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Summary of NESCAUM Analysis Evaluating the NOx, HC, and CO Emission Reduction Potential from Adoption of the California Low Emission Vehicle (LEV II) Standards
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I. Overview

This summary provides the results of modeling conducted by NESCAUM to evaluate the NOx, HC, and CO emissions reductions that will be realized in Northeast states adopting the California Low Emission Vehicle ("LEV II") program. The study is a follow-up to modeling conducted in 2002 to evaluate the HC, toxics, and CO_2 emissions reductions gained from adoption of the California LEV II program. The analysis itself was conducted by Cambridge Systematics, Inc., an independent consulting firm that, for more than 20 years, has conducted projects associated with the implementation of transportation and air quality planning initiatives.

The purpose of the analysis is to compare Tier 2 and LEV II light-duty vehicle emissions in different NESCAUM member states. The modeling results described in this summary provide an estimate of State Implementation Plan (SIP) credits that could be claimed from LEV II program adoption. In addition, the modeling conducted for this analysis addresses issues raised by the U.S. EPA about a prior NESCAUM analysis published in 2003.[1] The current analysis evaluates criteria pollutants but not other pollution reduced through adoption of the CA LEV program, such as greenhouse gas emissions.[2] This summary also provides the results of an evaluation - not using MOBILE6.2 - to assess the evaporative emission reductions achieved from the introduction of "zero evaporative" standards that are a part of the LEV II program. Section III summarizes the MOBILE6.2 modeling results, Section IV provides estimates for the VOC emission reductions that will result from introduction of zero evaporative emission standards in the Northeast, and Section V provides an overview of the method used to estimate the criteria pollutant reductions.

II. Background

Light-Duty Motor Vehicle Emissions Standards

All new vehicles sold in the U.S. are subject to emissions standards set by either the federal government or the State of California. California is the only state with the authority to set its own vehicle standards; other states may adopt either the California or the federal standards.[3] In the

[1] NESCAUM, "Comparing the Emissions Reductions of the LEV II Program to the Tier 2 Program," October, 2003.
[2] Reductions in GHG emissions that will be realized in the Northeast states through LEV II program adoption are summarized in "Quantifying the GHG Emission Reductions Achieved Through Adoption of the LEV II Program," NESCAUM, 2005
[3] The authority of other states to adopt California standards in lieu of federal standards was granted under Section 177 of the Clean Air Act Amendments of 1977.

1990s, several Northeast states (specifically, Maine, Massachusetts, New York and Vermont) adopted the California Low Emission Vehicle (LEV) program in lieu of federal standards. Three other Northeast states (Connecticut, New Jersey, and Rhode Island) adopted the LEV II program in 2004 and 2005.[4]

Air Quality Background

The substantial contribution of motor vehicles to ozone pollution is well established. Automobiles and other mobile sources emit hydrocarbons and nitrogen oxides (NOx), the two primary precursor pollutants that – when mixed in the atmosphere in the presence of sunlight – combine to form ozone. In fact, light-duty vehicles account for approximately one-third of all ozone precursor (NOx and HC) emissions in the Northeast. Light-duty vehicles also emit particulate ($PM_{2.5}$). Both ozone and fine particle pollution are associated with serious health impacts. In the case of ozone, documented health risks include decreased lung function and increased respiratory problems, and – with repeated exposure – long-term and potentially irreversible lung damage. Meanwhile, large-scale epidemiological studies of the health risks associated with fine particle pollution have produced convincing evidence for a host of adverse effects, including premature mortality, aggravation of respiratory and cardiovascular disease and increased incidence of asthma attacks, chronic bronchitis and hospital visits.

In the case of fine particles – which have emerged as a focus of air quality regulation and public health concern only in the last decade or so – the relative contribution of different source categories to ambient concentrations is less well understood. However, it is clear that light-duty vehicles emit primary $PM_{2.5}$ in addition to organic aerosols. Organic aerosols constitute a significant fraction of overall fine particle mass in many urban locales. Together with other sources of organic compounds – notably highway and nonroad diesel-powered engines – light duty vehicles are therefore likely to play at least some role in the formation of fine particle pollution in most urban areas. In this context, any additional hydrocarbon and NOx reductions achieved through the California LEV program will help states address the formidable challenge of attaining (and maintaining) new ozone and fine particle ambient air quality standards despite continued growth in vehicle miles traveled and other pollution-generating activities. More importantly, resulting air quality improvements will translate to potentially significant public health benefits, especially for the millions of citizens who live in urban areas of the Northeast that frequently experience unhealthy concentrations of ozone and fine particle pollution.

