

# Proposition 1B: Goods Movement Emission Reduction Program

## Truck Emissions Benefits Calculator Directions and Methodology

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To: User

This document includes directions for using the Truck Emissions Benefit Calculator to estimate the emission reductions and cost effectiveness of truck projects identified in the Proposition 1B: Goods Movement Emission Reduction Program “Final 2013 Guidelines for Implementation”. If you are interested in a project that is not included in the Truck Calculator or one of the other posted calculators, please contact us for guidance at the Goods Movement Hotline (916-444-6637). We recommend you print this document in color.

## Background

The Proposition 1B Goods Movement Emission Reduction Program (or Prop. 1B) provides incentives that help owners upgrade or replace diesel equipment and reduce emissions of particulate matter (PM), nitrogen oxides (NOx) and other air pollutants. The Proposition 1B Truck Emissions Benefit Calculator (Truck Calculator) allows a user to estimate the weighted emission reduction benefits of a proposed truck project. This document provides directions for using the Truck Calculator and describes the methodology to determine both emissions reductions and cost-effectiveness.

The Truck Calculator only yields emissions benefits for trucks with engine model years that are 2006 or older, in accordance with an ARB Executive Order that expanded the engine model years which are eligible for funding<sup>1</sup>. Emissions reductions are estimated for both NOx and PM10 (particulate matter with an aerodynamic diameter less than or equal to a nominal 10 microns).

## Directions

The Truck Calculator contains the following tabs. Each tab will be described in greater detail below.

**Table 1: Summary of all the worksheets in the calculator**

<b>Worksheet Tab</b>	<b>Description</b>
<b>Directions</b>	Provides directions on using the calculator to calculate emission reductions for various project options.
<b>Sample Inputs</b>	Contains sample projects with sample inputs.
<b>Input Data</b>	The applicant or the local agency inputs data on this tab for each truck project. These data are required for the emissions benefit estimation.
<b>Benefits Summary With Rule</b>	Contains a summary of the PM10 and NOX emission reductions, weighted emission reductions, and cost-effectiveness (CE) for each project. It also provides a summary of the total reductions and overall CE for all projects.

<sup>1</sup> [Air Resources Board, Executive Order G-13-089, October 2013, available at [http://www.arb.ca.gov/bonds/gmbond/docs/prop\\_1b\\_goods\\_movement\\_2013\\_october\\_eo\\_g13089.pdf](http://www.arb.ca.gov/bonds/gmbond/docs/prop_1b_goods_movement_2013_october_eo_g13089.pdf)

## “Directions” Tab

This tab provides directions on using the calculator to calculate emission reductions for various project options. Shown below are the available data fields, descriptions, and valid entries. Please note the following general directions:

- **ONLY INPUT DATA IN THE "INPUT DATA" TAB.**
- Data fields shown in **RED** below must be filled out.
- Data fields shown in **BLUE** below can be left blank if no information exists.

**Table 2: Data Fields and Descriptions**

	Data Field	Description	Valid Entries
<b>PROJECT DETAILS</b>	<b>Project Name</b>	Enter a name that is unique to each vehicle/engine or each vehicle/engine group. No two projects should have the same name and each project should be input in a single row.	Any value/ character the user chooses.
	<b>Number of Trucks in Fleet?</b>	Select an option that describes the total number of trucks in the applicant's fleet with a manufacturer's gross vehicle weight rating (GVWR) of 14,001 pounds or greater. If the fleet has more than three trucks, select "3+ trucks" – don't enter a number.	1 truck, 2 trucks, or 3+ trucks
	<b>1st Year of Operation</b>	Select the first calendar year when the new equipment will become operational and the project starts achieving emission reductions.	2013 - 2021
	<b>Equipment Project Option</b>	Select the project option. <b>Replacement:</b> Funding is received for a replacement truck and the existing, old truck is scrapped. <b>2-for-1 Replace:</b> Funding is received for one replacement truck and two existing, old trucks are scrapped. If this option is selected, enter information for the second old truck under the columns labeled "2-for 1 Replacement: 2nd Truck Info." <b>Repower:</b> Funding is received to replace an existing truck engine with a new engine. For additional information on the project options, see Appendix A of the 2013 Guidelines. For 3-Way Truck transactions, please contact the Goods Movement Hotline (916-444-6637) for assistance in determining project benefits.	Replacement; 2-for-1 Replace; or Repower

