Methodology for Calculating
LEVII Program Benefits in Pennsylvania

Technical Support Document

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INTRODUCTION

In 1998, Pennsylvania promulgated the New Motor Vehicle Emissions Control Program (25 Pa. Code Chapter 126, Subchapter D). This program created the Pennsylvania Clean Vehicles (PCV) Program that beginning in model year (MY) 2006 required new light-duty highway motor vehicles offered for sale within Pennsylvania to be certified by the California Air Resources Board (CARB) under that Board's Low Emitting Vehicle (LEV) program. The Pennsylvania Clean Vehicles Program does not require the California Zero Emitting Vehicle (ZEV) requirement. In December 2006, Pennsylvania promulgated amendments to the PCV program that:

- Postponed the compliance date from MY 2006 to MY 2008,
- Updated program definitions in 25 Pa. Code Chapter 121, § 121.1 (relating to definitions),
- Makes program regulatory clarifications, and
- Provides a transition mechanism for compliance with the program.

This document provides estimates of the potential LEVII program benefits within the state and summarizes the methodology used to calculate emissions. The document provides future year projections of mobile (highway) vehicle miles of travel (VMT) and emissions (ozone precursors VOC and NOx) for the years 2010, 2015, 2020, and 2025.

Emission Calculation Methodology

Technical guidance documents from EPA were used in the development of base and future year emissions inventories to support the analyses of potential LEVII program benefits in Pennsylvania. They include:

- *Policy Guidance on the Use of MOBILE6 for SIP Development ad Transportation Conformity*, US EPA Office of Air and Radiation, dated January 18, 2002.
- *Technical Guidance on the Use of MOBILE6 for Emission Inventory Preparation*, US EPA Office of Air and Radiation, and Office of Transportation and Air Quality, dated January 2002, revised February 2, 2005.
- *User's Guide to MOBILE 6.1 and MOBILE6.2, Mobile Source Emission Factor Model*, EPA420-R-02-028, dated October 2002.

Mobile source emission factors were calculated using EPA's MOBILE6.2 emission model. The methodologies used to produce the emission results conform to the recommendations provided in EPA's Technical Guidance. A mix of local data and national default (internal to MOBILE6.2) data has been used for this submission. Local data has been used for the primary data items that have a significant impact on emissions. These include:

- VMT and speeds
- Vehicle type mixes
- Vehicle age distributions
- Hourly distributions
- Temperatures/humidity
- Inspection/Maintenance parameters
- Fuel program characteristics.

For this analysis, local data inputs reflect the latest planning assumptions at the time of the analysis (based on 2002 data). These include current assumptions on control strategies (e.g. Inspection-Maintenance programs) and fuel characteristics. The analysis methodology is consistent with the 2002 National Emissions Inventory (NEI) submission. A detailed methodology is provided in **Appendix 1**.

Methodology for Estimating LEVII Program Credits

The emission benefits of the Pennsylvania Clean Vehicles Program have been calculated using the assumptions and data files documented in EPA's June 5, 2002 guidance entitled, "*Modeling Alternative NLEV Implementation and Adoption of California Standards in MOBILE6*" and the '*Technical Guidance on the Use of MOBILE6 for Emissions Inventory Preparation*". Several key revisions to the EPA guidance assumptions were needed to reflect the program to be implemented in Pennsylvania. The revisions include the removal of the zero-emitting exhaust vehicle (ZEV) component of the program and a revised phase-in start date of 2008 (EPA guidance assumptions are based on a 2004 start date).

Inventory Submission Materials

To complement this document, attachments have been provided with additional detail regarding the analysis methodology, the MOBILE6.2 input parameters, and the output emission results for the counties in Pennsylvania. These include:

Table 1:   Summary of Appendices

Appendix	Title	Description
1	Mobile Source Highway Emissions Inventory – An Explanation of Methodology	Provides summary of methodology used to calculate the VMT and emissions.
2	MOBILE6.2 Input Parameter Summary	Provides summary of input parameters related to traffic data sources, fuel, weather, I/M, and other MOBILE6.2 related parameters.
3	MOBILE6.2 LEVII Input Files	Provides phase-in percentages and exhaust certification bin standards used to reflect LEVII program
4	MOBILE6.2 Sample Input File	Provides example of MOBILE6.2 input files.
5	Pennsylvania ozone (VOC, NOx) Emission Results (By County, Year)	Provides county emissions for a *summer weekday* in 2010, 2015, 2020, 2025 (Results included for 2004, 2006, 2009 LEVII start date) (2008 start date results interpolated)

EMISSION DATA SOURCES AND ANALYSIS TOOLS

This section provides a summary of the input data and analysis tools used to evaluate the potential emission benefits of the Pennsylvania Clean Vehicles Program. The key elements to the modeling protocol are described in the sections below. A more detailed description of the analysis process and tools is provided in the methodology report in **Appendix 1**.