NESCAUM 2003 LEV II and Tier 2 Analysis

In 2002, NESCAUM evaluated the LEV II program and estimated the amount of hydrocarbon (HC), toxics and carbon dioxide ($CO_{2)}$ emission reductions that would be achieved in states adopting the LEV II program. Following the publication of the results, EPA provided comments and noted areas for further analysis or revision. Specifically, EPA commented on the need to: 1)

[4] Another state in the Northeast - Pennsylvania - adopted the LEV II program in 2006.

include LDT3 and LDT4 vehicles in the modeling; 2) use bin mix assumptions included in an EPA 2002 guidance document;[5] and 3) evaluate the emissions reductions achieved in states that recently adopted LEV II. At the time EPA issued its 2002 guidance document, the NESCAUM modeling of LEV II emissions was already underway, and NESCAUM did not change the assumptions in the evaluation to conform to the EPA guidance. This follow-up analysis re-evaluates the LEV II and Tier 2 program benefits using the EPA guidance for MOBILE6.2 (see Attachment A for the EPA guidance document).

III. Results: NOx, HC, and CO Emission Reductions

This section summarizes the NESCAUM modeling results using the EPA MOBILE6.2 model and the June, 2002 EPA guidance entitled "Modeling Alternative NLEV Implementation and Adoption of California Standards in MOBILE6." Results for early adopting LEV II states (New York, Massachusetts, Vermont, and Maine) are presented separately from recently adopting LEV II states (New Jersey, Connecticut, and Rhode Island) since the date of program implementation impacts emissions reductions.

Both the federal Tier 2 program and the California LEV II program will provide substantial further reductions in new vehicle exhaust emissions (on the order of 90 percent or more) over the next two decades. However, the analysis conducted by Cambridge Systematics for NESCAUM finds that California's standards provide additional emissions reduction benefits over and above what the federal program is expected to achieve. Specifically, the analysis finds additional reductions in light duty vehicle emissions of 31 tons per day of NOx+VOC in 2020 for early adopting states (MA, NY, VT, and ME) and reductions of 17 tons per day of NOx+VOC for newly adopting states (CT, NJ, and RI) under the LEV II program compared to the federal Tier 2 program. Reduced formation of secondary organic aerosol is likely an additional benefit of the LEV II program, although this has not been quantified in this study.

Tables 1 and 2 summarize the annual NOx, VOC, and CO emissions reductions that will be realized in the Northeast LEV states between 2015 and 2025. Table 1 provides reductions for the early adopting LEV states and Table 2 provides reductions for recently adopting states. The emissions reductions are presented for all light-duty vehicles (passenger cars and light-duty trucks 1, 2, 3, and 4).

[5] EPA, "Modeling Alternative NLEV Implementation and Adoption of California Standards In MOBILE6," June, 2002. NESCAUM assumed that most vehicles would be certified in bin 5 in the earlier analysis, and the EPA guidance document assumes somewhat of a different mix of vehicles.

Table 1: Emissions Reductions Achieved in Early Adopting LEV States

Calendar Year	NOx Reduced (% light duty emissions)	NOx Reduced (tons per day)	CO Reduced (% light duty emissions)	CO Reduced (tons per day)	VOC Reduced (% light duty emissions)	VOC Reduced (tons per day)
2015	11.4%	18.8	.2%	5.3	6.3%	11.4
2020	14.7%	19.3	.4%	11.8	7.6%	12.1
2025	16.4%	20.1	.9%	25.1	8.4%	13.4

Table 2: Emissions Reductions Achieved in Recently Adopting LEV States

Calendar Year	NOx Reduced (% light duty emissions)	NOx Reduced (tons per day)	CO Reduced (% light duty emissions)	CO Reduced (tons per day)	VOC Reduced (% light duty emissions)	VOC Reduced (tons per day)
2015	4.5%	4.9	1.5%	23.5	2.2%	2.6
2020	10.8%	8.1	3.0%	44.8	4.8%	4.5
2025	15.2%	9.7	3.7%	54.7	6.9%	6.0

The results above show that in 2025, more than 49 tons of smog-forming pollutants (NOx + VOC) will be reduced per day in the seven Northeast LEV states as a result of adoption of the LEV II program.