**Table 2: Data Fields and Descriptions (continued)**

	<b>Data Field</b>	<b>Description</b>	<b>Valid Entries</b>
<b>EXISTING TRUCK INFORMATION</b>	<b>Engine Model Year</b>	Select the engine model year for the existing truck that will be replaced or repowered. The engine model year is most often one year older than the truck chassis model year.	1972 – 2006
	<b>Filter (DPF) Currently Installed?</b>	Select "None" if the existing truck does not have a diesel particulate filter (DPF) Installed. If a DPF is installed, select the appropriate DPF device: Level 1 PM (25% PM reduction), Level 2 PM (50% PM reduction), Level 3 PM (85% PM reduction), Level 3 PM+ Mark I NOX (85% PM + 25% NOX reduction).	None, Level 1 PM, Level 2 PM, Level 3 PM, or Level 3 PM+ Mark I NOx
	<b>Mfg. GVWR</b>	Select the manufacturer's Gross Vehicle Weight Rating for the existing truck. This is usually found on a tag affixed to the chassis or door frame. This is NOT the weight listed in DMV records. GVWR choices are: 33,001 lbs. or greater (Class 8), 26,001-33,000 lbs. (Class 7), or 19,501-26,000 lbs. (Class 6).	33,001+, 26,001-33,000 or 19,501-26,000
	<b>Weight Class</b>	User entry is not allowed in this column. The system automatically generates Class 8, Class 7 or Class 6 after the Mfg. GVWR is entered by the user.	<i>Automatically populated</i>
	<b>Engine Duty Cycle Cert</b>	Select the engine duty cycle for which the existing truck was certified. Select "HHD" if the existing truck has a heavy-heavy-duty engine (Class 7 or Class 8). Select "MHD" if the existing truck has a medium-heavy-duty engine (Class 6, Class 7, or Class 8).	MHD or HHD
	<b>Annual VMT</b>	Enter the annual miles traveled for the existing truck to be replaced or repowered. Include miles travelled inside and outside of California. For 2-for-1 Replace projects, input only the VMT for the 1st truck in this cell. For information on the minimum VMT that is required to qualify for funding, see Appendix A of the 2013 Guidelines.	Any number <i>(at or above minimum required in Guidelines)</i>
	<b>% CA Operation</b>	Enter the % California operation for the past two years of the truck to be replaced or repowered. California operation must be 75% or higher.	75% - 100%

**Table 2: Data Fields and Descriptions (continued)**

	<b>Data Field</b>	<b>Description</b>	<b>Valid Entries</b>
<b>NEW TRUCK INFORMATION</b>	<b>Weight Class</b>	Select the weight class of the truck that will be purchased with Prop. 1B funding. The available choices are determined by the Existing Truck Information entered previously.	Class 8, Class 7, or Class 6
	<b>New Engine Details</b>	Select the option that describes whether the engine will be new or used and the engine model year. The available options in the pull-down menu will be limited, based on the information selected for the existing truck. <ul style="list-style-type: none"> <li>• For Class 7 and 8 replacement and 2-for-1 projects, select either "New 2013+" if replacing with a brand new truck, or "Used 2010+" if replacing with a used truck.</li> <li>• For Class 6 replacement and 2-for-1 projects, only "New 2013+" can be selected.</li> <li>• For Class 8 repower projects, only "New 2013+HHD" can be selected.</li> <li>• For Class 7 repower projects, select either "New 2013+HHD" if repowering with a heavy-heavy-duty engine, or "New 2013+MHD" if repowering with a medium-heavy-duty engine.</li> <li>• For Class 6 repower projects, only "New 2013+MHD" can be selected.</li> </ul>	New:2013+HHD, New: 2013+, or Used: 2010+
	<b>% CA Operation</b>	Enter the percentage of total annual miles that are expected to be travelled in California for the new (or used) truck that will be purchased with Prop. 1B funding. Prop. 1B now offers the option of 90% California operation for trucks funded with Prop. 1B grants.	90% or 100%
	<b>CA VMT</b>	User entry is not allowed in this column. The system automatically generates the California VMT after the Annual VMT of the existing truck and % CA Operation of the new truck are entered by the user.	<i>Automatically populated</i>
	<b>Fuel Type</b>	Select the fuel type for the new (or used) truck that will be purchased with Prop. 1B funding.	Diesel, LNG/CNG, Hybrid, Electric, or Electric w/ AB-118

