APPENDIX C: COST-EFFECTIVENESS CALCULATION METHODOLOGY

Contents

I. Introduction

Cost-effectiveness is the measure of dollars provided to a project for each ton of covered emissions reduced. California H&SC§44283 requires that the California Air Resources Board (CARB) evaluate the cost-effectiveness limit annually. In addition, changes in statute per Senate Bill (SB) 513 (Beall, Chapter 610, Statutes of 2015) now allow CARB, in consultation with air districts, to establish new cost-effectiveness limits that reflect the cost of regulations and technology. Currently established and historical cost-effectiveness limits can be found in Appendix E.

Formulas for determining cost-effectiveness, emissions and emission reductions, and other calculations needed to administer the Moyer Program are outlined in this appendix. To determine a project's cost-effectiveness, all Moyer Program funds, air district match funds, and local Assembly Bill (AB) 923 funds must be included. Non-Moyer funds used to co-fund a Moyer eligible project do not need to be included in the cost-effectiveness calculation. Projects that include such funds must meet all Moyer Program requirements and the other funding source requirements.

II. General Cost-Effectiveness Calculations

The calculation methodology must be applied to ensure final grant amounts meet the cost-effectiveness limit requirement, and do not exceed the incremental cost based on the maximum percentage or any other funding caps. The maximum grant amount for any given project is the lowest of the three following calculations:

A. The potential grant amount at the cost-effectiveness limit;
B. The potential grant amount based on maximum percentage of eligible cost; or
C. The potential grant amount based on any maximum dollar amount or other funding cap specified in the relevant source category chapter.

The formulas utilize inputs such as emission factors, load factors, fuel consumption rates, etc. These calculation inputs are available from the tables in Appendix D. Cost-effectiveness limits are necessary as part of the methodology and can be found in Appendix E, where their applicability and usage are defined. Additionally, Appendix E houses tables containing the discount rate and capital recovery factors used in the methodology outlined.

Previously, the 2017 Moyer Program Guidelines introduced and implemented a dual cost-effectiveness limit, also known as the two-step calculation, which was limited to advanced technology projects. Advanced technology projects included equipment and engines that were optionally certified as cleaner than the required standards in place or zero-emission technologies. The current Moyer Program Guidelines will not require that advanced technology projects perform a two-step calculation.

A. Determining the Maximum Grant Amount

Formula C-1: Potential grant amount at the cost-effectiveness limit ($)

$$PGA = \frac{CEL * WER}{CRF}$$

Table C-1: Formula C-1 Variables

Equation Variable	Description	Units
PGA	Potential Grant Amount	$
CEL	Cost-effectiveness limit	$/ton
WER	Estimated weighted annual emissions reductions	tons/yr
CRF	Capital Recovery Factor	yr^{-1}

The potential grant amount at the cost-effectiveness limit is determined by multiplying the cost-effectiveness limit by the estimated weighted annual emission reductions and dividing by the CRF in Formula C-1. The cost-effectiveness limits are available from Appendix E, and the estimated weighted annual emission reductions can be calculated using formula C-4. Capital recovery factors can also be found in Appendix E or calculated using formula C-2.

Formula C-2: Capital recovery factor

$$CRF = DR * \frac{(1+DR)^{PL}}{(1+DR)^{PL} - 1}$$

Table C-2: Formula C-2 Variables

Equation Variable	Description	Units
CRF	Capital Recovery Factor	yr^{-1}
DR	Discount Rate	yr^{-1}
PL	Project Life	-

The CRF is based on a discount rate and evaluated annually. The CRF uses an interest rate and project life to determine the rate at which earnings could reasonably be expected to accrue if the same funds were invested over that length of time. The CRF may be calculated using Formula C-2, or Appendix E may be referred to, where the CRF has been calculated for various project lives. Each source category chapter will specify which project lives are acceptable to determine which CRF value to use.

