vehicle that gets 20 percent better fuel economy based on what's on the window sticker, you can be pretty confident that that vehicle is really going to deliver better fuel economy than the vehicle with the lower rating. But when you start talking about some of the more advanced technologies, the degree of benefit associated with implementing that technology is quite a bit different the way people are actually driving in California these days than what you end up seeing on the cycles that were used by the staff. (Tom Austin, Sierra Research)

Agency Response: As noted in the response to Comment 252, to be consistent with current practice staff relied on the test cycles used to determine compliance with California and federal emission standards. These are the best available source of the needed information.

Staff recognizes that USEPA is currently evaluating changes to the federal test procedures so that they more accurately reflect real world vehicle fuel usage. Preliminary discussions with USEPA indicate that any proposed revisions to the procedures will not result in a significant decrease in calculated fuel usage such that the regulations would not be cost-effective to the consumer.

548. Comment: The California Electric Transportation Coalition (CaETC) supports the Proposed Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, which will be considered by the Board on September 23, 2004.

However, we want to bring to your attention one aspect of the Proposed Regulations that act as a strong disincentive for automakers to bring to market an extremely promising and beneficial technology: grid-connect hybrid electric vehicles (aka, "plug-in" hybrid electric vehicles, or PHEVs).

Under the Proposed Regulation's credit scheme, an automaker gets no credit in the first year of introduction of a grid-connect hybrid vehicle model for the amount of time that the vehicle is running on the clean electric power. In other words, the assumption in this first year of operation is that these vehicles are run on gasoline alone and never plug into the grid. This assumption makes little sense, because consumers will have paid more for this vehicle just because of this "plug-in" feature, and because it is cheaper to use electricity than gasoline. So why has staff proposed to treat these vehicles in this manner? The rationale is that since we have little experience with these grid-connect vehicles and how frequently consumers will plug-in, the first year will be used to measure how much the vehicles are operated on electricity alone, and then this information will be used to give them appropriate credit in the second and subsequent years. But not crediting them for

their actual electricity use in the first year is not right or fair, and is a disincentive to bringing this technology to market.

We understand staff's concern about the need to accurately measure the electric fraction of vehicle operation for these grid-connect vehicles. We do not object to the data gathering phase in the first year of introduction. But we do think that once this electric fraction is determined from this first year of data, then automakers should get credit for that first year.

CalETC offers three possible alternative solutions to this issue:

1. In the second year of operation, after the data from the first year of operation has been evaluated, automakers should get credit for the measured electric fraction of driving for the second year and an additional amount equal to the fraction from the first year. So the automaker still gets no credit in the first year, but gets credit in the second year of operation for the first and second year combined.
2. Use the best available technical information to estimate the electric fraction in the first year; make it a conservative value if necessary. A 2001 report from the Electric Power Research Institute cites a Society of Automotive Engineers analysis using the 1995 National Personal Transportation Survey that calculated the percentage of time that a grid-connect hybrid with 20 miles of all-electric range would be operated on electricity: 39%. This figure, or a more conservative one, could be estimated for the first year of operation and then adjusted based upon the actual data evaluated in the second year.
3. Retroactively re-calculate an automaker's fleet average for the first year based on the information evaluated in the second year.

In conclusion, we urge you to correct this disincentive for the production of grid-connect hybrid electric vehicles, and then to adopt the modified Proposed Regulations to Control Greenhouse Gas Emissions from Motor Vehicles. (Dave Modisette, California Electric Transportation Coalition)

Agency Response: Staff agrees with the commenter, and the staff proposal has been modified accordingly to allow a manufacturer to earn credit for the first model year in which a grid-connected hybrid (i.e., plug-in hybrid) is produced and sold in California. Specifically, a manufacturer will be allowed to estimate the sales and percentage of total vehicle miles traveled at the time of certification in lieu of providing actual data. The manufacturer will then be required to provide to ARB final sales data and data demonstrating the percentage of total vehicle miles traveled using electricity by no later than March 1 of the calendar year following the close of the applicable model year. The March 1 date was chosen to be consistent with the date when manufacturers are required to provide to ARB final vehicle sales data for a model year.

549. Comment: There is one small aspect of existing regulations that we would urge you to correct. Existing regulations contain a disincentive for what we think is an

extremely promising new vehicle technology – plug-in hybrids. The disincentive in the regulation is that in the first year of model introduction the vehicle -- or the automaker, gets no credit for the actual amount of time that the vehicle's operated on the grid-supplied electric power. We agree with a need to accurately determine the percentage of time the vehicle is actually operated on electricity. We have no objection to that. And we don't object to using the first year of that model introduction to actually collect the -- collect the data. But once that data is collected and evaluated, in the second year we believe that auto makers should be credited with this amount of time for the first year operation of that vehicle on the grid-supplied electricity. (Dave Modisette, Executive Director, California Electric Transportation Coalition)

Agency Response: See response to comment 548.

550. Comment: Given the tremendous potential of this technology, we are very concerned about several barriers included in the proposed regulatory language. First, it does not guarantee that an automaker will ever receive credit for the electricity use in a plug-in hybrid, even after submission of verifying data. As written, the regulation only says that an automaker *may* receive credit for use of alternative fuels in dual fuel vehicles, but leaves this determination up to the Executive Officer.

Bluewater Network's attorney has determined that this is a critical barrier to implementation of these vehicles. Before investing millions of dollars into a new technology, automakers must have certainty that they will receive appropriate credit.

The other critical barrier is the act that plug-in hybrids will receive no credit for emissions reductions as a result of electricity use until model year 2010—the second year of the program. In year one, automakers would only get credit for gasoline, the more polluting fuel. This is a further disincentive to the production of plug-in hybrids.

We also believe that there is inadequate justification for requiring manufacturers to employ the alternative compliance pathway for plug-in hybrid technology instead of the main compliance pathway that is afforded other vehicles whose actual use of alternative fuels is unquestioned, such as dedicated LPG and CNG vehicles. Unlike other flexible or dual-fuel vehicles, where fueling behavior is hard to predict or monitor, we believe it is possible to determine with sufficient accuracy the percentage of time that consumers would plug these vehicles into the electricity grid. Providing a direct compliance credit in the main pathway for this electricity use would give automakers much more incentive to build these vehicles. An additional suggestion is that if automakers are able to prove electricity use beyond the automatic credit, they could apply for additional credit through the alternative compliance pathway. (Elisa Lynch, Bluewater Network)

Agency Response: See response to comment 548. Regarding the use of “may” versus “shall,” staff agrees with this comment. The regulation was modified accordingly in the first 15-day notice of modified text.

551. Comment: I'm concerned that PHEVs may continue to be overlooked. Over a car's lifetime PHEVs save money. PHEV area highly effective solution for global warming and people will buy these much better cars. (Felix Kramer, California Cars Initiative)

I wanted just to echo the comments made on plug-in hybrids that were made by two of the previous speakers. (Dr. Russell Long, Executive Director, Bluewater Network)

Agency Response: ARB recognizes that grid-connected hybrids (or plug-in hybrids (PHEVs)) can provide worthwhile greenhouse emission benefits. So the regulations include two provisions to encourage the sale of these vehicles in California. A manufacturer may earn credit for the first year in which a grid-connected hybrid is sold (See response to comment 548). In addition, another change to the originally proposed regulations will allow a manufacturer to use a lower upstream emission factor for the electric portion of the vehicle miles traveled than the factor included in the regulations if the manufacturer demonstrates that a lower number is warranted.

552. Comment: Additional emphasis in incentives could also be provided for more aggressive introduction of lower emitting greenhouse gas vehicles such as the plug-in hybrids that have already been mentioned. (Larry Allen, Air Pollution Control Officer for San Luis Obispo County, representing the California Air Pollution Control Officers Association)

Agency Response: See response to comment 551.

3. Legal Comments

a. Issues of California Law

(1). Requirements of the Administrative Procedure Act

553. Comment: Given the complexity and importance of the rulemaking, it is questionable whether the formal comment period provided would have been adequate under any circumstances. Alliance (Appendix H).

Agency Response: The commenter implies that the formal comment period required by the Administrative Procedures Act (APA) was inadequate. However, the commenter neglects to note that, pursuant to Government Code §11346.45, and consistent with other complex ARB rulemakings, staff provided the public, including this commenter, with multiple opportunities for comment and input during the two years of regulatory development preceding the 45-day notice. The multiple workshops and informational Board meetings were referenced in the staff presentation at the September Board hearing, and included the following:

- September 26, 2002 Informational Board Meeting
- December 3, 2002 Workshop (Emission Inventory)
- March 11-13, 2003 International Vehicle Technology Symposium

- September 18, 2003 Workshop (Standards, Economics)
- October 14, 2003 Workshop (Alternative Compliance)
- November 20, 2003 Informational Board Meeting
- February 18, 2004 Workshop (Environmental Justice)
- April 20, 2004 Workshop (Technology Assessment)
- July 6, 2004 Workshop (Environmental Justice)
- July 7, 2004 Workshop (Draft Staff Report)
- July 8, 2004 Workshop (Environmental Justice)
- July 13, 2004 Workshop (Environmental Justice)

Unlike previous complex rulemakings, the commenter and its member companies took little advantage of these opportunities, which the Board duly noted at the hearing. See e.g. September 24, 2004 Transcript at pp. 120-121.

554. Comment: The public has not been provided the mandatory minimum 45 days to review the cost analysis on which the staff is relying to support its recommended action. During the 45 day period certain material was omitted from the rulemaking file, there was an informal “updating” of the ISOR’s cost and benefit estimates, and an “Addendum” and “Review” document was added. Alliance (Appendix H).

Agency Response: As an initial matter, it is obvious from the structure of Government Code §11347.3(b) that not all of the rulemaking file items listed therein will be available at the commencement of the 45-day comment period cited in §11347.3(a). See e.g. §11347.3(b)(6) (“...written comments submitted to the agency in connection with...the regulation” as cited by the commenter), and §11347.3(b)(8) (the hearing transcript).

In addition, the commenter cites Government Code section 11347.1 for the proposition that what the commenter calls “supplementation” of the record cannot occur during the 45-day period but must occur after the public hearing. This is quite odd, as it presupposes that the initial decision-maker—here the Board—and the public would be better served by keeping known errors and potentially responsive corrections thereto from review until a later 15-day comment period following the public hearing. We do not read the APA as requiring such an absurd result. In any event the “supplemental” material cited received the required further 15-day comment period before final adoption of the proposed action on August 4, 2005.

The ARB did ensure that all information on which the proposal was based was available for review at the commencement of the 45-day period. The ISOR lists 82 references used to support the proposal, none of which the commenter alleges was unavailable. Rather, the commenter alleges that one item – a draft doctoral dissertation – was unavailable until September 2, 2004. While ARB concurs that this was the case, this item was not among the listed References and was not a basis for the proposal. Rather, it was listed in a

technical support document as one reference for the CARBITS model, which in turn was in the “Other Considerations” portion of the ISOR and not foundational to the proposal. See response to comment 420; see also page 171 of the ISOR. As the commenter states (Appendix H, Exhibit 1, Macomber Declaration, p. 2), this one item was already the subject of a previous Public Records Act request; ARB went beyond its Public Records Act duties in responding to that request by seeking and obtaining a copy for the commenter’s consultants. This one item and its use in this rulemaking thus comes nowhere close to the level of “privately acquired data” (*California Optometric Association v. Lackner* (1976) 60 Cal.App.3d 500 at 510) that could render the Board’s decision procedurally suspect.

What the commenter characterizes as a late-published September 22 “Review” document was simply the results of the peer review process mandated by Health and Safety Code section 57004 and not a document requiring review under the APA. This review, like the draft doctoral dissertation above, was not published as support for or a basis of the regulation, but rather to fulfill the peer review requirements. Those requirements do not place a specific time frame on public availability of the peer reviewers’ comments or staff’s responses. Rather, those requirements would have prohibited the Board from adopting the regulation if a peer reviewer found that the Board failed to demonstrate that a scientific portion of the proposed rule is based upon sound scientific knowledge, methods, and practices, and the Board had not responded to that finding. Health and Safety Code §57004(d)(2). No reviewer made such a negative finding. See Peer Review Comments and Responses, September, 2004, p. ii.

Regarding what the commenter characterizes as the informal “updating” of the ISOR’s cost and benefit estimates, it is true that during the 45-day period, in response to comments from this commenter’s consultants, the Board released to those consultants revised cost estimates that affect several tables in the ISOR. (Contrary to commenter’s footnote 14 see August 16, 2004 email exchange between Tom Austin (Sierra) and Paul Hughes (ARB)). As stated in releasing an addendum reflecting those changes on September 10, 2004, the revisions supplemented but did not alter the fundamental conclusions presented in the ISOR. As a result, the addendum did not change the proposed regulatory text. If we were to take this comment at face value, the ARB could never accept and respond to negative comments in a way that questioned assumptions contained in the ISOR. To do so would risk restarting the 45-day clock once, twice, or ad infinitum. This makes no sense, and would do violence to the function of the APA, i.e., to take and respond to comment within a defined period. See the observation in *Rybachek v. U.S. EPA* (1990) 904 F.2d 1276, 1286 “...either the comment period would continue in a never-ending circle, or, if the EPA chose not to respond to the last set of public comments, any final rule could be struck down for lack of support in the record” [citations omitted].

Alternatively here, staff arguably could have responded to the commenter’s comments as a report to the Board at the hearing, providing the commenter and the public with only a 15-day comment period per Government Code §11347.1. Instead, staff quickly examined errors brought to its attention, ensured that revised information was as correct and complete as possible, relayed that information to the commenter, and sought additional public comment on the revised information as far in advance of the hearing as possible.

The public (including this commenter) then had an additional, formal 15-day comment period, and as a practical matter had nearly an additional month between the end of the hearing on September 24, 2004, and the start of that 15-day comment period on October 19, 2004. The revised estimates were thus subject to nearly two months of public review; even more for the commenter. This comports with both the letter and the spirit of the APA. See also *Western Oil & Gas. Assoc. v. Air Resources Board (WOGA)* (1984) 37 Cal.3d 502 at 526 (holding pre-Gov. Code Section 11346.7 APA allowed four-day period to review and comment on a full staff report developed for a complex ARB rulemaking.)

555. Comment: The staff report claims support from other studies and evidence that have not been placed in the rulemaking file or identified with sufficient specificity to permit public review. Alliance (Appendix H).

Agency Response: The ITS work that the commenter mentions was not drawn on for staff's development of the regulation or the related assumptions (e.g., assumptions related to cost pass-through). The ITS work is briefly mentioned in the ISOR and technical support document in a supplemental fashion under "Other Considerations." Staff was hopeful that the ITS reports would provide considerable insight on the behavior of the automotive industry that would in turn help with its analysis. However, the reports were not sufficiently quantitative to rely on for staff's development of the regulation and were therefore not relied on for the development of the regulations including the proposed standards, estimated costs of regulation, impacts on vehicle pricing, pay-back periods, etc. At most, staff's brief review of these reports "...help put the economic impact analysis into perspective." ISOR p. 191. See also the response to comment 482.

Even if one could find that the ITS work was more than a tangential reference, the ITS documents were subject to additional public comment per Government Code §11347.1. See Attachment II to 15-day Notice, items 11-16.

With respect to the existence of more than one version of the document, ARB staff provided industry with different versions of the draft reports as they became available. Again, providing such draft reports was arguably not required under the Public Records Act, but was provided anyway to this commenter. It is not unusual for contractors to make revisions to the draft with the intent of improving the document. In any event, the commenter had and exercised the opportunity to comment during the 45-day comment period on what it perceived to be the shortcomings of at least the draft version as a potential basis for the regulations, though for the above reasons these comments are largely irrelevant.

Finally, it was entirely appropriate to base much of ARB staff analysis of technology costs and controls upon the draft NESCCAF study cited by the commenter. See Agency Response to Comments 150 and 228. Given the sheer volume and depth of comments on this topic (see comments and responses 207 through 242), clearly this commenter had more than enough information to determine the basis of ARB's cost estimates. Any argument to the contrary goes solely to the sufficiency of evidence in the record to support the adopted regulations, not to whether ARB had an obligation under the APA to obtain

and provide all data on which that draft study relied, or in turn upon additional data on which that data relied, etc. To rely in part on outside experts' results that in turn were based on the foremost consultants to the auto industry comes nowhere close to an improper delegation of power. Instead, staff here properly exercised its judgment to conclude that the NESCCAF study results were reliable.

556. Comment: A postponement of the public hearing is reasonable and consistent with the legislative rulemaking schedule, and essential to comply with the APA. Alliance (Appendix H).

Agency Response: Postponing the hearing was not essential to complying with the APA. First, the commenter cites no APA provision requiring requests for postponement to be granted, and we find none. Second, the ARB did carefully evaluate the commenters' two such requests, and though not specifically expressed in our responses, given the minimal time remaining after September 24, 2004 to process at least one period and potentially more 15-day change comment periods, postponement could easily have rendered impossible ARB's ability to meet its January 1, 2005 statutory deadline.

Finally, there is no question here that ARB did consider all relevant matter, including negative evidence provided by this and other commenters – including comment on the “Addendum” and “Review” documents of concern – before taking final action to adopt the regulations by Executive Order G-05-061. This is entirely consistent with the APA, since “to restrict the agency to evidence produced at the time and place specified in the public notice would generate undesirable inflexibility.” *California Optometric Association v Lackner*, 60 Cal.App.3d 500, 508 (3rd Dist. 1976).

(2). Requirements of the California Environmental Quality Act

557. Comment: CEQA applies to this rulemaking. Alliance (Appendix H).

Agency Response: The ARB agrees that the California Environmental Quality Act applies to this rulemaking.

558. Comment: The 1978 program certification does not apply to this rulemaking. Alliance (Appendix H).

Agency Response: The ARB disagrees, and finds that the Certified Regulatory Program granted by the Resources Agency in 1978 applies to this rulemaking.

First, contrary to the commenter's assertion, this rulemaking furthers the protection and enhancement of ambient air quality in California. The staff analysis shows that there will be a positive impact on criteria pollutant emissions in California. See Addendum pp. 17-18 and Resolution 04-28 p. 14, findings.

Second, the rulemaking will reduce California's passenger vehicle contribution to global greenhouse gases. This reduction will have a small but measurable effect on lowering

global greenhouse gas emissions. See Agency Response to Comment 95. Combined with greenhouse gas reductions from vehicles sold in other states likely to adopt California's standards under Clean Air Act §177, and potential reductions from the federal fleet, it is clear that directionally the reductions in greenhouse gases achieved by this rulemaking are likely to reduce temperatures in California to some extent, however small, and will therefore help improve ambient air quality by reducing the frequency and severity of ozone episodes and resulting health impacts.

Finally, even if this rulemaking were not considered sufficiently related to ambient air quality, "it appears the Legislature intended a state agency's certified regulatory program to remain in force notwithstanding subsequent additions and amendments to the program, unless and until the Secretary withdraws certification." *Mountain Lion Foundation v. Fish and Game Commission*, 16 Cal.4th 105, 128 (1997) (holding endangered species delisting decision covered within program certified before California Endangered Species Act enacted). This is further supported by the placement of new Health & Safety Code section 43018.5 within the other mobile source authority sections in Part 5 of Division 26, and the cross-reference in that section (§43018.5(e)) to the Board's existing passenger vehicle regulations. Against this textual placement, there is nothing in the text of AB 1493 to indicate that the Legislature intended these regulations to be subject to any environmental review beyond the Certified Regulatory Program that has governed ARB's mobile source rulemaking for over 25 years.

Further support is provided by legislation enacted subsequent to certification of ARB's regulatory program. For example, expansion of ARB's authority of toxic air contaminants (see e.g. Health & Safety Code section 39667) in 1983 simply specified additional contaminants for ARB to control. Though these air toxic contaminants – like greenhouse gases – are not criteria pollutants for which ambient air quality standards are established, there has been no question that ARB rulemakings to control air toxics also fall under its Certified Regulatory Program. Given this evolution of ARB's regulatory program, the focus of the Certified Regulatory Program is more properly ARB's mobile and other source control program as a whole. Greenhouse gases are simply additional air contaminants (defined at Health & Saf. Code section 39013) that the Legislature has required ARB to regulate within its longstanding passenger vehicle regulatory program.

559. Comment: If the 1978 certified program rules applied to this proceeding, the current process and the record would not comply with CEQA and ARB's Title 17 regulations because it fails the analytical requirements under the Board's CEQA Regulations. ARB cannot make a negative declaration because the record contains credible cost estimates different from ARB's, and because the CARBITS model predicts increased criteria pollutant emissions. Therefore, ARB must consider and approve feasible alternatives or mitigation measures, like those contained in the commenter's principal comments. Alliance (Appendix H).

Agency Response: This comment reflects a misunderstanding of the Board's obligations under its certified regulatory program. The commenter argues that because they have introduced certain evidence into the record, there exists a "fair argument" of a significant

adverse environmental impact, and therefore an EIR or its certified program equivalent must be prepared. Even if this were true, the ARB has satisfied this requirement by following its Title 17 regulations to prepare a staff report, which, under its Certified Regulatory Program, serves as the functional equivalent of an environmental impact report (EIR). ARB is not here adopting a negative declaration or functional equivalent thereof, and is not asserting that doing so would satisfy its CEQA obligations.

We assume that the potential adverse environmental impacts of concern to the commenter are the adverse emissions impacts claimed to result from the “fleet turnover effect” and the “rebound effect.” We believe that the discussion in Section 12.0 of the ISOR and its Addendum – and its reference to and reliance on the CARBITS model, rebound effect, and Fuel Cycle Benefits – together satisfied the ARB’s obligations to consider the potential adverse emissions impacts resulting from the fleet turnover effect. That Section of the ISOR (III.A.2.i(3)) estimated the potential overall emissions impact of the staff’s proposal, and expressed the staff’s conclusion that the fleet turnover effect will play a minimal role under the staff proposal. The principal economic and feasibility analysis used for this and countless previous ARB regulations find no fleet turnover effect, where as here increased costs are absorbed into already rising new vehicle costs.

While the “fair argument” principle is relevant to determining what claimed adverse environmental impacts need to be fully analyzed by an agency operating under a certified program, it is not relevant to the question of what feasible mitigation measures and alternatives may need to be considered once the agency has determined whether the proposal will result in significant adverse environmental impacts. After extensive analysis – both in the ISOR and Addendum and in response to significant environmental issues raised (see e.g. Agency Response to Comments 418 through 477) the ARB has determined that the combined effects from fleet turnover, rebound, and upstream emissions will not cause the greenhouse gas regulations to result in adverse emissions impacts. See Response to Comments Raising Significant Environmental Issues, Executive Order G-05-061, Attachment 3.

As a result, the Board is not obligated to identify or implement feasible mitigation measures or alternatives. The commenter seems to argue that the identification and implementation of such measures and alternatives is required where a party has made a “fair argument” that there could be adverse impacts, despite the agency’s environmental analysis and conclusion that these adverse impacts will not occur. CEQA imposes no such requirement.

560. Comment: Regardless of the time limits specified for rulemakings under the general terms of the APA, CEQA requires an additional 30-day comment period if any “significant” changes occur after the initial comment period is completed. (Citations.) Alliance (Appendix H).

Agency Response: This comment does not identify the significant changes or new information added for which ARB has allegedly failed to provide a 30-day comment period. More importantly, this comment was submitted before the initial public comment period

and hearing was completed, so the comment appears not to apply to this rulemaking. In addition, the asserted 30-day comment period applies only to draft EIRs and negative declarations, not to the 45-day and 15-day comment periods that are the only comment periods provided under and required by ARB's certified regulatory program. Even if the 30-day comment period did apply, the initial environmental analysis in the ISOR and the subsequent Addendum were subject to 45 and 30 days of formal comment, respectively. And as a practical matter, the commenter had additional weeks to consider the Addendum for comment; see Agency Response to Comment 554.

561. Comment: If the 1978 certified program rules applied to this proceeding, the current process and the record would not comply with CEQA and ARB's Title 17 regulations because it fails the procedural compliance requirements of delegation. The Board is the decision maker under CEQA, and must respond to comments in writing before approving the project. Alliance (Appendix H).

Agency Response: Under Health and Safety Code sections 39515 and 39516, any authority the Board has may be delegated to the Executive Officer, and any authority that may be delegated is to be conclusively presumed to have been delegated unless the Board reserves the power to itself in writing.

The Board's regulation on responses to environmental assessments – section 60007(a), title 13, CCR – provides in part:

(a) If comments are received during the evaluation process which raise significant environmental issues associated with the proposed action, the staff shall summarize and respond to comments either orally or in a supplemental written report. Prior to taking final action on any proposal for which significant environmental issues have been raised, the decision maker shall approve a written response to each such issue.

In Resolution 04-28, the Board made clear that it was “initiating steps towards final adoption,” “subject to further environmental analysis.” It then directed the Executive Officer, after going through the “15-day notice” supplemental comment process, to:

then take appropriate final action with the adoption and amendments in this rulemaking, after preparing a written response to all comments received that have raised significant environmental issues, and assuring that all feasible mitigation measures or feasible alternatives available that would substantially reduce any significant adverse environmental impacts have been incorporated into the final action.

The Executive Officer took final action modified amendments by issuing Executive Order G-05-061. Attachment 3 thereto consisted of an ARB Staff Response to Comments Raising Significant Environmental Issues Regarding the Proposed Rulemaking to Adopt Motor Vehicle Greenhouse Gas Regulations. In the Executive Order, the Executive Officer expressly approved each of the written responses in Attachment 3.

The Board, in implementing its own regulation, clearly intended that the Executive Officer would be the ultimate decision-maker in this rulemaking. Section 60007(a) refers to final action by “the decision maker,” not by “the Board.” Under these circumstances, adoption of the Executive Order by the Executive Officer – after approving the responses to environmental issues – accordingly constitutes final action by the decision-maker consistent with the ARB’s regulation.

562. Comment: If the 1978 certified program rules applied to this proceeding, the current process and the record would not comply with CEQA and ARB’s Title 17 regulations because it fails the procedural compliance requirements of consultation and timing. ARB was required to consult with state and federal agencies, such as the California Highway Patrol (CHP) and the National Highway Traffic Safety Administration (NHTSA). Alliance (Appendix H).

Agency Response: Neither CHP nor NHTSA have jurisdiction by law over the proposed activity, here reducing greenhouse gas and other emissions from motor vehicles. Neither do those agencies have authority over air as a resource.

CHP does have jurisdiction over those aspects of the Board’s program that affect enforcement of motor vehicle regulations, as provided in Appendix B of the CEQA Guidelines cited by the commenter. The Board regularly consults with CHP concerning proposed ARB regulations that may impact CHP’s enforcement resources. Here, however, there was no reason to believe that in proposing regulations to control greenhouse gases – which require manufacturer certification with ARB, but which neither require nor provide for any CHP enforcement role – that CHP should be consulted. Similarly, whatever role NHTSA may have concerning traffic safety and fuel economy, there was no reason to consider consulting NHTSA concerning a regulation that targets greenhouse gas emissions, which are not under NHTSA’s authority.

563. Comment: If the 1978 certified program rules applied to this proceeding, the current process and the record would not comply with CEQA and ARB’s Title 17 regulations because it fails the procedural compliance requirements of timing. ARB has not provided a 30-day comment period for CARBITS, cost and price estimates loaded into CARBITS, CARBITS outputs, the method by which CARBITS cost inputs were developed, or the staff report “Addendum” published September 10, 2004. Alliance (Appendix H).

Agency Response: The ARB disagrees with this comment, as ARB fully complied with both the letter and spirit of the APA and CEQA in this rulemaking. As an initial matter, the asserted 30-day comment period applies only to draft EIRs and negative declarations, not to the 45-day and 15-day comment periods that are the only comment periods provided under and required by ARB’s certified regulatory program. Even if the 30-day period did apply, the commenter was provided with a 45-day period to comment on the initial environmental review provided in the staff report. This included, for CARBITS, the Technical Support Document on Other Considerations, released in August 2004, containing a 34-page Appendix that describes CARBITS in considerable detail. The

Appendix explains, among other things, how CARBITS takes input and produces output. Section 12.1.B. of the ISOR explains that the price increases used in the CARBITS scenario are set equal to the cost increases for the technologies reported in Section 6 of the ISOR.

A full 30 days of formal comment period was provided for the Addendum, and as a practical matter the commenter had additional weeks to consider the Addendum for comment. (See Agency Response to Comment 554.) This included revised-Table 12.1-2 of the Addendum, which reports the price increases used in the regulation scenario for CARBITS. The text just above the revised table explains how the cost inputs were developed. Revised-Table 12.1-3 shows how the price increases compare to the baseline prices. Revised-Table 12.1-6 and Revised-Table 12.1-7 of the Addendum report the CARBITS output.

564. Comment: With respect to the substance of the analysis under CEQA, the Alliance believes that the Board must address the effects of the proposed rule on motor vehicle safety. Alliance (Appendix H – Attachment).

Agency Response: The ARB disagrees that CEQA requires the Board’s rulemaking to analyze potential effects on motor vehicle safety. The CEQA Guidelines make clear that a “significant effect on the environment,” i.e., the effects that ARB must analyze under its certified regulatory program (see 17 CCR §60005(a)), are those that could result in a substantial adverse change in any of the physical conditions within an area affected by the project. 14 CCR Sections 15382, 15360, 15358. Motor vehicle or traffic safety in the CEQA context typically concerns changes in physical conditions such as increases in traffic, air pollution, danger to pedestrians, lack of sight distance, or physical obstructions or obstacles. CEQA is concerned with the health and safety problems caused by such physical changes. 14 CCR Section 15126.2(a). Even assuming that the type of safety impacts that the commenter suggests were reasonably foreseeable (though ARB views these as speculative at best and therefore not requiring analysis (14 CCR §15064(d)(3) – see Agency Response to Comments 254 and 329) such impacts would not even rise to the level of an indirect impact that would require CEQA analysis (14 CCR §15064(d)(2)) because they are not a physical change. 14 CCR Section 15358(b).

Nevertheless, as cited above, the Board did respond to safety concerns elsewhere in this FSOR pursuant to its responsibilities under the APA. See also Agency Response to Comment 562.

(3). Special Requirements for Greenhouse Gas Rulemaking under AB 1493

565. Comment: The Executive Officer has not demonstrated the feasibility and cost-effectiveness of the proposed rule. To do so requires the regulations to meet four mandatory feasibility factors – environmental, economic, social and technological – while the standard-setting process here focused almost exclusively upon technological feasibility and the cost to the owner. The normal analytical tools that ARB can use in motor vehicle emission regulation do not apply to rulemaking under AB 1493. Alliance (Appendix H).

Agency Response: The ARB disagrees with this comment, as it misreads the plain language of the statute and unnecessarily resorts to legislative history.

The environmental, economic, social, and technological factors cited by the commenter are not four separate tests, as the comment implies. Rather, they are factors to be considered in determining whether the reductions meet the predicate test of “capable of being successfully accomplished within the time provided in this [43018.5] section.” See Health & Safety Code Section 43018.5(i)(2)(A). The quoted phrase does indeed track closely with longstanding grants of authority to ARB to adopt technologically feasible standards and regulations. See Health & Safety Code Sections 43101, 43013, 43018. These grants have long been considered analogous to the federal charge to set limits that take effect after a period “necessary to permit the development and application of the requisite technology.” Clean Air Act §202(a)(2). These tests of technological feasibility have in turn often considered economic (e.g. effects on engine manufacturers and others), environmental (e.g. effects on other pollutants and other media), and even social factors (e.g. consumer response to changes in compliant products’ attributes.) The Board therefore does not believe that this rulemaking is subject to the fundamentally different analysis suggested in the comment. The ARB believes it gave proper consideration to the cited factors, in many cases using the cutting edge of available analytic techniques, as detailed in response to more specific comments on those factors, below. And there is nothing in the statute suggesting how each of these factors should be weighed.

However, the Board does agree that the “economical to the owner...” criterion (HSC §43018.5(i)(2)(B)) represents a more significant variation on ARB’s usual standard-setting criteria. Previous grants of authority to ARB and standards and regulations adopted thereunder have in a sense assumed only that manufacturers would be able to either absorb cost increases for technologies meeting those standards or regulations or to pass on part or all of those costs to consumers. This statute requires something more, or at least describes the test differently – that the regulations reducing greenhouse gas emissions are “economical” to the end-user, taking into account the full life-cycle costs of a vehicle. As exhaustively explained in Section III.A.2.c(5) of this FSOR and below, the Board believes the adopted standards meet that test.

566. Comment: Lead-time is inherent to any assessment of technological feasibility and is scarcely discussed in the August 6 staff documents. Staff have indicated that 36-months of lead time is sufficient for compliance beginning with the 2009 model year. This represents an overly optimistic view of the technological improvements needed, is not supported by any evidence in the record, and is inconsistent with industry conditions. The Executive Officer must follow a more systematic analysis, an example of which we have outlined, to enable Board, Legislative, and court review. Alliance (Appendix H).

Agency Response: The ARB agrees that an assessment of lead-time is inherent to assessing technological feasibility. That is why the staff report devoted its largest chapter (ISOR, Chapter 5, pp. 42-102), and numerous voluminous references, to an analysis of the technologies that could be available to meet emission reduction standards beginning in

2009. See also FSOR section III.A.2.c. The 2009 standards assume that not all technologies will be available in sufficient quantity in 2009, and the standard is set accordingly modestly. In addition, trading provisions plus the additional years before compliance is measured and equalized in 2012 again ensure a gradual phase-in of technologies. This certainly constitutes substantial evidence supporting a 36-month lead time for the standards as a whole.

More importantly, lead time is traditionally needed to develop and apply new, projected technologies, which for the most part are not at issue here. But to the extent the 2009 standard requires the use of at least some technologies that require substantial further planning and development, it is appropriate for the standards to push such technologies to fruition earlier than what might otherwise occur. This is not being “overly optimistic” but rather is the essence of ARB rulemaking.

567. Comment: Consideration of environmental factors rules out the “feasibility” of any greenhouse gas regulation that would cause an increase in the emission of criteria pollutants. Alliance (Appendix H).

Agency Response: This comment is arguably irrelevant because the Board finds there will be no net increase in any criteria pollutant as a result of this regulation. See ISOR Section 11.3 and Addendum, p. 18. , Executive Order G-05-061, and Attachment 3 thereto. See also the general consideration of environmental impacts in Section 8 of the ISOR and Addendum.