**Table 2: Data Fields and Descriptions (continued)**

	Data Field	Description	Valid Entries
<b>FINANCIAL INFORMATION</b>	<b>Funding Requested (\$)</b>	Enter the amount of funding requested in dollars. For information on the available funding options, see Appendix A of the 2013 Guidelines.	Any number ( <i>up to maximum allowed in Guidelines</i> )
	<b>Maximum Allowed Funding (\$)</b>	User entry is not allowed in this column. This field will automatically be populated, based on the equipment option and other information entered by the user.	<i>Automatically populated</i>
	<b>AB 118 HVIP Funding</b>	User entry is not allowed in this column. This field will automatically be populated, based on the "Fuel Type" that the user selects for the new truck. If the user selects "Electric w/ AB-118", this field will show "Yes".	<i>Automatically populated</i>
<b>2-FOR-1 REPLACEMENT: 2<sup>nd</sup> Truck Information (if applicable)</b>	<b>2 Trucks replaced by 1?</b>	User entry is not allowed in this column. This field is automatically populated, based on the "Equipment Project Option" selected. If a 2-for-1 Replace project is selected, "Yes" will be displayed.	<i>Automatically populated</i>
	<b>Engine Model Year of 2nd Truck</b>	Select the engine model year for the second existing truck that will be replaced. The engine model year is most often one year older than the truck chassis model year.	1972 – 2006
	<b>Filter (DPF) installed on 2nd Truck?</b>	Select "None" if the second existing truck does not have a diesel particulate filter (DPF) installed. If a DPF is installed, select the appropriate DPF device: Level 1 PM (25% PM reduction), Level 2 PM (50% PM reduction), Level 3 PM (85% PM reduction), Level 3 PM+ Mark I NOX (85% PM + 25% NOX reduction).	None, Level 1 PM, Level 2 PM, Level 3 PM, or Level 3 PM+ Mark I NOx
	<b>Mfg. GVWR of 2nd Truck</b>	Select the manufacturer's Gross Vehicle Weight Rating for the second existing truck. This is usually found on a tag affixed to the chassis or door frame. This is NOT the weight listed in DMV records. GVWR choices are: 33,001 lbs. or greater (Class 8), 26,001-33,000 lbs. (Class 7), or 19,501-26,000 lbs. (Class 6).	33,001+, 26,001-33,000 or 19,501-26,000
	<b>Weight Class of 2<sup>nd</sup> Truck</b>	User entry is not allowed in this column. The system automatically generates Class 8, Class 7 or Class 6 after the Mfg. GVWR is entered by the user.	<i>Automatically populated</i>
	<b>Annual VMT for 2nd Truck</b>	Enter the annual miles traveled for the existing truck to be replaced or repowered. Include miles travelled inside and outside of California. For 2-for-1 Replace projects, input only the VMT for the second truck in this cell. For information on the minimum VMT that is required to qualify for funding, see Appendix A of the 2013 Guidelines.	Any number ( <i>at or above minimum required in Guidelines</i> )
	<b>% CA Operation for 2<sup>nd</sup> Truck</b>	Enter the % California operation for the past two years of the second truck to be replaced. California operation must be 75% or higher.	75% - 100%
	<b>CA VMT Trucks</b>	User entry is not allowed in this column. The system automatically generates the CA VMT after the Annual VMT and % CA Operation of second truck is entered by the user.	<i>Automatically populated</i>
	<b>2-for-1 Replacement Status</b>	User entry is not allowed in this column. This field is automatically populated. If "Incomplete", the user needs to fill in the missing information.	<i>Automatically populated</i>

If all of the required input data have been entered, the last column “Completed Entry” shows “Completed”.

**Please note the following:**

- If you need to make any changes after a project option has been selected and information has been entered for that project option, clear all entries and start with a new project option.
- Three-way truck transactions are not included in the 2013 Truck Calculator. Please contact the Goods Movement Hotline (916-444-6637) for assistance in determining project benefits for three-way truck projects.



## “Sample Inputs” Tab

The "Sample Inputs" tab provides sample projects with the correct inputs to provide guidance for entering data on the “Input Data” tab. Ten sample projects have been provided for illustration purposes.

## “Input Data” Tab

To estimate the emission reduction benefits for a proposed project, the user must enter information on the "Input Data" tab of the Truck Calculator as shown below. This is the only tab where the user can enter data. After all of the required input data have been entered, the last column “Completed Entry” shows “Completed”. Data fields, descriptions, and valid entries are described above in Table 2.

### Input Data for Equipment Projects

Project Details				Existing Truck Information						
Project Name	Number of Trucks in Fleet?	1st year of operation	Equipment Project Option	Engine Model Year	Filter (DPF) Currently Installed?	Mfg. GVWR	Weight Class	Engine Duty Cycle Cert	Annual VMT	% CA Operation

New Truck Information					Financial Information		
Weight Class	New Engine Details	% CA Operation	CA VMT	Fuel Type	Funding Requested (\$)	Maximum Allowed Funding (\$)	AB-118 HVIP Funding?

2-for 1 Replacement: 2nd Truck Info. (if applicable)									
2 Trucks Replaced by 1?	Engine Model Year of 2nd Truck	Filter (DPF) Installed on 2nd Truck?	Mfg. GVWR	Weight Class of 2nd Truck	Annual VMT of 2nd Truck	% CA Operation 2nd Truck	CA VMT Trucks	2-for 1 Replacement Status	Completed Entry?

## “Benefits Summary with Rule” Tab

The “Benefits Summary with Rule” tab contains an automatically updated table of the PM10 and NOX emission reduction benefits and cost-effectiveness by project name, project year, project type, and state investment for the entire contract life of that project. A summary of total emission reductions and overall cost-effectiveness for all projects is also provided at the top of this tab.

### Emission Benefits Summary

This tab provides the emissions benefits (PM10 and NOX) for each proposed project. If "FALSE" or "N/A" or "#VALUE" or "0" appears in the table there is an invalid project entry.