Formula C-3: Potential grant amount based on maximum percentage of eligible cost ($)

$$PGA = Cost * Maximum\ Percentage\ of\ Eligible\ Costs$$

Table C-3: Formula C-3 Variables

Equation Variable	Description	Units
PGA	Potential Grant Amount	$
Cost	Moyer Eligible Cost(s) of Reduced Technology	$
Maximum Percentage of Eligible Cost	Maximum Percentage of Eligible Cost as outlined in the source category chapters	%

The potential grant amount based on maximum percentage of eligible cost is a measure of the incremental cost as determined by multiplying the cost of the reduced technology by the maximum percentage of eligible cost (from the applicable chapter) as described in Formula C-3. The potential grant amount based on any maximum dollar amount or other funding cap is specified in the relevant source category chapter.

B. Calculating Emissions and Emission Reductions

Formula C-4: Annual weighted surplus emission reductions (tons/yr)

$$WER_{Total} = ER_{NOx} + ER_{ROG} + (20 * ER_{PM})$$

Table C-3: Formula C-4 Variables

Equation Variable	Description	Units
WER_{Total}	Total Weighted Emission Reductions	tons/yr
ER_{NOx}	Nitrogen Oxides Emission Reductions	tons/yr
ER_{ROG}	Reactive Organic Gases Emission Reductions	tons/yr
ER_{PM}	Particulate Matter Emission Reductions	tons/yr

Annual weighted surplus emission reductions are calculated using Formula C-4. Note that particulate matter (PM) is weighted by a factor of 20. The result of Formula C-4 is used to complete Formula C-1 to determine the potential grant amount at the cost-effectiveness limit. Formulas to calculate the emission reductions for specific pollutants (NOx, ROG, PM) can be found throughout this appendix.

Formula C-5: Annual surplus emission reductions (tons/yr) (not weighted)

$$ER_{Total} = ER_{NOx} + ER_{ROG} + ER_{PM}$$

Table C-5: Formula C-5 Variables

Equation Variable	Description	Units
ER_{Total}	Total Emission Reductions	tons/yr
ER_{NOx}	Nitrogen Oxides Emission Reductions	tons/yr
ER_{ROG}	Reactive Organic Gases Emission Reductions	tons/yr
ER_{PM}	Particulate Matter Emission Reductions	tons/yr

Unweighted annual surplus emission reductions are calculated using Formula C-5. Formulas to calculate the emission reductions for specific pollutants (NOx, ROG, PM) can be found throughout this appendix.

Formula C-6: Emission reductions by pollutant (tons/yr)

$$ER = AE_{Baseline} - AE_{Reduced}$$

Table C-6: Formula C-6 Variables

Equation Variable	Description	Units
ER	Annual Surplus Emission Reductions by pollutant	tons/yr
$AE_{Baseline}$	Baseline Annual Emissions by Pollutant	tons/yr
$AE_{Reduced}$	Reduced Annual Emissions by Pollutant	tons/yr

Annual emission reductions by pollutant are calculated by subtracting the reduced technology's annual emissions from the baseline technology's annual emissions. This formula can be applied to all project types, including replacement projects, repower projects, and retrofit projects. More detailed formulas can be applied for retrofit and hybrid engine projects which are outlined later in this appendix.

Formula C-7: Emission reductions by pollutant (tons/yr) for multi-engine projects

$$ER = \sum AE_{Baseline} - \sum AE_{Reduced}$$

Table C-7: Formula C-7 Variables

Equation Variable	Description	Units
ER	Annual Surplus Emission Reductions by pollutant	tons/yr
$AE_{Baseline}$	Baseline Annual Emissions by Pollutant	tons/yr
$AE_{Reduced}$	Reduced Annual Emissions by Pollutant	tons/yr

For projects where multiple engines are being replaced or repowered for a single piece of equipment, vehicle, vessel, locomotive, etc., all the emissions from baseline engines can be summed and all the emissions from the reduced engines can be summed. This would include all main/propulsion engines as well as all auxiliary/secondary engines. This formula can be applied in scenarios where there are more baseline engines than reduced technology engines, such as Two for One equipment replacement projects.