Discussion:

Several assumptions specific to the Northeast vehicle fleets evaluated were made in this analysis. First, different LEV II program implementation dates for the states are used. For example, Massachusetts first implemented the LEV program in 1994 and other states will implement the program in 2009. Since fleet turnover affects total fleet emissions, the analysis is specific to the different implementation dates assumed. Second, the analysis assumed that I/M programs are in place for a substantial fraction of the fleet evaluated. Last, fleet mixes for the Northeast states were also used in the analysis.

It is also important to note the results are reported in terms of tons reduced for light-duty vehicles and as a percent of the emissions difference between a Tier 2 fleet and a LEV II fleet. Heavy-duty vehicle emissions were not included in calculating percent reductions from the fleet. If emissions reduced are reported as a percent of total emissions from all motor vehicles - including heavy-duty vehicles - the percent reductions would be lower. Heavy-duty vehicle emissions are not included since light-duty vehicle emissions comprise roughly one third of the ozone forming pollutant inventory in the Northeast, and thus merit a stand alone analysis.

IV. Additional Analysis Using EMFAC Assumptions for "Zero" Evaporative Standards

The MOBILE model does not include an assumption for differences in evaporative emissions between near zero evaporative standards (standards for LEV, ULEV, and SULEVs) and for zero evaporative standards (standards for PZEVs, AT PZEVs, and ZEVs). The LEV program sets different certification standards for these different types of vehicles. The standards are summarized in Table 3.

Table 3: Comparison of Evaporative Standards (3-day diurnal + hot soak emissions: g/test)

Vehicle Class	LEV II "near zero" evap standards	LEV II "zero" evap standards
LDV	.5	.35
LDT1 and LDT2	.65	.5
LDT3 and LDT4	.9	.75

Unlike the federal program, the LEV II program requires a set percentage of vehicles sold to be zero emission vehicles ("ZEVs") or their equivalent (ZEVs and their equivalent are referred to as advanced technology vehicles in this summary). These advanced technology vehicles must meet the more stringent evaporative emission standards shown in column three of Table 3 labeled "LEV II zero evap standards." The requirement in 2006 is that 10 percent of passenger cars and LDT1s sold be zero emission vehicles, or their equivalent. This percentage requirement increases gradually until 2018, when it is fully implemented. In 2018, the requirement is 16 percent of combined passenger car, LDT1, and LDT2 sales are to be advanced technology vehicles. A flexible credit mechanism is available to manufacturers to facilitate compliance with the advanced technology vehicle requirement. As part of this compliance mechanism, up to 6 percent of the 10 percent ZEV requirement can be met with PZEV sales, however a PZEV does not receive the same amount of credit as a ZEV. Each PZEV sold receives 1/5 of a ZEV credit. Thus, five PZEVs must be sold to equal one ZEV. Assuming that at least 30 percent of the passenger car, LDT1, and LDT2 sales will be sold and will meet the more stringent evaporative emissions, the zero evaporative requirement will have a positive impact on air quality in the Northeast.[6]

To estimate the additional benefits that will be realized in the Northeast LEV II states from the zero evaporative standard, NESCAUM adjusted the MOBILE6.2 evaporative emission factors to reflect the emissions benefit of the more stringent zero evaporative standards. Since many PZEVs and some AT PZEVs will be powered by gasoline engines, deterioration in emissions over time is expected. To account for this, NESCAUM used lifetime average evaporative

[6] If full volume manufacturers meet 6% of the ZEV requirement with PZEVs, then 30% of passenger cars and LDT1s sold in 2006 will need to be PZEVs. The number of PZEVs required increases in later years.

emission factors from EMFAC for PZEVs and AT PZEVs. Differences between LEV II and Tier 2 program VOC emissions for the seven Northeast LEV states - adjusted to include the more stringent evaporative emissions standards - are presented in Table 4. Columns 2 and 4 show the additional total VOC emissions reduced with LEV program adoption in the early and recent adopting LEV states using the EPA 2002 guidance method. Columns three and five show the additional total VOC emissions reduced with LEV program adoption in the early and recent adopting LEV states - including additional VOC reductions from the zero evaporative standards.