Total for All Projects				
Total Funding Requested (\$)	Total PM10 Benefits (lbs)	Total NOX Benefits (lbs)	Total Weighted E/R (lbs)	Overall Cost Effectiveness (CE) (lbs/State \$)

Project Name	Qty	Equipment Project Option	Existing Truck Information				New Truck Information			
			Engine MY	Mfg. GVWR	CA VMT (miles)	DPF Installed	Model Year of New Engine	Weight Class	% CA	Fuel Type

Funding Requested (\$)	Project Benefits			
	PM Emission Reductions (lbs)	NOx Emission Reductions (lbs)	Weighted Emission Reductions NOx + 20*PM (lbs)	Cost Effectiveness NOx+20*PM (lbs/State \$)

## Methodology

The Prop. 1B Program funds projects that can achieve early or extra emission reductions which are not otherwise required by law or regulation. “Early” reductions are those that occur before a regulatory deadline takes effect and “extra” reductions are those that occur because the technology is cleaner than required by regulatory emission standards. The 2013 Truck Calculator has been designed to account for regulatory requirements and it only shows reductions that qualify as early or extra (i.e., “with rule”). For example, if a regulatory deadline becomes effective in year 3 of a 5-year project, the Truck Calculator will only show the “early” reductions during years 1 and 2. No reductions will be included from years 3 to 5 of the project, after the regulatory requirements have taken effect, because those reductions are credited to the regulation.

To estimate the emission reductions from a Prop. 1B project, the Truck Calculator determines the PM10 and NOx emissions during each year of the project for both the existing truck (i.e., old truck) and the replacement truck (i.e., new truck). The difference between the old truck and new truck is the emissions reduction for each year and the annual reductions are summed up by pollutant to provide the total reductions over the full project life. To calculate the project’s weighted emissions reduction benefit, the Truck Calculator uses the Carl Moyer Program protocol of weighting combustion PM emissions (essentially diesel PM) by a factor of 20, relative to NOx, to account for the greater health impacts of diesel PM. This protocol helps target incentive funding to the projects that will achieve the greatest reduction in health risk - a key focus of the Prop. 1B Program.

Provided below are equations being used in the Truck Calculator. Example calculations are provided in the Appendix.

### **Equations:**

- (1) [Emissions, lbs] = [Emission rate, g/mi] x [Annual VMT, mi] x [1 - DPF control %] x [1 lb/453.6 g]
- (2) [Emissions reduction, lbs] = [Emissions from old truck, lbs] - [Emissions from new truck, lbs]
- (3) [Total emissions reduction, lbs] =  $\Sigma$  [Emissions reduction, lbs] over the entire life of the project
- (4) [Weighted emission reduction, lbs] = [Total NOx reduction, lbs] + [Total PM reduction x 20, lbs]
- (5) [Cost-effectiveness, lbs/\$] = [Weighted emission reduction, lbs] / [Total applicable State funding, \$]

where

DPF control % = diesel particulate filter control percent (e.g., a Level 3 DPF has an 85% control factor)

VMT = vehicle miles travelled

## Data References and Assumptions

**1. Emission Rates for Diesel Trucks** - The emission rates are based on the emission inventory developed for ARB's Truck and Bus Regulation<sup>3</sup>. Emission rates are based on in-use testing of heavy heavy-duty and medium heavy-duty diesel trucks, which is different than certification data. Since similar data are not available for liquid natural gas (LNG) or compressed natural gas (CNG) trucks, diesel emission rates were used for LNG/CNG engines (model years 2007 and newer). This methodology will still account for the additional benefits of a LNG/CNG heavy-duty truck meeting 2010 standards over a diesel heavy-duty truck meeting 2007 standards.

For heavy-duty diesel trucks (Class 6 – 8), running emission rates (grams/mile) for NO<sub>x</sub> and PM<sub>2.5</sub> (particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 microns) were obtained from the emission inventory database developed for the Truck and Bus Regulation<sup>4</sup>. For Class 8 trucks, we used the "T7 tractor" fleet category from the inventory database, based on the GVWR range assigned to this category. For Class 7 trucks, we used "T6 instate heavy", and Class 6 trucks used "T6 instate small". Note: Emission rates are the same for both "T6 instate" fleet categories since both are covered under the medium heavy-duty group.

To convert emission rates between PM<sub>2.5</sub> and PM<sub>10</sub>, we used ARB's PM Speciation Profile Code #425<sup>5</sup>:

$$\begin{aligned} [\text{PM}_{2.5}] &= [\text{Total PM}] * 0.92 \text{ and } [\text{PM}_{10}] = [\text{Total PM}] \\ \text{Therefore, } [\text{PM}_{2.5}] &= [\text{PM}_{10}] * 0.92 \text{ or } \text{PM}_{10} = \text{PM}_{2.5}/0.92 \end{aligned}$$

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<sup>3</sup> "Regulation to Reduce Emissions of Diesel Particulate Matter, Oxides of Nitrogen and Other Criteria Pollutants, from In-Use Heavy-Duty Diesel-Fueled Vehicles", California Code of Regulations, Title 13, Division 3, Chapter 1, Section 2025.