Nonetheless, the Board believes that in harmonizing the Legislature’s separate charges to reduce greenhouse gas emissions and other air contaminants, each to the maximum extent feasible, it could adopt a regulation allowing a slight criteria pollutant impact in exchange for substantial greenhouse gas reductions. In fact, the Board has for many years weighed and balanced potentially competing proposals that would reduce certain pollutants at the expense – (and this to a certainty, as opposed to a risk that ARB here disagrees exists) – of increasing others. For example, the Board resolves the continuing tension between “maximum possible reduction in public exposure to toxic air contaminants” (HSC §39667) versus its charge to achieve the “maximum degree of emission reductions” (HSC §43018(a)) of what the commenter describes as smog-forming pollutants. The historical trade-off between NOx and hydrocarbons is a more obvious example. The Board thus has and has exercised considerable discretion in interpreting such statutory phrases. Exercising that discretion here for greenhouse gases would be no different than the many times the Board could arguably have adopted more or less stringent standards, but chose not to due to cost, technological feasibility, consideration of other pollutants, or other factors.

568. Comment: Consideration of social and economic feasibility requires ARB to establish a total cost for the regulations, which must include consumers’ opportunity costs from being unable to purchase a vehicle with features they would have desired more. The history of fuel economy regulation demonstrates that there is a clear limit on the welfare trade-offs consumers are willing to endure in the service of increased fuel economy.

Consumers demand safety, performance, capacity, comfort and aesthetics, and these are not analyzed. Alliance (Appendix H).

Agency Response: The comment cites no authority for its interpretation of the terms “social” or “economic” with regard to feasibility, and instead combines the two terms and develops its own preferred economic theory which it considers mandatory. On the other hand, the Board has made a reasonable interpretation of these two terms by considering a multitude of economic and social criteria. See Section 12 of the ISOR and its Addendum. In addition, the staff analysis concludes that the consumer demands cited can be met, without the need for trade-offs. Finally, the ARB does not believe it is appropriate to directly compare prior federal experience with fuel economy measures with ARB’s experience with emission reduction measures like this one.

569. Comment: The proposed regulations do not pass the statutory test for cost-effectiveness because they do not pass that test using any plausible set of estimates for the following factors: (1) the private discount rate of California drivers for fuel savings; (2) representative driving cycles; (3) the need to operate the new vehicles required by this rule on high-octane gasoline; (4) retail prices based upon realistic costs. Alliance (Appendix H).

Agency Response: This comment assumes that its interpretation of the term “cost-effectiveness” (which it equates to “economical to an owner or operator of a vehicle” despite lack of that specific link in the statutory text) requires analysis of the four cited factors, in the manner suggested in the comment. However, ARB has interpreted cost-effectiveness to mean a simple calculation, comparing the increased costs of technology improvements needed to meet the standard against consumers’ operating cost savings over the full life-cycle of the vehicle. See Section 9 of ISOR and Addendum. There is nothing in the statutory text to even suggest that the Board’s method is inappropriate.

In addition, elsewhere in this FSOR staff responds to each of these factors. See Agency Response to Comments 243 through 284. Further, the Board received information that using the cited factors would make little net difference. See September 24, 2004 Transcript at 89-95.

570. Comment: The proposed regulations do not pass the statutory test for cost-effectiveness because they must demonstrate that reduction of each greenhouse gas is cost-effective, which has not been done for methane, nitrous oxides, upstream emissions, or air conditioning. In addition, AB 1493 does not provide the Board authority over these other greenhouse gases, and even if it did, the Board would have to and did not value reductions in those emissions as beneficial in reducing global warming. Alliance (Appendix H).

Agency Response: There is nothing in the statute to indicate that each greenhouse gas must meet a separate cost-effectiveness test, and the commenter provides no citation or analysis to support this position. Even if such a requirement existed, however, the comment is incorrect. The standard does not assume any reduction in methane or nitrous

oxides. Thus even under the commenter's interpretation there is no need for a cost-effectiveness evaluation for those pollutants. The cost of improved conditioning systems was included in the technology packages used to determine the emission standards, which were determined to be cost-effective as a whole. The commenter's point regarding upstream emissions is unclear. The regulation does not require any reduction in upstream emissions. It provides appropriate credit for any upstream emission reductions due to the use of alternative fuels, but the cost of any such reductions cannot be separated from the cost of the technology itself.

AB 1493 provides ARB with explicit authority to regulate motor vehicles emissions of greenhouse gas emissions other than CO₂. (Health and Safety Code Section 42801.1 list incorporated at Section 43018.85(i)(1)). The climate change benefit of reducing such emissions is inherent in their treatment under the regulation. Emissions of greenhouse gases other than CO₂ are converted to their CO₂ equivalent in calculating the emission reductions used to meet the standard, and thus are granted appropriate credit for compliance purposes.

571. Comment: The proposed rule requires any manufacturer who wishes to remain competitive in the California new-vehicle market to reduce the weight of some or all of the vehicles it sells in California. The Legislature prohibited weight reduction as a compliance. Alliance (Appendix H).

Agency Response: Because AB 1493 specifically prohibits requiring weight reduction, and because the Legislature would be reviewing the adopted regulations, the ARB took great pains to ensure that the regulations do not require any particular vehicle, or any manufacturers' fleet as a whole, to reduce weight to meet the standard. Rather, the ARB analyzed and projected the availability of suites of technologies that could be applied to given weight classes of vehicles. See ISOR Section 5.2 pp. 46-48 and Agency Response to Comments 143 through 242. In addition, ARB does not believe that weight reduction is among the more cost-effective or practical compliance paths. See Agency Response to Comment 254.

It is irrelevant that affected manufacturers, in order to avoid compliance with the regulations and to support their challenge of them, choose to frame their intended compliance path so that they must use a prohibited compliance method that ARB has already shown need not be used. In addition, while AB 1493 does require certain economic analyses, it does not guarantee any manufacturer a specific market share or maintenance of existing competitive conditions, so long as the regulations do not require a ban on any particular vehicle category.

572. Comment: The proposed rule regulates commercial vehicles such as pick-up trucks, sport utility vehicles, vans, and daily rental vehicles weighing less than 8,500 pounds. The Legislature prohibited regulation of such vehicles. Alliance (Appendix H), (GM).

Agency Response: The ARB agrees that the regulation does apply to the listed vehicles, however, such vehicles are not commercial vehicles exempt from AB 1493 regulation, as that term has been historically applied and as the Legislature specified. The regulations are to apply to "...passenger vehicles, light-duty trucks, and any other vehicle determined by the state board to be a vehicle whose primary use is noncommercial personal transportation." Health and Safety Code Section 43018.5(i)(3). Into this the commenter reads a specific prohibition or exemption for any vehicle that is of a type that can be registered commercially. But the statute quoted above says nothing of the sort.

Instead, the statute begins by incorporating two commonly understood terms, "passenger vehicles" and "light-duty trucks." See "passenger car" and "light-duty truck" definitions at 13 CCR Sections 1900(b)(12) and (8), now at 1900(b)(11) and (17), respectively. It then goes further to recognize ARB's ability to make a "primary use" determination to expand the types of vehicles subject to the regulation. That determination, however, is required only for these additional categories; the statute does not require ARB to revisit longstanding definitions (and certifications thereunder) as to what is or is not a passenger car or light-duty truck. Rather, passenger cars and light-duty truck are simply examples of the types of vehicles that are commonly understood to be used primarily for Californians' noncommercial personal transportation, as recognized in the LEV II rulemaking and resulting regulations. In addition, the Legislature was fully aware that some light-duty trucks – those arguably performing primarily a work or commercial vehicle function – should be exempted from regulation under AB 1493. The sole exemption is provided in Health and Safety Code Section 43018.5(e), which the regulations implement at 13 CCR Section 1961.1(a).

Here ARB has made the determination required of it by adding "medium-duty passenger vehicles" to those subject to the regulation. See amended 13 CCR Section 1900(a)(12). And here the Board followed its charge to identify those vehicles with primary use as noncommercial personal transportation by limiting the reach of "medium-duty passenger vehicles" to those "designed primarily for the transportation of persons." *Ibid.* The Board's interpretation follows its current practice of defining light-duty trucks that primarily perform a work or commercial function as trucks that have a carrying capacity greater than 2,500 lbs. Vehicles under 8,500 pounds gross vehicle weight (GVW) meeting this criterion are granted a relaxed oxides of nitrogen (NOx) exhaust emission standard under the LEV II program and are exempted from the greenhouse gas requirements. Maintaining this vehicle classification scheme will also make the mechanics of certification easier for manufacturers by allowing them to submit certification applications meeting both LEV II and AB 1493 requirements, and will streamline staff review and approval to the manufacturers' benefit.

573. Comment: The proposed rule constitutes a de facto ban on medium-duty passenger vehicles, a measure prohibited by the Legislature.

Agency Response: This comment is a more extreme version of other comments concerning the technological feasibility of the regulations. It appears to treat medium-duty passenger vehicles as those that will have the most difficulty meeting the regulations.

Clearly the regulation does not “ban” such vehicles, but instead recognizes the difficulty suggested by the commenter and includes them with the heavier light-duty trucks that must meet a higher (i.e., less stringent) fleet average standard for averaging in these vehicles. Like the other weight categories evaluated, the Board projects that technology packages will be available for this “large truck” segment of the regulated vehicles. See e.g. ISOR summary table 5.3-8, p. 98. Regarding authority to regulate medium-duty passenger vehicles, see Agency Response to Comment 572.

574. Comment: The proposed rule does not provide the “maximum feasible” compliance flexibility required. Use of the adopted provisions is completely impractical. It is unnecessary and arbitrary for the regulations to exclude controls on unregulated vehicles, controls that would achieve equal or greater reductions in greenhouse gases, or controls on sources in other States. Alliance (Appendix H), GM.

Agency Response: The Board believes that the compliance flexibility provisions provided, based in part on existing, proven programs, is entirely practical, and indeed expects manufacturers will use them. Aggregating, averaging, banking, and trading of greenhouse gases among the different pollutants, and between manufacturers, ensures that manufacturers need not design and produce every engine family to the standard. Manufacturers can also emphasize reductions in some pollutants over others, and can either accelerate or delay compliance based on their willingness to bank or trade and on their other marketing concerns. The regulations also provide substantial opportunities for manufacturers to bring alternatively-fueled vehicles and their fuels to market to achieve substantial greenhouse gas reductions. See ISOR pp. 133-134 and Agency Response to Comments 342-344.

This comment fails to recognize that the maximum feasible compliance flexibility provided must be “consistent with this section” (HSC §43018.5(c)(3)), the operative parts of which are the “reduction of greenhouse gas emissions from motor vehicles” (HSC §43018.5(a)) beginning with the 2009 model year new motor vehicle fleet. (HSC §43018.5(b)(1)). See also AB 1493, SEC. 1., findings (f) and (g). The commenters’ suggested control of sources in other states would present substantial if not insurmountable problems for ensuring such controls achieve equivalent or greater emission reductions (see Criteria at ISOR pp. 130-132). More importantly, such controls, in combination with controls on unregulated vehicles, and the other unspecified controls suggested, could entirely eliminate the need for any manufacturer to achieve a reduction in greenhouse gases from their vehicles sold in California. The commenter’s interpretation of maximum feasible compliance flexibility thus appears intended to and would likely eviscerate the prime objective of the bill – to reduce greenhouse gases from the motor vehicle categories (HSC §43018.5(i)(3)) that the Legislature specifically mandated ARB to regulate. This is not consistent with the section as a whole.

Finally, we note that the comment made no specific recommendation for a specific control that would achieve equal or greater reductions in greenhouse gases, rendering a response difficult. But again, generally such controls could swallow the primary purpose of the legislation. We do not consider the Legislature to have engaged in such an idle act.

575. Comment: The rulemaking proceeding has not complied with AB 1493's analytical requirements to conduct an economic impact analysis to assess the impact of the regulations on the economy of the state, because the Board's initial cost estimates were understated and because the Board improperly focused that assessment on the San Diego area. The Board also has not conducted and published a Statewide economic analysis as required by the APA, Government Code Section 11346.2(b)(5). Alliance (Appendix H).

Agency Response: As the commenter points out, both AB 1493 and the APA require consideration of proposed regulations on the economy of the state. This required considering the several specific factors listed in Government Code Section 11346.3, their duplicates in Health and Safety Code Section 43018.5(c)(2)(A)-(D), and the additional factors in Health and Safety Code Section 43018.5(c)(2)(E) & (F). In addition, by the time of the notice the Board had to estimate fiscal impacts and make an initial determination of whether the regulations would have a significant, statewide adverse impact on business. Government Code Section 11346.5(a)(6)-(8). The Board did all of this and more.

Board staff began seeking cost estimates from this commenter and others on the likely greenhouse gas emission reduction technologies as early as the March 11-13, 2003 International Vehicle Technology Symposium. At that workshop, staff had provided substantial detail on the costs estimates for these technologies and continued to solicit comment. See Draft Technology and Cost Assessment, released April 1, 2004. These estimates were further refined in the June 14, 2004 draft staff proposal, discussed at a July 7, 2004 workshop. The commenter thus had plenty of opportunity to assist staff in its assessment of potential costs and economic impacts but did not avail itself.

Nevertheless, as detailed in Agency Responses to Comments 143 through 242, the Board had good reason to rely for its cost estimates on the NESCAF study. The Board then fed these cost estimates into the most comprehensive statewide economic analysis model available, E-DRAM, to assess economic impacts. See ISOR pp. 150-161. This analysis more than "considered" the necessary statutory factors for cost estimates and initial determinations; it represents state-of-the-art, in-depth analysis for agency rulemaking. The results of that analysis were summarized as required in the Public Hearing Notice.

While it is true that in response to the commenter's delayed input into the pre-hearing process staff found and corrected some errors in its cost estimates, these errors were not of the magnitude asserted by the commenter, and did not affect any of the required statutory findings. See ISOR Addendum and Agency Response to Comment 554. We also note that the APA acknowledges that even at the start of the formal 45-day comment period these cost figures remain estimates, with an initial determination based on those estimates, which are subject to refinement.

With regard to focusing on the San Diego area, that focus applied not to the entire impact on the state – the result of the E-DRAM analysis – but to the more specific requirement to consider the regulations' impact on specific communities and on the automotive industry

and affiliated businesses. See ISOR pp. 162-170 and 191-196. It was entirely appropriate to choose San Diego as a representative area for this purpose. As noted in the ISOR, the income distribution in San Diego roughly mirrors the income distribution for the entire state. This San Diego-focused analysis was supplemental to the coverage of the automotive sector and specific communities already covered in E-DRAM. Thus like other areas covered under “Other Considerations” in the ISOR, this analysis attempted to go beyond the standard state-level economic impact analysis in E-DRAM. See ISOR p. 171.

Finally, it is unclear from the comment why the commenter believes Government Code Section 11346.2(b)(5) imposes an additional or different statewide economic analysis. We note, however, that there are no federal regulations contained in the Code of Federal Regulations (CFR) addressing the same issue of reducing new motor vehicles’ greenhouse gas emissions. Even if some CFR sections arguably address similar issues, the Board considers there to be no potential duplication or conflict requiring additional analysis. See also Agency Response to Comment 576.

576. Comment: The rulemaking proceeding has not complied with AB 1493’s analytical requirements in subsection (h) to make a comparison with federal programs. Subsection (h) of AB 1493 is not even acknowledged, much less examined, in the staff report. Alliance (Appendix H).

Agency Response: This comment incorrectly assumes that the Board must go beyond compliance with its statutory mandate, to proactively examining and explaining each subsection of the statute it is tasked with implementing. Nevertheless, in response to this comment, we make that examination briefly here.

The text of subsection (h) speaks to a future contingency – federal adoption (“if the federal government adopts”) of a standard regulating greenhouse gases from new motor vehicles before the Board adopts California’s regulations – that simply did not occur here. Then and only then, and only at the Board’s discretion after findings, could the Board have elected to forego regulation.

In addition, the Board simultaneously addressed this subsection, and its APA obligations to address comparable federal regulations, by stating that there were no comparable federal regulations that control greenhouse emissions from new motor vehicles, and that no such federal standards had even been proposed. Public Hearing Notice at p. 5. In fact, U.S. EPA’s failure to regulate greenhouse gases from new motor vehicles was challenged in the U.S. Court of Appeals for the D.C. Circuit (No. 03-1361 *et. al.* (consolidated).) Whatever the impact of the splintered opinions in that case, the decision clearly holds that EPA need not now regulate new motor vehicle greenhouse gas emissions.

577. Comment: AB 1493 does not authorize rules that would increase smog-forming pollutants. Such rules would represent an unconstitutional delegation of power from the Legislature to ARB. Alliance (Appendix H).

Agency Response: See Agency Response to Comment 567. ARB analysis shows there will be no net increase in smog-forming pollutants, and that even if there were, this would be a permissible harmonization of potentially competing statutory directives.

578. Comment: The Board cannot approve the Executive Officer's proposal as consistent with AB 1493 on the current record. Alliance (Appendix H).

Agency Response: This comment restates several of the commenter's separate comments, which are responded to elsewhere in this FSOR, and therefore only a few of the bulleted items are treated here.

To begin, the "current record" includes not only what was in the record as of this commenter's September 23, 2004 submittal, but also all subsequent rulemaking documents generated and added to the record subsequently, including this FSOR. There is clearly substantial, indeed abundant evidence in the record to support the regulatory action.

The Board did make the threshold decision as to whether or not to adopt the regulation, and at what level of stringency. Therefore the delegation of decision-making to the Executive Officer that the commenter complains of did not even occur. See also Agency Response to Comment 561.

ARB has not historically made cost estimates by model; there are simply too many unknowns to be able to determine which models will use which technologies, and presuming so might hamper manufacturers' flexibility.

579. Comment: The regulation does not meet the grammatical, functional, and volitional requirements for severability. Alliance (Appendix H).

Agency Response: The severability provision states that "...in the event that any provision of this section [1961.1] is held to be invalid, the remainder of this article remains in full force and effect." The "article" at issue here is Article 2 within Title 13, Division 3, Chapter 1, Sections 1950-1978. Thus in addition to the more narrow view of severability the commenter espouses, this severability provision speaks broadly to preserving the remainder of California's new motor vehicle regulations. Because the proposed regulatory section occasionally references LEV II and other motor vehicle regulatory sections and test procedures, the Board considered it prudent in this subsection (f) to make it unmistakably clear that existing regulations and test procedures remain intact even if part or all of this regulatory action is invalidated. Obviously, the current LEV II and other motor vehicle programs can function, as they have, without this regulatory section. There is no question that the Board considered this greenhouse gas regulation as an addition to, and not a replacement for, the existing LEV II program. See Resolution at p.7. The Resolution makes clear that this action incorporates greenhouse gas standards into the existing LEV II standards, and does not create a combined program requiring LEV II program adjustments to accommodate greenhouse gas standards. See also finding (1) in

Executive Order 05-061 at p. 4. Further, we disagree with the import of the clause; it does establish an intent to retain the remainder. *Schenley* 21 Cal.App. 3d. at 199.

Finally, it is quite common for courts to sever portions of regulations without requiring a full, new rulemaking for the remaining provisions adopted or amended; otherwise there would be little point to the severance. *Tidewater* and other APA cases cited by the commenter do not support their contrary position. *Schenley* itself did allow implementation of non-severed or “revised” portions of the regulation to proceed without further rulemaking. 21 Cal.App. 3d at 199-200. Further *Schenley* does not stand for the proposition that administrative regulations present severability issues inherently more complex than those presented by decisions concerning ordinances, initiatives, or statutes that provide the 3-part test the commenter cites.

Regarding the specific severability of the PC/LDT1 and aggregation provisions, see responses to comments 588 and 597, respectively.

b. Issues of Federal Law

(1). The Federal Clean Air Act

580. Comment: California has clear legal authority under the Federal Clean Air Act to set standards for air pollutants emitted by vehicles. The regulations you are considering today are squarely about air pollution and not fuel economy. Many sources contribute to global warming and it will take many separate actions to cut global warming pollution – so CA’s actions are important. CA standards are just one of the measures CA’s taken to contribute to reductions in global warming pollution. (David Doniger, Senior Attorney, NRDC)

Agency Response: The ARB agrees.

581. Comment: California has never been required to show that its air pollution problem is totally unique. The smog problems that affect California affect many other states as well. The same is so for global warming. As others have testified, California will be heavily affected by global warming. David Doniger, Senior Attorney, NRDC.

Agency Response: The ARB agrees, and notes that to obtain a federal waiver of preemption, California need not show it is uniquely affected by global warming. See also Agency Response to Comment 584.

582. Comment: It is also argued that California’s actions alone will not solve the global warming problem. There are three answers to this complaint. The first is to note that many sources contribute to global warming, and it will take many separate actions to cut global warming pollution – each measure *contributes* to the solution to the problem, even though no one measure will be sufficient. Second, these standards are just one of the measures California is taking to contribute to reductions in global warming pollution. Third, California standards have repeatedly leveraged much larger vehicle emission reductions by other jurisdictions – other states, the federal government, and many other countries.

The action California takes today will be magnified as your standards once again are adopted by other jurisdictions, and as the technologies on which your standards are based diffuses into the vehicle fleet well beyond your borders. David Doniger, Senior Attorney, NRDC.

Agency Response: The ARB agrees. These arguments further support a waiver of federal preemption under Clean Air Act section 209(b).

583. Comment: The proposed greenhouse gas emission standards are preempted under Section 209(a) of the Clean Air Act, and the ISOR does not identify any valid legal basis for a waiver. Alliance (Appendix H).

Agency Response: The ARB agrees that the proposed greenhouse gas emission standards face a potential preemption argument under Clean Air Action Section 209(a). That is why in Resolution 04-28 (p. 16) the Board directed its Executive Officer to forward the regulations to U.S. EPA for a waiver or “within the scope” determination. In support of that waiver or within the scope request, the Board made the required findings at p. 15 of the Resolution. Those findings are amply supported by the record.

584. Comment: The proposed emission standards are not necessary to meet “compelling and extraordinary conditions” in California. The ISOR does not explain how the threat of global climate change to California presents a “compelling and extraordinary” situation in California, as Congress intended and as it used those terms. Global climate change is not a local problem susceptible of local solutions, nor was California regulating greenhouse gases before Congress granted California its unique authority in March 30, 1966. California’s position is not “extraordinary” vis a vis other states. Clean Air Act Section 209(b) is not a statement of general principle that California receives special treatment under federal law. Alliance (Appendix H).

Comment: Climate change gases cannot be effectively regulated state by state because they're fundamentally different from criteria air pollutants. Throughout the staff report, ARB treats climate change gases the same way it treats criteria pollutants. The fundamental error distorts all of ARB's analysis. Air pollution is primarily a local problem, while climate change is a worldwide phenomenon. California's air quality needs are special in many respects. But California does not have a special or unique situation with respect to global climate change. When the federal motor vehicle provisions of the Clean Air Act were adopted, California already had its motor vehicle emission standards program in place. Conversely, the federal government has been regulating carbon dioxide emissions from vehicles through the Corporate Average Fuel Economy Program for nearly 30 years. (John Cabaniss, Director of Environment Energy, Association of International Automobile Manufacturers).

Agency Response: Longstanding federal waiver law and practice makes clear that in reviewing California’s waiver requests, U.S. EPA is not to micro-manage each California standard for each pollutant regulated in its mobile source programs. 58 Fed.Reg. 4166 (January 13, 1993), LEV I Decision Document at 53-57, citing 36 Fed. Reg. 17458 (August

31, 1971). Rather, under a narrow standard of review 49 Fed.Reg. 18887 at 18890 (May 3, 1984) the burden is on waiver opponents (LEV I Decision Document at 18-26) to show that California no longer has a compelling need, informed by its own circumstances and the benefits that would accrue to it and other states, to maintain its own motor vehicle program as a whole (LEV I Decision Document at pp. 46-52). Therefore, California need not demonstrate in this rulemaking that the state faces unique threats from greenhouse gas emissions. And California clearly continues to face extraordinary and compelling conditions generally.

Nevertheless, this rulemaking record does provide strong evidence for extraordinary and compelling conditions in California due solely to global warming from greenhouse gas emissions. In particular, while California's coastal resources are threatened like those in other states, California is particularly vulnerable to saltwater intrusion from sea-level rise, levee collapse, and flooding in the Bay-Delta area, which would severely tax California's increasingly fragile water-supply system. The predicted decrease in winter snow pack would exacerbate these impacts by reducing spring and summer snowmelt runoff critical for municipal and agricultural uses, a situation further strained by fish and wildlife considerations. See e.g. ISOR pp. 19-25, Gleick and Chalecki, Roos, Wilkinson, Cayan (15-day Attachment II), Cayan Testimony, and Hayhoe et. al. PNAS August 24, 2004, vol. 101, no. 34, pp. 12422–12427. Also, of course, California's high ozone levels (clearly a condition Congress considered) will be exacerbated by higher temperatures from global warming. Even if we accepted the commenter's contention, then, California's circumstances are no less extraordinary and compelling than those it faced when Congress first recognized and provided for California's separate motor vehicle emission control program.

Finally, we note the obvious fact that Congress is fully aware that while California has separate authority to address its particular air pollution problems, California is not expected to solve them on its own. The history of State Implementation Plans (SIPs) in this state (and others) clearly envisions that emission reductions are needed from sources subject to federal or others' control. See also Agency response to comment 365.

585. Comment: The proposed standards are not "consistent with section 202(a)" because EPA cannot regulate CO₂ under Section 202(a). Alliance (Appendix H).

Agency Response: As the commenter is aware, U.S. EPA's determination that it cannot regulate CO₂ (68 Fed. Reg. 52922 (September 8, 2003)) was challenged in the U.S. Court of Appeals for the D.C. Circuit (No. 03-1361 et. al. (consolidated).) Nearly all of the commenter's detailed comments on this issue (items (1)-(4) on p. 55) were repeated in industry intervenors' briefs in that action and are addressed by the challengers' briefs in that case. California's Governor and the Air Resources Board are plaintiffs/challengers in that action, and as such disagree with both U.S. EPA's result and the principal rationales the agency used to support it. The recent decision in that case, which may be appealed, did not reach the central issue of whether EPA has authority to regulate new motor vehicles' greenhouse gas emissions. Slip Opinion July 15, 2005. The court reached a judgment but stated no majority opinion. Judge Randolph's opinion (p. 10, n. 1 and

accompanying text) explicitly declined to address the issue. We also note that Judge Tatel's strong dissent reached and found such EPA authority to regulate. Slip Opinion, Judge Tatel (dissent) pp. 11-22. The decision, therefore, leaves some or all of U.S. EPA's rationales – and the challengers' arguments against them – at issue. More importantly, U.S. EPA's determination did not directly address California's ability to regulate new motor vehicles' greenhouse gases, leaving this issue for the waiver process, not for the state rulemaking process.

However, even had the D.C. Circuit specifically addressed and supported U.S. EPA's determination based at least in part on an inability for U.S. EPA to regulate CO₂, California would retain its separate ability to regulate air contaminants it considers to be pollutants under the Clean Air Act. This is because nothing in Clean Air Act Section 209(b) precludes California from regulating a state "air contaminant" (Health & Safety Code Sections 39013, 43013(a)) before U.S. EPA identifies such as a "pollutant" under the Act. In fact, the history of California's waived new motor vehicle emission control standards clearly allows, indeed expects, that California may act to identify and control air pollutants that U.S. EPA may or may not regulate, before U.S. EPA decides whether or not to do so.

The early history of the waiver provision shows that California initially and repeatedly regulated emissions of certain pollutants before EPA did, and that Congress approved. See e.g. *MEMA I*, 627 F.2d. 1095 (D.C. Cir. 1979) at 1109 fn26 (finding California was regulating motor vehicle emissions before Congress established first federal authority in 1965). The federal government was not regulating the motor vehicle pollutants that California was when Congress passed the first waiver provision in 1967 (§208(b), Air Quality Act of 1967 (P.L. 90-148, 81 Stat. 485), in 1967 USSCAN at p. 534-535), as HEW's regulations under the prior act did not apply until the 1968 model year. House Report No. 728, 1967 USCCAN at p. 1956. And the House Report on the near-final version of the 1967 amendments (S.780) refers to this earliest California waiver provision as permitting California to establish, "... (2) standards applicable to emissions not covered by Federal standards..." (House Report No. 728, 1967 USCCAN at p. 1957), and standards "... applicable to emissions not covered by the national standards..." (Id. at 1972). The subsequent Conference Report indicated no changes were made to §208(b) in conference. Conference Report No. 916, 1967 USCCAN pp. 1986-1989.

More recent history continues to show that California can and does receive waivers for those parts of its motor vehicle pollution program that regulate emissions of pollutants not yet regulated by EPA. For example, in 1992 California received a waiver for extending its exhaust and evaporative standards to methanol and flex-fuel vehicles, and for regulating formaldehyde emissions that federal motor vehicle standards had yet to address. California State Motor Vehicle Pollution Control Standards; Waiver of Federal Preemption; Decision (Methanol Waiver), 57 FR 38503 (August 25, 1992).

No part of the Methanol Waiver Decision Document mentions the lack of federal §202(a) "pollutant" status as an issue. In fact, the Decision Document uses the formaldehyde standard as additional evidence supporting the protectiveness finding. Decision Document at 23-24. See also Decision Document at 27-30 (finding formaldehyde

standard forces technology but that available evidence shows costs will be minimal). These findings are reiterated in the waiver extending California's formaldehyde standard into 1995 and later model years. California State Motor Vehicle Pollution Control Standards; Waiver of Federal Preemption; Decision (MDV Waiver), 59 FR 46978 (September 13, 1994), Decision Document at 78-81, 86, and 89-92. And the "consistency" prong of Section 209(b)(1)(C) is clearly focused on technological feasibility and lead-time, not on whether U.S. EPA can or would adopt the same regulations as California has. So contrary to the commenter's assertion, the intervenors' arguments against regulating CO₂ apply less, not "considerably more," to California.

586. Comment: The proposed standards are not "consistent with section 202(a)" because EPA cannot adopt the MAC design standards under Section 202(a). EPA can regulate hydrofluorocarbons only under Title VI of the Clean Air Act. And generally, neither EPA nor California can adopt design standards under Section 202(a). Alliance (Appendix H).

Agency Response: The ARB believes that EPA can regulate HFCs under its Clean Air Act section 202(a) authority, and is not limited to regulating "traditional" pollutants, whatever those are. California joined others to challenge EPA's contrary determination. See *Brief for Petitioners*, D.C. Circuit No. 03-1361 et.al. (consolidated) at pp. 43-44, though the recent decision, which may be appealed, does not reach the issue. Even if California was limited to adopting the same type of standards as is EPA, nothing in the text of 202(a)(1) precludes EPA from adopting design standards. And section 202(a)(4) clearly contemplates potential limitations on or prohibitions against certain devices, systems, or elements of design that might be used to meet 202(a)(1) standards.

Design standards such as positive crankcase ventilation (PCV) are among the most longstanding emission controls for on-road vehicles. See 40 CFR §1810-01(d) (light-duty vehicles, light-duty trucks, some heavy-duty vehicles), 40 CFR § 410-80(b) (motorcycles). Those federal controls have now been extended to other heavy-duty vehicles. See e.g. 40 CFR §86.008-10(c). Requiring exhaust system designs to be "leak-free" is another design requirement. 40 CFR §1844-01(d)(16). Even EPA's prohibition against "defeat devices" (40 CFR §§86.004-16, 86.409-78) is arguably a design standard. These EPA and waived California design standards actually go further than the subject optional HFC crediting provisions, since in some cases they amount to an outright prohibition of certain vehicular emissions, regardless of their potential quantitative measurement. Thus the two 202(a) provisions cited by the commenter – 202(a)(5)(fill pipes) and 202(a)(6) (onboard vapor recovery) – are simply two instances of Congress placing specific limits on EPA's preexisting rulemaking authority. And EPA has not found any of the parallel California requirements to be inconsistent with Section 202(a).

But California is not limited to standards that EPA could set. Harmonizing 209(b) and 202(a) allows, indeed arguably requires, California to regulate air contaminants (see Agency Response to Comment 585) in ways that EPA either cannot or chooses not to. These principles have been demonstrated over decades of EPA waiver practice. Simply put, section 209(b), and California's role as "a kind of laboratory for innovation" (*Motor and*

Equipment Mfrs. Ass'n, Inc. v. E.P.A. (D.C. Circ. 1979) 627 F.2d 1095, 1111) would be eviscerated if California's new motor vehicle regulations were limited to what EPA thought it could do or had done under 202(a). And the comment circles back on and extinguishes itself; if 202(a) is limited to quantitative levels that EPA could set, then MAC design standards are not "standards" under 209(a) and are not preempted.

Further, the ARB believes the commenter mischaracterized the MAC portion of the regulations as design standards. Rather, they are more appropriately characterized as one way to obtain credit toward the quantitative fleet average emission levels to which the commenter implies ARB is limited. As such, obtaining credits through the MAC provisions is no different than obtaining credits through the myriad of other potential technologies identified from which manufacturers can choose to mix together to meet the total quantitative greenhouse gas levels. As with California's other performance standards, manufacturers could also develop other technologies not projected by ARB as likely compliance mechanisms, or could develop as yet unknown technologies, to help meet the fleet average standards. Equally important, the commenter omitted to cite the flexibility provided in both the direct and indirect A/C emissions crediting provisions; these allow manufacturers to demonstrate equivalent or lower emissions from technologies other than those that the commenter characterizes as "design standards." See 13 CCR sections 1961.1(a)(1)(B)1.b.ii.B & C. (direct) and 1961.1(a)(1)(B)1.c. (indirect).

Addressing this issue in another context, this same commenter inexplicably cited the *Engine Mfrs. Ass'n v. S. Coast Air Quality Mgmt. Dist.* case (124 S. Ct. 1756, 1761 (2004)), as cited at EPA Docket I.D. 2004-0437-0145, pp. 17-18), for the proposition that EPA (and ARB by extension) cannot adopt design standards under Clean Air Act §202(a). However, the very quote cited – that regulatory criteria under 202(a) can include provisions that "the vehicle or engine must not emit more than a certain amount of a given pollutant, must be equipped with a certain type of pollution-control device, or must have some other design feature related to the control of emissions" (125 SCt. At 1761) states two out of three ways that a permissible design standard could arise.

Finally, it is worth noting that at this time there was simply no other practical way to provide direct A/C emissions credit without requiring a showing that specific technologies have been applied to minimize leakage. See Agency Response to Comments 171.