In Two for One equipment replacement projects, two baseline technology equipment are replaced with one reduced technology equipment. First, calculate the emissions based on activity for each baseline engine separately using the applicable formulas outlined in this appendix. Baseline technology emissions will then be summed together before deducting the summed emissions of the reduced technology.

Formula C-8: Estimated annual emissions (tons/yr)[(1)]

$$AE = (EF + DP(\text{if applicable})) * Act * Adj * \frac{\text{Percentage of Operations in CA}}{907{,}200}$$

$$DP = DET * TEA$$

$$TEA = Act * DL$$

$$\text{Baseline Equipment: } DL = FYOP - MY_{Baseline} + \frac{PL}{2}$$

$$\text{Reduced Equipment: } DL = \frac{PL}{2}$$

Table C-8: Formula C-8 Variables

Equation Variable	Description	Units[2]
AE	Annual Emissions by Pollutant	tons/yr
EF	Emission Factor	-
DP	Deterioration Product	-
Act	Annual Activity	-
Adj	Adjustment Factor	-
DET	Deterioration Rate	-
TEA	Total Equipment Activity	-
DL	Deterioration Life	yr
PL	Project Life	yr
FYOP	Expected first year of operation	-
MY	Engine Model Year	-

(1) The value of 907,200 is the conversion factor for grams to tons.
(2) Please note that many of the units are not shown in this table as this formula is intended to be general. Subsequent and more specific version of this formula will show units when appropriate.

Formula C-8 shows the general calculation to calculate the emissions by pollutant (NOx, ROG, and PM). The subsequent formulas are specific variations of Formula C-8 for use with mileage, hours of operation, fuel use, and shore power systems, respectively.

The Moyer Program allows the emission reductions from a project to be calculated using a variety of methods, but mileage and hours of operation are the primary methods. Specific activity factors allowed for each project category may differ and are identified in the source category chapters. An engine emission factor (found in Appendix D) is multiplied by the annual activity level and by other adjustment factors (such as load factor in the case of off-road equipment calculations) as specified for the calculation methodologies presented. Emission factors are also adjusted to account for in-use deterioration, where applicable, by calculating and adding a deterioration product.

Formula C-9: Estimated annual emissions based on mileage (tons/yr) [(1)]

$$AE = (EF + DP(\text{if applicable})) * Act * Adj * \frac{\text{Percentage of Operations in CA}}{907{,}200}$$

$$\text{Miles-based deterioration product: } DP = DET * TEA$$

$$TEA = Act * DL$$

$$\text{Baseline Equipment: } DL = FYOP - MY_{\text{Baseline}} + \frac{PL}{2}$$

$$\text{Reduced Equipment: } DL = \frac{PL}{2}$$

Table C-9: Formula C-9 Variables

Equation Variable	Description	Units
AE	Annual Emissions by Pollutant	tons/yr
EF	Emission Factor	g/mi
DP	Deterioration Product	g/mi
Act	Annual Activity	mi/yr
Adj	Adjustment Factor	-
DET	Deterioration Rate	g/mi-10,000 mi
TEA	Total Equipment Activity	mi
DL	Deterioration Life	yr
PL	Project Life	yr
FYOP	Expected first year of operation	-
MY	Model Year	-

(1) The value of 907,200 is the conversion factor for grams to tons.

Calculations based on annual miles traveled are used for on-road projects only. Mileage records must be maintained by the engine owner as described in Chapter 4: On-Road Heavy-Duty Vehicles. Formula C-9 describes the method for calculating pollutant emissions based on miles traveled, including the method for calculating mile-based deterioration products.

Total equipment activity (TEA) for mile-based calculations cannot exceed 400,000 miles for school buses and 800,000 miles for other on-road vehicles. Used heavy heavy-duty replacement vehicles add 500,000 miles, medium heavy-duty vehicles add 250,000 miles, or light heavy-duty vehicles add 150,000 miles.