<sup>4</sup> Air Resources Board, "The Truck and Bus Regulation, The Drayage Truck Regulation and The Tractor-Trailer Greenhouse Gas Regulation Amendments, Background Materials on Air Emissions, Health Impacts, and Economic Impacts", AB1085 documentation, available at: <http://www.arb.ca.gov/msprog/onrdiesel/ab1085compliance.htm> .  
Emission Inventory Database (Nov. 17, 2010), available at: [http://www.arb.ca.gov/msprog/onrdiesel/1085/truck%20and%20bus%20rule\\_ei\\_1112\\_2010\\_viewlink\\_fixe\\_d.zip](http://www.arb.ca.gov/msprog/onrdiesel/1085/truck%20and%20bus%20rule_ei_1112_2010_viewlink_fixe_d.zip)

<sup>5</sup> ARB speciation Profiles are available at: <http://www.arb.ca.gov/ei/speciate/speciate.htm> .  
The reference document for Speciation Profile Code #425 is available at: <http://www.arb.ca.gov/ei/speciate/r01t20/rf20doc/refnum20.htm> .

**2. Emission Rates for Replacement Trucks (new and used)** - To estimate emission rates for used 2010 diesel engines that meet the 0.2 NOx standard, we used the 2012 engine model year. Engine manufacturers may use fleet averaging to comply with the heavy heavy-duty diesel emission standards, so the emission rates for calendar year 2010 may reflect some engines that are dirtier than the 2010 standard. For the Truck & Bus Regulation emission inventory, ARB worked with manufacturers to estimate market penetration rates which indicate the percentage of engines that would actually meet the emission standards. These market penetration rates were used when developing emission rates for NOx and PM. Based on the table below, the 0.2 NOx standard achieves 100% market penetration during the 2012 engine model year. Therefore, ARB staff believe that the emission rates for a 2012 engine provide the best representation of an engine that meets the 0.2 NOx standard. For the Truck Calculator, we used the emission rates for a 2012 engine to estimate emissions for a used 2010 engine that meets the 0.2 NOx standard. For a new 2013 or later engine, we used the emission rates for a 2013 engine.

**Table 3. ARB Estimated Penetration Rates of 2005-2012 Model Year Engines <sup>6</sup>**

Model Year	Certified NOx (g/bhp-hr)				Certified PM10 (g/bhp-hr)	
	2.2	1.2	0.5	0.25/0.2	0.1	0.01
<b>Heavy Heavy-Duty Diesel</b>						
2005	100%					
2006	99%	1%			98%	2%
2007	14%	86%			1%	99%
2008	7%	93%				100%
2009		90%	10%			100%
2010			10%	90%		100%
2011			10%	95%		100%
2012				100%		100%
<b>Medium Heavy-Duty Diesel</b>						
2005	100%					
2006	100%				98%	2%
2007	23%	77%				100%
2008	12%	88%				100%
2009		90%	10%			100%
2010			10%	90%		100%
2011			10%	95%		100%
2012				100%		100%

<sup>6</sup> This table is an excerpt obtained from: Air Resources Board, “Technical Support Document: Proposed Regulation for In-Use On-Road Diesel Vehicles”, October 2008, Appendix G, Emissions Inventory Methodology and Results, Table 18. Additional information on this document is available at: <http://www.arb.ca.gov/regact/2008/truckbus08/truckbus08.htm> and <http://www.arb.ca.gov/regact/2008/truckbus08/appg.pdf>.

**3. Hybrid Diesel-Electric Trucks** – The emission benefits of hybrid technology can vary widely, depending on factors such as vehicle configuration, load, vocation, mileage, duty cycle, and even driver performance. Due to this uncertainty, the Truck Calculator uses the emission rates for a conventional diesel engine to estimate emissions for a hybrid diesel-electric engine. ARB is currently working on a research study with the U.S. Department of Energy National Renewable Energy Laboratory (NREL) to help estimate the real world benefits of advanced hybrid truck technology in California. It is expected that this study will provide the data needed to develop emission rates for hybrid trucks that can be used in future Prop. 1B calculators.

**4. Emission Rates for Electric Trucks** - For electric trucks, we estimate emissions from grid electricity to account for the energy needed to charge batteries. ARB staff determined incremental emission rates for grid electricity, based primarily on natural gas plants using an average between high load and low load. The estimated emission rates include adjustments for the phase-in of California’s Renewable Portfolio Standard which requires 33% renewable energy by 2020.