(2). The Federal Fuel Economy Program:

587. Comment: Despite the fact that California is addressing an air pollution problem under its Clean Air Act authority, it is being argued that the state is pre-empted under the Energy Policy and Conservation Act (EPCA), the federal law under which CAFÉ standards are set. The argument depends on the false premise that California is regulating fuel economy, not air pollution. The subject is air pollution, not fuel economy, and thus California is operating under the green light of the Clean Air Act. As a result, there simply is no red light coming from EPCA.

Moreover, from its beginning, the federal fuel economy law has expressly dealt with the relationship between air pollution standards and fuel economy.

- In early instances where air pollution controls made meeting fuel economy standards *more difficult*, the fuel economy law gives priority to the pollution safeguards – not the other way around. In these cases, the law said that – if anything – the fuel economy standard is the one that should be relaxed, not the air pollution standard.
- Today, when it sets fuel economy standards, the National Highway Transportation Safety Administration is required by law to take federal and California air pollution standards into account when determining new fuel economy targets.
- More recently – and certainly in the case of the standards before you now – most modern air pollution control technology *lowers* fuel consumption.
- If the federal fuel economy law did not stand in the way of California’s air pollution standards when they made better fuel economy *harder* to achieve, then certainly it does not stand in the way when California’s air pollution standards make better fuel economy *easier* to achieve. David Doniger, NRDC

Agency Response: The ARB agrees.

588. Comment: The proposed CO₂ emission standards are expressly and impliedly preempted by the federal fuel economy program. Alliance (Appendix H).

The proposal is in fact a fuel economy rule and as such is clearly preempted by federal law. The federal preemption issue and state fuel economy standards, which are prohibited. Since virtually all greenhouse gas emissions from vehicles are tailpipe carbon dioxide emissions, regulating vehicle carbon dioxide emissions is tantamount to regulating fuel economy. Fred Webber (Alliance), GM.

Regulation of fuel economy is and should be a federal issue. California Motor Car Dealers Association.

No state, including California, has the authority to regulate CO₂ emissions or fuel economy. Toyota Technical Center, USA.

Federal law prohibits states from adopting or enforcing a law or regulation related to fuel economy. Restrictions on CO₂ emissions are fuel economy measures. DaimlerChrysler.

The greenhouse gas emissions report and AB 1493 has no impact on greenhouse gases or global warming, but only on vehicle efficiency and gas mileage. The courts have defined vehicle mileage efficiency as being a Federal area, off limits to states. This effort should be abandoned. (John Dodds)

Agency Response: As an initial matter, several commenters referred directly or indirectly to the proposed regulations as setting fuel economy standards or levels or implied as much, or otherwise inserted the term “fuel economy” at various points in their comments. In the remainder of the Agency Responses in this FSOR, ARB may not have separately responded to each such reference or implication, but it does respond here with its responses to Comments 589 through 593 below. As to express and implied preemption in particular, see Agency Response to Comments 590 and 591, respectively, which also respond to the general allegation of preemption.

If a reviewing court were to find part of this action expressly or impliedly preempted, that ruling would not apply after model year 2007 to LDTs 3751-8500 lbs or to MPVs, as no EPCA/CAFÉ standard is in effect for vehicles of these types and model years. Thus in furtherance of the severability provision, the PC/LDT1 standards could be severed from the remainder of this regulatory action. First, the text for this weight group and vehicle type can be mechanically separated from both the regulations and the incorporated test procedures. Second, the PC/LDT1 is not necessary for the LDT2/MDV provisions to function. Because the technological feasibility of each (PC/LDT1 and LDT2/MDV) standard was separately set to the highest weight manufacturer, and because trading of credits from PC/LDT1 to LDT2/MDV was not assumed needed (see ISOR p. 113-114, Figures 6-1 and 6-2), the rulemaking analysis for the LDT2/MPV standard can stand on its own. Finally, given the substantial global warming impacts identified in the rulemaking, and Governor Schwarzenegger's recent Executive Order S-3-05 setting aggressive greenhouse gas reduction targets, the Board most certainly would want the substantial greenhouse gas reductions that would be achieved from severance of the PC/LDT1 standard and implementation of the LDT2/MDV standard.

589. Comment: The Executive Officer must acknowledge that NHTSA administers a comprehensive federal fuel economy program, including CO₂ emission standards for motor vehicles. Miles/gallon and CO₂ grams/mile are different metrics for measuring fuel consumption. The public will not be fully informed of the import of the proposed CO₂ standards unless it is provided accurate information in the miles/gallon metric. Alliance (Appendix H).

Comment: Federal law prohibits states from adopting separate fuel economy standards. This preemption language was put into place because of the impact that fuel economy standards would have on the national economy. The U.S. Congress reserved the issue of regulating vehicle fuel economy to the federal government to balance all sectors of the economy and to avoid a patchwork quilt of state regulations which hurt businesses and, perhaps more importantly, consumers.

It is a simple fact. This regulation is federally preempted. And I would like to quote, sir, from the California Energy Commission and California Air Resources Board Joint Agency Report back in August of 2003. I'll just quote: "Requiring vehicle manufacturers to improve fuel economy, however, is the sole domain of the federal government. The challenge for California policy makers is to work effectively with the federal government to improve new vehicle fuel economy."

And I would say to you, I think NHTSA's doing a pretty good job. And if you're not happy with the way NHTSA's progressing -- and they're already addressing light truck fuel economy standards and they're about to address automobile fuel economy standards -- again, go to Washington. You've got a great presence there. You've got a strong congressional delegation. And slug it out with them. But federal law to us is very clear here, the position of the previous speaker notwithstanding. (Fred Webber, The Auto Alliance)

Comment: The past decisions of Congress on preemption should not be treated simply as a legal issue. These were not arbitrary decisions. Rather, they properly reflected the differences between criteria air pollutants and fuel economy and, indirectly, carbon dioxide emissions, greenhouse gas emissions.

With the Clean Air Act Congress recognized that California had special air quality concerns, differing significantly from the other states, and provided California the unique ability to set its own vehicle emission standards.

Congress also correctly recognized that vehicle manufacturing and marketing are necessarily conducted on a national level and that varying state-to-state regulation of fundamental vehicle design elements would be extremely harmful to the industry and cost to the consumers.

Accordingly the U.S. Department of Transportation was established as the sole agency authorized to set fuel economy standards, expressly preempting states from setting standards related to fuel economy. And that's a quote from the statute. (John Cabaniss, Director of Environment Energy, Association of International Automobile Manufacturers)

Comment: At the time of the passage of the Federal motor vehicle provisions of the Clean Air Act, California already had its motor vehicle emissions standards program in place. Conversely, the federal government has been regulating carbon dioxide emissions from vehicles through the Corporate Average Fuel Economy (CAFÉ) program, pursuant to the Energy Policy and Conservation Act adopted nearly thirty years ago. (Statement of John Cabaniss, 9/23,04).

Agency Response: While the ARB and the Executive Officer acknowledge that NHTSA administers a federal fuel economy program, they do not acknowledge that NHTSA's program includes a CO₂ emission standard for motor vehicles. Neither NHTSA nor EPA (see Agency Response to Comment 576) have set emission standards for CO₂ or any other greenhouse gas. See also Agency Response to Comment 562. Rather, NHTSA's fuel economy program regulates fuel economy by implementing a minimum corporate average fuel economy, or "CAFÉ" standard. As the commenter points out, this is a miles per gallon or "mpg" standard. The focus of EPCA and CAFÉ, of course, was and is to increase new motor vehicles fleet average mpg in order to promote energy independence.

The commenter appears to infer that because NHTSA uses CO₂ grams/mile results from EPA's exhaust emission standard test procedures to determine manufacturer compliance with CAFÉ standards, then NHTSA has set a CO₂ standard. Yet nowhere does the commenter cite to any statute, or to any draft, proposed, or final federal regulation, that indicates that NHTSA has exercised authority over greenhouse gases such as CO₂, much less claimed such authority. And as the commenter points out, EPA's CO₂ test results serve more than one purpose. ("For labeling purposes, EPA can (and does) calculate fuel economy differently than it does for CAFE purposes." Macomber Declaration, Appendix H, Exhibit 1, p. 4.)

Finally, because the Board and Executive Officer were targeting not miles per gallon but rather a total reduction in greenhouse gases (in addition to CO₂) from new motor vehicles, the Board has no reason to know, does not know, and could not reliably estimate, the miles per gallon that a purchaser of vehicles subject to this regulation would achieve.

590. Comment: The proposed CO₂ standards are expressly preempted under EPCA because they are "related to" fuel economy standards in that they have a prohibited connection with or reference to such standards. Alliance (Appendix H), GM.

Agency Response: The commenter attempts to expand a recent U.S. Supreme Court case finding preemption based on analysis of the term "standard" (*Engine Mfrs. Ass'n v. S. Coast Air Quality Mgmt. Dist.* (2004) 124 S.Ct. 1756) into a general principle that federal statutes preempting state requirements "related to" them must be broadly read. No such principal exists generally, and specifically not in the area of state environmental regulation.

As the commenter acknowledges, nowhere do the regulations reference corporate average fuel economy, fuel economy, or miles per gallon. The most the commenters can point to is what they characterize as a "connection with" a federal test procedure. But contrary to the commenter's assertion, neither the regulations nor their incorporated test procedures directly reference or connect with the fuel economy regulations (40 CFR Part 600) they cite. Rather, the regulations and test procedures reference 40 CFR Part 86, as modified for California, as the method to measure CO₂ and the other greenhouse gases CH₄ and N₂O (Test Procedures, Part II.A. 100.5.2.1, p. II-12), just as California currently measures other vehicular emissions for compliance with the LEV program. As discussed in the ISOR (pp. 102-103), the highway driving schedule, which applies to more than just greenhouse gas emissions, will be used in certifying and testing vehicles to ensure fleet greenhouse gas emission reductions occur under real world driving conditions.

The above-described scheme of the regulations and test procedures to measure CO₂ and other greenhouse gases thus hardly rises to the level of a prohibited reference to or connection with the federal issues of concern to the commenter. State environmental regulations such as these typically enter the preemption analysis with a strong presumption against preemption. *Exxon Mobile Corp. v. EPA* (9th Cir. 2000) 217 F.3d. And the Supreme Court has repeatedly cautioned against reading "related to" at face value. *Egelhoff v. Egelhoff* (2001) 532 U.S. 141 at 146-147, and at 152-153 (Scalia Concurring). See also *California Div. of Labor Standards Enforcement v. Dillingham* (U.S.

Cal., 1997), 519 U.S. 316, *335-336 (Scalia concurring) (in the ERISA context, "...applying the 'relate to' provision according to its terms was a project doomed to failure, since, as many a curbstone philosopher has observed, everything is related to everything else.") Further, it is worth noting that the current LEV II program measures oxides of nitrogen with an explicit reference (13 CCR §1961(a)(6)) to the supposedly "forbidden" 40 CFR Part 600, yet California has been granted a waiver of federal preemption for such measurement. 68 FR 19811 (April 22, 2003). See also 13 CCR section 1960.1(f)(2) note 3, (g)(1) note 5, and (h)(1) note 5. See also agency response to comment 188.

The commenters further dwell on their statement that the federal fuel economy program also uses emission test results that in part measure CO₂--(without noting that the federal fuel economy program does not use the results from testing for other greenhouse gas emissions as the subject ARB regulations do)--by converting those results to miles/gallon to determine compliance with NHTSA's fuel economy standards. This is true, but it is the federal government that is doing so, for a different purpose. Regardless of the commenter's unnecessary resort to AB 1493 legislative history, the administrative record upon which the Board relied in adopting these regulations and test procedures clearly demonstrates that their purpose and intent is to reduce motor vehicles' greenhouse gas emissions. See for example the extensive ISOR description of the climate change problem and need for reductions, Chapters 2 and 3, and summary of regulations, Chapter 4. See also Resolution at pp. 1 and 9.

Finally, the commenter poses five questions in an apparent attempt to summarize their comment. With regard to (1), the accuracy of a former Executive Officer's statements in previous litigation regarding different regulatory text is not a determination that must be made for this rulemaking. With regard to (2), "increasing fuel economy" may be how the commenter chooses to characterize its potential efforts to meet the greenhouse gas emission reduction standards, and it may be true that that is how they perceive their alternatives. With regard to (3), the commenter has chosen to use the term "unrelated" in an apparent attempt to trap ARB into admitting that if it identifies such methods, then the others must be "related to" improved fuel economy. ARB does not so admit. Having said that, the ARB does anticipate that at least some manufacturers will employ greenhouse gas emission reduction technologies that we believe even the commenter would concede are "unrelated" to improved fuel economy. See Response to Comments 171. With regard to (4), see earlier paragraphs in this response. Finally, with regard to (5), ARB's duty in this rulemaking is to adopt and enforce regulations until and unless such regulations are held to be preempted; ARB has no duty to explore and speculate as to the scope of express preemption generally.

It is also worth noting that statutes allowing regulation of motor vehicle emissions though they might impact fuel economy is not novel or limited to the 209(b) context. Elsewhere in the Clean Air Act Congress provided examples of emission reduction measures that would no doubt improve fuel economy. See e.g. the transportation control measures at Clean Air Act 108(f)(1)(A)(v) (traffic flow improvements) and (xi) (extended idling). Whether enacted to meet these Clean Air Act requirements or for other purposes (see Title 13, California Code of Regulations, Sections 2480 and 2485 to reduce airborne toxic emissions),

numerous state and local measures notably affect fuel use and resultant fuel economy, though that is not their purpose and intent. As many of these measures have been on the books for decades, this cannot be the type of “connection with” fuel economy that would render such measures, as here, preempted.

591. Comment: The proposed CO₂ emissions standards are impliedly preempted by the federal fuel economy program because they frustrate federal objectives and intrude upon NHTSA’s field of regulation. Alliance (Appendix H).

Comment: The proposed California standards are considerably higher than federal fuel economy levels, the way the standards are arrived at are different, and the fleet structure is different from CAFÉ. DaimlerChrysler (Attachment 10).

Agency Response: The first commenter’s factual statements elsewhere fundamentally undermine their premise regarding implied preemption. See Alliance (Appendix H), pp. 44-45. There the commenter indicates that manufacturers will react to these greenhouse gas regulations by producing for sale outside California vehicles with higher greenhouse gas emission vehicles (which the commenter terms “more fuel-intensive vehicles”). They argue that there will thus be no net impact on greenhouse gas emissions globally, and following their own logic, no net change in fleet average fuel economy. Though ARB disagrees with the argument, in the commenter’s own words there is no implied preemption by frustration of, intrusion into, or conflict with, the federal program.

Further, the ARB disagrees with several of the commenters’ factual assertions. First, the Board (and not the Executive Officer) established fleet average greenhouse gas emission standards, not CO₂ standards. Second, as the commenters’ own charts show, the Board did not establish fleet greenhouse gas emission standards for the federal categories NHTSA regulates. Third, as stated in Agency Response to Comment 593, in proposing the greenhouse gas standards, the Executive Officer did not consider the CO₂/Fuel Economy Conversion that the Commenter entered into the record, and the referenced conversion formula is not incorporated in the adopted regulations or test procedures. Therefore the Board did not evaluate, and takes no position on, whether “the federal vehicle categories and respective fuel economy standards” that the commenter identifies – and for which it generates its own fuel economy conversion numbers – differ from the two categories of vehicles California identifies for separate fleet average greenhouse gas emission standards under 13 CCR Section 1961.1(a)(1)(A). However, if there exists such a difference, it would hardly be remarkable, given the different purposes and considerations inherent in implementing the respective state and federal regulatory schemes.

Even if ARB were to ignore the commenter’s conflicting statement(s) and the above factual disagreements, ARB disagrees with each of the commenter’s five bases for finding implied preemption. First, while NHTSA does regulate fuel economy, ARB is setting a fleet average greenhouse gas emission standard, not a fuel economy standard. In addition, the commenter conveniently and entirely ignores the balancing factor most at issue here that NHTSA historically has accepted and must continue to accept as a given; motor vehicle

emission standards. 49 U.S.C. §32902(f). Thus greenhouse gas emission standards, like other motor vehicle emission standards, do not even fall within the occupied field. Second, regulation of greenhouse gas emissions from motor vehicles above 8500 GVWR does not conflict with NHTSA's CAFÉ standard for such vehicles for several reasons: A) there is no citation to where NHTSA found that only some of said vehicles could be subject to CAFÉ; B) again, California has here set a greenhouse gas emission standard, not a CAFÉ standard; and C) CAFÉ itself does indeed reserve – in the form of acknowledgment in 49 U.S.C. §32902(f) – regulatory authority for California and federal motor vehicle emission standards. Third, even if the manufacturers unnecessarily (see e.g. Agency Response to Comment 254) choose to create size, weight, power, or other differences between California and non-California vehicles, and further choose to attribute such differences to these greenhouse gas regulations, the resulting vehicles with differing emissions characteristics are permissible – indeed encouraged – under Clean Air Act Sections 177 and 209(b), so long as no “third vehicle” is created. (The commenter does not and could not assert that California's regulations here create a potential third vehicle problem.) Moreover, the history of the interaction between the Clean Air Act and EPCA/CAFÉ shows clear Congressional acceptance of potentially different fuel economy levels from California versus non-California vehicles. And even if all other states opted to adopt these California greenhouse gas regulations, NHTSA's role – to set minimum average fuel economy standards for manufacturers' fleets by balancing emission standards among many factors – would remain intact. Fourth, California's greenhouse gas regulations do not conflict with NHTSA's consideration of the safety consequences of its CAFÉ standards; we presume NHTSA will continue considering safety among the factors, including emission standards, as required by EPCA. And again, to meet state law requirements, the purpose, intent, and practical effect of these regulations is to reduce fleet greenhouse gas emissions without affecting weight; a fundamental concern in developing the regulations was to achieve a “weight-neutral” result that leaves consumer choice intact. See ISOR pp. 57 and Agency Response to Comment 167. Fifth, California's greenhouse gas regulations do not conflict with NHTSA's consideration of the consequences of its CAFÉ standards on the domestic automobile manufacturing industry; we presume NHTSA will continue considering this among other factors, including emission standards, as required by EPCA. Further, though the Board was not engaged in the weighing of fuel economy factors as NHTSA would be, the greenhouse gas emission standard is set to ensure that the manufacturer that may have the most difficulty meeting the standard (which here happens to be GM, a domestic manufacturer) can do so. See ISOR p. 105 and Agency Response to Comment 315. Again (see Agency Response to Comment 586), the backdrop to all of the commenter's implied preemption arguments is a strong presumption against finding repeal of state or local environmental regulations, and the courts' duty to give effect to statutes that are potentially overlapping yet capable of co-existence absent a clearly expressed congressional intention to the contrary. *Morton v. Mancari*, 417 U.S. 535, 551 (1974). See also Agency Response to Comment 590 and D.C. Circuit Slip Opinion No. 03-1361 (July 15, 2005), Tatel dissent at pp. 21-22.

Finally, we note that in considering the effect of other government standards on fuel economy, NHTSA stated the following regarding the effect of California's LEV II emission standards: “The agency notes that compliance with increased emission requirements is

most often achieved through more sophisticated combustion management. The improvements and refinement in engine controls to achieve this end generally improve fuel efficiency and have a positive impact on fuel economy.” 68 Fed.Reg. 16868, 16896 (April 7, 2003). The ARB agrees, and believes the quote should be read to cover compliance with greenhouse gas emission standards, such as those proposed for adoption here, which in part rely on projected improvements and refinements in engine controls to meet them.

592. Comment: The Executive Officer cannot avoid preemption by avoiding use of “fuel economy” in all formal regulatory documents and instead insisting that only “emissions” are being regulated. Alliance (Appendix H).

Agency Response: The commenter makes much of the lack of “fuel economy” and related terms in the “formal regulatory documents” for this rulemaking. As a preliminary matter, the Board is not avoiding use of those terms, as this Final Statement of Reasons is now part of the rulemaking documentation. Use of those terms by commenters, including this commenter, is also part of the rulemaking record. It is true, however, that the lack of such terms in the Board-promulgated documents reflects the true purpose of the regulations; to control greenhouse gas emissions from the California fleet. See ISOR pp. 3-39 (describing climate change pollutants, their impact in California, and California’s historical responses). Also, there was no “masking” here of one benefit of reducing such emissions; a reduction in operating costs, due primarily to reduced fuel purchases.

The commenter’s reliance on *Engine Mfrs. Ass’n v. S. Coast Air Quality Mgmt. Dist.* (2004) 124 S.Ct. 1756) is again misplaced. While in that case the Court determined that the “purchase” requirement at issue was as much a “standard” as a sales restriction, that case concerned a political subdivision’s attempt to enforce a “standard” prohibited by Clean Air Act section 209(a). Here one could argue that the Board is adopting an emission standard that would be subject to preemption under section 209(a), but this completely ignores the fact that U.S. EPA is to waive that preemption under 209(b) under a test deferential to California. More importantly, the cited case concerns one statutory scheme – the Clean Air Act – not the court’s duty to give effect to both Clean Air Act §209(b) and EPCA statutes that are potentially overlapping yet capable of co-existence absent a clearly expressed congressional intention to the contrary. *Morton v. Mancari*, 417 U.S. 535, 551 (1974).

The commenter then poses several possible “legal defenses” ARB might use, and their problems. While the Board believes such defenses are unnecessary, we respond here for the purposes of completeness and for the commenter’s benefit. First, characterization of the Clean Air Act section 209(b) as a “savings” clause is unnecessary. When Congress passed EPCA in 1975 and amended it in 1977, it specifically acknowledged California’s (and U.S. EPA’s) ability to continue setting motor vehicle emission standards that Congress knew would have an impact, positive or negative, on fuel economy. See 49 U.S.C. 32902(f), H.R. Rep. No. 94-340 at 86-87, 89-91, and H.R. Rep. No. 95-294 at 244-51. If regulating emissions under the Clean Air Act could be considered a “direct conflict” with EPCA as the commenter asserts, it’s a conflict that Congress knew about and

approved. Second, the commenter cites no authority, beyond grasping at factually distinguishable cases (see Brief for the Petitioners in Consolidated Cases, *Commonwealth of Massachusetts, et. al. v. U.S. EPA, nos. 03-1361 (D.C. Circuit), pp. 36-38*) for the proposition that the emission standards that NHTSA must consider in setting fuel economy standards means only “traditional” emission control measures; we do not read such language into the statute. The commenter’s third point about California’s ability to regulate under Clean Air Act section 209(b) is addressed in Agency Response to Comments 580 through 586. Finally, the Board agrees that to meet the adopted greenhouse gas emission standards, manufacturers will need to reduce their CO₂ emissions, in combination with potential reductions in other greenhouse gases. However, for all the reasons stated in this and the previous responses, we do not believe that that CO₂ reduction is either expressly or impliedly preempted.

593. Comment: The proposed “CO₂ emission standards” are legally indistinguishable from the preempted “CO₂ reduction method” in *Central Valley Chrysler-Plymouth v. CARB* (E.D. Cal. (Fresno), June 11, 2002). No reasonable reader of this decision, the U.S. brief in support of affirming it, or EPCA, would conclude that California can promulgate CO₂ emission standards for new motor vehicles. Alliance (Appendix H).

Agency Response: The regulations at issue here are distinguishable because they set greenhouse gas emission standards, not “CO₂ emission standards” or a “CO₂ reduction method” as the commenter asserts. In addition, the greenhouse gas emission standard here does not refer to and directly depend on the vehicle’s EPA fuel economy rating, as argued in the U.S. brief. (See Agency Response to Comment 590.) Further, it is not clear from the *Central Valley* decision what role the CO₂ reduction method played in comparison to the other provisions there at issue.

Even if the two regulatory provisions were not distinguishable, no less a “reasonable reader” than counsel for the federal U.S. EPA did at one point conclude that greenhouse gas emissions such as CO₂ were potentially subject to EPA regulation under the Act. Testimony of Gary S. Guzy, EPA, General Counsel, before a Joint House Subcomm. Hearing (Oct. 6, 1999) (reiterating predecessor Jonathan Cannon’s conclusions.) See also D.C. Circuit Slip Opinion 03-1361, July 15, 2005 Tatel dissent. What EPA can regulate it can also waive preemption for California to regulate. On appeal to the 9th Circuit, the Board respectfully disagreed with the District Court in *Central Valley* and the U.S. Department of Justice, and will do so here as necessary. Several other reasonable readers, including many states and non-governmental organizations, will likely join us, as many did in the *Central Valley* appeal.

Finally, the cited preliminary injunction decision does not create legally binding precedent for any purpose, including this rulemaking. The cited case was settled and voluntarily dismissed, and no judgment was entered. Thus, the intermediate rulings in that case do not bind ARB here and will not bind a reviewing court on this issue. *Pyramid Lake Paiute Tribe v. Hodel*, 882 F.2d 346, 369 n.5 (9th Cir. 1989); *In re Duncan*, 713 F.2d 538, 541, 542, 544 (9th Cir. 1983). Even if the cited ruling had been published, it would not be binding authority. See *Hart v. Massanari*, 266 F.3d 1155, 1174 (9th Cir. 2001) (explaining

that trial court decisions, unlike appellate court decisions, are not "binding authority"); *Cactus Corner, LLC v. U.S. Department of Agriculture*, 346 F.Supp.2d 1075, 1106 (E.D. Cal. 2004) ("No trial court decision is binding precedent."). And "an unpublished decision is usually not suitable as a source of persuasive authority." *Wilson v. Union Security Life Ins. Co.*, 250 F.Supp.2d 1260, 1262 n.3 (D. Idaho 2003) (citing *Hart*, 266 F.3d at 1278). Again, the ARB believes that the factual situations are distinguishable here anyway. And in any event, the potential for litigation over this question of federal law does not preclude or excuse ARB from fulfilling its statutory rulemaking duties under AB 1493. Cal. Const. Art. III, Sec. 3.5.

(3). Federal Foreign Policy

594. Comment: The proposed regulations are preempted because they conflict with the U.S. government's efforts to reduce global warming through diplomatic initiatives; the Constitution prohibits a state from taking measures that interfere with the foreign policy of the United States. Alliance (Appendix H).

Agency Response: The commenter's own factual assertion elsewhere – that California's new motor vehicle fleet contributes only a minute fraction of worldwide greenhouse gas emissions – undermines their argument here. Obviously, if their other argument were true, the federal government would have little to worry about. In addition, though the commenter cites a few cases in support of their argument, they do not state what the foreign policy of the United States is with which these regulations would arguably conflict. This renders a response impossible and puts into question whether there is actually a comment here in need of response.

595. Comment: The proposed regulations are preempted because they conflict with the U.S. government's efforts to reduce global warming through diplomatic initiatives; the Executive Officer's proposal would interfere with established federal efforts to combat climate change through multilateral international agreements. Alliance (Appendix H).

Agency Response: See response to comment 594. In addition, the subject greenhouse gas regulations not only do not conflict with minimal federal efforts underway, they actually further them. See Brief for the Petitioners in Consolidated Cases, *Commonwealth of Massachusetts, et. al. v. U.S. EPA*, nos. 03-1361 (D.C. Circuit), pp. 58-60) (arguing parallel EPA greenhouse gas emission standards would further U.S. requirements under the Rio Treaty).

596. Comment: A global climate program can be effective only if it is at least a coordinated national effort. California should instead focus on ways to complement federal efforts to improve fuel efficiency and reduce greenhouse gases. (John Cabaniss, Director of Environment Energy, Association of International Automobile Manufacturers).

Agency Response: See response to comment 594. In addition, the subject greenhouse gas regulations not only do not conflict with minimal federal efforts underway, they actually further them. See Brief for the Petitioners in Consolidated Cases, *Commonwealth of*

Massachusetts, et. al. v. U.S. EPA, nos. 03-1361 (D.C. Circuit), pp. 58-60) (arguing parallel EPA greenhouse gas emission standards would further U.S. requirements under the Rio Treaty).

Equally important, this argument proves too much. Any state or local measure – e.g. energy conservation measures – could conceivably implicate a “foreign policy” concern, in this example oil diplomacy in the Middle East. More specifically in the air pollution context, state or local efforts to reduce particulate emissions in California, for example, would theoretically conflict with potential foreign policy with China on reducing its emissions from reaching the U.S. (By extension of the commenter’s analogy, it wouldn’t be fair to force U.S. companies in California to reduce their particulates given China’s increasing production.) These examples are no less far-fetched than that provided by the commenter.

In addition, as noted in the above *Brief*, mercury crosses international boundaries yet EPA regulates it. So does California. The *Brief* also points out that there would appear to be no distinction between emission reductions that are being achieved and documented through EPA’s voluntary reduction efforts (in California, through its Energy Commission and Registry), and those that would be achieved through a regulatory measure such as this. While no majority opinion issued in that case, we note the dissent’s observation that “EPA’s concern that regulations could weaken U.S. negotiating power with other nations has nothing to do with whether GHGs contribute to welfare-endangering air pollution .” D.C Circuit Slip Opinion 03-1361, Judge Tatel (dissent) p. 36. Finally, given the uncertainty over whether these greenhouse gas regulations actually conflict with established federal efforts or the “...President’s prerogative...” cited, the Board must follow its charge to adopt regulations to reduce greenhouse gas emissions from California’s motor vehicle fleet. HSC §43018.5(a).

(4). Federal Antitrust Law

597. Comment: Proposed Sections 1900(b)(9) and 1900(b)(13) are preempted by the federal antitrust laws because they would require unlawful cooperation by competitors in the California automobile market. The regulation encourages the exchange of supply information, the coordination of supply decisions, and the coordination of product designs between two or more otherwise competing manufacturers, in violation of the Sherman Act. Alliance (Appendix H).

Comment: Comprehensive coordination with these companies in some areas such as the numbers of vehicles offered for sale in California and product pricing could potentially be unlawful. GM.

Comment: Section 1900(b)(9) would require MMNA to aggregate its annual sales with DaimlerChrysler in violation of antitrust and fair competition laws. Mitsubishi Motors North America.

Agency Response: For clarification, we presume that the first commenter above intended to refer to 1900(b)(22), rather than 1900(b)(13), since they quoted the text of the former.

As the commenter points out, the complained of provisions are identical to those contained in the federal test procedures affecting small volume manufacturers and small volume engine family test groups. See 40 CFR §§86.1838-01(b). These provisions were adopted federally as part of the joint ARB-U.S. EPA-industry “CAP 2000” effort to streamline certification procedures for new motor vehicle manufacturers. See 64 Fed.Reg. 23925 (May 4, 1999). These federal provisions in part built on the federal aggregation formulas for small-volume manufacturer certifications, which have been in effect since 1990, and which were U.S. EPA policy for many years before that. See 55 Fed.Reg. 7178 (February 28, 1990). See also related small-volume certification procedures at 40 CFR §§ 86.092-14, 86.1801-01(d), 86.1826-01, 86.1810(i)(8), 86.1838-01, 86.1845-01, and 86.1845-04.

California aligned a substantial portion of its LEV II test procedures with the CAP 2000 provisions, for which U.S. EPA granted a waiver of federal preemption. 68 Fed.Reg. 19811 (April 22, 2003). California took another step toward this alignment in the LEV II context by adopting an “independent low volume manufacturer” definition (13 CCR §1900(b)(21)) to apply these identical aggregation provisions for purposes of meeting fleet average NMOG requirements, which U.S. EPA also waived. 70 Fed. Reg. 22034 (April 28, 2005).

This rulemaking simply continues California’s alignment with the federal test procedures by allowing manufacturers to certify in California to meet LEV II (and these greenhouse gas) emission standards as they will certify federally to federal Tier II standards. For Tier II, small volume manufacturers are not subject to the exhaust and evaporative phase-in for 2004-2006. 40 CFR §86.1811-04(k). Similarly for LEV II, small-volume manufacturers are not subject to the phase-in requirements for LEV II in the 2004-2006 model years. See 13 CCR section 1961(b)(2) (light duty vehicles), and section 1961(b)(3)(B) (medium duty vehicles.) Given this history, it would make no sense to establish a different, potentially market-disrupting and burdensome scheme for certification to the greenhouse gas emissions standards. And for the following reasons, ARB disagrees that the provisions in question promote anti-competitive behavior in violation of the Sherman Act.

Far from restraining competition, the adopted aggregation provisions continue federal and state efforts to promote competition (and prevent monopoly by larger corporations) by reducing or delaying requirements on true small and intermediate-volume manufacturers to continue their viability in the market. In addition, the provisions are optional in that both the smaller and the larger manufacturer can continue to separately certify their vehicles. The definition of a small volume manufacturer in Title 13, section 1900(b)(22) gives criteria for evaluating whether or not a manufacturer that “seeks certification as a small manufacturer” can qualify. A manufacturer must meet these requirements in order to be eligible to certify to the small volume manufacturer provisions of the LEV II and greenhouse gas regulations. A manufacturer always has the option of meeting large volume manufacturer requirements, regardless of the size of the manufacturer. So, for example, MMNA is wholly-owned by DaimlerChrysler. DaimlerChrysler can aggregate

MMNA's sales with theirs. Alternatively, if the two companies don't want to exchange and coordinate product information, MMAN can certify its own vehicles to large volume manufacturer requirements and DaimlerChrysler can certify the rest of its vehicles (i.e. those sold under the Mercedes and Chrysler nameplates) to large volume manufacturer requirements; this would obviate the need to exchange supply information, coordinate supply decisions, or coordinate product designs. See also agency response to comment 527.

By contrast, the cases cited by the commenter present factual situations involving exchanging and coordinating information to stabilize prices and restrict supply (*Petroleum Products*, 906 F.2d 432, 447-53), or to fix prices (*Freeman v. San Diego Association of Realtors*, 322 F.3d 1133, 1146-47 (9th Cir. 2003)). Because the aggregation provisions here refer to an optional method of demonstrating compliance and would not tend toward an ability by any affected company to raise prices, we do not foresee the aggregation provisions at issue creating anywhere near the same kind of factual problems. And though the Board would argue that the provisions do not compel anticompetitive conduct, to the extent they did, there is a possibility here that the challenged provisions would qualify as "state action" that immunizes from antitrust liability the manufacturers' private conduct to meet the regulations. See *Rice v. Alcoholic Beverage Control Bd.* (1978) 21 Cal.3d 431.