Table 4: VOC Emissions with Default and "Adjusted" Evaporative Emissions

	Early Adopting States		**Recently Adopting States**	
	MOBILE6 no "zero" evap (%VOC reduction from Tier 2)	**With "zero" evap (% VOC reduction from Tier 2)**	**MOBILE6 - no "zero" evap (% VOC reduction from Tier 2)**	**With "zero" evap (% VOC reduction from Tier 2)**
2015	6.3%	10.2%	2.2%	6.2%
2020	7.6%	12.1%	4.8%	9.5%
2025	8.4%	13.1%	6.9%	11.7%
Tons per day reduced in 2025	13.4	21.0	6.0	10.1

The additional evaporative emissions reductions that will likely be realized as a result of the zero evaporative emission standards will equal an additional 11.6 VOC tons per day reduced in 2025 in the seven states.

V. Overview of Method to Estimate Emission Reductions

Estimates were developed for HC, CO, and NOx emissions reductions achieved by the adoption of the LEV II program in early adopting states (New York, Massachusetts, Maine, and Vermont) and recently adopting states (New Jersey, Connecticut and Rhode Island) relative to emissions under the Tier 2 program. Passenger cars and light-duty trucks (vehicles weighing less than 8,500 lbs) were included in the analysis. Assumptions about vehicle emissions and fleet characteristics under the federal base case and the California LEV II program were input to MOBILE6.2, EPA's most recent mobile source emission factor model, in accordance with EPA's technical guidance issued in June of 2002. The resulting emission factors were then combined with estimates of future light-duty vehicle travel in the seven states to predict future emission levels for projection years through 2025.

Early-adopting states were assumed to implement LEV-II beginning at the same time as Massachusetts (2004), and late-adopting states at the same time as New Jersey (2009). EPA input files were adjusted to account for state specific sales mix. State specific I&M program parameters were used for Massachusetts and New Jersey, again representing early-adopting and late-adopting states, respectively. Emissions are expressed as a percent (and in tons) of additional reduction over and above emissions reduced from implementation of the Tier 2 program - in other words:

$$\frac{\textbf{(Tier 2 Fleet Emissions - LEV II Fleet Emissions)}}{\textbf{Tier 2 Fleet Emissions}}$$

MOBILE6.2 Inputs

Where available, state-specific data were used for inputs that would have a potentially significant impact on the results, such as inspection and maintenance (I/M) programs. Emission factors were developed separately for two regions, representing early-adopting and late-adopting states. State-specific inputs for Massachusetts and New Jersey were used for fuel, temperature, I/M program, and vehicle age distribution parameters. Emission factors were developed for these regions both with and without I/M programs, since some areas in the Northeast do not have I/M programs. No-I/M emission factors were applied to the VMT from these areas. Different phase-in schedules for the Tier 2 and/or LEV II programs were developed for the early versus late adopting states.

With the exception of these inputs, national defaults embedded in MOBILE6.2 were used for other model parameters. The use of defaults rather than state-specific assumptions in these instances is unlikely to create a significant difference in the relative benefits calculated for the LEV II versus Tier 2 programs.

To calculate total emissions, emission factors were combined with estimates of vehicle-miles of travel (VMT) for each region analyzed. Since consistent VMT forecasts were not available from every state, VMT baseline estimates for 2004 and forecasts through 2020 were obtained for each state from the Highway Performance Monitoring System (HPMS). The impact on the difference in emissions for LEV II versus Tier 2 resulting from the use of HPMS rather than state-derived forecasts was determined to be small. For New York State, VMT estimates for downstate (I/M program) and upstate (no I/M program) were obtained from the Department of Environmental Conservation (NYDEC) and these proportions were applied to the total VMT projections from HPMS. Forecasts of total VMT were allocated to different vehicle types based on EPA forecasts which account for the growing percentage of light trucks in the light-duty vehicle fleet.[7]

[7] The methodology for allocating Massachusetts VMT by vehicle class is the same as used in the 1999 study by Cambridge Systematics for NESCAUM of the benefits of the CA LEV II program.

Pursuant to the revised EPA guidance it was assumed that evaporative emissions for all LEV and PZEV vehicles were equivalent to those under Tier 2. Subsequent analysis was performed to compare HC emissions assuming a reduction in evaporative emissions from PZEV vehicles. "Zero" evaporative emission standards are more stringent than near zero (LEV II) evaporative standards (as seen in Table 3) for vehicles that are not eligible for ZEV credit. With deterioration over the life of the vehicle factored in, the EMFAC model assumes that evaporative emissions from vehicles subject to the PZEV and AT PZEV evaporative emissions standards are approximately 30 percent lower over the life of the vehicle, when compared to LEV vehicles meeting the less stringent "near zero" evaporative emission standards.