**Table 4: Estimated Incremental Emission Rates for Grid Electricity**

Pollutant	Emission Rates		
	(grams/Megawatt-hour)	(grams/mile)	
		Class 7 & 8	Class 6
PM2.5	13.319	0.040	0.027
PM10	14.477	0.043	0.029
NOx	27.429	0.082	0.055

**5. Conversion Factors –**

To convert (g/MW-hr) into units of grams/mile, we used the following estimates based on electric drayage trucks currently in development for the Ports of Los Angeles and Long Beach<sup>7</sup>:

Class 7 and 8 electric trucks use 3 kWh/mile or 0.003 MWh/mile.  
 Class 6 trucks use 2 kWh/mile or 0.002 MWh/mile.

Example conversion calculations:

[PM10 for Class 7&8 electric trucks] = [14.477 g/MWh]\*[0.003 MWh/mile] = 0.043 g/mile  
 [NOx for Class 7&8 electric trucks] = [27.429 g/MWh]\*[0.003 MWh/mile] = 0.082 g/mile

<sup>7</sup> These energy consumption estimates are supported in a recent study by CE Delft; "Zero Emissions Trucks, An overview of state-of-the-art technologies and their potential", Tables 3 and 4; July 2013; commissioned by the International Council for Clean Transportation (ICCT).

**6. Emission Reductions for Electric Truck Projects with AB 118 Co-Funding –**

Applicants that want to purchase a new electric truck have the option of combining a Prop. 1B grant with co-funding from ARB’s Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) (also known as AB 118). For these projects, emission reductions are divided between the two incentive programs as follows:

- Prop. 1B: estimate emission reductions from the old diesel engine to a new 2013 diesel engine
- HVIP/AB 118: estimate emission reductions from the new 2013 diesel engine to a new 2013 electric truck

**7. Assumptions for Truck and Bus Regulation Compliance Deadlines –**

The 2013 Truck Calculator only estimates “early or extra” emission reductions that are not otherwise required by the Truck and Bus Regulation. Under this Regulation, the engine model year schedule generally has the most stringent requirements, but there are a variety of flexibility options available which may give fleets more time to comply. The 2013 Truck Calculator has been designed to use the flexibility options that yield the maximum emission reductions allowable for a fleet that is compliant with the Truck and Bus Regulation.

- For Class 7 or 8 small fleets (1 to 3 trucks), the Calculator assumes that the small fleet compliance option is in effect, rather than the engine model year schedule. The standard small fleet compliance options are summarized in Tables 5 and 6. If a small fleet project qualifies for the “Good Faith Effort” compliance option, the Truck Calculator only estimates NOx emission reductions.

**Table 5: Optional Small Fleet Requirements for Heavier Vehicles <sup>8</sup>**

<i>Compliance Date</i>	<i>Optional Small Fleet Requirements for Heavier Vehicles*</i>
January 1, 2012	If any 1996 to 1999 model year engines in the fleet you must report
January 1, 2013	If any 1996 to 2004 model year engines in the fleet you must report
January 1, 2014	One truck must have a PM filter installed & report
January 1, 2015	Two trucks must have a PM filter installed & report
January 1, 2016	All three trucks must have a PM filter installed & report
January 1, 2020	Replace all 1999 or older model year engines
January 1, 2021	Replace all 2000-2004 or older model year engines
January 1, 2022	Replace all 2005-2006 or older model year engines
January 1, 2023	All must have 2010 model year engines

*\* If you need to report, you must report all heavier trucks in the fleet by March 30, 2012 and January 31 of future years.*

<sup>8</sup> This table is an excerpt obtained from: Air Resources Board, “Truck and Bus Regulation Small Fleet Compliance Options”, February 2012. Additional information on this document is available at: <http://www.arb.ca.gov/msprog/onrdiesel/documents/FAQsmall.pdf>

**Table 6: Optional Requirements by January 1 of the Compliance Year for a Single Truck Owner <sup>7</sup>**

Engine Year	Optional Requirements by January 1 of the Compliance Year for a Single Truck Owner*												
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
Pre-1994			PM filter & report										All must have 2010 model year engines
1994-1995			PM filter & report										
1996-1999	Report	Report	PM filter & report										
2000-2004		Report	PM filter & report										
2005-2006			PM filter & report										
2007-2009	No requirements												

\* If you are required to report, you must do so by January 31 of the applicable year.

- For Class 7 or 8 large fleets (4 or more trucks), the Calculator assumes that the phase-in option is in effect, rather than the engine model year schedule. The phase-in option for Class 7 and 8 trucks is summarized in Table 7.

**Table 7: Phase-In Option for Heavier Trucks <sup>8</sup>**

Phase-In Option for Heavier Trucks	
Compliance Date	Vehicles with PM Filters
January 1, 2012	30%
January 1, 2013	60%
January 1, 2014	90%
January 1, 2015	90%
January 1, 2016	100%

- For Class 6 trucks, the Calculator uses the engine model year schedule because there are no small fleet or phase-in options available. The model year schedule for Class 6 trucks is summarized in Table 8.