In addition, the comment seems to assume that the subject provisions would be per se violations of the Sherman Act, when they would undoubtedly be judged instead under a rule of reason analysis. See *National Socy of Professional Engrs v. United States*, 435 U.S. 679, 691-92 (1978) and *Copperweld Corp. v. Independence Tube Corp.*, 467 U.S. 752, 768 (1984) (joint ventures and similar agreements are judged under rule of reason to assess combination's actual effect and tendency toward monopoly). This analysis would first require the commenter to have shown an adverse effect on competition in the relevant market. The commenter has provided no facts or even speculation as to such potential adverse effects. Further, ARB experience with affected manufacturers shows most arrangements are of a joint venture nature which face reduced antitrust scrutiny. Even if the commenter had made the required factual showing here, this would merely shift the burden of proof to the Board to demonstrate that the subject provisions promote rather than restrain competition. Here we believe that the subject provisions would promote competition in the market, as described above. Finally, to accept the comment at face value would potentially subject the commenter's member companies – who over the years have likely taken advantage of the patterned-upon federal and state aggregation provisions – to numerous anti-trust claims. We assume that the commenter does not read the Sherman Act to require such a result.

Even if the subject provisions were held to violate the Sherman Act, they are clearly severable from the remainder of the proposed regulations under the test in *Schenley Affiliated Brands Corp. v. Kirby*, 21 Cal.App.3d 177, (1971). The text is easily grammatically and functionally severable; the existing small volume and intermediate volume manufacturer definitions can continue to apply to the remainder of the LEV II certification requirements as amended herein for the purposes of meeting both LEV II and

greenhouse gas emission standards. The intermediate-volume manufacturer language applies only to the new greenhouse gas emission standards in section 1961.1, and the remainder of the greenhouse gas regulations can function without aggregating such sales. The existing small-volume manufacturer language can continue to function, as it has, for both the existing LEV II program and the new greenhouse gas standards.

With regard to the “volitional” test, it’s clear that while the Board considered each aggregation provision useful for providing flexibility to manufacturers (see ISOR pp. 122-123), they were not a focus of the hearing, the potential effects thereof were not relied upon for setting the standard, and the Board would have wanted to achieve the substantial greenhouse gas reductions from the regulation action despite the loss of a potential break for unknown manufacturers.

Clearly, then, if the aggregation provisions are found invalid, they are severable from the remainder of these greenhouse gas regulations and from the remainder of the LEV II program.

(5). The Federal Commerce Clause

598. Comment: If the proposed rule were implemented, the burden on interstate commerce so far exceeds any putative benefits that the proposed rule would violate the dormant Commerce Clause. Alliance (Appendix H).

Agency Response: The commenter’s factual assertions elsewhere arguably render this a non-issue. The commenter elsewhere asserts a manufacturer meeting California’s greenhouse gas regulations will easily offset those vehicles by selling what they term “more fuel-intensive” vehicles in other States. Alliance (Appendix H, pp. 44-45). Thus in the commenter’s own words there would be few if any burdens on interstate commerce; the commenter tells us their member companies would simply produce greenhouse gas-compliant vehicles for California while continuing to produce other vehicles for other States. If however the commenter’s factual assertion is false, there is no dormant Commerce Clause violation here, either because the Clean Air Act exempts these regulations from dormant Commerce Clause analysis, or because under deferential review of public health and environmental regulations, the benefits here clearly outweigh the burdens under the *Pike* balancing test (*Pike v. Church*, 397 U.S. 137 (1970)). cited by the commenter.

“Where state or local government action is specifically authorized by Congress, it is not subject to the Commerce Clause even if it interferes with Interstate Commerce.” *White v. Massachusetts Council of Constr. Employers, Inc.*, 460 U.S. 204 (1983), quoted in *Oxygenated Fuels Association, Inc. v. Davis* 163 F.Supp.2d 1182 (E.D. Cal. 2001) {subsequent history omitted}. California courts have recognized the Commerce Clause exemption that Clean Air Act section 209(b) provides for California’s new motor vehicle emission program. *People ex.rel. State Air Resources Bd. V. Wilmshurst* (App 3 Dist. 1999) 68 Cal.App. 4th 1332, 1345. See also discussion in *Jordan v. Department of Motor Vehicles*, (1999) 75 Cal.App.4th 449, 461. Thus if California intends to or does seek a

waiver of federal preemption under section 209(b), a court should exempt the subject regulations from dormant Commerce Clause analysis.

Even if a court were to evaluate these regulations under the *Pike* balancing test – either because it found section 209(b) did not exempt them from dormant Commerce Clause analysis or because California was not seeking a waiver – the benefits of the regulation clearly outweigh the burdens. ARB’s analysis of the burdens to manufacturers flatly contradicts the commenter’s assertions. See Agency Response to Comments 207 through 242 and 254. Even if compliance in California “will require a different mix of vehicles” sold in California, vehicles that “will be less available in the rest of the country,” those truisms are potential, ongoing outcomes of section 209(b) well-known to the regulated industry, to the public, and to Congress. Far from having a “distorting effect,” then, the regulations would continue furthering Congresses’ choice to permit California to continue blazing its own trail to the benefit of its citizens and those in the other States.

Against these modest burdens are the substantial putative benefits provided by these regulations. The Legislature expressed and the rulemaking justifies a strong public interest in addressing the serious impacts global warming would impose on California by limiting a principal cause of California’s greenhouse gas emissions. AB 1493 (Pavley), Stats. 2002, Ch. 200, SEC. 1(d) & (e). In fact, given the magnitude of potential structural changes to California’s water supply, agricultural base, and coastal and other natural resources, it could well be argued by California (and other states) that the magnitude of potential impacts from global warming justifies far greater state action than that contemplated by AB 1493. Recent actions, e.g. by Governor Schwarzenegger to set aggressive greenhouse gas emission reduction targets for California, indicate that is the case. See Governor Schwarzenegger’s Executive Order S-3-05. The putative benefits are hardly illusory, as California’s and maybe other states’ citizens will substantially reduce vehicular contributions to global warming, while saving money.

Finally, even if *Pike* balancing led to a close call, it would occur under a strong presumption of validity given to public health and safety regulations in general (see *Huron Cement Co. v. Detroit*, 362 U.S. 440 (1960) and *Kassell v. Consolidated Freightways Corp.*, 450 U.S. 662, 669-70 (1981)), and to air pollution control in particular. *Exxon Mobil Corp v. U.S. EPA*, 217 F.3d 1246, 1255-56 (9th Circ. 2000). This should tip the scales in California’s favor, upholding its regulations against a dormant Commerce Clause challenge.

B. COMMENTS RECEIVED DURING THE FIRST 15 DAY COMMENT PERIOD

1. Overview Comments on the Regulation as a Whole

599. Comment: Environmental Defense recommends immediate adoption of staff’s changes. Our evaluation of the proposal is that it is scientifically and economically sound, meeting the requirements of AB 1493, as demonstrated by the careful analysis and assessment reflected in the Initial Statement of Reasons (ISOR) for Proposed Rulemaking prepared by CARB staff to justify the regulations. The 15-day changes are an appropriate

and thorough response to stakeholder testimony to the Board on September 23rd and 24th and in written comments submitted separately. We support these changes and view them as a critical last step in finalizing a technically feasible and economically justified rule. (Haxthausen, Environmental Defense, 11/05/04).

Agency Response: The comment is supportive of the staff analysis. No further response needed.

600. Comment: We would like to take this opportunity to comment specifically on a number of issues raised in the 15-day changes and September 10th addendum, including several pertaining to the economic analysis supporting the rulemaking.

CARB's decision to adopt the proposed regulations with minor technical changes represents a very significant step forward to address a mounting environmental problem facing California. Presentations made to the Air Resources Board at the hearing on September 23 by Dr. Benjamin Santer of Lawrence Berkeley National Laboratory and Dr. Barbara Weller of CARB provide dramatic evidence that in the absence of action, California will face a future of dramatically higher temperatures, severely diminished snowpack, reduced water availability for human consumption, power generation, and agriculture, and increases in harmful impacts to public health. Moreover, higher temperatures will exacerbate the formation of ozone in the troposphere over California, offsetting measures to control ozone by controlling nitrogen oxides and reactive organic gases. Thus, CARB is squarely within its mission to take on this problem. Action on climate change is a necessary component of any forward-looking strategy to address California's entrenched air pollution problems, and addressing the air pollution---in this case, carbon dioxide and other greenhouse gas emissions---from motor vehicles is an essential element of any serious and comprehensive strategy to mitigate human-induced warming.

Some opponents of this regulatory action have suggested that action in California is unnecessary and ultimately futile because of the worldwide scope of global warming. However, addressing global warming will require a series of actions large and small by governments all across the world. California is prudent to prioritize emissions from motor vehicles as part of its comprehensive strategy on global warming because motor vehicles constitute the state's largest and fastest growing source of greenhouse gases.

California is pressed to act decisively to address its emissions and exert policy leadership because it is especially vulnerable to the consequences of any degree of warming. It is a coastal state, reliant on a constrained water supply, and facing air pollution problems that are exacerbated by high temperatures. Moreover, as a large, industrialized economy that relies heavily on motor vehicles, California has a relatively large share of global emissions both relative to its population and its geographic area. Action by CARB to address California vehicle emissions is both necessary and prudent in light of California's need to manage its air quality, its vulnerability to the effects of further warming, and its relatively significant share of the sources of the problem. (Haxthausen, Environmental Defense, 11/05/04).

Agency Response: The comment is supportive of the staff analysis. No further response needed.

2. Comments on Specific Issues

a. ISOR Section 2--Climate Change Science

601. Comment: In the materials placed in the rulemaking file for public comment prior to the public hearing on the greenhouse gas regulatory proposal in September, the Executive Officer offered no scientific or other evidence establishing that the proposed rules would reduce the environmental or public health risks identified in the Initial Statement of Reasons for the proposed rulemaking (the “ISOR”) and in the accompanying Technical Support Document. None of the additional materials placed in the rulemaking file last month establish such a connection. (Second Declaration of Jon Heuss).

Agency Response: The passage of Assembly Bill 1493 in 2002 directed the California Air Resources Board to develop greenhouse gas emission standards for passenger vehicles. The legislation explicitly discussed the rationale for the direction to develop regulations (i.e., concerns over the impacts of climate change on California). Thus the commenter is questioning the merits of the enabling legislation, not the Board’s implementation of its directives. The regulations that the Air Resources Board staff developed in close coordination with a broad spectrum of stakeholders through a series of workshops and public comment periods are consistent with the direction given by the Legislature.

It is true that the contribution to a reduction in global warming from the actions of California alone will be small. This is true of any individual contribution. The point here is that human-induced climate change is a truly global problem – one that will eventually require actions by all countries. By assuming a leadership role, California will show the way for other states and countries, and eventually reap the benefits of more widespread emission reductions. Just as the Kyoto Protocol is only a first step towards solving the climate change problem, so, too, is California’s proposed action a first step towards more geographically comprehensive actions. Without this first step, California, the U.S., and all countries will be subjected to the consequences of unmitigated climate change.

602. Comment: The ISOR indicates that the regulations will reduce climate change emissions by an estimated “85,900 CO₂ equivalent tons per day statewide in 2020 and by 143,300 CO₂ equivalent tons per day in 2030.” Nevertheless, none of the additional materials provided by the Executive Officer for comment last month attempts even the most basic type of inference from (i) *the assumed reduction in greenhouse gases* to (ii) *changes in temperature* that would be observed in the biosphere. The same omission existed in the materials that the Executive Officer placed in the rulemaking file in support of her proposal prior to the public hearing in September. (Second Declaration of Jon Heuss).

Agency Response: As noted elsewhere, staff has not claimed that this regulation alone will solve the climate change problem; rather, it is a first step and provides leadership that will help ensure progress in other jurisdictions.

603. Comment: The additional materials placed in the rulemaking file cannot provide an inference or connection between the claimed reductions in greenhouse gases and the temperatures that would be observed in the biosphere because none is possible. The impossibility of such a demonstration can be established from work like that of Dr. T.M.L. Wigley of the National Center for Atmospheric Research in Boulder, Colorado. Wigley has examined the effects of the Kyoto Protocol and several other cases on CO₂ concentrations, mean temperatures, and mean sea level, using models also used by the IPCC. Wigley estimated CO₂ equivalent emission inventories, CO₂ concentrations, and global mean temperature for several scenarios projected out to calendar year 2100. Under all three scenarios, CO₂ equivalent inventories are assumed to follow a “No Protocol” case until 2000. Between 2000 and 2010, emissions for the developed countries (listed in Annex B of the Protocol) are reduced by 5% over the 2000-2010 period in a linear fashion. Beyond 2010, there are 3 different scenarios:

- No further emission reductions past 2010 (NOMRE)
- Constant “Annex B” emissions after 2010 (B=const)
- Larger Annex B reductions after 2010 of 1% per year, compounded (B=-1%)

Wigley estimated CO₂ equivalent emission inventories for the three cases. Global emissions reductions for these three cases are shown in the top plot of Figure 2 of Dr. Wigley’s 1998 paper in *Geophysical Research Letters*, which appears at the conclusion of my Declaration. Dr. Wigley also estimated climate changes for the three scenarios using the models used by the IPCC. Temperature changes are shown in Figure 4 in the 1998 report. For B=CONTS, the global mean temperature warming in 2100 is reduced by 0.10-0.21°C, depending on the climate sensitivity assumed for CO₂. In Dr. Wigley’s second scenario, the global CO₂ equivalent emission reductions in 2100 were 2.161 Gt C/year. (Second Declaration of Jon Heuss).

Agency Response: While the reductions in climate change associated with individual policies or the actions of individual regions will not be identifiable, that does not mean that they cannot be quantified using climate model results. This is clearly demonstrated by the Wigley (1998) paper cited by the commenter. Wigley (1998) considered only the effects of the Kyoto Protocol. The primary conclusion that should be drawn from the paper is that Kyoto alone will not solve the climate change problem. As shown by Wigley *et al.* (1996), CO₂ concentration stabilization requires sustained and increasing emissions reductions over the 21st century and longer, with reductions phased in gradually.

604. Comment: The estimated temperature changes can be predicted from the CO₂ emission reductions from any of the scenarios from the Wigley paper and the attendant temperature changes, and the emission reductions of the climate change emission standards adopted by the ARB. The expression used is:

$$\text{Temperature change due to ARB regulation} = (\text{Emission reduction of ARB regulation})^* \\ (\text{Temperature change of global scenario})/(\text{Emission reduction of global scenario})$$

The above expression simply estimates the temperature change for the California GHG regulations from the ratio of the global emission reductions to the California emission reductions. This expression assumes that the temperature changes are proportional to the emission changes, an assumption which is supported by the temperature changes and the emission reductions of the three different scenarios mentioned in Point 4. From the Wigley paper, the “B = CONST” scenario is estimated to reduce temperatures by 0.1-0.21°C by calendar year 2100. The midpoint temperature impact is 0.15°C. The emission reductions associated with this temperature change are 2.161 Gt C/year. This translates to 7.92 Gt/CO₂/year. From the ISOR, the CO₂ emission reductions in 2030 are 143,300 tons per day, or 52,304,500 tons per year. Using the above expression:

$$\text{Change in T} = 0.15^{\circ}\text{C} * (52,304,500/7.92 \text{ Gt})$$

$$\text{Change in T} = 0.15^{\circ}\text{C} * 0.0066 =$$

$$0.001^{\circ}\text{C}$$

A calculated decrease in global warming in 2100 of about 0.001°C cannot be measured or observed, and none of the environmental or public health conditions of concern identified by the Executive Officer or in the materials she has placed in the record would be affected by such a theoretical decrease. The ISOR did not quantify greenhouse reductions beyond calendar year 2030. Using the carbon emission reductions due to the Protocol in 2030 from Table 1 and the mid-point temperature change from Figure 4 of Wigley 1998, a similar calculation predicts a decrease in 2030 of 0.0008°C due to the California regulations. Temperature decreases of the order of 0.0008 to 0.001°C would not have any impact on or benefit for the State of California. (Second Declaration of Jon Heuss).

Agency Response: It is true that the contribution to a reduction in global warming from the actions of California alone will be small. This is true of any individual contribution. The well-known book The Tragedy of the Commons speaks to such issues and illustrates the environmental damage that can occur when individuals do not take action to address collective problems.

The point here is that human-induced climate change is a truly global problem – one that will eventually require actions by all countries and political subdivisions. By assuming a leadership role, California will show the way for other states and countries, and eventually reap the benefits of more widespread emission reductions. Just as the Kyoto Protocol is only a first step towards solving the climate change problem, so, too, is California’s proposed action a first step towards more geographically comprehensive actions. Without this first step, California, the U.S., and all countries will be subjected to the consequences of unmitigated climate change.

605. Comment: Reference 2 in the materials added to the rulemaking file last month is a paper by Hayhoe and others entitled “Rising Heat and Risks to Human Health.” The paper by Hayhoe *et al.* does not establish or attempt to establish a connection between the proposed rule and the conditions of concern. As shown in paragraph 5 above, the proposed rule will not change temperatures in California in any observable way. In addition, the paper does not address the critical and fatal problems in the type of modeling

it presents that I described in paragraphs 19 and 20 of my September 2004 Declaration submitted to the record. Consequently none of the claims made in this appendix regarding extreme-heat days, future temperature extreme probabilities, and future heat-wave intensity have any scientific basis or credibility. While the paper by Hayhoe et al. also adverts to the issue of temperature and mortality, it does not address my analysis of this issue in paragraph 21 of my September 2001 Declaration. Hayhoe et al. assume that future mortality rates associated with heat waves can be extrapolated from current data, ignoring the current evidence of adaptation in their own report (at page 12), the evidence for changing mortality-heat relationships in the literature, and any likelihood of adaptation in the population's behavior or in the general urban structure over the next century. (Second Declaration of Jon Heuss).

Agency Response: Though heat-related mortality is certainly one of the most compelling impacts of heat waves, it is not the only one with relevance to human societies. Adaptive behavior – such as increasing use of air conditioning – could indeed be expected in industrialized countries like the U.S. However, there are health impacts during heat waves for people working outdoors, for recreation and tourism, and there are economic impacts related to energy infrastructure. For example, adaptation to more intense heat waves by increasing use of air conditioning would increase demand for electric power generation, with substantial economic and environmental consequences, including the upward spiraling effect on greenhouse gas emissions from more energy production.

The first part of this comment points out that the Hayhoe et al. (2004) paper does not establish a connection between the proposed rule and the climate conditions in California. We agree with the statement that the Hayhoe et al. paper does not link the ruling to California climate. The Hayhoe et al. paper contrasts the projected climatic changes and corresponding impacts in California under a higher emissions and lower emissions future.

The second part of the comment suggests that the proposed rule will not change temperatures in California in any observable way. While we agree that it would be difficult to show that the proposed rule alone will directly affect California's climate, it is a critical precedent-setting step.

In the third part of the comment, the commenter questions the credibility of the Hayhoe et al. (2004) study referred to in the Staff Report in part because the commenter does not accept the scientific contributions to and consensus achieved during the IPCC process, the validity of reconstructions of proxy temperature records over the past millennium, and the more recent surface and satellite temperature records. These points are fundamental to our understanding of global climate change, its impacts, and the outcome of actions taken to limit human emissions of greenhouse gases. Peer-reviewed research unmistakably refutes each of the commenter's views. Specifically,

- There is indeed scientific consensus not only by the IPCC but in the scientific literature as a whole (>99.9%) that warming is occurring and that a large part of the warming is a result of human activities (Oreskes, 2004).

- Mann et al. (2003) and Jones and Mann (2004) address the issue of historical temperature records, refuting claims by Soon et al. (2003) and others that the present-day warming was not unprecedented in the historical record.
- Parker (2004) and Peterson (2003) show a negligible effect on warming over the past century from the urban heat island effect with little evidence to the contrary. Benestad (2004a) also shows numerous flaws with the analysis of McKittrick & Michaels (2004) that relates urban temperatures to economic activity, some of them absolutely fundamental, render their conclusions invalid.
- Numerous studies describe the methods and present results of pattern-matching analyses that clearly attribute the observed warming over the past few decades to human-induced forcing rather than natural variability.
- The argument that CO₂ and other greenhouse gases are contributing to climate change is not based on ice core data, as the commenter incorrectly assumes, but on the fact that CO₂ is known and proven to absorb and re-radiate infrared radiation at wavelengths emitted by the earth

Given the scientific consensus that climate change is occurring as a result of human activities, we believe that the Hayhoe et al. (2004) study that the commenter questions has a strong foundation on which to build an assessment of the potential impacts of a range of future scenarios on California.

The fourth part of the comment questions the accuracy of climate models. In regards to Hayhoe et al. (2004), the commenter raises questions regarding the use of global-scale general circulation models (GCMs). The two GCMs used by this study have been rigorously evaluated against the observational record (Washington et al. 2000, Pope et al. 2000) and shown to adequately reproduce global temperature trends over the last century as well as other key climate features including the ENSO phenomenon. The Hayhoe et al. (2004), clearly acknowledges the limitations of the models used, as imperfect representations of the climate system yet still useful tools, particularly for temperature projections.

We agree with the commenter that the number of GCM gridcells overlying California are inadequate to assess the differential impacts of climate change on the California coast vs. the Sierra Nevada mountains. This is precisely the reason that the modeling cited by staff employed two peer-reviewed statistical downscaling methods to produce climate projections (rather than predictions) for a 12km by 12km grid over California (for hydrological and agricultural analyses) and for individual cities within California (for analysis of extremes). The downscaling methods are clearly described in Hayhoe et al. (2004) and accompanying supplemental material. The fact that the commenter believes that the Hayhoe et al. study was based solely on GCM output suggests that it was not read thoroughly before dismissing it by stating “none of the claims have any scientific basis or credibility.” The paper addresses directly the concerns the commenter raises. For example, the “extrapolations” used to produce detailed estimates of snowpack in the Sierra Nevada mountains were in fact produced by a fine-scale hydrological model of the

region that has been extensively tested, peer-reviewed, and previously applied for short-term hydrological forecasting in the region.

The fifth part of the comment suggests that the heat-related mortality analysis in Hayhoe et al. (2004) is not valid because it does not account for adaptation measures. As explained in the response to the comment above, the Hayhoe et al. study does adjust the historical heat-mortality relationship to account for acclimatization using an “analogue summer” approach. This approach attempts to determine how mortality responds to weather during the hottest summers that presently occur, and uses these hot summers as analogues for future extreme. The mortality estimates, while still impressive, are lower using the analogue approach. The commenter is thus incorrect in stating that the study does not account for acclimatization.

606. Comment: Reference 3 in the materials added to the rulemaking file by the Executive Officer is a report by the Climate Change Science Program and the Subcommittee on Global Change Research of the U.S. government. That report discusses on page 47, in Figure 9, the use of General Circulation Model (GCM) results and what is sometimes called the “human influence component.” My prior Declaration described the serious and unacceptable flaws in such models, in paragraphs 17 to 20. Dr. Richard Lindzen (in Lindzen, 2004) of MIT has recently addressed the fallacy of the “human influence” interpretation of constructs like that in Figure 9. After pointing out the large uncertainties associated with aerosols (Anderson et al., 2003), Lindzen goes on to say:

“In brief, we start by assuming the model is correct including its internal variability. We then attribute differences between the model behavior in the absence of external forcing, and observed changes in ‘global mean temperature’ to external forcing. We separately introduce ‘natural’ and ‘anthropogenic’ forcing in such a manner as to obtain a ‘best fit’ to observations. If we succeed (which is inevitable in this procedure), we assert that the attribution of part of the observed change to the greenhouse component of the ‘anthropogenic’ forcing must be correct. Of course, model internal variability is not correct, and ‘anthropogenic’ forcing includes not only CO₂ but also aerosols, and the latter are unknown to a factor of 10-20 (and perhaps even sign). Finally, we have little quantitative knowledge of ‘natural’ forcing so this too is adjustable. This would have been an embarrassment even to the Ptolemaic epicyclists yet an almost identical analysis has just been presented to our government.” (Second Declaration of Jon Heuss).

Agency Response: The comments regarding the “serious and unacceptable flaws” in GCMs have already been addressed. The commenter then questions the “human influence” conclusions of the IPCC, U.S. National Academy of Sciences, etc. These conclusions are based on:

- 1) Our physical understanding of the climate system, and the heat-trapping properties of greenhouse gases;

- 2) Evidence from paleoclimate reconstructions, which enables us to place the warming of the 20th Century in the context of temperature changes over the last 1-2 millennia;
- 3) The qualitative consistency between observed changes in many different aspects of the climate system (*e.g.*, increases in ocean heat content, widespread retreat of glaciers, sea-level rise, decreasing coverage of Arctic sea ice, warming of the Earth's surface, cooling of the stratosphere, increase in tropopause height, *etc.*) and model predictions of the changes that should be occurring in response to human influences;
- 4) Evidence from rigorous statistical "fingerprint" studies, which compare modeled and observed patterns of climate change.

Prof. Lindzen's comments (which are cited in the comment) relate to the latter category of evidence. Although Prof. Lindzen dismisses fingerprint research, it is worth noting that there is a rich history of such work in the climate science community. Since the first paper on this subject, many dozens of fingerprint studies have been performed, by groups at the Max Planck Institute for Meteorology, Lawrence Livermore National Laboratory, Texas A&M University, the Hadley Centre for Climate Prediction and Research, the Canadian Climate Center, the Jet Propulsion Laboratory, *etc.* The underlying idea in fingerprinting is to search for a model-predicted pattern of climate change (the "fingerprint") in actual observations. The fingerprint is derived from a model experiment in which one or more human factors (such as atmospheric concentrations of greenhouse gases, or sulfate aerosol particles) are varied according to the best-available estimates of how these factors changed over space and time. The level of agreement between the model fingerprint and observed patterns of climate change is quantified with various statistical metrics. The same model fingerprint is then compared with estimates of purely natural climate variability. This enables researchers to test different hypotheses regarding the possible causes of recent climate change.

As noted above, many research groups around the world have been involved in fingerprinting studies. These groups have employed a wide variety of statistical techniques, climate models, and observational data sets. Fingerprint studies have been applied to surface temperature changes, stratospheric and tropospheric temperatures, ocean heat content, tropopause height, and surface pressure fields. Despite the wide variety of techniques, data sets, and climate variables, the common denominator in virtually all of this work is that natural climate variability alone cannot explain the observed climate changes over the second half of the 20th Century. The best statistical explanation of these changes invariably involves a large human contribution.

Prof. Lindzen is not an expert in fingerprinting, and has published no peer-reviewed papers on this topic. His comments betray a fundamental misunderstanding of many aspects of fingerprinting:

- 1) Fingerprint studies rely on complex modeled and observed patterns of temperature change (as well as changes in other climate variables). They do not consider changes in global-mean temperature only, as Lindzen incorrectly asserts.
- 2) Lindzen is incorrect in claiming that there is “inevitability” about the success of fingerprint detection work. Fingerprint results can be sensitive to a variety of processing options, such as choice of observational and model data sets, processing options, etc. (see Thorne *et al.*, 2003, and Santer *et al.*, 2005). For example, Santer *et al.* (2003) showed that a model-predicted fingerprint of tropospheric temperature changes could be identified in one satellite data set, but not in another.
- 3) According to Lindzen, fingerprint studies implicitly assume that model estimates of natural internal climate variability are correct. In fact, many fingerprint studies explicitly test whether model-based estimates of natural climate variability are realistic.
- 4) Lindzen claims that natural and anthropogenic factors are somehow skillfully adjusted “in such a manner as to obtain a ‘best fit’ to observations”. This, too, is incorrect. It is true that climate modelers rely on comparisons with observations in order to improve model portrayal of the mean climate (that is, the average climate over decades or longer). However, modelers do not manipulate the historical changes in greenhouse gases, aerosol particles, or solar variability in order to improve correspondence between the modeled and observed temperature changes over the 20th Century (which are very complex space-time patterns). Detailed comparisons between modeled and observed climate changes – such as fingerprint studies – are performed after the model experiment has been completed, not during the experiment itself.

It is immutable fact, not idle speculation, that human activities have changed the chemical composition of Earth’s atmosphere. The key scientific question is not whether human activities have influence global climate. Rather, it relates to the size of the human influence. Our best scientific evidence is that the human effects on global climate have been substantial (Mitchell *et al.*, 2001).

607. Comment: Consequently, the “human influence” interpretation of the results is based on fatally flawed logic. In fact, the large uncertainty about the effects of aerosols on the Earth’s radiation balance is noted on page 49 of reference 3 as a “crucial factor limiting the predictability of global climate,” which support’s Dr. Lindzen’s critique and analysis. (Second Declaration of Jon Heuss).

Agency Response: Staff disagrees with the comment. “Human influence” conclusions are based on a wide range of scientific evidence – they are not based on “fatally flawed logic,” as the commenter incorrectly claims. See response to Second Declaration of Jon M. Heuss, comment #7. Although there are considerable uncertainties in the size of aerosol effects on climate, many independent “fingerprint” detection studies have statistically

identified the cooling signature of sulfate aerosols in observed surface temperature changes (e.g., Hegerl *et al.*, 1997; Stott and Tett, 1998; Tett *et al.*, 1999; Stott *et al.*, 2000, 2003). Furthermore, it is worth noting that aerosol effects on climate are also largely human-induced (Ramaswamy *et al.*, 2001), and that the surface cooling caused by sulfate aerosols (and perhaps also by soot aerosols) has probably offset some of the surface warming caused by increasing greenhouse gases. Since aerosols have important effects on air quality and human health, there will be increasing pressure (in both developed and developing countries) to reduce atmospheric concentrations of sulfate and soot aerosols. When this occurs, the warming signal induced by increasing gases should be very obvious.

608. Comment: Reference 6 in the additional materials is a paper by Fiore *et al* entitled “Linking ozone pollution and climate change: the case for controlling methane.” The article predicts that rising concentrations of methane associated with a “pessimistic” 2030 emissions scenario will lead to higher background ozone resulting in higher peak ozone, more days above an 80 ppb threshold, and an extension of the U.S. ozone season into April-May. That scenario is not supported by ambient methane data. The latest global methane trend analysis shows that the methane concentration is no longer increasing and has been constant for the last four years (Dlugokencky, 2003). In fact, reference 3 in the additional materials (a report on the U.S. Climate Change Science Program) highlights (at page 31) the fact that global atmospheric methane levels, as measured at an extensive network of surface sampling sites, are now constant. Reference 3 attributes the change to reductions in emissions from the former Soviet Union since there was an abrupt drop in the early 1990’s in the difference between methane values in the Northern and Southern Hemispheres. (Second Declaration of Jon Heuss).

Agency Response: All of the emissions scenarios give CH₄ increases of 10% or more and project tropospheric ozone increases to 2030. After 2030, the slow-growth scenario B1 then levels off and shows modest CH₄ decreases by 2100. It is unusual to describe these scenarios as “pessimistic,” since the alternative scenarios (which have only recently become available) involve extension of current legislative controls of air quality and climate gases like CH₄ – an option seemingly rejected by the commenter. Tropospheric O₃ is projected to increase due to both CH₄ and NO_x increases (read the Fiore *et al.* paper more carefully, or the IPCC TAR chapter 4, or the Prather *et al.*, 2003 summary).

The very recent leveling off of tropospheric CH₄ abundances can be understood (as Dlugokencky explains) in terms of known changes in anthropogenic emissions. This actually reinforces the credibility of the future scenarios provided that our projections of those anthropogenic activities are correct. The Dlugokencky study points to the massive changes in the former USSR as the cause of the current leveling off of CH₄. Basically, it says that we understand CH₄ behavior. Furthermore, the commenter should reference current data – the record of global CH₄ abundance (as reported by Dr. Dlugokencky at NOAA/CMDL) has been increasing over the past two years, indicating that the zero-growth rate was an anomaly due to reduced anthropogenic emissions in those years.

609. Comment: Reference 9 in the additional materials is an informal summary of other work and an expression of various claims by Krista Ebi at the ARB public meeting on July 22, 2004 Board Hearing. Ebi presents a list of public health problems that she says will occur with climate change and associated warmer temperatures. These problems include: 1) increased geographic range of malaria and other vector-borne disease 2) increase in heat waves exacerbated by increased humidity and urban air pollution, 3) increased flooding which “could increase drowning, diarrheal and respiratory diseases, and 4) increases in water – and food-borne diseases. The first assumption that Ebi makes however, is that anthropogenic emissions of CO₂ are causing and will continue to cause, in the future, rising temperatures. This assumption ignores the many problems associated with the temperature record and the future predictions of the GCMs. Those problems have been discussed in my September 2004 Declaration in paragraphs 6 through 20. Reference 9 ignores those problems, and like the Executive Officer’s other new materials, it does not demonstrate any connection between this proposed rule and the conditions of concern. (Second Declaration of Jon Heuss).

Agency Response: That anthropogenic emissions of CO₂ are causing and will continue to cause in the future, rising temperatures is well-established as fact by the climate research community.

610. Comment: In addition, Reference 9 does not discuss the most significant and relevant work on the connection or lack of connection between warmer temperatures and increased vector-borne disease such as malaria. Such a connection has not been unequivocally established. As Paul Reiter of U.S. Center for Disease Control’s (CDC) Division of Vector-Borne Infectious Diseases (Reiter, 2001) states:

“Speculations on the potential impact of continued warming on human health often focus on mosquito-borne diseases. Elementary models suggest that higher global temperatures will enhance their transmission rates and extend their geographic ranges. However, the histories of three such diseases – malaria, yellow fever, and dengue – reveal that climate has rarely been the principal determinant of their prevalence or range; human activities and their impact on local ecology have generally been much more significant. It is therefore inappropriate to use climate-based models to predict future prevalence.”

In another CDC publication (Reiter, 2000), Reiter states:

“Discussions of the potential effects of the weather include predictions that malaria will emerge from the tropics and become established in Europe and North America. The complex ecology and transmission dynamics of the disease, as well as accounts of its early history, refute such predictions. Until the second half of the 20th century, malaria was endemic and widespread in many temperate regions, with major epidemics as far north as the Arctic Circle. From 1564 to the 1730s – the coldest period of the Little Ice Age – malaria was an important cause of illness and death in several parts of England. Transmission began to decline only in the 19th century, when the present warming trend was well under way. The history of the disease in England underscores the role of factors other than temperature in malaria transmission.”

Ignoring the analysis by Reiter that demonstrates why scientists cannot use current climate based-models to predict future prevalence of malaria, Ebi applies such a model to the east African country of Zimbabwe for 2025 and 2050 and predicts dire consequences. Hay et al. (2002) in a paper in *Nature* examined long-term trends in malaria and meteorology in the East African highlands and report:

“Here we show that temperature, rainfall, vapor pressure, and the number of months suitable for *Plasmodium falciparum* transmission have not changed significantly during the past century or during the period of reported malaria resurgence. A high degree of temporal and spatial variation in the climate of East Africa suggest further that claimed associations between local malaria resurgences and regional changes in climate are overly simplistic.” (Second Declaration of Jon Heuss).