Formula C-9 no longer applies for NOx emissions for on-road engines model year 2013 and newer. Updated formulas used to calculate on-road NOx emissions for engine model years 2013 and newer are shown in Formula C-10.

Formula C-10: NOx Emissions for On-Road Heavy-Duty Engine Model Years 2013 and Newer [1]

$$AE_{NOx} = EmR * Act * Adj * \frac{\text{Percentage of Operations in CA}}{907{,}200}$$

Gross Vehicle Weight Rating 14,001-33,000 lbs
Engine model year 2013 and newer

For 0.20 NOx g/bhp-hr standard:

$$EmR = 0.1518 + 0.1518 * 2.498 * \frac{ODO^{0.3657769215}}{90{,}249^{0.3657769215}}$$

Engine model year 2016 and newer

For 0.10 NOx g/bhp-hr standard:

$$EmR = 0.0758 + 0.1518 * 0.9058 * 2.498 * \frac{ODO^{0.3657769215}}{90{,}249^{0.3657769215}}$$

For 0.05 NOx g/bhp-hr standard:

$$EmR = 0.03795 + 0.1518 * 0.9058 * 2.498 * \frac{ODO^{0.3657769215}}{90{,}249^{0.3657769215}}$$

For 0.02 NOx g/bhp-hr standard and 0.01 g/bhp-hr PM standard:

$$EmR = 0.01518 + 0.1518 * 0.9058 * 2.498 * \frac{ODO^{0.3657769215}}{90{,}249^{0.3657769215}}$$

For 0.02 NOx g/bhp-hr standard and 0.005 g/bhp-hr PM standard:

$$EmR = 0.01518 + 0.1518 * 0.9058 * 2.498 * \frac{ODO^{0.3657769215}}{90{,}249^{0.3657769215}}$$

Gross Vehicle Weight Rating Over 33,000 lbs
Engine model year 2013 and newer

For 0.20 NOx g/bhp-hr standard:

$$EmR = 0.6 + 0.6 * 2.498 * \frac{ODO^{0.3657769215}}{90,249^{0.3657769215}}$$

Engine model year 2016 and newer

For 0.10 NOx g/bhp-hr standard:

$$EmR = 0.3 + 0.6 * 0.9058 * 2.498 * \frac{ODO^{0.3657769215}}{90,249^{0.3657769215}}$$

For 0.05 NOx g/bhp-hr standard:

$$EmR = 0.15 + 0.6 * 0.9058 * 2.498 * \frac{ODO^{0.3657769215}}{90,249^{0.3657769215}}$$

For 0.02 NOx g/bhp-hr standard and 0.01 g/bhp-hr PM standard:

$$EmR = 0.06 + 0.6 * 0.9058 * 2.498 * \frac{ODO^{0.3657769215}}{90,249^{0.3657769215}}$$

For 0.02 NOx g/bhp-hr standard and 0.005 g/bhp-hr PM standard:

$$EmR = 0.06 + 0.6 * 0.9058 * 2.498 * \frac{ODO^{0.3657769215}}{90,249^{0.3657769215}}$$

Table C-10: Formula C-10 Variables

Equation Variable	Description	Units
AE_{NOx}	Annual NOx Emissions	tons/yr
EmR	Emission Rate	g/mi
Act	Annual Activity	mi/yr
Adj	Adjustment Factor	-
ODO	Odometer Reading	mi

Formula C-10 is used to calculate on-road heavy-duty NOx emissions for engine model years 2013 and newer. On-road heavy-duty ROG and PM emissions are still determined using Formula C-9. These formulas are the foundation of Tables D-2 and D-4 in Appendix D where calculations have been performed at various potential odometer readings to establish NOx emission rates that can be used in Formula C-10. Air district personnel should use the emission rate (EmR) values available in Table D-2 and D-4 of Appendix D when determining the annual NOx emissions. Power function formulas and details regarding those are present to provide background information.