**Table 8: Engine Model Year Schedule for Lighter Trucks <sup>9</sup>**

Engine Model Year Schedule for Lighter Trucks	
Engine Year	Replacement Date
1995 and older	January 1, 2015
1996	January 1, 2016
1997	January 1, 2017
1998	January 1, 2018
1999	January 1, 2019
2003 and older	January 1, 2020
2004-2006	January 1, 2021
2007-2009	January 1, 2023

For Class 6 trucks, NOx and PM10 benefits are attributed to a project based on the number of years the replacement is made ahead of the compliance deadline.

<sup>9</sup> This table is an excerpt obtained from: Air Resources Board, “Truck and Bus Regulation Compliance Requirements Summary”, March 2011. Additional information on this document is available at:

<http://www.arb.ca.gov/msprog/onrdiesel/documents/FSRegSum.pdf>



For example, if in 2015, a Class 6 truck with 1996 engine model year is replaced with one that meets 2010 emission equivalent, the project will be attributed one year of NOx and one year of PM10 benefits. If in 2015, a 2010 model year equivalent replaces a Class 6 truck with 1997 engine model year, the project will be attributed 2 years of NOx and 2 years of PM10 benefits. However trucks with a 1995 or older engine model year will not be given any NOx or PM10 benefits starting in 2015.

## **8. Adjustments During the First Year of Operation**

In the Truck Calculator, the user selects the calendar year when the replacement truck will become operational, but the user does not have to enter a month. If the truck becomes operational in February, the project would actually achieve almost a full year of emission reductions during that calendar year. However, if the truck doesn't become operational until November, it would only result in a couple of months of reductions during that year. Since we don't know exactly what month a truck will become operational and we don't want to overestimate emission reductions, the Truck Calculator assumes that projects that become operational in 2014 will get a full year of emission reductions in 2015, but zero reductions in 2014. This assumption is based on the operational deadline at the end of 2014 and the expected timeline for most projects.

## Appendix – Example Calculations and Sample Inputs

### Example Calculations

The proposed project would replace a 1994 diesel Class 8 truck (no DPF) with a new 2013+ Class 8 diesel truck. The first year of operation for the upgraded truck would be 2015 and the project life is five years. The annual VMT in California is about 40,000 miles/year and the new truck will operate 100% in California. The total project cost is \$110,000 and the applicant is requesting the maximum Proposition 1B funding of \$50,000.

Calendar Year	Emission Rates (grams/mile)			
	PM10		NOx	
	Old Truck (1994 engine)	New Truck (2013 engine)	Old Truck (1994 engine)	New Truck (2013 engine)
2015	0.73	0.07	19.34	1.47
2016	0.74*	0.07	19.28	1.67
2017	0.74*	0.08	19.28	1.88
2018	0.74*	0.09	19.28	2.11
2019	0.74*	0.10	19.28	2.28

\*Note: A regulatory deadline for PM takes effect in 2016. Therefore, emission benefits for PM will only include those early reductions that occur during 2015, prior to the regulatory deadline. NOx reductions will be included for all years up to 2019, because the NOx deadline doesn't occur until 2020.

Old Truck: [PM10 in 2015] = [0.73 g/mi] x [40,000 mi] x [1 - 0%] x [1 lb/453.6 g] = 64.74 lbs

New Truck: [PM10 in 2015] = [0.07 g/mi] x [40,000 mi] x [1 - 0%] x [1 lb/453.6 g] = 5.87 lbs

[PM10 reduction in 2015] = [64.74 lbs from old truck] - [5.87 lbs from new truck] / 2 = 29.43 lbs

This process is repeated for the next four years (project life is 5 years). Total PM10 emission reductions are calculated by summing reductions for each of the five years starting in 2015. The same process is repeated for NOx emissions.

[Total PM10 reduction, 2015-2019] = [29.43+0+0+0+0 lbs] = 29.43 lbs PM10

(Regulatory deadline for PM occurs in 2016, so we're not claiming credit for PM10 reductions from 2016-2019)

[Total NOx reduction, 2015-2019] = [788+1553+1535+1514+1499 lbs] = 6888 lbs NOx

[Weighted emission reduction, lbs] = [6888 lbs NOx] + [29.43 lbs PM10 x 20] = 6888 + 589 = 7477 lbs or 3.7 tons over project life

Cost-effectiveness of each project is calculated by computing the total weighted emission reductions (NOx + 20\*PM) over the project life and then dividing by the State contribution.

[Cost-effectiveness, lbs/\$] = [7477 lbs] / [\$50,000] = 0.15 lbs/\$

**Sample Inputs #1: Replacement of Class 8 Truck**

The proposed project would replace a 1994 diesel Class 8 truck (no DPF) with a new 2013+ Class 8 diesel truck. The first year of operation for the upgraded truck would be 2015 and the project life is five years. The annual VMT in California is about 40,000 miles/year and the new truck will operate 100% in California. The total project cost is \$110,000 and the applicant is requesting the maximum Proposition 1B funding of \$50,000.