Agency Response: Climate is one factor that determines the distribution and incidence of malaria. Temperature affects both the *Plasmodium* parasite and the *Anopheles* mosquito, with thresholds at both temperature extremes limiting the survival or development of the two organisms. *Anopheles* must live long enough to bite an infected person, allow the parasite to develop and then bite a susceptible human. As noted, while climate is an important driver of malaria, it is not the only one. As discussed by Dr. Reiter, presence of the vector does not mean that the disease will be present.

Therefore, the modeling work from Ebi et al. projected future climatic conditions conducive for stable *Plasmodium falciparum* malaria transmission in Zimbabwe; it did not project malaria prevalence. The model was based on the MARA/ARMA model of climatic constraints on the survival and development of the *Anopheles* vector and the *Plasmodium falciparum* malaria parasite. The model explored potential future geographic distributions of malaria using sixteen projections of climate in 2100. The results suggested that, assuming no future human-imposed constraints on malaria transmission, changes in temperature and precipitation could alter the geographic distribution of malaria in Zimbabwe, with previously unsuitable areas of dense human population becoming suitable for transmission.

611. Comment: Reference 9 next adverts to heat waves, air pollution and mortality. Those factors have been discussed in detail in my September, 2004 Declaration in section III, “Public Health Studies,” and section IV, “Temperature and Ozone,” which demonstrates the fallacy of any attempt to draw connections among those factors using the type of review in Reference 9. Reference 9 does not address the scientific issues raised in my analysis of those factors. (Second Declaration of Jon Heuss).

Agency Response: This comment objects that the general presentation (reference 9) by Ebi, K. does not adequately address some of the known challenges of linking heat waves and air pollution with mortality. We acknowledge that there are challenges that must be considered in the analysis and evaluation of time-series studies. In particular, the commenter highlights the findings of a 2003 report by the Health Effects Institute (HEI) that points to the need to account for other time varying factors such as weather and

unmeasured risk that may affect health outcomes. Otherwise the effects of the factors could be counted as air pollution effects. However, the HEI study, to which the commenter refers, does not draw the same conclusion as those of the commenter. In fact, the conclusion of the HEI report that the commenter references is that despite the fact that some time-series studies linking air pollution with mortality have not adequately addressed certain statistical challenges; the expert re-analysis of the data taking these issues into account suggests that the general conclusions drawn in the original studies remain unchanged. Several statements to this effect are provided in the HEI study including: 1) In general, [in the re-analysis] the estimates of effect in the National Morbidity, Mortality, and Air Pollution Study (NMMAPS) decreased substantially, but the qualitative conclusions did not change; and 2) Therefore, many conclusions that were initially drawn from the NMMAPS study are to a large degree unchanged.

Furthermore, there is a range of statistical techniques that have been used in studies linking air pollution to mortality, (Dominici 2004) not just those techniques referred to by the commenter. For example, Krewski et al. (2000), whose analysis demonstrated an increase in mortality with air pollution, uses a long-term cohort study to link air pollution to mortality rather than the standard time-series approach. Another HEI study (Daniels et al. 2004), which was designed specifically to address some of the statistical challenges identified in the Health Effects Institute report that the commenter references, also noted a strong association between air pollution and mortality and morbidity.

612. Comment: Reference 9 then refers to flooding that Reference 9 presumably is attributing to climate change. The IPCC (IPCC, 2001) found some evidence for an increase in extreme precipitation events using a limited time horizon (since 1950), and some panelists were willing to speculate that the post-1950 data established a significant trend. More recent analyses conducted with a longer record, 100 years in Canada and 105 years in the U.S., found a much different picture. In Canada, no trend was found over the length of the record (Kunkel, 2003). In the U.S. (Kunkel et al., 2003), heavy precipitation frequencies were relatively high during the late 19th and 20th centuries. The frequencies decreased to a minimum in the 1920s and 1930s then increased gradually into the 1990s. The frequencies of 1-day events during 1895-1905 are comparable to those in the 1980s and 1990s while the frequencies of 5-day and 10-day duration events are only slightly smaller in the 1895-1905 period. Consequently, the use of a 100-year database does not indicate a significant trend. Reference 9 does not discuss those studies. Reference 9 also does not rebut the analysis in Kunkel (2003) indicating that even if the GCM are correct about increased future temperatures, the net change in extreme precipitation events is uncertain. In sum, there is no competent scientific evidence that floods are going to increase because of global warming. Similarly, there is no such support for the conjectures in Reference 90 about floods, drowning, diarrheal and respiratory, and water-and food-borne diseases. (Second Declaration of Jon Heuss).

Agency Response: The statement about the time horizon in contemporary studies is incorrect. For the regions where the data were available (e.g., for most of the USA), century-long trends in heavy precipitation were found as early as in 1998 (Karl and Knight, 1998) and then confirmed by Groisman *et al.* (2004) and Groisman *et al.* (2005). The latest

studies are based upon ~6,000 stations in the conterminous United States (more than a ten-fold increase in stations compared to the first analysis of this phenomenon).

In Canada, the flooding (except in British Columbia) usually occurs due to snow melt, not due to intense rains. For British Columbia, an increasing positive trend was found in the probability of heavy precipitation since the 1910s. Other Canadian scientists (e.g., Zhang *et al.* 2001) reported an increase in heavy rainfall in Canada using the period of record that in many parts of the country is less than 100 years.

The conclusion by Groisman *et al.* was that *there were no statistically significant increases in very heavy precipitation (with return period of ~4-5 years) during the period of record in the Western U.S., which is important for California.* For the entire Southwestern U.S., this conclusion was further supported by analyses based on a new NOAA-14 Atlas (<http://hdsc.nws.noaa.gov/hdsc/pfds/>). Furthermore, it was shown that in the 1890s, the western U.S. was insufficiently covered by the meteorological network for any statement about the impact of this decade on “extreme” precipitation and thus there is no need to rebut the Kunkel (2003) work.

The intense precipitation increase does not automatically mean an increase in flooding. Moreover, a significant fraction of peak flow is routinely intercepted and stored in various reservoirs throughout the United States. Also, with significant dam construction during the 20th century, it is practically impossible to see trends in flooding in the country. The same is true for many extratropical regions of the world. Nevertheless, increasing trends in the frequency of occurrence of catastrophic floods were documented for the globe by Milly *et al.* (2002). Unfortunately, dams and dykes are still an insufficient protection from catastrophic flooding events.

We acknowledge that there are challenges that must be considered in the analysis and evaluation of time-series studies. In particular, the commenter highlights the findings of a 2003 report by the Health Effects Institute (HEI) that points to the need to account for “other time varying factors such as weather and unmeasured risk that may affect health outcomes. Otherwise the effects of the factors could be counted as air pollution effects.” However, the HEI study, to which the commenter refers, does not draw the same conclusion suggested by the comment --“the derivation of a dose-response function for ozone and mortality from any time-series study is inappropriate.” In fact, the conclusion of the HEI report that the commenter references is that despite the fact that some time-series studies linking air pollution with mortality have not adequately addressed certain statistical challenges, the expert re-analysis of the data taking these issues into account suggests that the general conclusions drawn in the original studies remain unchanged. Several statements to this effect are provided in the HEI study including: 1) “In general, [in the re-analysis] the estimates of effect in the National Morbidity, Mortality, and Air Pollution Study (NMMAPS) decreased substantially, but the qualitative conclusions did not change.” and, 2) “Therefore, many conclusions that were initially drawn from the NMMAPS study are to a large degree unchanged.”

Furthermore, there is a range of statistical techniques that have been used in studies linking air pollution to mortality (Dominici 2004) not just those techniques referred to by the commenter. For example, Krewski et al. (2000), whose analysis demonstrated an increase in mortality with air pollution, uses a long-term cohort study to link air pollution to mortality rather than the standard time-series approach. Another HEI study (Daniels et al. 2004), which was designed specifically to address some of the statistical challenges identified in the HEI 2003 report that the commenter references, also reported a strong association between air pollution and mortality and morbidity

613. Comment: Dr. Ebi has a background in public health. The Executive Officer did not include Dr. Ebi's remarks on these issues at the July public meeting in the record, and so has not attempted to provide even a partially complete report on Dr. Ebi's views on these issues. In any event Dr. Ebi is not qualified to assess the impact of a regulation like that proposed here on the public health concerns identified in Reference 9, and so her work cannot be used to establish any connection between implementation of that regulation and any change in the risks to human health of concern to her profession. Indeed, Reference 9 and her remarks to the Board do not indicate or even suggest such a connection. (Second Declaration of Jon Heuss).

Agency Response: Dr. Kristie L. Ebi's remarks were part of a non-regulatory information update provided to the Air Resources Board at its meeting in July 2004. The presentation which was added to the record provided context for the potential impacts associated climate change. Dr. Ebi did not discuss a link between the proposed regulations (i.e., the proposed climate change regulations that the Board considered at its meeting in September of 2004) and a change in the risks to human health.

For background, Dr. Ebi credentials as a health expert are substantial. She is a Senior Managing Scientist in Exponent's Health practice, based in Alexandria, VA. Dr. Ebi, an epidemiologist, has worked on a range of environmental issues including both potential human health and environmental impacts. In the field of climate change, she specializes in research both on potential impacts, including impacts associated with extreme events, thermal stress, and vector-borne diseases, and on the design of adaptation response options to reduce negative impacts.

She recently worked with the WHO European Centre for Environment and Health in Rome, Italy to provide scientific oversight to the three-year, EU-funded project entitled climate Change Adaptation Strategies and Human health (cCASHh). She is a Convening Lead Author on the just-released WHO publication Methods of Assessing Human Health Vulnerability and Public Health Adaptation to Climate Change. She is a Lead Author for the Human Health chapter of the Intergovernmental Panel on Climate Change Fourth Assessment Report. She is a lead author for two chapters in Working Group II (Response Options) of the Millennium Ecosystem Assessment, and for the Adaptation Policy Framework. She was a lead author of the Health Sector Analysis Team of the U.S. National Assessment of the Potential Consequences of Climate Variability and Change, and was a contributing author to the Human Health chapter of the Third Assessment Report of the Intergovernmental Panel on Climate Change. Dr. Ebi has more than 25

years of multidisciplinary experience in environmental issues, and has more than 50 publications. Dr. Ebi's scientific training includes a M.S. in toxicology and a Ph.D. and MPH in epidemiology, and two years of postgraduate research in epidemiology at the London School of Hygiene and Tropical Medicine.

614. Comment: Reference 10 placed last month in the rulemaking file by the Executive Officer is the other slide presentation at the July 2004 public meeting of the Board. Reference 10 presents some of the material from the IPCC (2001). Slide 3 in Reference 10 contains a graph of methane concentrations from 1000 to 1999. That slide is misleading because it does not show that the methane has stopped increasing (Dlugokencky, 2003). Had the graph gone out to 2003, this would have been obvious. Slide 4 contains the erroneous "hockey stick" graph of the temperature since 1000 AD that is analyzed in detail in paragraphs 7 to 10 in my prior Declaration. Neither Reference 10 nor any other additional materials from the Executive Officer address my analysis. (Second Declaration of Jon Heuss).

Agency Response: Staff disagrees with the comment. The commenter is not up-to-date on the observed CH₄ growth rate or the reason for its fluctuations. This statement is incorrect – the current NOAA/CMDL record shows CH₄ increases in 2003. Likewise, the slide 4 figure from the IPCC is still a good representation of the recent temperature change.

615. Comment: Slide 5 in Reference 10 contains surface temperature trends for the western U.S. It should be noted that these data sets are likely contaminated by the urban bias. This issue has been addressed in my September 2004 Declaration in paragraphs 12 through 17. Here again, there is no response from the Executive Officer to my analysis. Similarly, Slide 6 in Reference 10 contains GCM results under different scenarios out to the year 2100, but it does not address the relevant literature. Lindzen (2004) contains an excellent discussion of why such forecasts are unreliable. I provide additional reasons why they are unreliable in paragraphs 17 and 18 in my September 2004 Declaration, which is also ignored by the Executive Officer's additional materials and her other analyses. Likewise Slides 7-10 in Reference 10 contain regional extrapolations of the GCM results for Northern California. My prior analysis in paragraphs 19 and 20 in my September 2004 Declaration on the inappropriateness of Hayhoe's regional extrapolations also applies here. (Second Declaration of Jon Heuss).

Agency Response: The additional material (regarding climate change science) placed in the rulemaking file was not the basis for the analysis or recommendations presented in the Staff Report. Rather, the materials were deemed to be of interest to stakeholders given comments at the ARB's Board Hearing. Previous work states that based on current knowledge of the global methane budget and how it has changed with time, it is not possible to tell if the atmospheric methane burden has peaked, or if we are only observing a persistent, but temporary pause in its increase. Generally, climate scientists are unsure whether the recent trend represents a peak in global methane levels or simply a pause in the longer climbing trend. Climate scientists are conducting research to better understand the global methane cycle, including how its sources and sinks have changed over the last

ten years, how they might change in future decades, and what the implications are for climate. A comprehensive research effort needs to be pursued to compile a current, complete, and internationally-recognized inventory of sources of methane.

With regards to the "hockey stick" graph of temperature since 1000 AD, please see responses to comments 1 to 5 (Declaration of Jon M. Heuss). In summary, instrumental data describing large-scale surface temperature changes are only available for roughly the past 150 years. Estimates of surface temperature changes further back in time must therefore make use of the few long available instrumental records or historical documents and natural archives or 'climate proxy' indicators, such as tree rings, corals, ice cores and lake sediments, and historical documents to reconstruct patterns of past surface temperature change. Due to the paucity of data in the Southern Hemisphere, recent studies have emphasized the reconstruction of the Northern Hemisphere (NH) mean, rather than global mean temperatures over roughly the past 1,000 years. The climate model simulations all show that it is not possible to explain the anomalous late 20th century warmth without including the contribution from anthropogenic forcing factors, and, in particular, modern greenhouse gas concentration increases. This conclusion which is documented in the IPCC third assessment is stated in the staff report. Although it is still a challenge to reduce current uncertainties, it nonetheless remains a widespread view among paleoclimate researchers that late 20th century hemispheric-scale warmth is anomalous in a long-term (at least millennial) context, and that anthropogenic factors likely play an important role in explaining the anomalous recent warmth.

616. Comment: Slide 11 in Reference 10 presents the same sea-level data contained in the ISOR with an extrapolation of the data to the year 2140. My analysis demonstrating why those data should not be used as an indicator of climate change appear in paragraphs 37 and 38 of my prior Declaration, which have not been addressed. The extrapolated trend is based on GCM forecasts of temperature. For the reasons mentioned in Lindzen (2004) and in paragraphs 17 and 18 of my September 2004 Declaration, such extrapolations are unreliable. Here again, there is no response to the relevant work in the Executive Officer's additional references. (Second Declaration of Jon Heuss).

Agency Response: The issues raised in paragraphs 37 and 38 of the First Declaration of Jon Heuss have already been addressed. The same applies to the issues identified in paragraphs 17 and 18 of his First Declaration. The claim that GCMs are incapable of simulating recent observed changes in tropospheric temperatures is simply incorrect (e.g., Santer *et al.*, 2003).

617. Comment: Using quotes from glaciologist Professor Lonnie Thomason (sic) and photographs of the glacier on Mt. Kilimanjaro Slide 12 of Reference 10 conveys the impression that human-caused global warming has caused the glaciers to melt and has reduced the spatial extent of the glaciers on Mt. Kilimanjaro and elsewhere in the tropics by 80 percent since 1912. However, two recently published papers by Molg *et al.* (2003) and Kaser *et al.* (2004) demonstrate that the interpretation by Thomason (sic) and its reiteration in Reference 10 are incorrect. Collectively, the works of Molg *et al.* and Kaser *et al.* show that the recession of the glaciers on Mt. Kilimanjaro and elsewhere in the

African tropics (Mt. Kenya in Kenya and Mt. Rwenzori in Zaire and Uganda) began around 1880, the same time the planet began to recover from the several hundred year Little Ice Age. However, the recession is not due to warming – it is due to a climatic shift that began in 1880 that resulted in reduced humidity and precipitation in East Africa that still persists today. On the contrary, temperature trends in the area show diverse trends and do not exhibit a uniform warming signal. On Kilimanjaro an automated weather station was installed in 2000 and the data show that monthly mean air temperatures vary only slightly around the annual mean of -71°C and never rise above freezing. Thus, it is the drier climatic conditions and sublimation by solar radiation that has caused, since 1880, and will continue to cause the recession of the glaciers on Mt. Kilimanjaro and elsewhere in the East African tropics. (Second Declaration of Jon Heuss).

Agency Response: The weather station temperature record since 2000 is hardly a relevant historical record of warming (or absence of warming) on Mt. Kilimanjaro, and cannot be representative of temperatures over the all glaciated areas on Kilimanjaro. Furthermore, it is almost certain that the sustained and accelerating retreat of glaciers on Kilimanjaro is due to local warming (in contrast to the comment), but it is not certain that that this local warming is due to CO_2 increases. A simple reading of the IPCC 2001 Synthesis Report states that “widespread retreat during the 20th century [of] non-polar glaciers” is “consistent with a warming climate near the Earth’s surface.”

618. Comment: The remaining slides in Reference 10 deal with spring run-off, snowpack, and snowmelt. I have provided my analysis of those points in section VI in my September 2004 Declaration which has also gone without comment or response in the Executive Officer’s materials. (Second Declaration of Jon Heuss).

Agency Response: The commenter refers to his comments on changes in Californian snowpack, snowmelt, and spring runoff. These correspond to comments 18 through 30 in his First Declaration. Comprehensive responses to these comments have already been supplied.

619. Comment: Reference 24 in the Executive Officer’s new materials is a paper by Knutson and Tuleya entitled, “Impact of CO_2 -induced warming on simulated hurricane intensity and precipitation: sensitivity to the choice of climate model and convective parameterization.” While the point is not explained, it is possible that the Executive Officer intends to suggest that climate change will result in more intense hurricanes and produce more rainfall. Reference 24 predicts wind speed increases of 6 percent if the CO_2 increases 1 percent per year for 80 years, but that is improbable because the estimated rate of CO_2 increase is about 0.4 percent per year, according to the 2001 IPCC panel. Reference 24 also concludes that after about a century of warming, heavier precipitation rates than those that occur in our present climate are likely. A review of recent observational studies on hurricanes reveal either no trend or negative trends for the absolute number of storms, the intensity, the wind speed, or the number of landfalls (Bailing and Cerveny, 2003; Easterling et al., 2000; Bove et al., 1998). (Second Declaration of Jon Heuss).

Agency Response: Knutson and Tuleya (2004) analyzed results from an idealized GCM experiment with a specific rate of the CO₂ increase in the atmosphere. Among their conclusions was a projection of more destructive (stronger) hurricanes. Knutson and Tuleya did not reach definitive conclusions regarding changes in hurricane frequency. The commenter (citing papers by Balling and Cervený, 2003, Easterling *et al.*, 2000, and Bove *et al.*, 1998) claims that there is no observational evidence for changes in hurricane properties. The commenter fails to note that observational records of tropical storms are uncertain in the pre-satellite epoch, and have homogeneity problems in many parts of the world (e.g., in India, Australia, Mozambique, and China). Even for the United States, we are confident in hurricane landfall records for the past century only. Analyses of precipitation associated with hurricane landfalls over the eastern United States (Karl *et al.* 2005, first presented at the Annual AMS Meeting, January 2005) show that there is not a pronounced correlation between precipitation totals and hurricane intensity. However, there is a tendency towards precipitation increases with more intense tropical depressions over the Central U.S.

620. Comment: Reference 7 in the additional materials is a paper by Mayer and others called “Linking local air pollution to global chemistry and climate.” CO₂ is not mentioned in the paper. The Executive Officer has not indicated how or why Reference 7 would be relevant to the decision to adopt the proposed regulation. Reference 7 links a simplified urban chemistry model to a two-dimensional global chemistry-climate model and investigates the impact of growing urbanization on global chemistry and climate. Even though the simulation assumes growing urbanization and increasing urban emissions for the next 100 years, global surface temperatures were not affected compared to the case without the urban emissions. Therefore, it is not clear how or why this reference is relevant. In addition, the projections in the paper for future urban air pollution emissions are overly pessimistic. The authors assume that the current pattern of local air pollutant emissions per unit of energy consumption continues for the next 100 years. This assumes that there are no technology changes, energy efficiency advances, or additional policy actions to curb local man-made emissions around the globe, which is totally unrealistic. (Second Declaration of Jon Heuss).

Agency Response: The reference represents a minor addition that may be of interest to some reviewers. However, it was not relied upon for analysis or conclusions as presented in the staff report. In addition, this comment is merely the commenter's speculation, and that ARB Staff Report neither directly nor indirectly draw any conclusion on linking future local air pollution to global chemistry. However, it seems that climate change may affect exposures to air pollutants by affecting weather, anthropogenic emissions, and biogenic emissions and by changing the distribution and types of airborne allergens. Local temperature, precipitation, clouds, atmospheric water vapor, wind speed, and wind direction influence atmospheric chemical processes, and interactions could occur between local and global-scale environments. If the climate becomes warmer and more variable, air quality is likely to be affected. However, the specific types of change (i.e., local, regional, or global), the direction of change in a particular location (i.e., positive or negative), and the magnitude of change in air quality that may be attributable to climate change are currently a matter of intensive research projects both at national and state levels.

b. ISOR Section 5—Maximum Feasible and Cost-Effective Technologies

(1). Section 5.2—Technology Assessment

621. Comment: ARB staff has overestimated the potential for reducing carbon dioxide emissions by calculating fuel savings from a single set of driving cycles, without considering how the design changes required to meet the proposed standards affect fuel economy based on driving patterns that more accurately represent the way that typical Californians drive. In response to my testimony, the ARB staff told the Board that the use of cycles that represent actual California driving would be burdensome. [This is a comment that totally misses the point raised by Sierra’s critique of the CARB staff’s analysis. The effect of actual California driving patterns on fuel economy is independent of the test procedures used. Sierra was able to calculate the effect using a vehicle simulation model. CARB staff could have done the same thing, which is necessary to determine the real effect of the proposed standards on fuel economy in customer service.] ARB staff could have used the modeling results I submitted to correct its estimates of consumer fuel cost savings or it could have contracted for independent simulation modeling to be done by someone else. Since it did neither, my estimates of the effect of the proposed standards on fuel economy in customer service are the only estimates in the record that are based on actual California driving patterns. (Second Declaration of Thomas C. Austin, Sierra Research)

Agency Response: Staff disagrees with the comment. Staff did not state or imply to the Board that using test cycles that represent California driving patterns would be burdensome. Rather, staff was concerned that existing data are not sufficient to warrant departing from the current accepted practice of using the federal test procedures to determine vehicle fuel usage. Nonetheless, staff recognizes that USEPA is currently evaluating changes to the federal test procedures so that they more accurately reflect real world driving. Preliminary discussions with USEPA indicate that any proposed revisions to the procedures will not result in a dramatic decrease in calculated fuel consumption.

622. Comment We are still concerned that the new regulations may have an adverse automobile safety impact, even if they do not require a “reduction in vehicle weight.” Because there are other ways to accomplish the same goal, such as more fuel efficient engines and transmissions, we believe CARB should work to ensure that automobile safety is not compromised during the emissions standard certification process. (California State Automobile Association and the Automobile Club of Southern California)

Agency Response: Staff disagrees with the comment. Staff identified numerous greenhouse gas technologies including improved engines and transmissions that do not require weight reduction. Accordingly, there is no reason for vehicle safety to be compromised in order to comply with the greenhouse gas requirements. ARB has traditionally worked with manufacturers during compliance with other emission reduction programs and looks forward to working with them as they comply with the greenhouse gas requirements.

623. Comment: Since the emissions standard is a performance-based emissions standard, it is still possible that some automobile manufacturers may choose to comply with the new regulations by “down-sizing” some of their fleet. Since the emissions standard is stated in terms on “grams per mile” of emissions, a reduction in vehicle size and weight would be one potential means to contribute to meeting the emissions standard. We encourage automobile manufacturers to continue to meet and exceed all automobile safety standards. (California State Automobile Association and the Automobile Club of Southern California)

Agency Response: As noted in previous responses, feasibility to the requirements has been demonstrated without resorting to reductions in vehicle size and weight. However, should manufacturers choose this compliance option, their vehicles would still be required to comply with California and federal vehicle safety standards.

624. Comment: The testimony Sierra submitted prior to the September 23 public hearing also pointed out that ARB staff overestimated the potential for reducing carbon dioxide emissions by assuming that significant reductions in aerodynamic drag and rolling resistance can be achieved despite evidence that customers will not accept changes and despite the fact that customers do not routinely use OEM replacement tires. The staff ignored this comment when providing its response to my testimony to the Board. (Second Declaration of Thomas C. Austin, Sierra Research)

Agency Response: Staff disagrees with the comment. See response to comment 165.

(2). Section 5.3—Incremental Costs of Technologies

625. Comment It appears that we are betting on the outcome that these standards will also be adopted nationally and/or globally. What are the impacts to California if that is not the case or if it is delayed and California consumers have to bear the cost alone? Won't the price of these vehicles be substantially higher than estimated by this proceeding if California consumers alone have to absorb these costs through this unilateral action? (Robert W. Lucas, California Council for Environmental and Economic Balance)

Agency Response California is not acting alone in requiring the reduction of vehicle greenhouse gas emissions. Programs to reduce greenhouse gas emissions are already underway in Europe, Japan and other parts of the world due to either government mandates or agreements reached with the vehicle manufacturers. Furthermore, these reductions are being phased-in at a more rapid pace than required by the ARB regulations. Accordingly, the demand for low greenhouse gas technologies abroad in combination with California's approximate annual sales of 1.7 million light-duty vehicles is consistent with the high volume production assumed in staff's cost estimates. While a number of States have expressed a firm interest in adopting California's greenhouse gas regulations, staff's cost estimates did not rely on their doing so.

626. Comment: ARB staff understated the costs associated with so-called “automated manual transmissions.” In response to my testimony, the ARB staff made a presentation to the Board, which claimed that “new data” show that a more conventional 6-speed automatic would provide approximately the same CO₂ reduction for an additional \$100 in cost over the staff estimate for the automated manual transmission. The staff also said that the use of a 6-speed automatic transmission would avoid plant retooling. As explained below, no data were provided documenting the claim that 6-speed automatic transmissions can provide approximately the same CO₂ reduction. In addition the claim that 6-speed automatic transmissions can be produced without retooling is inconsistent with what has actually been required at U.S. manufacturing facilities. For example, I confirmed that all new tooling was required to produce the new 6-speed automatic transmission that has recently been developed by General Motors during a telephone conversation with knowledgeable GM staff on November 5, 2004.

The CARB staff claims that 6-speed automatic transmissions will be equivalent to automated manual transmissions in CO₂ reduction was based on an estimated 7% benefit for a 6-speed automatic provided by ZF. No information has been made available regarding the basis for this estimate, what driving cycle it assumes, what shift logic was used, or what baseline transmission it assumes. It is therefore not possible to do any critical review of the estimate. However, Sierra has independently determined, and reported to CARB that the benefits of 6-speed transmissions are only 2.7% based on detailed vehicle simulation modeling of the type done by AVL. AVL’s analysis showed the benefits of 6-speed automatic to be 3%. Rather than use these documented estimates by two different firms, CARB is relying on apparently undocumented vendor estimate. Given the consistency between the estimates provided by AVL and Sierra, it is inappropriate for CARB staff to claim that 6-speed automatics will provide the same level of CO₂ reduction assigned to automated manual transmissions.

CARB’s cost estimate for 6-speed automatic transmissions is also incorrect because, as in the case of the cost estimate for automated manual transmissions, CARB ignored the costs associated with all new manufacturing facilities. CARB staff told its Board that new tooling would not be required for 6-speed automatics. That is unsupported and inconsistent with what has actually been required in practice. The new 6-speed automatic transmissions being built in the U.S. by General Motors required all new tooling. The CARB staff has produced no evidence that new tooling is not required and that position is not credible. (Second Declaration of Thomas C. Austin, Sierra Research)

Agency Response: Staff disagrees with the comment. The cost for automated manual transmissions was determined based on the Martec estimate plus input from one of the vehicle manufacturers planning on using this transmission in its products worldwide. One of the cost saving features of this transmission is that much of the current investment in manual transmission production facilities can be utilized since the automated manual transmission can be built using the current manual transmission case and some internals.

Most of the industry is planning on incorporating 6 speed automatic transmissions broadly in their product lines in the near future for competitive reasons, without regard to the

proposed regulations. While there will be tooling costs to revise their automatic transmission production facilities, staff expects that much of the machinery needed to produce transmission cases, gears, valve bodies, clutch retainers, and assorted other components can still be utilized to build the new 6 speed automatic transmissions. In any event, the cost of six speed automatic transmissions was based on a supplier-produced unit including research, development, investment, production, and other costs. Such units are produced by ZF, Aisin, and other transmission suppliers.

It should be clarified that staff did not claim an automatic 6 speed transmission would achieve the same benefits as a 6 speed automated manual transmission. What was claimed was that a 6 speed automatic transmission would achieve the same reductions in CO₂ as AVL claimed for the 6 speed automated manual transmission. As indicated earlier, AVL acknowledged that they did not have the latest detailed information from suppliers on the most recent 6 speed automated manual and 6 speed automatic transmissions and therefore made very conservative assumptions in modeling these transmissions. Upon review of AVL North America's estimate of the benefits of automated manual transmissions, AVL Graz replied that the estimate provided to NESCCAF was too low and that the 6 speed automated manual transmission should have a benefit in the 10-12 percent reduction range. As a result of this input, AVL examined other estimates of 6 speed transmission benefits and provided a chart of its findings to ARB (this chart was shown at the September 2004 hearing). The estimates were from modeling of both automatic and automated manual six speed transmissions by Ricardo and from real world data from ZF and LUK. While Mr. Austin offers that his modeling attempts showed a 2.7 percent improvement, he does not provide the source for his estimates and seems to believe the estimates from Ricardo, ZF, and LUK should somehow be less reliable. Staff continues to believe that a 7 percent improvement from a 6 speed automatic transmission relative to a 4 speed automatic transmission is appropriate and that the benefit of a 6 speed automated manual transmission should be in the range of 10 – 14 percent rather than the overly conservative estimate provided to NESCCAF by AVL North America. The features of the ZF 6 speed automatic transmission include a neutral idle capability. This provides lower engine output at idle since it is disengaged from being loaded against the torque converter. Also the new ZF transmission has lower losses due to further optimization than previous transmissions and lower friction losses from lower viscosity oils than in the past. In fact, the losses in some of the newest automatic transmission designs are so low that a thermostat is being placed in some vehicles in the transmission oil cooler line in the path to the engine radiator to avoid cooling until the transmission heats up sufficiently to operate most efficiently. In the past with older automatic transmissions, such a measure has not been needed.

627. Comment: CARB analysis estimates that in 2016, Californian's would face an approximate additional \$1,000 cost increase for new cars and light trucks as a result of the regulation, while auto industry representative maintain that the cost increase to consumers would be "at least" \$3,000. Much of the difference between the CARB estimates and the auto manufacturers estimates result from two different assumptions regarding the mark-up between the cost of auto production and retail cost to the consumer.

Both of these estimates of additional cost to consumers represent significant increases. The best interests of the automobile consumer are served by having a good choice of affordable automobiles in the marketplace that meet air pollution standards. Even without examining in detail the reasonableness of the estimated increases in costs for new purchase vehicles, it is clear that the consumer should not bear an unfair and unreasonable cost. (California State Automobile Association and the Automobile Club of Southern California)

Agency Response: Regarding the difference in ARB and industry cost estimates, see response to comment 254. Concerning costs to the consumer, staff's analysis demonstrated that greenhouse gas reductions can be achieved at a reasonable cost, which in most cases is recovered in the first few years of vehicle operation.

628. Comment: The Auto Clubs continue to be concerned that California consumers may in the short run pay for the research and development costs that should more fairly and realistically be spread over the national and international marketplace over a long period of time. The Auto Clubs encourage CARB to consider and adopt other approaches in regulatory development that will increase the cost-effectiveness of the greenhouse gas emissions standard, and reduce the cost to consumers to keep new automobiles at an affordable level. (California State Automobile Association and the Automobile Club of Southern California)

Agency Response: The technology requirements driven by the proposed regulation are consistent with development efforts around the world to reduce greenhouse gas emissions. Because many countries have adopted voluntary or mandatory greenhouse gas reduction requirements, technology developments are taking place rapidly around the world to reduce greenhouse gas emissions. Automobile manufacturers in many other parts of the world must meet greenhouse gas emission reduction targets set by Europe, Japan, China, and others. Suppliers looking for emerging technologies in which to invest are focusing on those that reduce climate change emissions. In any case, the technology assessment has shown that the modest incremental costs of new vehicles to consumers will be recovered in less than 5 years, even in the mid-term, and even earlier if fuel prices continue to escalate.

629. Comment: ARB staff underestimated the cost of compliance with the proposed regulation by using an unrealistic 40% markup factor (i.e., a 1.4 multiplier) for adjusting vendor-supplied parts to Retail Price Equivalent. A markup factor of at least 105% (i.e., a 2.05 multiplier) is necessary to cover elements of cost not accounted for by the 1.4 markup factor. I explained that the 1.4 markup factor was only appropriate in cases where research and development, engineering, integration, and warranty costs are included in the cost of parts purchased from vendors. I further explained that such costs were specifically excluded in the vendor cost estimates on which the ARB staff relied. In response to my testimony, the ARB staff told the Board that it consulted with the contractor who provided the vendor cost estimates and, based on the consultation, determined that the 1.4 multiplier was appropriate. As explained in detail below, the ARB staff

misrepresented the contractor's position on the appropriateness of the 1.4 multiplier. (Second Declaration of Thomas C. Austin, Sierra Research)

Agency Response: Staff disagrees with the comment. Mr. Austin is incorrect in characterizing ARB staff as citing Martec as a basis for our use of the 1.4 multiplier to arrive at a retail price equivalent using supplier component prices as the basis. Martec was very clear throughout our study that they had *no input* relative to an appropriate markup factor for estimating a retail price equivalent, and that they supplied only prices of components as delivered by a supplier to a vehicle manufacturer. What staff was emphasizing at the hearing was that Martec affirmed staff's understanding that the costs of components cited by Martec were generally those of a supplier that assumed the cost of research, design and development for the part, investment in the plants to build them, and some level of warranty costs. Thus these costs are all factored into the price that a vehicle manufacturer would pay for the part. Given that the parts for which costs were provided by Martec generally were not designed with significant involvement and investment by a vehicle manufacturer, it was appropriate for ARB staff to utilize the 1.4 markup factor and not a higher factor as suggested by Mr. Austin. The higher markup factor that Mr. Austin is calling for would only be appropriate if the vehicle manufacturer had significant involvement in the design and development of the part and in the investment in facilities to produce the part. Such was not the case with the costs cited by Martec. The 1.4 markup factor used by ARB staff was to cover the additional integration costs in terms of vehicle development to incorporate a supplier part, and any assembly plant changes needed to manufacture vehicles with the part, plus other indirect costs such as corporate salaries and pensions, dealer support and marketing. If Mr. Austin's markup factor was used, in effect there would be double counting of costs already incurred by suppliers in the parts costed by Martec.