In the additional analysis of "zero evaporative" emissions standards, post-processing adjustments of MOBILE6.2 output were made to account for the zero evaporative standards. To do this, evaporative emissions outputs for LEV II vehicles were obtained by model year. For LEV II advanced technology vehicles, evaporative emissions were then reduced in proportion to the estimated lifetime average evaporative emissions rate found in the California EMFAC model.

VI. Conclusions

The LEV II program provides significant NOx, HC, and CO emission reductions over the Tier 2 program. Specifically, modeling conducted using the MOBILE6.2 model indicates that nearly 50 tons of NOx+VOC per day will be reduced in the seven Northeast LEV II states in 2025 with adoption of LEV II. This assumes that the LEV program stringency will not increase between now and 2025. In addition, approximately 11 tons per day of VOC in 2025 will be reduced in our region from adoption of the zero evaporative emission standards.

Attachment A
EPA Guidance Document

Modeling Alternative NLEV Implementation and Adoption of California Standards in MOBILE6 June 5, 2002

This document supplements and revises the guidance given in Section 7.4.1 of the document entitled: "Technical Guidance on the Use of MOBILE6 for Emission Inventory Preparation" located on EPA/OTAQ's website (http://www.epa.gov/otaq/models/mobile6/m6techgd.pdf), and supercedes draft supplemental guidance on this subject dated December 21, 2001. This revision updates the treatment of the 2003 model year under the LEV II program, and the modeling of evaporative emissions for Partial Zero Emission Vehicles (PZEVs) based on consultation with California's Air Resources Board (ARB).

The default case in MOBILE6 for post-Tier 1 emission control programs assumes that the National Low Emission Vehicle (NLEV) program applicable to the non-Northeastern states is implemented in model year 2001, and that the Federal Tier 2 program begins implementation in model year 2004. Users who wish to use MOBILE6 with alternate control program scenarios will need to invoke additional input features as described in this guidance.

An earlier phase-in of these NLEVs would be modeled using an alternate input file in conjunction with the "**94+ LDG IMP**" command, detailed in the MOBILE6 User's Guide (Section 2.8.11.4). An alternate data file (NLEVNE.D), developed by EPA and provided with the final model release, reflects the appropriate phase-in of NLEV standards in the 1999 and 2000 models years. Northeastern states subject to the earlier phase-in provisions on NLEV should use the NLEVNE.D file instead of the MOBILE6 default for accurate representation of the NLEV program in their area.

Under Section 177 of the Clean Air Act, states have the option to adopt California emission control programs instead of the federal program if the California programs would help achieve the air quality goals of that state. The focus of this option has been the evaluation of programs which are alternatives to the Federal Tier 1 and Tier 2 programs. California's emission control program for light-duty vehicles consists of the LEV I and LEV II programs, which are considered separable for states outside of California and in MOBILE6's modeling approach.

California's LEV I program affects light-duty vehicles beginning with the 1994 model year and continuing until the start of the LEV II program. Some northeastern states adopted California's LEV I program as an alternative to the Federal Tier 1 and NLEV programs. Because the specific implementation schedules of the LEV I program vary from state to state, users wishing to model the LEV I program in a specific non-California state will need to develop a custom input file to be used in conjunction with the "**94+ LDG IMP**" command. This custom file should be based on the default file P94IMP.D provided with the final model release, modified as appropriate to reflect the appropriate

phase-in schedule of vehicles under the LEV I program (i.e. TLEV, LEV, ULEV and ZEV) for that state. The modified phase-in schedule should only affect model years 1994 through 2003; beginning in model year 2004, the model assumes implementation of the Tier 2 program.
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Beginning in 2004, the MOBILE6 default case is the federal Tier 2 program under the phase-in presented in the MOBILE6 report M6.EXH.004, "Accounting for the Tier 2 and Heavy-Duty 2005/2007 requirements in MOBILE6". States have the option of adopting California's LEV II program in place of the Federal Tier 2 program. The ARB's phase-in of the LEV II program (as of July 17, 2001) is given by vehicle type in the three tables in the appendix of this guidance. For all pollutants, analysis of the LEV II option in MOBILE6 will be performed using alternative input files (listed in parentheses) in conjunction with these four commands:

T2 EXH PHASE-IN, which provides phase-in percentages by exhaust certification bin, vehicle class and pollutant (corresponding input file **LEVIIPH.D**) (for model years 2004 through 2015),

T2 CERT, which defines the 50,000 mile standard levels by exhaust certification bin, vehicle class and pollutant (corresponding input file **LEVIIST.D**)), and

T2 EVAP PHASE-IN, which provides phase-in percentages for evaporative standards (similar to the phase-in of the exhaust standards) by vehicle class for model years beginning with 2004 (corresponding input file **LEVIIEVP.D**).