The following would be the correct inputs for this project:

Project Details				Existing Truck Information						
Project Name	Number of Trucks in Fleet?	1st year of operation	Equipment Project Option	Engine Model Year	Filter (DPF) Currently Installed?	Mfg. GVWR	Weight Class	Engine Duty Cycle Cert	Annual VMT	% CA Operation
project 59	3+ Trucks	2015	Replacement	1994	None	33,001 +	Class_8	MHD	40,000	100%

New Truck Information					Financial Information		
Weight Class	New Engine Details	% CA Operation	CA VMT	Fuel Type	Funding Requested (\$)	Maximum Allowed Funding (\$)	AB-118 HVIP Funding?
Class_8	New: 2013+	100%	40,000	Diesel	50,000	50,000	No

2-for 1 Replacement: 2nd Truck Info. (if applicable)									
2 Trucks Replaced by 1?	Engine Model Year of 2nd Truck	Filter (DPF) Installed on 2nd Truck?	Mfg. GVWR	Weight Class of 2nd Truck	Annual VMT of 2nd Truck	% CA Operation 2nd Truck	CA VMT Trucks	2-for 1 Replacement Status	Completed Entry?
No							0	N/A	Complete

**Sample Inputs #2: Replacement of a Class 6 Diesel Truck with a Class 6 Electric Truck**

The proposed project would replace a 2004 diesel Class 6 truck (no DPF) with a new 2013+ Class 6 electric truck. The first year of operation for the upgraded truck would be 2014 and the project life is five years. The annual VMT in California is about 40,000 miles/year and the new electric truck will operate 100% in California. The total project cost is \$150,000 and the applicant is requesting the maximum Proposition 1B funding of \$25,000 as well as co-funding from the AB-118 Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP).

The following would be the correct inputs for this project:

Project Details				Existing Truck Information						
Project Name	Number of Trucks in Fleet?	1st year of operation	Equipment Project Option	Engine Model Year	Filter (DPF) Currently Installed?	Mfg. GVWR	Weight Class	Engine Duty Cycle Cert	Annual VMT	% CA Operation
project 69	3+ Trucks	2014	Replacement	2004	None	19,501 - 26,000	Class_6	MHD	40,000	100%

New Truck Information					Financial Information		
Weight Class	New Engine Details	% CA Operation	CA VMT	Fuel Type	Funding Requested (\$)	Maximum Allowed Funding (\$)	AB-118 HVIP Funding?
Class_6	New: 2013+	100%	40,000	Electric w/ AB-118	25,000	25,000	Yes

2-for 1 Replacement: 2nd Truck Info. (if applicable)									
2 Trucks Replaced by 1?	Engine Model Year of 2nd Truck	Filter (DPF) Installed on 2nd Truck?	Mfg. GVWR	Weight Class of 2nd Truck	Annual VMT of 2nd Truck	% CA Operation 2nd Truck	CA VMT Trucks	2-for 1 Replacement Status	Completed Entry?
No							0	N/A	Complete

**Sample Inputs #3: 2-for-1 Truck Replacement**

The proposed project would replace two Class 8 trucks (one with a 1994 engine, one with a 2006 engine) with a new 2013+ Class 8 diesel truck. The first year of operation for the new truck would be 2014 and the project life is five years. Both of the old trucks report an annual California VMT of 20,000 miles/year and the new truck will operate 100% in California. The total project cost is \$110,000 and the applicant is requesting the maximum Prop 1B funding of \$50,000.

The following would be the correct inputs for this project:

Project Details				Existing Truck Information						
Project Name	Number of Trucks in Fleet?	1st year of operation	Equipment Project Option	Engine Model Year	Filter (DPF) Currently Installed?	Mfg. GVWR	Weight Class	Engine Duty Cycle Cert	Annual VMT	% CA Operation
project 22	2 Trucks	2014	2-for-1 Replace	1994	None	33,001 +	Class_8	HHD	20,000	100%

New Truck Information					Financial Information		
Weight Class	New Engine Details	% CA Operation	CA VMT	Fuel Type	Funding Requested (\$)	Maximum Allowed Funding (\$)	AB-118 HVIP Funding?
Class_8	New: 2013+	100%	20,000	Diesel	50,000	50,000	No

2-for 1 Replacement: 2nd Truck Info. (if applicable)									
2 Trucks Replaced by 1?	Engine Model Year of 2nd Truck	Filter (DPF) Installed on 2nd Truck?	Mfg. GVWR	Weight Class of 2nd Truck	Annual VMT of 2nd Truck	% CA Operation 2nd Truck	CA VMT Trucks	2-for 1 Replacement Status	Completed Entry?
Yes	2006	None	33,001 +	Class_8	20,000	100%	20,000	Complete	Complete