630. Comment: A 40% markup is less than half the markup required to cover manufacturers' cost for research and development, engineering, integration, tooling, assembly, labor overhead, warranty, manufacturer profit, advertising expense, and dealer margin. One of the reports CARB cites in support of the use of the 1.4 markup factor (by Argonne National Laboratory) does not support the use of such a low multiplier for the type of technology changes required to significantly improve vehicle fuel economy.

The multipliers developed by Argonne may not be unreasonable for their intended purpose in that they were being used to estimate the retail price equivalent of major components for electric and hybrid/electric vehicles. Components such as the battery used in an electric vehicle are more likely to be fully developed by a vendor and failures in customer service may be more readily assigned to the battery manufacturer. In contrast, most of the technologies needed for compliance with the proposed standards (new transmissions, major engine changes, redesigned bodies) are designed by the vehicle manufacturer, not a vendor, and the vehicle manufacturer has full responsibility for warranty costs as long as the vendors supplying component parts have manufactured the components to the vehicle manufacturer's specifications. (Second Declaration of Thomas C. Austin, Sierra Research)

Agency Response: Staff disagrees with the comment. Mr. Austin is incorrect in assuming that many of the components needed to improve greenhouse gas emissions would be designed and built by a vehicle manufacturer. Such components as valvetrain actuators, cylinder deactivation components such as lifters and solenoids, integrated starter generators, improved alternators, improved tires, electric water pumps or oil pumps, 6 speed automatic transmissions, diesel exhaust aftertreatment, advanced batteries, and nearly all the other components cited in the ARB staff analysis are designed and produced by suppliers, *not* vehicle manufacturers. (While vehicle manufacturers may manufacture their own automatic transmissions, the costs supplied in our study by Martec were for a company such as ZF that designs and builds their own units that many vehicle manufacturers use). ARB staff did not assume any significant costly body design changes were needed to comply with the proposed requirements, whereas Mr. Austin's analysis assumed the use of light weight aluminum vehicle structures featured in only a few \$70,000 luxury models that added some \$2,000 to the cost of each vehicle in his study. The ARB staff study was aimed at finding cost-effective solutions to reducing greenhouse gas emissions, not a high cost approach as Mr. Austin pursued.

631. Comment: CARB staff has also noted that U.S. EPA uses a markup factor of 1.26 to estimate retail price from the cost of components purchased from vendors. The source of the 1.26 markup factor is a report prepared by an EPA contractor almost 20 years ago ("Update of EPA's Motor Vehicle Emission Control Equipment Retail Price Equivalent (RPE) Calculation Formula," Jack Faucett Associates for U.S. EPA, Report No. JACKFAU-85-322-3, September 4, 1985). That report makes it clear that the 1.26 markup factor was intended to be applied to total manufacturing costs, not just the cost of vendor supplied components. Regardless of how EPA or CARB might have used the multiplier, assembly labor (and labor overhead) is not covered. This has been confirmed by the author of the report. The author also clarified that the 1.26 multiplier did not include full dealer margin, but only included dealer profit of 2.4%. The author said that this approach was considered acceptable for relatively small cost changes that would not significantly affect dealer flooring costs or sales volume. He concurs that full dealer margin (estimated by Sierra to be about 12%) would have to be accounted for in the multiplier for price changes as large as those required by the greenhouse gas regulations. Finally, the author confirmed that the 1.26 markup factor was intended at the time to cover pension obligations, which have increased substantially since the collection of the 20+ year-old data on which the report was based.

For the reasons described above, and as demonstrated by the more recent Argonne analysis cited by CARB staff, a 1.26 multiplier is not even sufficient to cover the markup necessary for components manufactured by vendors who had responsibility for research and development, engineering, and warranty. As described below, it is barely more than half of the markup factor supported in an analysis submitted to NESCCAF by the contractor responsible for the cost data on which CARB staff is relying. (Second Declaration of Thomas C. Austin, Sierra Research)

Agency Response: Staff disagrees with the comment. As was brought up by staff at the hearing, we examined past cost estimates in the Low Emission Vehicle program wherein

each factor contributing to the vehicle retail price equivalent was analyzed individually in arriving at the retail price of a new vehicle meeting that program's requirements. In looking at the total price of supplied components and comparing them to the estimated vehicle retail price that was determined, we found on average there was a factor of about 1.3 involved. In the staff report for this greenhouse gas reduction regulation, we also referenced the Argonne National Laboratory report "Comparison of Indirect Cost Multipliers for Vehicle Manufacturing". This report was relied on most in our study because it specifically took into account the use of vendor supplied parts (instead of components built in house) in deriving a multiplier to be used in determining a vehicle retail price equivalent. The Argonne report recommended a markup factor of 1.5. Staff also referenced EPA methodology that relied on an older report authored by Jack Faucett Associates, but this report recommended a factor of 1.26 that was based on determining retail price equivalent when total manufacturing costs of components built in-house were used as the basis of the markup. Because there was no straightforward means to accommodate outside supplier parts in that methodology and because it represented an era wherein there was much more vertical integration of vehicle manufacturers than today, staff relied more heavily on its own derivation of the equivalent markup factor used in the Low Emission Vehicle program and the Argonne study in arriving at the 1.4 multiplier used in this study.

Also, Mr. Austin tries to imply that a report supplied by Martec to NESCCAF on the matter of markup factor to arrive at a retail price equivalent means that Martec sanctions the contents of the report. However, such is not the case; as Martec has stated repeatedly they do not have an opinion on the matter. It was just a report they had in their possession on the subject. Staff notes that when the USEPA calculated the cost-effectiveness of a major emission control measure for light-duty vehicles, the Tier 2 program, it also used the 1.26 markup factor. Thus USEPA apparently believes that the 1.26 markup factor is appropriate for determining the retail price equivalent for components that are almost exclusively supplied by outside suppliers, as is the case here.

632. Comment: In addition to not covering a manufacturer's design and warranty costs, a multiplier in the range of 1.4 cannot possibly cover the "integration costs" associated with using many vendor-supplied components. For example, components used in a cylinder deactivation system or a variable valve lift and timing system cannot simply be bolted to an engine that hasn't been specifically designed to use such components. The cost associated with the design changes necessary to use such components can exceed the cost of the vendor-supplied components. CARB's analysis totally ignores such costs. (Second Declaration of Thomas C. Austin, Sierra Research)

Agency Response: Staff disagrees with the comment. When the Chrysler group set out to design their new Hemi 5.7 liter V-8 engine, they specifically designed it to accommodate cylinder deactivation should they decide to include that feature in future engines. Therefore, from a cost standpoint, to incorporate the cylinder deactivation engine feature was a matter of the cost of the supplied components, in their case supplied from INA. Also, Thomas Stephens, group president of GM powertrain, indicated in previously cited remarks from the GM website that the new 3.6 liter V-6 was designed from the start to

incorporate dual overhead camshafts, variable valve timing, spark ignition direct injection, turbocharging and other features. When engines are designed from the outset to accommodate new features, there is no re-engineering needed to incorporate them. Given the 10 years until the end of the phase-in period for the proposed greenhouse gas requirements, there is ample time to provide for incorporating these new technologies at the same time as engines are being freshened or when new powerplants are designed. Manufacturers can no longer keep engine designs in place for decades and remain competitive in the marketplace.

633. Comment: The NESCCAF report on which the CARB staff relies acknowledges that a 1.4 multiplier does not cover all costs. The NESCAFF report specifically states the following:

“Additional manufacturer-level costs that were not captured in this analysis but that could be associated with the use of new technologies include:

- Engineering costs, including advanced R&D, vehicle design and development engineering for integrating new technologies and software development;
- Warranty and possible recall costs;
- Factory capital costs associated with vehicle-level technology changes;
- Manufacturing costs for powertrain or vehicle assembly.”

(Second Declaration of Thomas C. Austin, Sierra Research)

Agency Response: Mr. Austin’s comment is out of context. It is the cost of the supplied components that does not cover all the costs cited above, not the 1.4 multiplier itself. It is the above cost factors on the part of the vehicle manufacturer for incorporating the supplied parts that the 1.4 multiplier is in fact *intended* to cover. The ANL report is very clear on this point.

634. Comment: As explained in our September 22, 2004 report, the appropriate multiplier for vendor-supplied components of the type required to comply with the regulation is 2.05. In response to our position on the appropriate multiplier, CARB staff member Steve Albu told the Board, “I did check with Martec on some of the assumptions. And, in fact, I checked with their main consultant on the matter about what these costs really represented.

Mr. Albu then told the Board that, based on his discussion with the Martec representative, vendors “...take on the research and development tasks themselves because they see a business case to sell these parts.”

Regarding the issue of warranty costs, Mr. Albu told the Board, “typically the vendor pays the cost of the recall, and this is even increasingly the case.”

Finally, Mr. Albu told the Board, “So increasingly, the pressure’s put on the vendors for investment, for research and warranty. But the fact that we’re talking about high volume parts being sold to a multiple mix of manufacturers, that’s why in fact they do incorporate

those costs in the parts that Martec reported. And this was verified on the phone yesterday with their chief consultant.”

Clearly Mr. Albu was implying that Martec supported the use of the 1.4 multiplier that Sierra has disputed. However, when Sierra contacted Martec the following morning, it became immediate apparent that Mr. Albu was misrepresenting Martec’s position on the appropriateness of the 1.4 multiplier. The Martec representative with whom Mr. Albu had talked (Kevin McMahon) denied that he had supported the use of the 1.4 multiplier and expressed his willingness to immediately send a written confirmation of that fact.

Mr. McMahon’s letter, which was submitted for the record, clearly states that elements of cost were excluded from Martec’s analysis, as Sierra had pointed out. Mr. McMahon wrote that the cost estimates Martec provided exclude “R&D,” “engineering for integration of new technologies,” “warranty and possible recall costs,” and “capital costs associated with changes at the vehicle level.” Mr. McMahon’s letter also makes the point that Martec specifically pointed out to NESCCAF that “...the estimates do not necessarily capture the complete set of variable costs that might be associated with the introduction of new technologies – for example, applying some technologies might require body and chassis redesigns that would in turn incur additional costs.” Mr. McMahon’s letter also points out that Martec specifically advised NESCCAF that technologies like variable valve lift would require “cylinder head redesign” and that “These significant costs are not captured in the Martec study.” Mr. McMahon also pointed out that certain costs associated with gasoline direct injection engines were also excluded. Finally, Mr. McMahon’s letter points out that Martec submitted a “white paper” containing an analysis of the auto industry value chain and that “This analysis suggested a factor of 2.44.”

Even after receiving McMahon’s letter, Mr. Albu told the Board, “We continue to feel that the 1.4 markup is valid for purchased parts.” For the reasons summarized above and in our September 22, 2004 report, this position is simply not credible. (Second Declaration of Thomas C. Austin, Sierra Research)

Agency Response: Staff disagrees with the comment. Staff has carefully reviewed this issue and maintains its position that the commenter is misrepresenting and confusing what was said, and staff is confident that the facts fully support the staff conclusions. First, Mr. Albu did not speak to Kevin McMahon about what was included in the costs supplied by Martec. Kevin McMahon is an employee of Martec, not a consultant. Second, all that staff confirmed was that the costs provided by Martec were for parts supplied by independent vendors who do their own research, engineering, investment and production of their supplied components.

As long as the supplied component is not produced according to a design specification provided by a manufacturer, the supplier is usually expected to cover associated warranty costs. As stated previously, these suppliers see a business case for developing components that can be sold to a number of vehicle manufacturers. The economies of scale from a larger sales base reduces the cost of supplied components. That is why most of the components that would be used by vehicle manufacturers to meet the

proposed requirements would be sourced from independent suppliers; they are not usually built in house because each manufacturer alone can't achieve the volumes needed to achieve economies of scale that an independent supplier can by selling to multiple manufacturers.

None of the above in any way suggests that Martec supports the use of a 1.4 multiplier to arrive at the retail price equivalent from the cost of supplied parts. The above was only a verification from Martec of what the costs they provided included, nothing more. What Mr. Austin continues to fail to realize is that the vendors incur costs of research, investment in plants to produce the parts, warranty and other costs and that these costs, insofar as they were incurred by the vendors, are included in the Martec costs. But staff also acknowledges that the vehicle manufacturer has costs associated with incorporating the supplied components into its products that involve integration engineering, production changes, and others such as corporate overhead, retirement and health, marketing, and dealer support, just as Martec has stated above. However, *that is exactly what the 1.4 multiplier is intended to cover*. This is discussed clearly in the Argonne report.

As stated previously in issue, Martec has never voiced an opinion on this latter markup factor and ARB staff has never indicated otherwise. For Mr. Austin to imply that Martec supports a 2.44 factor contained in a report on this matter they happened to have in their possession *does* mischaracterize what they said. Martec has simply stated they have no expertise in internal financial accounting matters of a vehicle manufacturer and they do not have any opinion on the matter.

635. Comment: CARB staff also told its Board that the 1.4 markup factor it used was more conservative than a 1.26 markup factor routinely used by EPA. However, the consultant who estimated the 1.26 factor that the staff referred to did not intend that it be applied to the cost of vendor supplied components. It was intended to be applied to total manufacturing costs, including labor and labor overhead. In addition, the 1.26 factor was developed using data more than 20 years ago and it no longer reflects pension and health care costs that have escalated dramatically in the last 20 years. According to EPA's consultant, the 1.26 factor also does not fully account for dealer margin, which would need to be accounted for when the cost increase is large enough to affect dealer flooring costs and sales volumes. On November 5, 2004, I confirmed the foregoing information in this paragraph during a telephone conversation with the author of the report for EPA that shows the derivation of the 1.26 factor. (Second Declaration of Thomas C. Austin, Sierra Research)

Agency Response: Staff disagrees with the comment. See previous responses to comments concerning the retail price equivalent mark-up factor.

636. Comment: At the Board hearing, Mr. Tom Austin of Sierra Research asserted that a 1.4 markup used in this study understates the engineering costs original equipment manufacturers (OEMs) will incur in introducing technologies to reduce motor vehicle greenhouse gases (GHGs).

The NESCCAF study relied on component hardware costs provided by The Martec Group, Inc. for the specific technologies and technology packages simulated as part of the study. These costs, as Sierra Research pointed out, “do not attempt to capture all costs to the manufacturer or incorporating new technologies, nor do they include estimates of cost impact at the consumer level as reflected in the purchase price of a new vehicle. Additional manufacturer-level costs that were not captured in this analysis but that could be associated with the use of new technologies include:

- Engineering costs, including advanced R&D, vehicle design and development engineering for integrating new technologies and software development;
- Warranty and possible recall costs;
- Factory capital costs associated with vehicle-level technology changes;
- Manufacturing costs for powertrain or vehicle assembly.”

While it is important to note these cost exclusions, it is critical to recognize that (as stated in the NESCCAF report) the exclusions apply only to the cost estimates provided to NESCCAF by Martec. They do not apply to the final cost estimates used by NESCCAF. The final estimates are based on the Martec cost estimates multiplied by a retail markup factor specifically intended to incorporate the cost impacts excluded in the Martec variable costs. Thus, while it is true that the Martec costs exclude certain elements of the supply chain, it is not true that these same exclusions apply to the NESCCAF estimated retail costs.

Mr. Austin questioned the propriety of using 1.4 as a retail markup factor. In selecting the 1.4 markup factor, NESCCAF conducted a detailed review of a number of regulations and publications. The first was the U.S. EPA’s Tier 2 rulemaking (“Regulatory Impact Analysis – Control of Air Pollution from New Motor Vehicles: Tier 2 Motor Vehicle Emission Standards and Gasoline Sulfur Control Requirements,” EPA 420-R-99-023, December 1999), which included an analysis of both variable and fixed cost components. This analysis revealed effective markup factors of 1.4 to 1.7. In addition, NESCCAF reviewed the California Air Resources Board cost estimates for the Low-Emission Vehicle (LEV II) program, which also included a detailed analysis of both variable and fixed cost components of LEV II technology. This analysis resulted in effective markup factors between 1.2 and 1.6. Finally, NESCCAF consulted a National Academy of Sciences study of vehicle technologies (“Effectiveness and Impact of Corporate Average Fuel Economy “CAFÉ” Standards,” 2002) and that study assumed an RPE markup of 1.4.

In sum, NESCCAF consulted a number of sources and considered markup factors ranging from approximately 1.2 to 2.5. Based on all sources evaluated, NESCCAF selected an RPE markup factor of 1.4 as the most appropriate markup factor for converting Martec variable costs to retail price equivalent. It is important to note that the use of a higher markup factor (Mr. Austin suggested the use of a 2.05 factor) would presume high levels of in-house OEM parts manufacturing and overhead, while industry trends suggest a continuing shift toward the outsourcing of component manufacturing. Such outsourcing tends to reduce overall costs through competitive forces. Moreover, OEMs have added to

downward price pressures by aggressively targeting supplier costs, both of which suggest a lower markup factor.

In supporting his claim that a higher markup factor should have been used, Mr. Austin introduced a letter from Martec into the Hearing record. The Martec letter provided an overview of Martec's participation in the NESCCAF study RPE decision. As stated in the letter sent by Martec:

“When asked for our opinion on an “RPE” factor, we stated to the NESCCAF project team that we had no valid formula to calculate the spread between what an OEM purchases a piece of hardware for and what it ends up selling for on the dealer lot at retail.”

The letter goes on to say that Martec sent a white paper to NESCCAF, which suggested a markup factor of 2.44. Mr. Austin summarized the letter by saying that Martec had recommended the NESCCAF team adopt an RPE of 2.44. In fact, Martec declined to provide any comment on what RPE was appropriate – as is clearly stated in the above quote. Martec, in sending the paper to NESCCAF, was merely responding to a request from NESCCAF to the study team members that any and all literature pertaining to an RPE factor be forwarded. Martec forwarded the paper but did not recommend that we use the RPE of 2.44

It is important to note that Martec was retained specifically to develop the variable costs of hardware, not retail equivalent technology costs. (Coralie Cooper, Northeast States Center for a Clean Air Future (NESCCAF))

Agency Response: The comment clarifies Martec's role in the NESCCAF study and provides further support to ARB's responses to this issue.

637. Comment: The testimony Sierra submitted prior to the September 23 public hearing pointed out that ARB staff failed to account for the average 8% sales tax that applies in California when it calculated how the cost of compliance with the proposed regulation compares to the net present value of the fuel savings. The staff ignored this comment when providing its response to my testimony to the Board. (Second Declaration of Thomas C. Austin, Sierra Research)

Agency Response: See response to comment 243.

638. Comment: The revised cost tables accurately reflect technology costs as stated in the NESCCAF study. Whether the engineering cost of adopting new technologies (plus a mark-up to retail price equivalent) is the appropriate metric for assessing the cost to consumers of the proposed regulation is an interesting question. Some studies have found that historically auto manufacturers have difficulty passing on costs themselves. As the draft staff proposal notes (at p. 150), there is reason to believe that auto manufacturers would not likely pass through 100 percent of the increased compliance costs associated with a greenhouse gas emission standards as higher retail prices. An examination of this

question by Crandall, Gruenspecht, Keeler, and Lave found that costs are indeed shared by producers and consumers. Using an econometric model, the authors found that in the first year, costs are borne largely by producers, but in the second year, two-thirds of costs are passed on to consumers. This result is consistent with findings from research on the pass-through associated with exchange rate fluctuation. A review of this literature by Goldberg and Knetter (1997) finds a range of pass-through estimates centered around 60 percent pass-through. CARB staff's analysis assumes that manufacturers will be able to pass all of the costs of developing new technologies on to consumers. This assumption appears to be conservative, in light of published research. These published studies suggest that some of the costs will ultimately be borne by manufacturers outside the state of California. (Eric Haxthausen and Kate M. Larsen, Environmental Defense)

Agency Response: ARB agrees with the comment and accepts that its estimates may be conservative in light of these studies.

639. Comment: The staff's cost estimates shown in Table 6.2-8 of the Addendum is well justified and reasonable. In addition to the thorough technical and cost analysis performed by the CARB staff, it is well understood that the cost estimates by regulators are typically conservative, especially for motor vehicle control technologies. NRDC reviewed past analysis of cost estimates by regulators and industry and found the following:

- The auto industry and its allies have overestimated the actual costs by a factor of about 2 to 10 times the actual costs.
- Regulators (including CARB and EPA) also tend to overestimate costs, albeit to much less extent. A typical regulator estimate of actual automaker compliance costs are 1 to 2 times the actual costs.

Hence based on historical experience, it is fair and reasonable to assume that both the automakers and the CARB staff cost estimates will be higher than the actual costs. NRDC based the above conclusions primarily on the first five reports listed in the Additional Submittals section. (National Resources Defense Council)

Agency Response: As noted in previous responses, staff believes its cost estimates are correct. Nonetheless, staff appreciates the comment.

640. Comment: In regard to the retail price equivalent estimates of incremental cost in Tables 5.2-5 through 5.2-9, pages 4-8 in the September 10th Addendum, Presenting and Describing Revisions to the Initial Statement of Reasons for Proposed Rulemaking, we find the cost estimates reasonable and perhaps even conservative. (Haxthausen, Environmental Defense, 11/05/04).

Agency Response: The comment is supportive of the staff analysis. No further response needed.

(3). Section 5.4—Lifetime Cost of Technologies to vehicle Owner-Operator

641. Comment ARB staff mistakenly concluded that turbocharging in combination with engine downsizing would reduce consumer fuel costs because it failed to account for the fact that, to achieve the engine downsizing assumed, premium fuel would be required, which would cost 20 cents more per gallon. In response to my testimony, the ARB staff told the Board that its estimate of improved fuel economy was not based on the assumed use of premium fuel. As explained in detail below, the computer modeling used to estimate the fuel economy benefits of turbocharging was based on the use of premium fuel and the argument being made in support of the claim that the fuel economy improvement is representative of what can be achieved with regular fuel is not credible.

In the email to CARB, AVL acknowledges that “For the GDI Stoichiometric Turbocharged engine technology, the engine full load curve and maps used for simulation represent 95 RON (premium) fuel operation.” However, AVL then offers the opinion that “AVL believes the assumed technologies (Dual Independent Cam Phasers and Gasoline Direct Injection) would allow operation on 91 RON (regular) fuel without reducing full load output” when “large valve overlap” is used and the cylinder is efficiently purged of “residual gases.”

The explanation for why the same results could have been obtained with 91 RON fuel is opaque. If AVL is saying that it did not account for the use of cam phasers, then presumably the engine on which the engine map is based would have been equipped with exhaust gas recirculation (EGR). External EGR does not increase the octane requirement of the engine; it reduces it. Using cam phasers to eliminate internal EGR does not result in a lower octane requirement than an engine with external EGR (or an engine with no EGR).

Second, the combination of compression ratio and spark timing that can be tolerated at “full load” is not the key issue here. Virtually all passenger cars and light-duty trucks have a high enough power-to-weight ratio so that testing with the driving cycles used for the CAFÉ test procedures involves no operation at full load. Under part load operation, residual gases are required to achieve adequate NO_x control. AVL’s explanation for why the premium fuel engine map is representative of regular fuel operation doesn’t apply at part load and it therefore does not justify the use of a premium fuel engine map to estimate the fuel economy of a turbocharged engine using regular grade fuel.

An additional problem with AVL’s analysis is that the fuel economy benefits assigned to the combination of turbocharging and engine downsizing did not account for the reduced launch performance associated with off-idle turbocharger lag. To maintain launch performance, a larger engine would be required and fuel economy would be reduced. (Second Declaration of Thomas C. Austin, Sierra Research)

Agency Response: Staff disagrees with the comment. The commenter fails to take into account the value of direct injection engines. The turbocharged engine scenarios that staff relied upon also included a direct injection engine. Because of the cooling effects of direct fuel injection into a cylinder, compression ratios can be safely increased, and higher specific outputs can be achieved from the engine using regular fuel. A number of direct

injection, turbocharged engines are being introduced currently, and the reviews on these engines have been very favorable from a performance standpoint. Also, variable geometry turbochargers in conjunction with 6 speed automatic transmissions can achieve very good launch characteristics when used in conjunction with high compression ratios. Given that AVL consults with numerous manufacturers worldwide regarding advanced engine designs and is involved in their own advanced development efforts, staff believes it is appropriate to rely on their expertise.

642. Comment: Mr. Austin said that the NESCCAF study understated the net costs of vehicles equipped with turbocharger technology because the simulation modeling assumed the use of premium gasoline, while the cost benefit analysis used the cost of regular gasoline. This statement is largely false, for the following reasons.

First, for the NESCCAF technology packages that couple turbocharger technology with direct injection gasoline (GDI) technology, AVL design engineers have determined that the fully estimated greenhouse gas (GHG) reduction benefits can be attained using regular gasoline. Therefore, the benefits and costs assumed for these technology packages in the NESCCAF study are accurate. It is our understanding that all of the turbocharger technology packages utilized by the Air Resources Board in developing their regulation are combination GDI/turbocharger technology packages, which do not presume a requirement for premium gasoline.

Only the NESCCAF technology packages that couple turbocharger technology with conventional MPFI (multi port fuel injection) would require the use of premium gasoline to capture the fully modeled GHG benefits. There were three technology packages that included the MPFI/turbocharger technology combination. The cost benefit analysis for two of the packages concluded that over the life of the vehicles, the net savings to consumers would be approximately \$1,600. For the third package including MPFI and turbocharger technologies, the cost benefit analysis showed a net lifetime savings of \$1,400. This is assuming the use of regular gasoline at a cost of \$1.58 per gallon. Premium fuel costs approximately 10% more than regular gasoline. If the lifetime fuel savings for the three packages is adjusted to account for the use of premium fuel instead of regular fuel, the lifetime cost savings of the three packages would be reduced by approximately \$160 for two packages and \$140 for one package. As a result, the lifetime savings would be \$1,440 for two packages and \$1,260 for the third package. This is a modest change, which does not alter the conclusion of the study: these three technology packages provide substantial GHG reduction benefits at a net cost savings to consumers. (Coralie Cooper, Northeast States Center for a Clean Air Future (NESCCAF))

Agency Response: Staff agrees with the comment, which provides information supporting ARB's previous responses on this issue.

643. Comment: In addition to the lifecycle cost analysis presented in the ISOR, CARB staff presented the Board with a revised analysis based on a gasoline price of \$2.30/gallon during the public hearing. As shown below, when our analysis is revised to reflect this higher gasoline price, the standards still have a negative net present value to consumers.

In performing the revised analysis, we also updated the discount rate. (Sierra Research Supplemental Analysis of Engineering Costs and Benefits and Cost-Effectiveness, Appendix P, P. 17)

Table 3 shows how the lifetime cost analysis changes when the gasoline price is increased to \$2.30/gallon and the discount rate used by Sierra is increased to 10%. The higher gasoline price increases the “base cost” under the no-regulation case and it also increases the value of the fuel savings over the lifetime of the vehicle. Using CARB’s assumptions, the net savings associated with the regulations increases from \$1,703 to \$2,601. Using Sierra’s assumptions, the net cost increase drops from \$3,129 to \$2,759. In other words, we still show that the cost of the regulations substantially exceeds their lifetime benefits even when the assumed long-term fuel price is increased to \$2.30/gallon. (Sierra Research Supplemental Analysis of Engineering Costs and Benefits and Cost-Effectiveness, Appendix P, P. 20)

Agency Response: Staff disagrees with the comment. As noted in previous responses, Sierra’s lifecycle cost analysis is based on a completely different set of assumptions than those used by the ARB staff. The only similarity between the two analyses is that both assume the same gasoline prices of \$1.74 and \$2.30 per gallon. In this case, the main source of difference between the two analyses is the assumption with regard to the initial price increase for PC/LDT1. In its analysis, Sierra estimates a price increase of \$4,573 for PC/LDT1 due to the regulation while ARB assumes a price increase of \$1,064. This represents a difference of \$3,750. Sierra also estimates the lifetime savings of \$2,161 while ARB estimates the lifetime savings of \$3,665, representing a difference of \$1,504. ARB continues to believe that Sierra’s analysis is based on a number of erroneous assumptions. See for example responses to comments 247,253,254, and282.

644. Comment: Using our original assumptions, Table 5 shows how our estimate of lifetime gasoline savings for LDT2s, ignoring the rebound effect, compares to the estimate made using CARB’s methodology. Note that the “CARB NPV” column has been substantially modified to correct an error in our September 22, 2004 report. Although our main report contained the correct estimate of fuel savings using CARB’s assumptions, the table in attachment C-1 of our earlier report had numbers in CARB NPV column that did not reflect CARB’s error in the baseline fuel economy estimate described above. The original table showed an NPV value of \$899 using CARB’s assumptions; the correct value, as shown in the corrected table, is \$2,061. The original estimate using Sierra’s assumptions was shown correctly as a net loss of \$540. (Sierra Research Supplemental Analysis of Engineering Costs and Benefits and Cost-Effectiveness, Appendix P, P. 21-22)

Agency Response: For the LDT2 category, the main source of difference between Sierra and ARB analyses is the benefit estimations, rather than the increase in vehicle price. Sierra estimates a lifetime benefit of \$873 for LDT2 while ARB estimates a lifetime benefit of \$3,090, a difference of \$2,217. The significant difference in benefit estimation is the result of noticeable differences in assumptions with regard to lifetime VMT, vehicle life span, operating cost savings, and discount rate that staff has addressed in numerous

previous responses (see for example the responses to comments 247,253, and 282. ARB staff continues to believe that the assumptions used by Sierra are erroneous.

645. Comment: Table 6 shows how the lifetime cost analysis changes when the gasoline price is increased to \$2.30/gallon and the discount rate used by Sierra is increased to 10%. As with passenger cars and LDT1s, the higher gasoline price increases the “base cost” under the no-regulation case and it also increases the value of the fuel savings over the lifetime of the vehicle. Using CARB’s assumptions, the net savings associated with the regulations increases from \$2,061 to \$3,056. Using Sierra’s assumptions, the net cost increase drops from \$540 to \$362. We are therefore still showing that the cost of the regulations exceeds their lifetime benefits even when the assumed long-term fuel price is increased to \$2.30/gallon. (Sierra Research Supplemental Analysis of Engineering Costs and Benefits and Cost-Effectiveness, Appendix P, P. 22)

Agency Response: The use of the higher gasoline price, as expected, increased benefit estimations by both ARB and Sierra. However, Sierra’s benefit estimation was partially offset by the increase in the discount rate from 8% to 10%. ARB staff continues to stand by its analysis and believes Sierra’s analysis is based on a number of erroneous assumptions. See response to comments 629 through 642.

646. Comment The Auto Clubs are concerned about the potential for and likelihood of additional costs to consumers for the purchase of new vehicles. We understand that it is expected that the new regulations would result in lower operating costs for these vehicles than would otherwise be the case if the regulations were not in force. As a result, the overall evaluation of the cost impact to consumers must balance the benefit to the consumers of the operating cost savings with the increase in new vehicle purchase prices for the vehicles. (California State Automobile Association and the Automobile Club of Southern California)

Agency Response: The staff analysis demonstrated that even for the mid-term technologies, consumers would payback their investment in less than 5 years through reduced operating costs. For the near term, the payback typically occurs in less than 3 years. Since this payback calculation was predicated on gasoline at a much lower price than in the market today, the payback would be even sooner at today’s fuel prices. Since most purchasers finance their vehicles, staff calculated there would be a net reduction in monthly expenses for vehicles financed over a typical 5-year period due to reduced operating costs of vehicles meeting our proposed requirements.

647. Comment: Automobile operation, maintenance, and repair represent major costs to consumers that the regulation is likely to impact. The CARB analysis focused on the expected potential for reductions in vehicle operating costs as a result of less fuel consumption on a per mile basis. In addition, CARB indicated that it expects that there will be reductions in operating costs related to the air conditioning system.

The Auto Clubs are concerned about the cost impact that increasing per gallon gasoline prices has upon the automobile user. To the extent that automobiles can be more fuel-efficient, the operating costs to consumers can be reduced. As a result, the potential savings in operating costs from successful implementation of these regulations may represent a significant financial benefit to the consumer. (California State Automobile Association and the Automobile Club of Southern California)

Agency Response: Staff agrees with the comment. The staff analysis demonstrated that the regulations will result in lower vehicle operation costs for consumers. To the extent that fuel prices increase in the future, which seems likely in light of recent market forces, the savings will be more even more significant than estimated by staff.

648. Comment: We encourage CARB and the automobile manufacturers to work together to keep both new purchase and operating costs affordable and economical to consumers. In fact, the authorizing legislation (AB 1493) requires that the new regulation be “economical to an owner or operator of a vehicle, taking into account the full life-cycle costs of a vehicle.” (California State Automobile Association and the Automobile Club of Southern California)

Agency Response: As noted in numerous previous responses, ARB believes that the regulations have met the intent of AB 1493 in that they are economical to the consumer when accounting for the full life-cycle costs of a vehicle.

649. Comment: On October 19, 2004, CARB’s website listed a Notice of Public Availability of Modified Text, including Attachment II: Additional Supporting Documents and Information. One of those documents was entitled “Estimation of Average Lifetime Vehicle Miles of Travel” and included a review and discussion of CARB staff’s methodology for estimating average vehicle lifetime and a critique of several aspects of the methodologies described by Sierra Research in the pertinent part of Sierra’s written testimony to CARB (Attachment C-3 to Sierra’s September 22, 2004 report, “Mileage Accrual and Full-Life Mileage of Vehicles”).