Analysis Tools

The statewide emissions analysis utilizes several key software/programs for producing the county emissions totals. These tools are outlined in **Table 2**.

Table 2: Summary of Inventory Analysis Tools

Tool	Purpose
MOBILE6.2	Produces emission factors for each pollutant in grams/mile for VOC and NOx
PPSUITE	Processes the highway data, Calculates hourly congested speeds for each state roadway segment, Prepares MOBILE6.2 input files, Processes MOBILE6.2 output files

The statewide inventory reflects the highway mobile source emission estimations using EPA's MOBILE6.2 emission model. PPSUITE represents an enhanced version of the Post Processor for Air Quality (PPAQ) software system that has been used for previous inventory and conformity submissions in Pennsylvania. The software has undergone significant revisions to ensure consistency with the MOBILE6.2 emissions model. PPSUITE plays a key role in the development of hourly roadway speed estimates, which are supplied as input to the MOBILE6.2 model. The software is also used to prepare the MOBILE6.2 input shell and to process the MOBILE6.2 outputs.

Traffic Data Source/Fleet Data Inputs

The 2002 PENNDOT Roadway Management System (RMS) data serves as the primary highway data source for the county and functional class VMT estimates. The data source provides a "snapshot" of the regional roadway system and volumes in 2002. The data includes the 2002 average annual daily traffic volumes for all state roadways in Pennsylvania. To account for additional local roadway VMT and to ensure consistency with reported HPMS totals, the 2002 VMT totals are adjusted to match the 2002 HPMS VMT totals reported to FHWA.

Based on the requirements for ozone inventories, traffic volumes on each RMS roadway segment must be adjusted to a summer weekday. The daily and monthly seasonal factors are developed from data contained in the document, *2002 Pennsylvania Traffic Data*, as prepared by PennDOT's Bureau of Planning and Research. The seasonal and daily factors provided in this document are based on statistical analyses of 2002 traffic counts taken at permanent and in-pavement ATR (automatic traffic recorder) locations throughout the state. Based on these seasonal traffic volumes, the PPSUITE software calculates unique congested speeds for each roadway segment during an ozone summer weekday scenario.

PPSUITE calculates <u>congested speeds by hour of the day</u> for each roadway segment and provides the information as input to the MOBILE6.2 software. To disaggregate the daily RMS volumes to hourly volumes, auto and truck hourly pattern data from PennDOT's *2002 Pennsylvania Traffic Data* report are used to determine the temporal variations in traffic volumes.

<u>Vehicle mix patterns</u> are calculated for each county and functional class grouping utilizing a combination of 2002 RMS truck percentages and MOBILE6.2 default vehicle mix distributions. The development of vehicle type pattern data input to the MOBILE6.2 software is described in more detail in **Appendix 1**. The distribution of vehicles to fuel type (diesel, gas) is determined from the MOBILE6.2 default diesel sales fractions.

<u>Vehicle age distributions</u> are input to MOBILE6.2 for each county based on registered vehicles that reflect July 1 summer conditions. These distributions reflect the percentage of vehicles in the fleet up to 25 years old and are listed by the 16 composite MOBILE6 vehicle types. 2002 vehicle age distributions have been used for this inventory from the PennDOT Bureau of Motor Vehicles Registration Database. Due to insufficient data, only data for light-duty vehicles are used as local inputs. The heavy-duty vehicles use the internal MOBILE6.2 defaults.

Traffic Growth Assumptions

Traffic growth forecasting plays a pivotal role in estimating future year emissions for the region. This inventory utilizes county-specific growth rates, as used for past conformity and inventory submissions, based on an extrapolation of historic HPMS VMT growth trends. The growth rates were originally shared between PennDOT, PaDEP, and other Interagency Consultation Group members, including the PA Conformity Work Group (which includes EPA, FHWA, and representatives from larger MPOs within the state).