For engine model year 2013 and newer, a NOx emission rate is determined which includes NOx deterioration and must be calculated through an emission rate power function (results in grams/mile).

Factors for 2016 and newer engines are reduced values of 2013 factors by 50%, 75%, 90%, and 95% to correspond with 0.10 g/bhp-hr NOx, 0.05 g/bhp-hr NOx, 0.02 g/bhp-hr NOx, and 0.01 g/bhp-hr NOx optional low NOx standards, respectively.

Formula C-11: Estimated annual emissions based on hours of operation (tons/yr)

$$AE = (EF + DP(\text{if applicable})) * HP * Act * Adj * \frac{\text{Percentage of Operations in CA}}{907{,}200}$$

$$\text{Hours-based deterioration product: } DP = DET * TEA$$

$$TEA = Act * DL$$

$$\text{Baseline Equipment: } DL = FYOP - MY_{\text{Baseline}} + \frac{PL}{2}$$

$$\text{Reduced Equipment: } DL = \frac{PL}{2}$$

Table C-11: Formula C-11 Variables

Equation Variable	Description	Units
AE	Annual Emissions by Pollutant	tons/yr
EF	Emission Factor	g/bhp-hr
DP	Deterioration Product	g/bhp-hr
Act	Annual Activity	hrs/yr
HP	Horsepower	hp
Adj	Adjustment Factor	-
DET	Deterioration Rate	g/bhp-hr-hr
TEA	Total Equipment Activity	hr
DL	Deterioration Life	yr
PL	Project Life	yr
FYOP	Expected first year of operation	-
MY	Model Year	-

When hours of equipment operation is the basis for determining emissions, the horsepower rating of the engine and an engine load factor must be used.

The engine load factor is an indicator of the nominal amount of work done by the engine for a particular application. It is given as a fraction of the rated horsepower of the engine and varies with engine application. Load factors for a variety of equipment types may be found in Appendix D.

The method for calculating emissions based on hours of operation includes the method for calculating an hour-based deterioration product. Total equipment activity for hour-based calculations is limited to a maximum of 12,000 hours for diesel engines, 3,500 hours for large-spark ignition (LSI) engines with a model year of 2006 or older, or 5,000 hours for LSI engines with a model year of 2007 or newer. Not all source categories that use Formula C-11 account for engine deterioration, such as marine projects.

Formula C-12: Estimated annual emissions based on fuel consumption (tons/yr)

$$AE = EF * FCR * Act * \frac{\text{Percentage of Operations in CA}}{907{,}200}$$

Table C-12: Formula C-12 Variables

Equation Variable	Description	Units
AE	Annual emissions by pollutant	tons/yr
EF	Emission Factor	g/bhp-hr
FCR	Fuel consumption rate factor	bhp-hr/gal
Act	Annual Activity	gal/yr

In some cases, as outlined in each source category chapter, fuel consumption may be used to calculate annual emissions. In such cases a fuel consumption rate factor must be used to convert emissions given in g/bhp-hr to units of grams of emissions per gallon of fuel used (g/gal). The fuel consumption rate factor is a number that combines the effects of engine efficiency and the energy content of the fuel used in that engine into an approximation of the amount of work output by an engine for each unit of fuel consumed.

Formula C-13: Estimated annual emissions for shore power systems (tons/yr)

$$AE = \frac{\text{Ship } EF * PR * BT * ANV * 0.9}{907{,}200}$$

Table C-13: Formula C-13 Variables

Equation Variable	Description	Units
AE	Annual emissions by	tons/yr

Equation Variable	Description	Units
	pollutant	
Ship EF	Ship Emission Factor	g/kW-hr
PR	Power Requirements	kW
BT	Berthing Time	hrs/visit
ANV	Annual Number of Visits	visits/yr

For marine shore power systems, calculate the estimated annual emissions by pollutant as shown in Formula C-13.