CARB’s main conclusions are as follows:

- “The method used by ARB staff still results in the best available estimate of average lifetime VMT (vehicle miles traveled). Though staff examined other approaches for making this estimate, we did not arrive at a method that is superior to that presented in the staff report.”
- “...the alternative method presented by SRI (Sierra) is likely to result in a significant underestimation of lifetime VMT.”
- “...we believe that the method used in the staff analysis results in a reasonable estimate of average lifetime VMT, and that no change to the MAC credit is necessary.”
- “ARB does not find that SRI provides compelling evidence that our (ARB’s) estimates of average lifetime VMT are substantially overestimated.”

After reviewing CARB staff’s response, including rationale, we conclude that:

- CARB has not demonstrated that its estimate of VMT is the “best available” and CARB has failed to make any downward adjustment for what it acknowledged was a clear error in its methodology for calculating lifetime average VMT.
- Five independent data sources all show that CARB’s lifetime average VMT estimates are substantially inflated and that the true lifetime average VMT value for cars and trucks is approximately 155,000. These sources are (1) a snapshot of rollover-adjusted Smog Check data; (2) California’s Roadside Pullover data; (3) data from CARB’s pilot scrappage program in Los Angeles; (4) scrappage data collected by the California Bureau of Automotive Repair; and (5) Kelly Blue Book data on sales offerings of cars in Los Angeles.

(Sierra Research Supplemental Analysis of Engineering Costs and Benefits and Cost Effectiveness, page 2. A similar, related comment is found as item #10 in the Second Declaration of Thomas Austin, dated November 5, 2004)

Agency Response: Staff disagrees with the comment. During the September 23, 2004 Board hearing on the proposed AB 1493 regulation, Sierra Research, Inc. (SRI) provided both oral and written comments asserting that ARB staff had overestimated the miles traveled (VMT) in a vehicle’s average lifetime. Sierra also stated the overestimation of VMT had in turn resulted in overestimation of lifetime fuel savings and the payback period for vehicle owners. ARB staff responded to these assertions in the document Estimation of Average Lifetime Vehicle Miles of Travel, which was included as an attachment to the 15-day notice package (available at <http://www.arb.ca.gov/regact/grnhsgas/vmt.doc>).

In the above comment, SRI purports to list ARB staff’s main conclusions. However, SRI failed to include one very important conclusion dealing with the impact on operating cost savings. The following paragraph is found on page 3 in Estimation of Average Lifetime Vehicle Miles of Travel:

In staff’s September 24 presentation to the Board in response to the SRI comments, we provided the results of a sensitivity analysis for the lifetime operating cost savings and payback period. Using the SRI estimate of 155,000 miles for average lifetime VMT, we calculated lifetime operating cost savings of \$2,142 (based on gasoline price of \$1.74/gallon in 2004 dollars) and a payback period of 5.9 years. These figures compare to the results presented in the staff’s August 6, 2004 Initial Statement of Reasons (ISOR), showing lifetime operating cost savings of \$2,691 and a payback period of 5.6 years for light duty vehicles subject to the regulation. Thus, even with SRI’s low estimate of lifetime miles traveled, the regulation is very cost effective to consumers and has a reasonable payback period.

Thus, the issue of which estimate of lifetime VMT to use is not critical to the outcome of determining the cost effectiveness and payback period for the regulation.

ARB staff continues to acknowledge that our estimates of lifetime VMT are biased high, but as the above analysis of cost effectiveness and payback period shows, this does not alter the conclusion that the regulation is highly cost effective for consumers.

We also note that SRI's various analyses of lifetime VMT continue to show bias toward underestimation. SRI has used both BAR and ARB scrappage data in estimations of lifetime VMT. As expressed in "Estimation of Average Lifetime Vehicle Miles of Travel," ARB staff has concerns with using this data to determine end of life mileage, since vehicles must be in running condition when scrapped. SRI defends their method by inferring that all scrapped vehicles only "marginally" meet the requirements, and therefore are at end of life. However, these requirements were written with the express purpose of ensuring that the vehicles scrapped are not vehicles at end of life, but rather vehicles that would continue to be repaired and driven unless an economic incentive to replace them is provided to their owners.

In their analysis of BAR scrappage data, SRI states that "...we (SRI) have removed from the data set a relatively small number of vehicles with reported odometer values greater than 500,000 miles." SRI offers no explanation as to why these high mileage vehicles were removed from the analysis. SRI offers no evidence that these high mileage vehicles are not valid and should be removed from further consideration. Removing valid vehicles with greater than 500,000 miles from the analysis results in an underestimation of lifetime VMT.

In discussing the BAR scrappage data, SRI states, "Furthermore, because of its importance in the scrappage program, greater care should have been taken to correctly transcribe odometer readings at the time of scrappage than is usually taken by Smog Check technicians. Therefore, we believe, all other factors being equal, that Sierra's assessment of ending odometer readings for the scrappage program, with rollover accounted for, is more reliable than CARB's assessment." However, there is no evidence, anecdotal or otherwise, to show that odometer readings for scrappage are handled any differently than odometer readings for Smog Check inspections. ARB staff disagrees with SRI's assertion that its odometer data are more reliable than those used by ARB.

SRI did an analysis of lifetime VMT using data collected from a website supported by Kelley Blue Book. This website offers national listings of vehicles for sale. SRI used data taken from this website to correlate vehicle price and vehicle odometer reading in the Los Angeles area for nine specific make and model of vehicles. SRI used this data to construct regression lines to project odometer reading at scrappage. ARB staff has examined this website and is concerned that it overwhelmingly reflects late model vehicles offered for sale by dealerships. ARB staff queried for listings in Los Angeles for the Toyota Corolla, the same vehicle model used by SRI as an example in their analysis. Staff found roughly 900 listings for the Corolla, of these, over three-fourths were for 2000 – 2005 model year used vehicles being sold by new car dealerships, primarily Toyota dealerships. Since dealerships tend to auction off higher mileage vehicles, and only offer the more desirable, low mileage vehicles for resale, the listings found on this website will be biased toward lower mileage vehicles. This would skew the regression analysis toward

underestimation of lifetime VMT. ARB staff also found that for the 1999 and older vehicles that fully one-third to one-half of the sales listings did not include the odometer mileage. Again this would bias the data toward the newer, low mileage vehicles which almost always had the odometer mileage listed.

650. Comment: ARB staff overestimated the fuel savings associated with the proposed standards for light-duty trucks by failing to account for the fuel economy improvements required under the 2007 federal CAFE standards. (Second Declaration of Thomas C. Austin, Sierra Research)

Agency Response: Staff disagrees with the comment. See response to comment 251.

c. ISOR Section 6—Climate Change Emission Standards

(1). Section 6.1—Determination of Maximum Feasible Emission Reduction Standard

651. Comment: The regulations drafted by CARB as reflected in the 15-day notice meet the requirements of AB 1493 that the regulations achieve the “maximum feasible and cost-effective reduction of greenhouse gas emissions from motor vehicles.” (Eric Haxthausen and Kate M. Larsen, Environmental Defense)

Agency Response: ARB appreciates the comment. No further response is required.

652. Comment: The Auto Clubs are pleased that the regulation follows the language and intent of the legislation in preserving consumer choice. The Auto Clubs encourage involved parties to ensure that the regulation does not result in a reduction in classes of vehicles or reduction in vehicle attributes that have positive utility to consumers. Consumers should continue to have a wide range of options for new automotive vehicles so that they can make choices according to their individual preferences and situations. (California State Automobile Association and the Automobile Club of Southern California)

Agency Response: Consistent with other emission programs adopted in the past, ARB took great care in selecting technologies that can reduce emissions while maintaining the vehicle performance to which consumers are accustomed. During the implementation phase, ARB will endeavor to work with the automotive industry to assure that consumers will continue to have the wide choice of vehicles that they have today.

653. Comment We are concerned that staff estimates of the timeframes necessary for companies to integrate new technology into their systems are overly optimistic. Testimony to date has indicated that the current report timeframes are unrealistically short for a company to adapt a new technology, design it, test it, perfect it, and rebuild factories to manufacturer it as part of a product offering supported by warranties. (Robert W. Lucas, California Council for Environmental and Economic Balance)

Agency Response: The technology paths outlined by staff include components that are already in production in numerous models, with most of the new technologies being provided by suppliers rather than vehicle manufacturers. Most of the work of the vehicle manufacturers will involve integration of new technology. Given that the endpoint of the proposed requirements is a decade away, there is plenty of time to incorporate new technologies as part of the process when new models are being designed and tested. Staff also addressed the issue of the cadence of technology rollout in response to comments 302 through 306.

654. Comment: To be competitive in the automotive industry today, it is necessary for manufacturers to ensure that their products and production corresponds to shifting customer demands and federal and state requirements. This is leading to shorter product life cycles requiring a high degree of flexibility, low-cost/low-volume manufacturing skills, and short time to market. Continuing improvements and emission reductions to comply with CARB's adopted regulation will benefit from this trend toward greater agility, making CARB's analysis of costs and necessary lead-time for manufacturers a conservative estimate. (Eric Haxthausen and Kate M. Larsen, Environmental Defense)

Agency Response: ARB agrees with the comment.

655. Comment: We encourage CARB to work towards realistic, achievable emissions standards in the development and implementation of its greenhouse gas emissions standards. The focus that CARB has taken on "off-the-shelf" technology is a preferable method than the "technology-forcing" approach that CARB has used with other regulations in the past. As we have seen with some regulations, such as the zero-emissions mandate, the technology forcing approach does not necessarily result in a benefit to consumers in the marketplace that is commensurate with the costs of research and development that are often passed on to the consumer. (California State Automobile Association and the Automobile Club of Southern California)

Agency Response: While the cost of battery electric vehicles has not declined to the point that they are competitive with conventional vehicles, the ZEV mandate resulted in numerous advancements that made the requirement successful. For example, component development that took place in response to the mandate, such as advanced electric motors, electronic controls technology, continuously variable transmission concepts, and even battery and ultracapacitor technology, have been key to emergence of hybrid electric vehicles that are increasingly attractive to consumers. These vehicles also will serve as the platform for future hydrogen fuel cell zero emission vehicles. Therefore, ARB staff continues to believe that technology forcing needs to be an element of our long-range programs. Nonetheless, the near term technologies outlined in the staff report are already available in numerous vehicle models. While the mid-term technologies are generally emerging, we believe that setting technology forcing goals will spur further development that will ultimately help industry in meeting the proposed greenhouse gas requirements.

656. Comment Since the emissions standard is a performance-based emissions standard, it is still possible that some automobile manufacturers may choose to comply

with the new regulations by “down-sizing” some of their fleet. Since the emissions standard is stated in terms on “grams per mile” of emissions, a reduction in vehicle size and weight would be one potential means to contribute to meeting the emissions standard. We encourage automobile manufacturers to continue to meet and exceed all automobile safety standards. (California State Automobile Association and the Automobile Club of Southern California)

Agency Response: As noted in previous responses, feasibility to the requirements has been demonstrated without resorting to reductions in vehicle size and weight. However, should manufacturers choose this compliance option, their vehicles would still be required to comply with California and federal vehicle safety standards.

657. Comment: While the proposed changes which triggered the 15-day notice do not raise additional material issues for AIAM’s member companies, the Association is particularly concerned that the staff report completely fails to address the issues raised in AIAM’s previous comments. Indeed, the report seems to virtually ignore most of the other comments, which were in any way adverse to the staff’s analysis and conclusions. AIAM believes that from both a policy and a legal standpoint the Board is obligated to not only address but resolve the many differences in the staff analysis and amend its conclusions accordingly. To facilitate accommodating that responsibility, I have attached another copy of AIAM's 45-day comments. (Association of International Automobile Manufacturers, Inc.)

Agency Response: AIAM’s resubmission of its previous 45-day comments does not address (and is therefore outside the scope of) the 15-day changes noticed and requires no response here.

With regard to the status of those comments, however, staff did not ignore the comments previously submitted by AIAM. Rather, staff carefully considered all of the issues raised by AIAM and made changes to the staff analysis as appropriate. In addition, staff fully responds to all AIAM comments elsewhere in this Final Statement of Reasons for the rulemaking. The commenter does not here raise any legal issues to which the Board must respond.

658. Comment: To be competitive in the automotive industry today, it is necessary for manufacturers to ensure that their products and production correspond to shifting customer demands and federal and state requirements. This is leading to shorter product life cycles requiring a high degree of flexibility, low-cost/low-volume manufacturing skills, and short time to market. A shortening of product cycles is particularly notable in the light truck segments, which traditionally had longer cycles than cars but now face an intensely competitive market situation brought about by their popularity. Many studies and industry trade press articles have highlighted this shift towards flexible manufacturing systems and lean manufacturing in the automotive industry. Following in the footsteps of Asian auto manufacturers, American automakers are switching over and starting to reap the benefits. Automotive News reported that Ford will have 80 percent of its plans converted to flexible manufacturing by 2010. (Haxthausen, Environmental Defense, 11/05/04).

Agency Response: No response necessary. This comment supports the staff analysis.

659. Flexible automotive manufacturing systems promise to speed time-to-market while adding significant gains for automakers in both cost efficiencies and product quality. In a Society of Manufacturing Engineers article, DaimlerChrysler reported an 8.3% reduction in time to design and manufacture a vehicle due to their switch to lean manufacturing. Although much of the adaptability of the flexible system has allowed manufacturers to move between existing vehicle modes, it will also allow them to make more speedy and efficient adjustments in power train design to meet federal and state emissions standards. Many of the elements of Ford's flexible manufacturing systems were designed to enable improvements in engine performance and facilitate emissions reductions. Continuing improvements and emission reductions to comply with CARB's adopted regulation will benefit from this trend toward greater agility, making CARB's analysis of costs and necessary lead-time for manufacturers a conservative estimate. (Haxthausen, Environmental Defense, 11/05/04).

Agency Response: No response necessary. This comment supports the staff analysis.

(2). Section 6.4—Treatment of Upstream Emissions

660. Comment: The proposed 15-day notice revisions to the proposed regulation to allow the Executive Officer to approve a lower upstream emissions factor for hydrogen-fueled ICE vehicles and hydrogen fuel cell vehicles falls short of the intended goal. There is no mandate for the use of renewables in the production of hydrogen to be sold in California under the State's hydrogen highway effort. While Executive Order S-7-04 calls for a significant and increasing use of renewables in the production of hydrogen, there is no regulatory component dictating any percentage of hydrogen to be produced from renewable energy sources. Manufacturers cannot be expected to spend billions of dollars to develop hydrogen-powered vehicles with absolutely no certainty as to whether those vehicles will meet the standard, in spite of the fact that these vehicles achieve zero CO₂ tailpipe emissions. The current approach is jeopardizing the development of clean hydrogen powered vehicles by including an upstream emissions factor that cannot be relied upon by either the automotive industry or the State of California. (Steven P. Douglas, Alliance of Automobile Manufacturers)

Agency Response: The established upstream adjustment factors for hydrogen and electric vehicles are maximum levels of greenhouse gas emissions assigned to these vehicles. The staff will continue to evaluate new information as it becomes available, to ensure that these factors represent the best real world data available. In addition, a manufacturer may propose to use lower upstream emission factors, if that manufacturer demonstrates to the Executive Officer the appropriateness of the lower values.

Furthermore, it is important to note that the methodology used to establish upstream emission factors for electric and hydrogen vehicles is entirely consistent with that used for gasoline vehicles in terms of overall contribution of the vehicles to global warming. The upstream emission factors for hydrogen and electric vehicles were developed by

determining that approximately 76 percent of greenhouse gas emissions attributable to a gasoline vehicles powered by an internal combustion engine come out of the tailpipe (the other 24 percent are upstream emissions). ARB then calculated the total upstream greenhouse emissions for a vehicle powered by electricity and hydrogen, multiplied those numbers by 76 percent, and used the new lower numbers as the “upstream emission factors” for electric and hydrogen vehicles.

661. Comment: The upstream emission factor penalizes, rather than rewards, manufacturers’ efforts to bring advanced hydrogen technology to market. The Alliance believes that this factor should be eliminated in the calculation of CO₂-equivalent emissions from these vehicles. A more productive approach to meeting ARB’s goals would be to provide tax incentives for both the production and purchase of hydrogen from renewable sources. (Steven P. Douglas, Alliance of Automobile Manufacturers)

Agency Response: ARB disagrees with the assertion that the upstream factor for hydrogen vehicles penalizes these vehicles. Rather this factor is based on an appropriate assessment of the contribution of those vehicles to global warming, while allowing for future improvements based on increased use of renewable resources. (See response to comment 660).

Regarding tax incentives, ARB does not have the authority to provide tax incentives. That authority lies solely with the legislature.

662. Comment: The record compiled in September 2004 demonstrated that hydrogen-fueled internal combustion engine-powered (“ICE”) vehicles and hydrogen fuel cell vehicles could not comply with the proposed regulation. The 15-day notice revisions would allow the Executive Officer to approve a lower upstream emissions factor for those vehicles. To receive this lower upstream emission factor, an automobile manufacturer must demonstrate the appropriateness of the lower value by providing information that includes, but is not limited to, the percentage of hydrogen fuel or the percentage of electricity produced for sale in California using a “renewable energy resource.” The ARB staff explained that this modification was prepared at the direction of the Board at the September 23-24, 2004 hearing to allow manufacturers to use lower upstream emission factors for hydrogen and electric vehicles if the goal of increased use of renewable resources for the production of hydrogen and electricity is achieved.

The 15-day notice revisions to the proposed regulation would allow the Executive Officer to approve a lower upstream emissions factor for hydrogen-fueled internal combustion engine-powered (“ICE”) vehicles and hydrogen fuel cell vehicles. The proposed modification does not meet the requirements for clarity under the Government Code and would invite or require the Executive Officer to engage in underground rulemaking, in violation of the APA. (Steven P. Douglas, Alliance of Automobile Manufacturers)

Agency Response: Section 11349 (c) of the Government Code defines “clarity” as follows:

“Clarity” means written or displayed so that the meaning of regulations will be easily understood by those persons directly affected by them.

The commenter did not specify what was unclear, or describe what meaning of what term they could not understand. Because they did not do so, the ARB arguably need not respond to this comment. The remainder of this response, then, is ARB’s good faith attempt – not required under the APA – to discern the allegedly unclear term or phrase.

ARB assumes that the commenter is claiming that it is unclear what the final upstream emissions factors will be, since the Executive Officer may approve lower upstream emission factors than those included in the current regulations. Such a claim, if valid, would make it difficult for a manufacturer to develop strategies for complying with the greenhouse gas regulations.

Title 1, Division 1, Chapter 1, Article 2, § 16, paragraph (a) of the California Code of Regulations (1 CCR § 16) instructs the Office of Administrative Law to apply the following standards and presumptions when examining a regulation for compliance with the “clarity” requirement:

- (a) A regulation shall be presumed not to comply with the “clarity” standard if any of the following conditions exists:
 - (1) the regulation can, on its face, be reasonably and logically interpreted to have more than one meaning; or
 - (2) the language of the regulation conflicts with the agency’s description of the effect of the regulation; or
 - (3) the regulation uses terms which do not have meanings generally familiar to those “directly affected” by the regulation, and those terms are defined neither in the regulation nor in the governing statute; or
 - (4) the regulation uses language incorrectly. This includes, but is not limited to, incorrect spelling, grammar, or punctuation; or
 - (5) the regulation presents information in a format that is not readily understandable by persons “directly affected;” or
 - (6) the regulation does not use citation styles which clearly identify published material cited in the regulation.

ARB believes that the regulatory language pertaining to upstream emissions factors does not meet any of the conditions under which a regulation shall be presumed not to comply with the “clarity” standard, as described in 1 CCR § 16 above, for the following reasons.

1 CCR § 16 (a)(1), says that a regulation shall be presumed not to comply with the “clarity” standard if the regulation can, on its face, be reasonably and logically interpreted to have more than one meaning. This condition does not apply, since the greenhouse gas regulations include “default” upstream emission factors for hydrogen and electric vehicles, which a manufacturer can rely on when developing its greenhouse gas compliance strategy. These default values represent the maximum values that will be applied to hydrogen and electric vehicles. This is clearly stated in the regulations. Therefore,

allowing the Executive Officer to approve lower values can not reasonably be viewed as creating any compliance uncertainty for a manufacturer, but rather will only provide an added compliance cushion for that manufacturer.

1 CCR § 16 (a)(2), says that a regulation shall be presumed not to comply with the “clarity” standard if the language of the regulation conflicts with the agency’s description of the effect of the regulation. This condition does not apply to the greenhouse gas regulations since upstream emission factors are designed to accurately account for the greenhouse gas emissions from hydrogen and electric vehicles and to include these emissions in a manufacturer’s fleet average calculation. This approach is consistent with ARB’s description of the greenhouse gas regulations, which is to reduce greenhouse gas emissions from the vehicle fleet.

1 CCR § 16 (a)(3) states that a regulation shall be presumed not to comply with the “clarity” standard if “the regulation uses terms which do not have meanings generally familiar to those “directly affected” by the regulation, and those terms are defined neither in the regulation nor in the governing statute.” The term “upstream emissions” is one that is regularly used by ARB to characterize emissions created due to the production and distribution of a fuel prior to that fuel being put into a vehicle and, hence, the term is generally familiar to those “directly affected” by the regulation (i.e., automobile manufacturers).

1 CCR § 16 (a)(4) states that a regulation shall be presumed not to comply with the “clarity” standard if “the regulation uses language incorrectly. This includes, but is not limited to, incorrect spelling, grammar, or punctuation.” This condition does not apply.

1 CCR § 16 (a)(5) states that a regulation shall be presumed not to comply with the “clarity” standard if “the regulation presents information in a format that is not readily understandable by persons “directly affected.”” This condition does not apply, since the upstream emissions factors are presented in a simple table, which is easily readable.

Finally, 1 CCR § 16 (a)(6) states that a regulation shall be presumed not to comply with the “clarity” standard if “the regulation does not use citation styles, which clearly identify published material cited in the regulation.” The table that contains upstream emissions factors does not use citations. So this condition is not applicable.

Furthermore, the commenter is apparently operating under a fundamental misconception regarding the structure of the greenhouse gas regulations and the authority of the Executive Officer. Title 13, CCR, (13 CCR) § 1961.1(a)(1)(B)1.e. expressly authorizes the Executive Officer to approve the use of lower upstream emissions factors for hydrogen and electric vehicles without the need for a further rulemaking. Although the ARB has chosen to establish the initial upstream emissions factors by rulemaking, and may use the rulemaking process to establish other upstream emissions factors in the future, 13 CCR § 1961.1(a)(1)(B)1.e. clearly authorizes the Executive Officer to approve the use of lower upstream emissions factors without an additional regulatory proceeding.

13 CCR § 1961.1(a)(1)(B)1.e. does not represent an unlawful delegation of rulemaking authority. It established clear criteria the Executive Officer is to use to evaluate the appropriateness of manufacturer-proposed upstream emissions factors. While the Executive Officer is directed to make specific determinations in implementing the regulations, 13 CCR § 1961.1(a)(1)(B)1.e provides well defined criteria for those determinations. This approach is analogous to the LEV II provisions, whereby the ARB established generic reactivity adjustment factors (RAFTs) for various fuels, but allows manufacturers to develop and use test group-specific RAFTs, upon approval of the Executive Officer (13 CCR § 1961(a)(2)(A)).

Another example in which this approach is used is 13 CCR § 1961(a)(12). This section gives the Executive Officer authority to determine the value of NMOG credits that may be used for a “direct ozone reduction technology,” when such a technology is used by an automobile manufacturer to meet its LEV II fleet average requirements.

A third example, 13 CCR § 1962(c), sets forth the criteria for identifying vehicles for sale in California as partial zero-emission vehicles (PZEVs). These criteria include a requirement that manufacturers determine the urban all-electric range (VMT) of a PZEV using a specific test procedure. However, subparagraph (3)(B) of this section allows a manufacturer to submit for Executive Officer approval an alternative procedure for determining the zero-emission VMT potential of a PZEV.

These are just three examples where ARB’s Executive Officer has been granted the authority to provide flexibility in implementing existing regulations without the need for additional regulatory proceedings. The precedent established, in part, by these existing regulations further demonstrates that allowing the Executive Officer to approve lower upstream emissions values than those contained in the regulations does not violate the standard for “clarity” under 1 CCR § 16 (a)(1).

663. Comment: Another area where we believe staff has erred in their proposed modifications is the omission of an adjustment to upstream emissions for plug-in hybrids to account for an increase in renewable electricity use in California. In response to comments, staff made adjustments to upstream emission factors for electric zero emission vehicles and hydrogen vehicles that use electricity. However, a similar adjustment was not applied to plug-in hybrid vehicles, even though they also use electricity from the grid.

Omission of a correction for the electricity used by plug-in hybrids means that the assumption from the ISOR—that the electricity used by plug-in hybrids would be generated only from natural gas—will stand. We believe this is a serious mistake, as it does not take into account California’s Renewable Portfolio standard. The Renewable Portfolio standard, signed into law by the Governor of California in September, 2002, requires retail sellers of electricity in California to increase their procurement of eligible renewable energy resources by at least one percent per year so that 20 percent of their retail sales are procured from eligible renewable energy resources by 2017. We believe the factor for renewable energy should be 20 percent.

Accounting for renewable electricity in the mix utilized by plug-in hybrid vehicles is very important, since the greenhouse gas emissions from renewable electricity are much, much lower than those from natural gas. Bluewater Network estimates that the total CO₂ equivalent emissions from a plug-in hybrid vehicle (accounting for both tailpipe and upstream emissions) would drop from 171 grams per mile to 140 grams per mile if renewable electricity was properly included. This results in a 69 percent emission reduction from conventional gasoline vehicles, which is significantly better than the 62 percent reduction reported in the ISOR.

Correcting the upstream emission factor makes a big difference in an automaker's cost of compliance. Using an updated upstream emissions factor that accurately reflects renewable electricity use, we estimate that a manufacturer would only need to produce plug-in hybrids for 45 percent of their fleet to meet the full phased in 2016 standard. If a manufacturer can produce fewer plug-in hybrids to meet the standard, their total cost of compliance will be reduced. Our calculations suggest that if a manufacturer only has to produce plug-in hybrids for 45 percent of their fleet, their fleet average incremental cost would be reduced to \$1,475.

If a manufacturer chose to build plug-in hybrid vehicles with cost-savings attributes such as better aerodynamics, better tires, and lower vehicle mass, (which, to our understanding is consistent with the assumptions staff used for conventional hybrid vehicles), the incremental cost of each plug-in hybrid would be reduced to approximately \$2,550, bringing down the fleet average cost of compliance to \$1,147 when accounting for renewable energy.

To put this cost in perspective, \$1,147 is only \$101 more than the average retail vehicle price increase estimated by staff for conventional technologies needed to meet the 2016 greenhouse gas standard, and less than 0.3 percent of today's average automobile price. Even if an automaker decided not to implement these additional cost-saving technologies, the incremental cost of \$1,475 would be only \$428 more than the vehicle price increase for conventional technology, and less than 1.4 percent of today's average automobile price. (Elisa Peters, Bluewater Network; comments endorsed by David Modisette, California Electric Transportation Coalition)

Agency Response: The 15-day amendments to allow adjustments to the upstream emission factors for electric and hydrogen vehicles to account for the use of renewable electricity will also apply to the upstream emissions for grid-connected HEVs.

A footnote was added to the regulatory text to indicate that "the Executive Officer may approve use of a lower upstream emissions factor if a manufacturer demonstrates the appropriateness of the lower value by providing information that includes, but is not limited to, the percentage of hydrogen fuel or the percentage of electricity produced for sale in California using a "renewable energy resource." While the footnote specifically identifies those fuels used in vehicles with no direct vehicle emissions, the adjustment would also impact the electricity used to recharge grid-connected HEVs.

Given the variety of potential grid-connected HEV designs possible, ARB staff did not develop a single adjustment factor for these vehicles. However, any changes to the adjustment factor for electricity would also be applied to the assessment of emissions impacts from grid-connected HEVs.

(3). Section 6.5—Early Reduction Credits

664. Comment: The California Council for Environmental and Economic Balance supports early compliance and alternative compliance options in this and other ARB rules. (Robert W. Lucas, California Council for Environmental and Economic Balance)

Agency Response: ARB appreciates the comment.

d. ISOR Section 8—Environmental Impacts

(1). Section 8.3—Emission Impact of the Staff Proposal in a Broader Context

665. Comment: Some commenters have suggested that California's actions might prove futile because automakers might choose to offset the production of cleaner cars for the California market with greater sales of more inefficient, more polluting vehicles in other states. We submit that this is unlikely for two reasons. First, many states have already indicated that they will follow California's lead: for example, Governor Pataki in New York and Governor Romney in Massachusetts have signaled their support for the greenhouse gas emission standards and stated their plans to follow California in adopting the standards. Second, the economics of the auto industry are such that in many cases it will be to auto companies' advantage to sell the new efficient models that they will produce to meet CARB's proposed standards in the highest volumes possible. Given the improvement in operating costs, and the greater cost advantage that these vehicles will offer over the lifetime of the vehicle, it is implausible that such efficient vehicles will not find a market in places outside of California. Automakers will have an inherent economic incentive to sell as many of these vehicles outside of California as possible in order to allow for economies of scale. Third, recent trends suggest that there is presently an excess demand for efficient vehicle technologies, such as hybrids, and demand for many of the most inefficient vehicles, for example many large SUV models, has been flagging, requiring manufacturers to offer greater discounts to move inventory. Many manufacturers have recently unveiled new production plans for current models. These and other trends suggest that it is unlikely that American auto consumers will be looking for vehicles that offer less efficiency than those on the market today. (Eric Haxthausen and Kate M. Larsen, Environmental Defense)

Agency Response: ARB agrees with the comment.

666. Comment: In the face of federal inaction to address global warming, California has a duty and a need to be a policy leader in addressing greenhouse gas emission sources in its purview. (Haxthausen, Environmental Defense, 11/05/04).

Agency Response: No response necessary.

(2). Section 8.4—Fuel Cycle Emissions

667. Comment: Only by making major changes in her estimate of “upstream” emissions of ozone precursors could the Executive Officer offset excess emissions of ozone precursors from the California motor vehicle fleet. The specific bases for her changes in her estimates of “upstream” emissions, however, were not placed in the public record prior to the Board’s hearing in September. The bases for those changes appear to also not have been known to the ARB staff, and indeed came from an ARB contractor whose estimates were accepted uncritically and simply presented to the Board as coming from the ARB staff. (Alliance)

Agency Response: The changes identified in the comment were made to correct inconsistencies with the emissions factors used to assess fuel cycle emissions. The revised estimates were made subject to public comment as part of the 15-day package released on October 19, 2004. The changes were well understood by ARB staff prior to their use in modifying the fuel cycle estimates. However, ARB staff relied on TIAX to develop the emission factors due to their extensive experience and modeling expertise. Given the inherent uncertainty in projecting emissions 20 to 30 years in the future, the changes made do not significantly change the ARB staff’s assessment of the criteria pollutant impacts provided to the Board at the September hearing.

668. Comment: The Alliance notes that key information is still missing from the rulemaking file, in addition to the peer review documents on which the Board and the staff are relying. In addition to the missing information identified in our September comments, it is apparent that ARB or its contractors are using currently undisclosed models, spreadsheets or other sources of data or analysis to support the Executive Officer’s latest revised “upstream” emissions analysis. That information should be placed in the rulemaking file as required by section 11347.3 of the Government Code and public comment should be permitted on the information as contemplated by the APA and CEQA. (Alliance)

Agency Response: Although it is not entirely clear from the comment what information is at issue, all data and methodologies used by ARB staff have been available for public review and comment. All emissions related material derived by a contractor, with the exception of a proprietary model, has also been made available to the public during the 45-day comment period or during the subsequent 15-day comment period.

669. Comment: The September 10, 2004, Addendum to the ISOR and one subsequent document present the staff’s revised estimates of the changes in overall direct and indirect emissions of smog-forming pollutants that would be created by the proposed rule. Appendix J of these comments analyzes the staff’s revised estimates and demonstrates why those estimates are unsupported and are not consistent with the available evidence. It is important for ARB to consider and address the analysis in Appendix J under CEQA. In addition, the Executive Officer needs to explain exactly how the staff derived their

revised upstream emission estimates, what inputs and assumptions they used, and why those inputs and assumptions were selected. The explanation must be sufficiently detailed to permit a replication of the staff's estimates. In addition, the Executive Officer needs to explain and justify with data any reasons why the staff does not agree with the estimates developed in Appendix J. Any such data should be accompanied by reference to the relevant documents in the rulemaking file. That is required under both CEQA and the APA. (Alliance)

Agency Response: Assumptions for tanker and shipping emissions were modified by TIAX during the regulatory development process as part of a new study. ARB staff used the new assumptions as part of the emissions analysis for this rulemaking. ARB staff publicly released the updated emissions as they were modified and provided them to this commenter on an ongoing basis. The change in fuel cycle estimates from the original estimate to the 15-day estimate is less than 3 tons per day for both NOx and NMOG combined in 2020.

A wide range of factors can affect the fuel cycle emissions associated with gasoline transport and delivery. ARB staff has reviewed the analysis referred to as "Appendix J" to determine the differences in the overall estimates for criteria pollutants. Regarding fuel cycle emissions, the analysis in Appendix J disagrees with many of the assumptions contained in two studies used by ARB staff to develop these estimates. The analysis contained in Appendix J represents possible outcomes for fuel delivery infrastructure, but the assumptions used represent lower bound estimates. The contractor used by staff also received input and considered other assumptions that would result in estimates higher than those projected by staff. The values used by ARB in this analysis represent sound engineering judgment and would certainly fall within the range of reasonable estimates.

670. Comment: Based on the information finally made available by CARB staff as part of the 15 Day Notice and information we received from TIAX via email on November 2, 2004, it is clear that there are two major differences between the emission factors being used by CARB staff for the AB 1493 process and those used by CARB and CEC during the AB 2076 process in 2003: (1) higher emission factors for gasoline cargo tanker trucks, and (2) an assumption that petroleum product tanker emissions should be based on 100 nautical miles, rather than the 26 nautical miles assumed previously.

Turning first to the issue of truck emission factors, in its latest analysis the CARB staff has used average emission factors for the 2020 fleet of heavy-duty vehicles operating in California. As discussed above, data collected by CARB show that trucks used in fuel transport are newer than those found in the total heavy-duty fleet. This is important because newer trucks used for fuel delivery in 2020 will have been certified to more stringent emission standards and will be cleaner than the average truck in the 2020 heavy-duty diesel vehicle fleet. In addition, CARB staff has also used the TIAX assumption of a 100 mile round trip distance for tankers, which is unsupported. Therefore, CARB staff has overestimated emission from this source.