I/M and Fuel Parameters

The <u>Inspection Maintenance (I/M) program</u> inputs to the MOBILE6.2 model are based on current programs within the county. The Pennsylvania inspection and maintenance (I/M) program was upgraded and expanded throughout the state with a phase-in period starting in December 2003 and fully implemented by June 2004. The program test requirements vary by region and include on-board diagnostics (OBD) technology that uses the vehicle's computer for model years 1996 and newer to download potential engine problems that could effect emissions. The program, named PAOBDII, is implemented in the Philadelphia, Pittsburgh, and South Central / Lehigh Valley Regions. The Northern Region receives gas cap and visual inspections and the other 42 counties in the Commonwealth receive a visual inspection. Vehicles subject to the program include 1975 and newer model year gasoline cars and light duty trucks up to 9,000 pounds GVW. New model years are exempt for the first year. The county of registration determines which inspections are required.

The summer weekday RVP values are consistent with values used for past inventory efforts. These assumptions, as well as the I/M program and fuel parameters, are summarized in **Appendix 2 and 4**.

Weather Data

Weather information is based on information obtained from the National Climatic Data Center to calculate the <u>minimum and maximum temperatures</u> and <u>absolute humidity</u> data inputs to the MOBILE6.2 model. These assumptions are consistent with the 2002 NEI inventory submission.

Other weather data required by MOBILE6.2 are assumed as the program defaults. These include the cloud cover, peak sun, and sunrise/sunset options.

Other Inputs

Federal vehicle emissions control and fuel programs are incorporated into the MOBILE6.2 software. The programs include:

- The Federal Motor Vehicle Control Program (FMVCP) including the National Low Emission Vehicle Program (NLEV) and federal Tier II / Low Sulfur Fuel Program;
- Emissions standards for medium and heavy duty vehicles in 2002, 2004 and 2007;
- Stage II and Onboard Refueling Vapor Recovery (ORVR).
  Note: Pennsylvania considers emissions from refueling operations an area source category. While MOBILE6.2 is employed to calculate emissions factors for that source category, refueling emissions are not included in highway vehicle emissions estimations.

For analyses used to determine benefits related to the Pennsylvania Clean Vehicles Program, modifications were made to the federal vehicle control assumptions in MOBILE6.2. The input parameters were revised according to EPA guidance as discussed in the following sections.

ESTIMATING LEVII PROGRAM CREDITS

The emission benefits of the Pennsylvania Clean Vehicles Program have been calculated using the assumptions and data files documented in EPA's June 5, 2002 guidance entitled, "*Modeling Alternative NLEV Implementation and Adoption of California Standards in MOBILE6*".

EPA's guidance provides key assumptions used to model the LEVII program impacts including:

- CARB LEVII phase-in schedules
- LEVII exhaust emission certification bin standards
- Methods for treatment of PZEV, AT-PZEV evaporative emissions

The calculations of LEVII benefits are determined by comparisons to a base-case, which is considered the Tier2 federal program. MOBILE6.2 assumes the default Tier2 phase-in schedule as estimated and prepared by EPA. This phase-in schedule is automatically applied within MOBILE6.2 applications. Assumptions must also be made for the sales of future vehicles under California's LEVII program. The analysis uses the CARB LEVII phase-in percentages for passenger cars and light-duty trucks as presented in EPA's June 2002 guidance (Tables A-1 to A-3). The phase-in percentages are based on a 2004 program start date. Since the Pennsylvania Clean Vehicles Program will start in 2008, alternative LEVII phase-in percentages have been developed for these analyses. Note that Pennsylvania's program will not include California's ZEV mandate, thus those phase-in assumptions are not used for the analysis.

The LEVII program may include significant sales of PZEV and AT-PZEV type vehicles. Under the ZEV mandate, such vehicles must produce "near-zero" evaporative emissions. As indicated in EPA's June 2002 Guidance, the MOBILE6 model can only produce evaporative emissions for the following conditions:

- Zero evaporative emissions consistent with Pure ZEV vehicles
- Evaporative emissions equivalent to LEVII/Tier2 vehicles

In reality, the PZEV and AT-PZEV evaporative emissions fall somewhere between these two options. The EPA June 2002 Guidance recommends an approach that assumes that such vehicles produce evaporative emissions consistent with LEVII vehicles.

Summary of Technical Data Files

EPA's June 2002 guidance provides the key input data needed to reflect the impacts of the California LEVII program. **Table 3** summarizes the files used for Pennsylvania's analyses, including the revisions and modifications made to each EPA file. **Appendix 3** provides a printout of the technical data files used in the analyses.