Formula C-14: Annual surplus emission reductions for marine vessels with wet exhaust systems (tons/yr)

$$ER = 0.8 * (AE_{Baseline} - AE_{Reduced})$$

Table C-14: Formula C-14 Variables

Equation Variable	Description	Units
ER	Annual Surplus Emission Reductions by pollutant	tons/yr
$AE_{Baseline}$	Baseline Annual Emissions by Pollutant	tons/yr
$AE_{Reduced}$	Reduced Annual Emissions by Pollutant	tons/yr

Annual emission reductions by pollutant are calculated by subtracting the reduced engine's annual emissions from the baseline engine's annual emissions.

For marine vessels with a wet exhaust system, a wet exhaust factor of 0.80 must be applied; calculate the annual surplus emission reductions as shown in Formula C-14.

Formula C-15: Annual surplus emission reductions for retrofits (tons/yr)

$$ER = AE_{Baseline} * RTVP$$

Table C-15: Formula C-15 Variables

Equation Variable	Description	Units
ER	Annual Surplus Emission Reductions by pollutant	tons/yr
$AE_{Baseline}$	Total annual emissions (all engines on vessel) for the baseline technology	tons/yr
RTVP	Reduced technology	%

Equation Variable	Description	Units
	verification percentage	

For retrofits, multiply the baseline technology pollutant emissions by the percentage of emission reductions that the CARB-verified reduced technology is verified to following Formula C-15.

Formula C-16: Annual surplus emission reductions for marine vessel hybrid systems (tons/yr)

$$ER = \sum AE_{Baseline} - \sum AE_{Reduced} * RTVP$$

Table C-16: Formula C-16 Variables

Equation Variable	Description	Units
ER	Annual surplus emission reductions by pollutant	tons/yr
$AE_{Baseline}$	Total annual emissions (all engines on vessel) for the baseline technology	tons/yr
$AE_{Reduced}$	Total annual emissions (all engines on vessel) for the reduced technology	tons/yr
RTVP	Reduced technology verification percentage	%

For marine vessel hybrid systems, calculate the annual surplus emission reductions as shown in Formula C-16.

C. Calculating Split Project Life Projects

Split Project Life Projects must use a separate project life for the two baseline technology scenarios. First, emission reductions by pollutant must be calculated for the two baseline scenarios:

1. Baseline technology to phase 1 reduced technology
2. Phase 1 reduced technology to phase 2 reduced technology

Next, a fraction of the project life must be applied to the annual emission reductions for each of the baseline scenarios, as outlined in Formula C-17.

Formula C-17: Split project life

$$WER_{Total} = \frac{(PL_1 * WER_1)}{PL_{Total}} + \frac{(PL_2 * WER_2)}{PL_{Total}}$$

Table C-17: Formula C-17 Variables

Equation Variable	Description	Units
WER_{Total}	Total annual weighted surplus emission reductions	tons/yr
PL_1	Fraction project life from transaction 1	yr
PL_2	Fraction project life from transaction 2	yr
WER_1	Annual weighted surplus emissions from transaction 1	tons/yr
WER_2	Annual weighted surplus emissions from transaction 2	tons/yr
PL_{Total}	Total project life	yr

D. Calculating the Applicant Cost Share

Moyer Program eligible costs are costs associated with a project that are eligible for reimbursement under the program prior to considering the cost-effectiveness limit or any project cap restrictions. Guidance on these costs is contained in Chapters 2, 3, and the applicable chapter for the Moyer Program project. The applicant cost share is determined by multiplying the Moyer Program eligible cost by 15 percent, as described in Formula C-18. Applicant cost share is determined from the Moyer Program eligible costs.

Formula C-18: Applicant cost share ($)

$$ACS \geq 0.15 * Cost$$

Table C-18: Formula C-18 Variables

Equation Variable	Description	Units
ACS	Applicant Cost Share	$
Cost	Total Moyer Program Eligible Cost(s) of Reduced Technology	$

E. Calculation for Co-funding Moyer Program Funds with Other Sources

Air districts must request information from grantee to determine what other funds will be used toward the project. This information and Formula C-19 will be utilized to ensure that the applicant is not overpaid for the project. The applicant cost share and the grants paid toward the project are added and compared against the total project cost value. The total project cost includes both Moyer Program eligible and Moyer Program ineligible costs. If the total project cost is exceeded, then adjustments must be made to ensure the project applicant is not overpaid for the project. Refer to Chapters 2 and 3 for additional criteria and guidance related to co-funding projects.