94+ LDG IMP (corresponding input file **LEVII94.D**) has two uses:

for model years 1994 through 2003 is used to establish the fraction of certification standard classes, from Tier 0 through ZEV. The provided file reflects the NLEV program for states not affected by the early NLEV phase-in provisions for Northeastern states.
for model years 2004 through 2025 is used **ONLY** to establish the fraction of zero-emitting exhaust vehicles (ZEVs). The remainder of vehicles (for each of those model years) are categorized simply as "Tier 2" and allocated according to the bin phase-in fractions provided with the preceding "**T2 EXH PHASE-IN**" and "**T2 EVAP PHASE-IN**" commands.
Users who would like to model the LEV I or northeastern NLEV and LEV II programs in conjunction can create a single input file (**94+ LDG IMP**) for this command (for both exhaust and evaporative emissions) which reflects the phase-in for the appropriate programs from 1994 onward.
These four commands and the corresponding input files are described in the User's Guide to MOBILE6 (Sections 2.8.11.3 and 2.8.11.4).
The four input files listed above were developed for MOBILE6 directly from LEV II phase-in assumptions developed for EMFAC2001 by the California ARB. Thus, these files reflect the California LEV II program as projected to be implemented in California. The analysis of LEV II-based programs which differ from California’s implementation

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will require modification to the above files. It is important to note that MOBILE6 only checks to make sure that phase-in percentages for a given vehicle class and model year add to 1. MOBILE6 does not check to ensure the phase-in schedule or standards entered in the model are in compliance with the provisions of either the Tier 2 rule or LEV II rule; it is, therefore, up to the user to ensure that alternate Tier 2 or LEV II phase-in schedules and standards are accurate and meet the requirements of these rules. Users should contact EPA to ensure the correct modifications are made to the default input files.

Two aspects of the LEV II rule cannot be modeled directly in MOBILE6, requiring approximations to be applied. The first applies to PZEVs in model year 2003. California's current requirement is that 0.4 percent of LDV/LDT1s be certified as ZEVs and 9.3 percent of LDV/LDT1s be certified as PZEVs in 2003. The 2003 ZEV requirement is in the ZEV column of the LEVII94.D input file. However, MOBILE6 does not provide the flexibility to model PZEVs in 2003, hence EPA is accounting for PZEVs as ULEVs in model year 2003 only.

The second aspect of the LEV II rule requiring approximation is the treatment of PZEV evaporative emissions in all model years. MOBILE6 does not provide the flexibility to model PZEVs as a separate evaporative category; the two candidate categories to account for PZEV evaporative emissions are the standard LEV II standards, or ZEV levels (i.e. zero emissions). Recent consultation with the ARB indicates that the EMFAC model does assign emissions and deterioration to PZEVs. EPA, therefore, believes that it is more appropriate to treat PZEVs no different than standard LEV II vehicles in terms of evaporative emissions, rather than ZEVs. This approximation is reflected by using the LEVII94.D file for both exhaust and evaporative emission phase-in.

Table A-1
ARB's LEV II Phase-In (as of July 17, 2001) of
Passenger Cars (PC) and Light-Duty Truck 1's (LDT1)