Technical data files were developed and applied for alternative LEVII program start dates including 2004, 2006, and 2009. The files provided by EPA were used directly for the 2004 program start date calculations; however, EPA's LEVII94.D file was not used since the Pennsylvania Clean Vehicles Program does not include California's ZEV mandate.

Table 3: LEVII Technical Data Input Files

MOBILE6 Command	EPA Guidance Input Data File	Description	Modifications for Pennsylvania Analysis
T2 EXH PHASE-IN	LEVIIPH.D	CARB LEVII Phase-in percentages by exhaust certification bin for model years 2004-2015	Files created for alternative program start dates:
			2004 start date: Use EPA file directly – No Modification
			2006 start date: Create pal2exh.06* Combination of M6 Tier2 defaults from T2EXH.D file for years 2004, 2005 and LEVII standards from LEVIIPH.D for years 2006 and above
			2009 start date: Create pal2exh.09* Combination of M6 Tier2 defaults from T2EXH.D file for years 2004-2008 and LEVII standards from LEVIIPH.D for years 2009 and above
T2 CERT	LEVIIST.D	CARB LEVII exhaust certification bins	Use EPA file directly – No Modification
T2 EVAP PHASE-IN	LEVIIEVP.D	CARB LEVII phase-in percentages for evaporative standards for model years 2004 and up	Files created for alternative program start dates:
			2004 start date: Use EPA file directly – No Modification
			2006 start date: Create pal2evp.06* Combination of M6 Tier2 defaults from T2EVAP.D file for years 2004, 2005 and LEVII standards from LEVIIEVP.D for years 2006 and above
			2009 start date: Create pal2exh.09* Combination of M6 Tier2 defaults from T2EVAP.D file for years 2004-2008 and LEVII standards from LEVIIEVP.D for years 2009 and above
94+ LDG IMP	LEVII94.D	For model years 2004-2025 used <u>only</u> to establish fraction of zero-emitting exhaust vehicles (ZEVs)	Use NLEVNE.D for all scenarios since Pennsylvania program does <u>not</u> have ZEV mandate

* Due to difference in Tier2 and LEVII bin definitions and the need to combine into one file, phase-in percentages were moved to different bin numbers to ensure correct vehicle standard representation

Calculation of LEVII Program Benefits

Analyses were conducted to identify the potential emission impacts of adopting the California LEVII program in Pennsylvania. The analyses provided in this memo focus on the ozone precursors VOC and NOx. The analyses were conducted before Pennsylvania agreed upon the 2008 program start date and were completed for 2004, 2006 and 2009 alternative program start dates. For this submission, 2008 LEVII emissions and benefits are determined by simple straight line interpolation between the 2006 and 2009 start date alternative runs.

Appendix 5 provides the emission tables for each alternative start date as well as the emission impacts for 2010, 2015, 2020, and 2025. **Table 4** provides the benefits of the Pennsylvania Clean Vehicles Program (with 2008 start date and no ZEV mandate) as compared to the existing federal Tier2 program. The table illustrates emission benefits in tons/day.

Table 4: Impact of the Pennsylvania Clean Vehicles Program vs Federal Tier2 Program

Statewide Results	2010		2015		2020		2025	
	VOC	**NOx**	**VOC**	**NOx**	**VOC**	**NOx**	**VOC**	**NOx**
Emission Benefits (tons/day)	-0.93	-0.97	-2.74	-3.52	-5.63	-6.79	-7.81	-9.13

* Negative values indicate emission benefits over Tier2 Program

RESOURCES

Draft Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations, EPA, June, 2003

Consolidated Emissions Reporting, Federal Register, June 10, 2002

2002 Pennsylvania Traffic Data, PENNDOT Bureau of Planning and Research, 2002.

User's Guide to MOBILE6.1 and MOBILE6.2, Mobile Source Emission Factor Model, EPA420-R-02-028, dated October 2002.

Technical Guidance on the Use of MOBILE6 for Emission Inventory Preparation, US EPA Office of Transportation and Air Quality, January 2002.

Policy Guidance on the Use of MOBILE6 for Emission Inventory Preparation, US EPA Office of Air and Radiation, January 18, 2002.

Modeling Alternative NLEV Implementation and Adoption of California Standards in MOBILE6, EPA, June 5, 2002, revised February 2, 2005.