Formula C-19: Project overpayment check ($)

$$\mathrm{Cost} \geq \mathrm{ACS} + \sum \mathrm{GP}$$

Table C-19: Formula C-19 Variables

Equation Variable	Description	Units
Cost	Total Moyer Eligible Cost(s) of Reduced Technology	$
ACS	Applicant Cost Share	$
GP	Grants Paid	$

F. Calculating the Cost-Effectiveness of a Grant Amount

The cost-effectiveness of a grant amount is determined by multiplying the CRF by the grant amount and dividing by the annual weighted surplus emission reductions.

Formula C-20: Cost-effectiveness of weighted surplus emission reductions ($/tons)

$$\mathrm{CE} = \frac{\mathrm{GA} * \mathrm{CRF}}{\mathrm{WER}_{\mathrm{Total}}}$$

Table C-20: Formula C-20 Variables

Equation Variable	Description	Units
CE	Cost-Effectiveness	$/ton
GA	Grant Amount	$
CRF	Capital Recovery Factor	yr^{-1}
$\mathrm{WER}_{\mathrm{Total}}$	Total annual weighted surplus emission reductions	tons/yr

III. Variables

Variable	Description	Units
ACS	Applicant Cost Share	$
Act	Annual Activity	Specific to formula
Adj	Adjustment Factor	-
AE	Annual Emissions by Pollutant	tons/yr
$AE_{Baseline}$	Baseline Annual Emissions by Pollutant	tons/yr
$AE_{Reduced}$	Reduced Annual Emissions by Pollutant	tons/yr
ANV	Annual Number of Visits	visits/yr
BT	Berthing Time	hrs/visit
CE	Cost-Effectiveness	$/ton
CEL	Cost-effectiveness limit	$/ton
Cost	Moyer Eligible Cost(s) of Reduced Technology	$
CRF	Capital Recovery Factor	yr-1
DET	Deterioration Rate	Specific to formula
DL	Deterioration Life	yr
DP	Deterioration Product	Specific to formula
DR	Discount Rate	yr-1
EF	Emission Factor	Specific to formula
EmR	Emission Rate	g/mi
ER	Annual Surplus Emission Reductions by pollutant	tons/yr
ER_{NOx}	Nitrogen Oxides Emission Reductions	tons/yr
ER_{PM}	Particulate Matter Emission Reductions	tons/yr
ER_{ROG}	Reactive Organic Gases Emission Reductions	tons/yr
ER_{Total}	Total Emission Reductions	tons/yr
FCR	Fuel consumption rate factor	bhp-hr/gal
FYOP	Expected first year of operation	yr
GP	Grants Paid	$
HP	Horsepower	hp
Maximum Percentage of Eligible Cost	Maximum Percentage of Eligible Cost as outlined in the source category chapters	%
MY	Engine Model Year	yr
ODO	Odometer Reading	mi
PGA	Potential Grant Amount	$
PL	Project Life	yr
PL_1	Fraction project life from transaction 1	yr

Variable	Description	Units
PL_2	Fraction project life from transaction 2	yr
PL_{Total}	Total project life	yr
PR	Power Requirements	kW
RTVP	Reduced technology verification percentage	%
Ship EF	Ship Emission Factor	g/kW-hr
TEA	Total Equipment Activity	Specific to formula
WER	Estimated weighted annual emissions reductions	tons/yr
WER_1	Annual weighted surplus emissions from transaction 1	tons/yr
WER_2	Annual weighted surplus emissions from transaction 2	tons/yr
WER_{Total}	Total Weighted Emission Reductions	tons/yr