Mdl Yr	LEV I	ULEV I	LEV II	ULEV II	Tier2-4	Tier2-3	PZEV	ATPZEV	ZEV
2003	70.3%	20.0%	0.0%	0.0%	0.0%	0.0%	8.4%	0.9%	0.4%
2004	61.0%	0.0%	20.1%	0.0%	0.0%	0.0%	16.6%	1.9%	0.4%
2005	12.0%	9.0%	51.3%	0.0%	0.0%	0.0%	25.1%	2.2%	0.4%
2006	0.0%	0.0%	40.5%	23.0%	0.0%	0.0%	33.0%	3.0%	0.5%
2007	0.0%	0.0%	25.0%	15.0%	19.1%	0.0%	36.9%	3.4%	0.6%
2008	0.0%	0.0%	15.0%	25.0%	14.6%	0.0%	41.0%	3.8%	0.6%
2009	0.0%	0.0%	4.0%	6.0%	10.0%	29.0%	44.9%	5.2%	0.9%
2010	0.0%	0.0%	4.0%	6.0%	10.0%	24.4%	49.0%	5.6%	1.0%
2011	0.0%	0.0%	4.0%	6.0%	10.0%	19.8%	53.1%	6.1%	1.0%
2012	0.0%	0.0%	4.0%	6.0%	10.0%	14.2%	56.6%	7.8%	1.4%
2013	0.0%	0.0%	4.0%	6.0%	10.0%	14.2%	56.6%	7.8%	1.4%
2014	0.0%	0.0%	4.0%	6.0%	10.0%	14.2%	56.6%	7.8%	1.4%
2015	0.0%	0.0%	4.0%	6.0%	10.0%	11.1%	56.7%	10.3%	1.9%

2016	0.0%	0.0%	4.0%	6.0%	10.0%	11.1%	56.7%	10.3%	1.9%
2017	0.0%	0.0%	4.0%	6.0%	10.0%	11.1%	56.7%	10.3%	1.9%
2018	0.0%	0.0%	4.0%	6.0%	10.0%	8.0%	56.7%	12.9%	2.4%
2019	0.0%	0.0%	4.0%	6.0%	10.0%	8.0%	56.7%	12.9%	2.4%
2020	0.0%	0.0%	4.0%	6.0%	10.0%	8.0%	56.7%	12.9%	2.4%

Table A-2
ARB's LEV II Phase-In (as of July 17, 2001) of
Light-Duty Truck 2's (LDT2)

Mdl Yr	LEV I	ULEV I	Tier2-9	LEV II	ULEV II	Tier2-4
2003	85.0%	15.0%	0.0%	0.0%	0.0%	0.0%
2004	0.0%	0.0%	75.0%	25.0%	0.0%	0.0%
2005	0.0%	0.0%	50.0%	50.0%	0.0%	0.0%
2006	0.0%	0.0%	25.0%	75.0%	0.0%	0.0%
2007	0.0%	0.0%	0.0%	50.0%	50.0%	0.0%
2008	0.0%	0.0%	0.0%	40.0%	60.0%	0.0%
2009	0.0%	0.0%	0.0%	40.0%	40.0%	20.0%
2010	0.0%	0.0%	0.0%	35.0%	45.0%	20.0%
2011	0.0%	0.0%	0.0%	35.0%	45.0%	20.0%
2012	0.0%	0.0%	0.0%	35.0%	45.0%	20.0%
2013	0.0%	0.0%	0.0%	35.0%	45.0%	20.0%
2014	0.0%	0.0%	0.0%	35.0%	45.0%	20.0%
2015	0.0%	0.0%	0.0%	35.0%	45.0%	20.0%
2016	0.0%	0.0%	0.0%	35.0%	45.0%	20.0%
2017	0.0%	0.0%	0.0%	35.0%	45.0%	20.0%
2018	0.0%	0.0%	0.0%	35.0%	45.0%	20.0%
2019	0.0%	0.0%	0.0%	35.0%	45.0%	20.0%
2020	0.0%	0.0%	0.0%	35.0%	45.0%	20.0%

Table A-3
ARB's LEV II Phase-In (as of July 17, 2001) of
Medium-Duty Trucks

Mdl Yr	LEV I	ULEV I	Tier2-10	Tier2-8	LEV II
2003	60.00%	40.00%	0.00%	0.00%	--
2004	0.00%	0	81.50%	18.50%	--
2005	0.00%	0	63.00%	37.00%	--
2006	0.00%	0	39.00%	61.00%	--
2007	--	--	0.00%	0.00%	100%
2008	--	--	0.00%	0.00%	100%
2009	--	--	0.00%	0.00%	100%

2010	--	--	0.00%	0.00%	100%
2011	--	--	0.00%	0.00%	100%
2012	--	--	0.00%	0.00%	100%
2013	--	--	0.00%	0.00%	100%
2014	--	--	0.00%	0.00%	100%
2015	--	--	0.00%	0.00%	100%
2016	--	--	0.00%	0.00%	100%
2017	--	--	0.00%	0.00%	100%
2018	--	--	0.00%	0.00%	100%
2019	--	--	0.00%	0.00%	100%
2020	--	--	0.00%	0.00%	100%