The second issue is the longer transit distance assumed by CARB staff for petroleum product tankers. First, as discussed above, it isn't clear that gasoline that would be brought to California in the absence of the AB 1493 regulations would in fact be supplied by tankers. Secondly, CARB has provided no explanation of why it is that 100 nautical miles is a more appropriate distance than 26 nautical miles, other than to suggest that longer tanker distances were warranted because statewide, rather than urban, emissions were considered as part of the AB 1493 process. (Alliance Appendix J)

Agency Response: Staff disagrees with the comment. Emission factors for gasoline cargo tanker trucks are not explicitly identified in EMFAC. These vehicles operate with an 80,000 lb. gross vehicle weight when laden with fuel. This vehicle weight is heavier than the average truck, and the TIAX analysis adjusted the EMFAC value to reflect the greater load. The value in Appendix J represents an overly optimistic situation for such heavily loaded trucks.

With regard to the use of 100 nautical miles for tanker emissions, prior fuel cycle studies funded by ARB focused on criteria pollutant emissions in the South Coast Air Basin. This approach was primarily driven by the desire to perform a power dispatch analysis that would represent the emissions impact of electric vehicles. The California Energy Commission, which was doing the power dispatch analysis to support the project, indicated that it would be expedient to analyze power generation emissions for the Southern California Edison service area. To achieve consistency the study participants chose to use the 26 mile limit used by the South Coast Air Quality Management District for inventory calculations as the basis for the emissions impact.

As fuel cycle studies were updated for other purposes, including support for AB 2076 and AB 1493, the contractor received input that the South Coast Air Basin boundaries were no longer relevant and that the fuel cycle analysis should look at broader application throughout the state. The rationale for the 100 nautical mile value was based on consultation with interested parties and a review of California geography. The contractor concluded that the value should be greater than 26 miles because transport emissions beyond the coast can contribute to pollution in the state, and California has over 400 miles of coastline where some of the tanker traffic will be parallel to the coast.

Regarding other emission aspects of the emission calculation, see the response to comment 669.

e. ISOR Section 9—Cost Effectiveness

671. Comment: In general, CARB's analysis of the economic impacts that would be associated with the proposed regulations demonstrates that the reductions in greenhouse gas emissions from new motor vehicles required by the regulations can be achieved in a way that is both cost-effective and economical to the consumer. This finding is consistent with a number of previous studies, including recent studies by the Northeast States Center for a Clean Air Future and the Union of Concerned Scientists, that have found that cost-

effective reductions of greenhouse gas emissions from motor vehicles can be achieved in a way that would repay the vehicle owner within its lifetime.

AB 1493 requires that CARB's implementing regulations achieve the "maximum feasible and cost-effective reduction of greenhouse gas emissions from motor vehicles." Section 3(i)(2) of the statute defines "maximum feasible and cost-effective reduction of greenhouse gas emissions" as those that the Board determines are both capable of being accomplished within the time frame set forth, taking into account environmental, economic, social, and technological factors; and "economical to an owner or operator of a vehicle, taking into account the full life-cycle costs of a vehicle." Haxthausen, Environmental Defense, 11/05/04).

Agency Response: The comment is supportive of the staff analysis. No further response needed.

672. Comment: The regulations drafted by CARB as reflected in the 15-day notice meet this test. They are feasible and cost-effective. They will be economical to an owner or operator of a vehicle subject to the regulations, taking into account the full life-cycle costs of that vehicle. CARB's analysis shows that the additional upfront costs of the mid-term technology needed to meet the standards will be repaid within an average of 4 years of purchasing the vehicle. Indeed, over the lifetime of a car or light truck, on average, an owner or operator would save approximately \$3,000, using an appropriate discount rate as discussed further below. Merriam-Webster's online dictionary defines "economical" as "marked by careful, efficient, and prudent use of resources; thrifty" or "operating with little waste or at a saving." The lifetime financial savings described above clearly meet this definition. (Haxthausen, Environmental Defense, 11/05/04).

Agency Response: The comment is supportive of the staff analysis. No further response needed.

673. Comment: A separate question is whether vehicle modes that are traded in the used vehicle market will continue to meet the "economical" test, given that interest rates are typically higher for used vehicle loans. The answer is that they will meet the test. As shown in the September 10th Addendum, Revised Table 11.4-2 (p. 26), a used-car buyer financing a ten-year old used car at an interest rate of 10 percent with a loan term of three years would experience a monthly operating cost savings of approximately \$14 or \$15 during the term of the loan (and a greater savings after the loan was paid). Using statistics reported by the Federal Reserve and the rolling 12-month consumer price index (CPI-U) reported by the Bureau of Labor Statistics, Environmental Defense calculates that borrowers of used car loans from auto finance companies during the past 10 years have faced an average real interest rate of 9.9 percent, marginally lower than the 10 percent rate used in the draft staff proposal. Purchasers of newer used cars would see a greater increase in the vehicle price, but also either (1) a greater residual price if the vehicles are sold within a few years of purchase, or (2) a longer time period during which higher operating costs are realized, if the vehicles are retained. (Haxthausen, Environmental Defense, 11/05/04).

Agency Response: The comment is supportive of the staff analysis. No further response needed.

f. ISOR Section 10—Economic Impacts

(1). Section 10.2—Potential Impacts on Business Creation, Elimination, or Expansion

674. Comment: The 5% discount rate used by CARB is lower than the interest charged on new car loans and is therefore unreasonable because consumers cannot be expected to borrow at a rate higher than 5% in order to receive a 5% return on the investment made in technology to improve fuel economy. (Sierra Research Supplemental Analysis of Engineering Costs and Benefits and Cost-Effectiveness, Appendix P, P. 16)

Agency Response: This comment is not supported by historical data. The 5% real interest rate is based on ten-year averages of automotive interest rates and the consumer price index. The commenter also misinterpreted the ARB analysis. The analysis actually assumes the reverse of what is stated above. The analysis implicitly assumes that consumers are willing to borrow money at a 5% real interest rate in order to achieve a higher than 5% return on their investment in greenhouse gas emission reduction technology.

675. Comment: Assuming a real interest rate of 7% for new car loans and 13% for used car loans, the weighted average loan rate over the life of the vehicle is estimated to be 10% real. As a check on the appropriateness of using this rate for a discount factor, we have analyzed the long-term average real return associated with conservative stock market investments (i.e., the Standard and Poor's Index). As explained in the footnote, this alternative investment analysis supports a real discount rate of 10%, which supports the use of 10% rate based on the interest on car loans. Setting the discount rate based on car loan interest rates is also consistent with comments ARB received from one of its peer reviewers. (Sierra Research Supplemental Analysis of Engineering Costs and Benefits and Cost-Effectiveness, Appendix P, P. 18)

Agency Response: Staff disagrees with the comment. The ARB staff used a 5% real discount rate in its analysis compared to the 10% rate used by Sierra. The ARB rate was based on ten-year averages of car loans at auto finance companies as reported by the Federal Reserve Bank and adjusted by the consumer price index (CPI) as reported by the Bureau of Labor Statistics. Sierra justifies its use of 10% real discount rate by comparing it to the long-term real return associated with conservative stock market investments. But decisions to purchase a vehicle or to invest in the stock market are based on a completely different set of factors. A vehicle is a consumer durable good that depreciates in value as it is used while a stock is an ownership right that allows an investor to benefit from the future earnings of a company. Consumers purchase a vehicle because it allows them mobility; that is, to go to work, to go shopping, to travel, etc. while they invest in a company based on the return which that investment will bring. It is not appropriate to compare these two types of investment. Thus, ARB staff believes that the long-term return on

conservative stock market investments is not an appropriate proxy for the cost of a car loan.

676. Comment: ARB staff overestimated the present value of fuel cost savings associated with the proposed regulation by using a discount rate of only 5%. Since the unsubsidized interest rate on vehicle loans significantly exceeds 5%, the ARB analysis is based on the assumption that consumers are willing to borrow money at an interest rate higher than 5% in order to achieve a 5% return on their investment in fuel economy technology. The staff ignored this comment when providing its response to my testimony to the Board. As explained in detail in the attached supplemental analysis that I have prepared, a more detailed assessment of the appropriate discount rate indicates that it should be at least 10%. My opinion regarding this issue is consistent with that expressed by a peer reviewer of the staff analysis that was selected by ARB. As my supplemental analysis shows, the ARB staff's response to the peer reviewer comments were inappropriate because they were based on the use of subsidized loan rates, which do not reflect the true cost to the consumer. When a more appropriate discount rate is used, the value of the fuel savings is less than estimated by the ARB staff. (Second Declaration of Thomas C. Austin, Sierra Research)

Agency Response: Staff disagrees with the comment. See response to comments 674 and 675.

677. Comment: The five percent discount rate used to evaluate whether the emission standards would be economical to the consumer is broadly consistent with the average real interest rate faced by new car purchasers over the past 10 years (as calculated using statistics reported by the Federal Reserve and the rolling 12-month consumer price index).

The analysis prepared by NERA and submitted in Appendix B of the Alliance comments also includes the Federal Reserve new car loan statistics as part of its model of scrappage behavior. While we take issue with some of the assumptions underlying NERA's scrappage model, NERA's reliance on the Federal Reserve Board's data on average financing rates for new auto loans to build its model of actual consumer behavior would appear to belie the Alliance's claim that the discount rate used in the staff's analysis "does not reflect mainstream economic analysis."

Some commenters have suggested that, rather than relying on widely used and reliable data on the actual interest rates faced by consumers, CARB should use the discount rate assumptions employed in a recent National Research Council report relating to the auto industry. We disagree. This report modeled scenarios using two separate sets of assumptions about tradeoffs by auto consumers between upfront costs and later cost savings, but provided no documentation for the discount rate assumptions used in the report. It would be inappropriate for CARB to base the analysis for its greenhouse gas emission standards on undocumented and apparently arbitrary assumptions contained in a report prepared in a different context and on a different topic. (Eric Haxthausen and Kate M. Larsen, Environmental Defense)

Agency Response: Staff agrees with the comments.

678. Comment: CARB staff's analysis of whether the regulations will be economical to the owner or operator of new motor vehicles relies on the use of a discount rate to compare new vehicle costs to operating cost savings over the lifetime of those vehicles. To address the requirement that the regulations be economical to the consumer, CARB has appropriately tried to estimate the net private cost (or cost savings) that would result from application of the draft staff proposal. The September 10, 2004, *Addendum Presenting and Describing Revisions to the Initial Statement of Reasons for Proposed Rulemaking* continues to rely upon a five percent discount rate to compare the flows of operating cost savings over the lifetime of new motor vehicles with the upfront costs associated with technologies that lower greenhouse gas emissions. The five percent discount rate used to evaluate whether the emission standards would be economical to the consumer is broadly consistent with the average real interest rate faced by new car purchasers over the past ten years. Using statistics reported by the Federal Reserve and the rolling 12-month consumer price index (CPI-U) reported by the Bureau of Labor Statistics, Environmental Defense calculates that borrowers of new car loans from auto finance companies during the past 10 years have faced an average real interest rate of 4.3 percent, slightly lower than the 5 percent rate used in the draft staff proposal. (Haxthausen, Environmental Defense, 11/05/04).

Agency Response: The comment is supportive of the staff analysis. No further response needed.

679. Comment: Some commenters have suggested that, rather than relying on widely used and reliable Data on the actual interest rates faced by consumers, CARB should use the discount rate Assumptions employed in a recent National Research Council report relating to the auto Industry. We disagree. This report modeled scenarios using two separate sets of assumptions about tradeoffs by auto consumers between upfront costs and later cost savings, but provided no documentation for the discount rate assumptions used in the report. It would be inappropriate for CARB to base the analysis for its greenhouse gas emission standards on undocumented and apparently arbitrary assumptions contained in a report prepared in a different context and on a different topic. (Haxthausen, Environmental Defense, 11/05/04).

Agency Response: The comment is supportive of the staff analysis. No further response needed.

g. ISOR Section 12—Other Considerations

(1). Section 12.1—Consumer Response Effects on Emissions and State Economy

680. Comment: CARB has relied on a detailed and California-specific model of the fleet turnover effect that would likely be induced by these regulations. NERA's scappage model relies on national data, rather than California data. This hampers the application of

that model to California. California differs in many ways from other parts of the country in respect to the automobiles that are driven there, and various factors that influence scrappage decisions.

The parameter estimate of the scrappage model reported in Attachment B2 of the NERA analysis indicate that at a 95 percent confidence level, the parameter estimates for the effect of new car price on the scrappage rate of vehicles more than 14 years old are not statistically different from zero. The higher scrappage rates for these older vehicles (representing pre-LEVII vehicles in 2020) form part of the core of the claim that the proposed standards would contribute to the higher excess emissions of criteria pollutants alleged by NERA's model. Yet the application of NERA's model to these older vehicles is the most speculative part of NERA's analysis of the fleet turnover effect. (Eric Haxthausen and Kate M. Larsen, Environmental Defense)

Agency Response: Staff agrees with the comment.

(2). Section 12.3—Effects of Regulation on Vehicle Miles Traveled

681. Comment: CARB's failure to account for a significant rebound effect is based on the staff's reliance on a rebound effect model developed by UC Irvine that has been fully rebutted and that produces results that are fundamentally inconsistent with actual California odometer data collected during periods when gasoline prices changed significantly. (Sierra Research Supplemental Analysis of Engineering Costs and Benefits and Cost-Effectiveness, Appendix P, P. 17)

Agency Response: The Sierra approach in estimating the fuel price elasticity (rebound effect) is not robust. The approach is based on the assumption that all changes in VMT can be explained by changes in fuel prices. This assumption fundamentally biases the results. It is not correct to associate all changes in VMT to changes in fuel price. In addition to fuel price changes, VMT changes by a host of other factors such as time costs, travel congestion, income, income level, etc. Furthermore, Sierra selectively chooses three time periods to compare changes in VMT to changes in fuel price. This approach, which is based on selective choice of data points, is not scientific and at best represents anecdotal evidence. In contrast, staff believes that the UC Irvine approach to estimate rebound effect is very robust because it is based on an econometric estimation using aggregate cross-sectional data for 1966 to 2001 on a cross-section of U.S. states and the District of Columbia. The evaluation of State level information allowed the UC Irvine researchers to identify California-specific effects in a systematic way.

682. Comment: Table 4 shows the same analysis accounting for a 17% rebound effect. Sierra's estimate of the net cost increase associated with proposed standards rises from \$2,759 to \$3,033. (Sierra Research Supplemental Analysis of Engineering Costs and Benefits and Cost-Effectiveness, Appendix P, P. 21)

Comment: Table 7 shows the same analysis accounting for a 17% rebound effect. The net cost increase associated with the proposed standards rises from \$362 to \$524. Sierra

Research Supplemental Analysis of Engineering Costs and Benefits and Cost-Effectiveness, Appendix P, P. 22)

Agency Response: The 17% rebound effect estimate that Sierra used in its analysis is based on the NERA revision of the rebound effect estimate by the University of California, Irvine. This revision is based on misinterpretation of the data and misunderstanding of the assumptions used in the UC Irvine study. Please see our responses to Comments 444 and 445. ARB staff has a great confidence in the rebound effect results generated by the UC Irvine study.

(3). Section 12.4—Combined Effect on Criteria Pollutant Emissions

683. Comment: The effect of correcting the obvious errors in CARB’s staff’s analysis of the rebound and fleet turnover effects – without challenging any of the underlying assumptions associated with CARB staff’s analysis – can be seen in Table 3. As shown, the estimated increase in 2020 statewide emissions of ROG, NO_x, and PM emissions due to the rebound and fleet turnover effects approximately doubles to about 5 tons per day of ROG + NO_x and 0.4 tons per day of PM. This changes the overall result that the total impact of the AB 1493 regulations on 2020 statewide criteria pollutant emissions is a decrease of 0.2 to 0.4 tons per day of ROG + NO_x emissions (as compared to CARB’s claim of 5 tons per day in the September 24 press release) and an increase of 0.35 tons per day in PM emissions.

Table 3 Current CARB Estimates of the Impact of the AB 1493 Regulations on 2020 Statewide Emissions of Criteria Pollutants Corrected for Errors in Estimating the Rebound and Fleet Turnover Effects			
Effect	ROG	NO _x	PM ₁₀
Corrected Rebound and Fleet Turnover	3.0/3.1 ^a	2.2/2.3	0.4/0.4
Fuel Cycle	-4.6	-1.0	-0.05
TOTAL	-1.6/-1.5	1.2/1.3	0.35/0.35

^a First value is additive impact of rebound and fleet turnover, second value is combined impact.

(Alliance Appendix J, Analysis of the Impact of CARB’s AB 1493 Regulations on Criteria Pollutant Emissions as a Result of Rebound, Fleet Turnover, and Reduced Fuel Consumption, page 4)

Agency Response: This comment is similar to Comments 472 and 473 submitted during the 45 day comment period. The emission impacts are overstated. See the responses to Comments 467 through 470, and comments 667 through 669.

684. Comment: Attachment B4 to the NERA analysis advances an argument that fleet VMT should remain constant between the baseline scenario and the control scenario, and

argues that an adjustment is needed to the CARB staff analysis. However, a clear consequence of the fleet turnover effect is an aging of the fleet, and older vehicles on average are driven fewer miles (in part because the per-mile maintenance cost is typically higher). A logical consequence of the fleet turnover effect is therefore a decline in VMT and an increase in the per-mile cost of driving. Assuming away this effect by “correcting” for the decline in VMT induced by delayed fleet turnover is inconsistent with basic economic principles, and therefore incorrect.

A related issue is the implication of the rebound effect for fleet turnover. As vehicles are driven more (under the rebound effect), they will age faster, which *ceteris paribus* will tend to generate faster fleet turnover. The consequences of these two effects – the rebound effect and the fleet turnover effect – cannot simply be added, but must be considered in tandem. To a certain extent, they are competing effects that will tend to mitigate each other.

It is not clear whether this aspect of these two effects has been incorporated either into CARB staff’s analysis or into the analysis submitted by NERA on behalf of the auto manufacturers. If not, summing the modeled effects will overstate their joint contribution, and the results of the analysis should be viewed in that light. (Environmental Defense, Comments on the 15-Day Notice of Public Availability of Modified Text to the California Air Resources Board Rulemaking to Control Greenhouse Gas Emissions from Motor Vehicles, page 8)

Agency Response: The concern about the interrelationship between rebound and fleet turnover is a valid one. This is why staff estimated the combined impact two ways. First, staff assessed the impacts of rebound and fleet turnover separately and then added them together to get the combined impact. Second, staff assessed the impact of both effects together. This was done using EMFAC inputs that included both a fleet mix adjustment to reflect vehicle sales impacts and an adjustment to the mileage accrual rates for the vehicles subject to the regulation. Regardless of method, the combined impact of rebound and fleet turnover was found to be small.

685. Comment: I find that the AB 1493 regulations will lead to significant increases in ROG and NOx emissions as well as PM emissions in 2020 and beyond based on my review of CARB staff’s estimates of criteria pollutant emissions and data developed by NERA and Sierra that has previously submitted to CARB. (Sierra Research)

Agency Response: As noted in the responses to Comments 683 and 684 above, ARB staff conducted a supplemental analysis that estimated the criteria pollutant emission impacts from the regulation by combining the emissions from fleet turnover, rebound and fuel cycle emissions. The emission impacts from rebound, fleet turnover and fuel cycle emissions are based on appropriate models and reasonable assumptions and applied to 2020. The conclusion of ARB’s supplemental analysis is that the regulation will result in a net decrease of about 2.8 tons per day in ROG + NOx, and a de minimis increase of about 0.18 tons per day in PM10. (Because light duty vehicles account for only a small portion of total PM10 emissions, the estimated PM10 increase of 0.18 tons per day represents

about 0.007 percent of the total statewide PM10 inventory for 2020, which is 2560 tons per day). Analyses by others using different emission factors and models will result in different estimates. ARB staff disagrees with the estimates noted in the Comment.

h. ISOR Appendix A: Regulatory Language and Test Procedures

686. Comment: AB 1493 requires an exemption for commercial-use vehicles. We believe that requirement is recognized in the 15-day notice, which indicates on page 14 that one intention of the proposed revision is “to exempt light-duty work trucks from greenhouse gas emission requirements.” The 15-day Notice proposes to address this issue by exempting a category of vehicles defined as meeting Option I LEV II NOx emissions standards.

The Alliance does not believe that the approach taken in the 15-day Notice addresses the requirements of the statute for two reasons. First, we do not believe the Option I LEV II NOx criterion is sufficient to identify and exempt commercial use vehicles. Second, it results in no commercial-use vehicles being identified and exempted. To the first point, commercial-use vehicles should be defined by the actual use of the vehicles, rather than by the emission level of the vehicle. (Alliance of Automobile Manufacturers)

Agency Response: Staff disagrees with the comment. AB 1493 specifies that this regulation “shall provide an exemption for those vehicles subject to the optional low-emission vehicle standard for oxides of nitrogen (NOx) for exhaust emission standards described in paragraph (9) of subdivision (a) of Section 1961 of Title 13 of the California Code of Regulations.” ARB characterizes vehicles that certify to these standards as “work trucks,” but the term “work truck” is not a legally defined term within the context of California’s motor vehicle emission regulations.

The intent of the regulations was always to carry out the requirements of AB 1493. The originally proposed regulatory language attempted to do this by specifying that vehicles certifying to the “optional LEV II NOx Standard” would be exempt from greenhouse gas requirements. However, this language was not clear enough to distinguish between vehicles certifying to the “option 1 LEV II NOx standard,” which was the intent of the bill, and vehicles certifying to “Optional 150,000 mile emission standards,” which was not the intent of the bill. The purpose of the 15-day notice change was to clarify that only vehicles certifying to “option 1 LEV II NOx standard” are exempt from greenhouse gas requirements.

Staff did not make any judgment regarding which vehicles would qualify as “work trucks” for the purpose of exempting them from the greenhouse gas regulations. Rather, this issue was evaluated extensively during the development of the LEV II program. After much effort in trying to define a “work truck,” ARB concluded that the only reliable determinant was payload capacity of the vehicle. Vehicles that had at least a 2,500 pound payload capacity were judged to have the mechanical upgrades necessary to qualify them as vehicles capable of real work--for example, hauling cement bags, drywall, tool chests,

and other heavy items. Such upgrades might include stronger axles, heavier springs, stronger frames, and similar measures to increase payload capacity.

To define a “work truck” based on the actual use of the vehicle rather than on the emission level of the vehicle, and to exempt these vehicles based on a newly created definition would be both arbitrary (since vehicles that are used for personal transportation can also be used for light work, such as a flower delivery vehicle) and contrary to the clear requirements of AB 1493. See also the agency response to comment 572.

687. Comment: To the second point, we are not aware of any vehicles in the Option I LEV II NOx category. To fall into the Option I LEV II NOx category, a vehicle must be a LDT2 truck having a base payload of 2,500 lbs. or more, yet not exceed 8,500 lbs. Gross Vehicle Weight Rating. This implies that the unloaded, curb weight of those trucks cannot exceed 6,000 lbs. Trucks capable of carrying a load of 2,500 lbs. or more necessarily have curb weights over 6,000 lbs. Because 2,500 lbs. is a heavy payload, only a small proportion of the current sales of pickup trucks provide such high capability, and these trucks are all classified as medium-duty vehicles. Even if some reduction in weight for these MDVs would otherwise be practical – which is not the case – a rule that encourages such a change would violate the separate provision of AB 1493 that prohibits “a reduction in vehicle weight.” In addition, the Option I LEV II NOx provisions limit the vehicles in this category to 4% of a manufacturer’s LDT2 sales. The 4% restriction on sales volume is not sufficient to exempt work trucks from the greenhouse gas regulations. (Alliance of Automobile Manufacturers)

Agency Response: When the LEV II program was developed in 1998 ARB determined that Ford F150 vehicles qualified for the Option I LEV II NOx provision because some vehicles in that line were in the 8500 lb. Gross Vehicle Weight (GVW) and below category but still were capable of a 2500 lb. payload. ARB reexamined the 2004 models and found that again the Ford F150 series has vehicles in this class, and that their sales represent about 2.3 percent of their fleet (3190 sales). Both GM and Chrysler trucks have similar vehicles, but they shift them up 100 lbs. GVW to the medium-duty vehicle category (8,600 lbs.) to avoid having to meet the more stringent LDT2 exhaust emission standards. Thus Ford has acted in good faith in providing cleaner vehicles in the LDT2 category that could qualify for the Option I LEV II NOx provision. Such vehicles represent about the same proportion of Ford's fleet in 2004 as they did in 1998.

688. Comment: We fully support the proposed amendment to allow plug-in hybrids to receive full credit for greenhouse gas emissions reductions for purposes of this regulation in the first model year. We believe it is appropriate to allow manufacturers to estimate the sales and percentage of vehicle miles traveled on electricity, and to verify this with final data no later than March 1 of the calendar year following the close of the model year. This rectifies an important oversight in the original regulations and allows these vehicles to be a viable compliance option for automakers. (Bluewater Network)

Agency Response: The comment supports a modification directed by the Board at the hearing to provide full credit for plug-in hybrid vehicles in the model year in which they are produced.

689. Comment: We do not support the proposed addition of a 10 percent discount factor to the greenhouse gas emissions equation for plug-in hybrid vehicles. This modification was prepared in response to concern that the all-electric range of plug-in hybrids will diminish with vehicle age due to battery deterioration, but we do not believe such a concern is warranted.

We believe that further advances in battery technology are very likely to occur by the first year this regulation is implemented (model year 2009), resulting in vehicles that will not lose emissions benefits over time. Should battery technology advancements not occur by model year 2009, we believe it is reasonable to assume that consumers will replace any batteries with diminished function, and therefore, that emissions benefits will not be lost. Vehicle owners will have a financial incentive to replace deteriorating batteries, since it is less expensive to operate the vehicle using electricity than on gasoline with the conventional engine. Furthermore, by the time a plug-in hybrid vehicle reaches 100,000 miles, it is likely that replacement battery costs will be less than projected, due to wide implementation of both conventional and plug-in hybrid technology. This will give consumers even further financial incentive to replace the battery should it deteriorate with use. (Bluewater Network)

Agency Response: The modification noted in the comment was included to address the concern that a grid-connected HEV may not be able to maintain its initial all-electric range due to deterioration of the battery. To address this concern, ARB staff used the best information currently available to estimate that there will be no loss of all-electric range for the first 100,000 miles of the vehicle's life. At that point, there is expected to be linear deterioration of the battery to 80 percent capacity at 150,000 miles. This corresponds to a 20 percent loss in all-electric range. Assuming that linear deterioration of the battery continues to occur between 150,000 and 200,000 miles, it is expected that the all-electric range of the vehicle will be reduced to 60 percent of its original range at 200,000 miles. A discount factor of 10 percent has been applied within the above equation to take into account this loss of all-electric range over the life of the vehicle.

However, the regulation does allow the Executive Officer to approve an adjustment to the discount factor if a manufacturer demonstrates that the vehicles can reasonably be expected to maintain more than 90 percent of their original battery capacity over a 200,000-mile vehicle lifetime. The manufacturer would need to justify the higher value by either providing data from real world vehicle operation, showing that the batteries do not lose energy storage capacity after 100,000 miles, or by offering a 10 year/150,000 mile warranty on the batteries.

690. Comment: The 15-day notice also includes a provision that appears to create a formal effective date for the proposed rule on January 1, 2006, and it also modifies the period for the use of credits to comply with the fleet average that would be set by the

regulation. The Alliance believes that neither change has any practical significance on the regulatory burdens imposed by the proposed rule, or the point in time when the industry must begin to spend unrecoverable resources to comply with the proposed rule. (Alliance of Automobile Manufacturers)

Agency Response: This comment is a declaration of the commenter's belief that does not require a response.

3. Legal Comments

691. Comment: The statutes that govern this rulemaking require that the record be reopened for general public comment and that a further public hearing be held. (Alliance of Automobile Manufacturers 15 day comments)

Agency Response: This is incorrect. The ARB responded to this argument in an October 21, 2004 letter that the commenter has placed into the record. The text of this letter was later published at California Regulatory Notice Register 2004, Vol. 49-Z, pp. 1621-1622.

692. Comment: Because ARB apparently relied on the peer review document when taking action in September, whatever documents the Board or the staff considered or relied upon should have been placed in the rulemaking record, and should have had at least 30 days for review and comment under CEQA. The Alliance assumes that the Executive Officer will soon place the peer review documents in the record for comment. (Alliance of Automobile Manufacturers, 15 day comments)

Agency Response: See Agency Response to comment 554. In addition, the peer review documents were placed in the rulemaking record.

693. Comment: The ARB General Counsel's statement at the hearing indicated that there would be an additional period to comment on staff's additional work and on those comments that were provided by other testifiers and other submissions. When will that be provided? (Alliance of Automobile Manufacturers)

Agency Response: The commenter took the General Counsel's statement out of context. The intent here was to allow comment on the Addendum and other documents added to the record. (This did occur.) It was not to broadly reopen the hearing or conduct another one. The transcript clarifies this at p. 112. See also Agency Response to Comment 553.

694. Comment: ARB or its contractors are using currently undisclosed models, spreadsheets or other sources of data or analysis to support the Executive Officer's latest revised "upstream" emissions analysis. This information should be placed in the rulemaking file as required by section 11347.3 of the Government Code and public comment should be permitted on the information as contemplated by the APA and CEQA. (Alliance of Automobile Manufacturers, 15 day comments)

Agency Response: The ISOR contained those documents and spreadsheets used to calculate the initial impacts of the staff proposal on upstream emissions. The fuel cycle estimates were subsequently revised to address a mistake and to take into consideration updated emission factors. The new fuel cycle estimates were included in the September 11, 2005 Addendum to allow interested parties the opportunity to comment on changes made subsequent to the ISOR. In addition, spreadsheets with more detail were emailed to a representative of the commenter on September 15, 2004, and further explanation of the modified assumptions was provided by the ARB contractor to a representative of the commenter via email on October 19, 2004. See also the responses to comments 370 through 372, and 668.

695. Comment: It should be noted that the materials made available for public comment were not actually provided for inspection until October 20, 2004, even though the ARB notice was dated October 19, 2004. It should also be noted for at least a week after the public hearing in Los Angeles in September, 2004, the rulemaking file was apparently in transit between the hearing location and the ARB offices and was not available to the public. (Alliance of Automobile Manufacturers, 15 day comments)

Agency Response: The ARB agrees that because the commenter's representative did not request inspection of the documents until after appropriate staff were no longer available to assist him on October 19, the representative was not able to inspect the materials until a few business hours later, on the next day. It is truly remarkable that the commenter, who provided six banker's boxes of documents at the Los Angeles hearing, and who likely noted the numerous postal size bags full of positive comment letters also provided at the hearing, found it necessary to comment on the reasonable time taken to package and send their and others' voluminous materials back to ARB's offices.

C. COMMENTS RECEIVED DURING THE SECOND 15 DAY COMMENT PERIOD

696. Comment: 1. Do not exempt heavy vehicles! They are the primary source of the problem and leaving that loophole simply gives the internal combustion vehicle manufacturers another loophole. If the vehicle is going to be that heavy, it should be a hybrid. I have lived in Redlands, CA for the better part of 36 years and am sick and tired of monster SUVs and trucks polluting my air as the IC vehicle manufactures chase loophole after loophole. 2. Give a golden carrot award to the company which makes the most carbon neutral vehicle, e.g. biodiesel powered hybrid. (Jonathan Baty)

Agency Response: ARB need not respond to this comment as it is not specifically directed to the additional supporting documents and information noticed May 11, 2005. With regard to the issues raised, however, staff notes that the regulation does not categorically exempt heavy vehicles. Most SUVs and pickup trucks are subject to the regulation. AB 1493 specifically states that the regulations must provide an exemption for certain work trucks. This exemption, which is limited in scope, was included in the regulations as required under the statute.

Separate from this rulemaking, the ARB provides recognition for manufacturers of clean vehicles and will consider the notion of a golden carrot award as part of its ongoing efforts.

697. Comment: As a resident of the State of California I am concerned that the major car manufactures are wanting to weaken regulations on greenhouse gas emissions from cars, busses and other vehicles.

While regulations on emissions have exempted older model cars from smog inspections, it is important to encourage motor vehicles which cut down on smog, a substance which has negative effects on the environment. If low income drivers could be given incentives so that can afford to replace their older cars without having to pay more than middle class car buyers (by way of interest caps, lower down payments and tax credits) it would do the world—and California—good by decreasing the level of greenhouse gasses which are produce by California drivers. (Cynthia Bage)

Agency Response: ARB need not respond to this comment as it is not specifically directed to the additional supporting documents and information noticed May 11, 2005. With regard to the issues raised, however, staff notes that the state administers vehicle scrappage programs that provide an incentive for vehicle owners to replace older, high polluting vehicles.

698. Comment: The “Additional Supporting Documents and Information” posted on May 11 indicates that staff is in the process of preparing responses to the comments received during the 45 day and initial 15 day comment periods, and that staff has not identified any issues that would warrant further changes to the regulatory language. On August 11, 2004 I submitted written commentary and analysis concerning several deficiencies of the proposed regulations, and I have recently revised the analysis based on new information that staff provided me in March, 2005. Based on this information, I have replicated staff’s calculation of the standard and have clearly identified a methodological error that would warrant revision of the standard, and which would also impact the additional analysis and calculations documented in the May 11 posting. (Kenneth Johnson)

Agency Response: Mr. Johnson’s first analysis was based on an incorrect interpretation of how passenger cars and light-duty trucks are defined in the regulations. As noted in the comment, Mr. Johnson adjusted his analysis when presented with the correct definitions in March 2004. In essence, Mr. Johnson used a slightly incorrect database when he originally calculated his proposed emissions standards. However, since the corrections to Mr. Johnson’s original database were minor, the relative difference between his original analysis and his subsequent analysis is also minor. Accordingly, staff’s responses to Comments 312 through 322 still apply.

699. Comment: The New Yorker Magazine recently ran a series of three articles on the subject of anthropogenic forcing of greenhouse gases and global warming. Robert Corell, an American oceanographer and a former assistant director at the National Science Foundation, the coordinator of the study on Arctic climate change said, “the Arctic climate

is warming rapidly now, with an emphasis on now". Please support the Greenhouse Gas Emissions September 23, 2004 regulation. (Douglas Anderson)

Agency Response: No response needed.