Texas Commission on Environmental Quality (TCEQ)
Texas Emissions Reduction Plan (TERP)

Emissions Reduction Incentive Grants Program
Technical Supplement No. 1
On-Road Heavy-Duty Vehicles

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Contents

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SUMMARY

This supplement contains the calculations for activities involving on-road heavy-duty vehicles, including: new purchases and leases, replacement, repower, retrofit, and add-on device activities.

For the purposes of the TERP, an on-road heavy-duty motor vehicle is defined as a motor vehicle with a gross vehicle weight rating (GVWR) of 8,501 pounds or more. This definition does not include a vehicle of 8,501 pounds or more that is classified by the United States Environmental Protection Agency (EPA) as a medium-duty passenger vehicle subject to federal light-duty on-road motor vehicle emissions standards.

A majority of on-road heavy-duty vehicles are powered by diesel-fueled compression-ignition (CI) engines. However, vehicles using other fuel types are also eligible for funding.

TIP: If the project being proposed involves a gasoline, LPG, or CNG powered equipment contact TCEQ for eligibility.

Use the instructions and worksheets provided below to calculate the emissions reductions and the cost effectiveness of the activities proposed for your project. Use OR-1 to do the calculations based on annual miles of operation. Use OR-2 for calculations based on annual fuel use.

The worksheets are divided into three major steps:

Step 1: Determine if the new vehicle and/or engine is certified to emit 25% less NO_x

Step 2: Calculate the reductions in NO_x Emissions

Step 3: Calculate the Cost per Ton

INSTRUCTIONS

STEP 1: DETERMINE IF THE NEW VEHICLE/ENGINE IS CERTIFIED TO EMIT 25% LESS NO_X.

All new purchase or lease, replacement, repower, retrofit, and add-on activities must achieve at least a 25% reduction in NO_X emissions when compared to a baseline emission rate according to the following formula:

Percent Baseline NO_X Emission Rate Reduction =
[(Baseline Emission Rate - Reduced Emission Rate) / Baseline Emission Rate] x 100%

Use Worksheet OR-1 or OR-2 below to determine if your activity meets the minimum emission reduction requirements. The TCEQ may establish a lower percentage reduction requirement for retrofit systems to convert an existing heavy-duty on-road diesel engine to operate under a dual-fuel configuration that uses natural gas and diesel fuel. The Request for Grant Applications (RFGA) will include any alternative percentage reduction requirements.

a) **Determine the Baseline NO_X Emission Rate**

The baseline NO_X emission rate will normally be the federal NO_X emission standard for the model year of the baseline engine. If the baseline engine was certified by the EPA or the California Air Resource Board (CARB) to the Family Emissions Limit (FEL), the TCEQ may use the FEL for the baseline NO_X emissions rate.

In some model years, the EPA used a combined NO_X + NMHC (non-methane hydrocarbons) standard. For the standards listed in NO_X + NMHC, the TCEQ will use a NO_X fraction of 0.95 of that standard for diesel engines and 0.80 of that standard for alternative fuel engines to determine the NO_X-only emissions based on the combined standards. See the example below.

See Appendix A for a list of federal NO_X emission standards by engine model year.

Calculate NO_X-only standard:
NO_X + NMHC = 6.6 (g/kW-hr)
NO_X-only = 6.6 x 0.95 = 6.27 (g/kW-hr)

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b) Determine the Reduced NOX Emission Rate

The new NO_X emission rate will normally be the federal NO_X emission standard for the engine model year or a certified emission rate. Certified means certified by the EPA or CARB, or otherwise accepted by the TCEQ. If the new engine was certified by the EPA or the CARB to the FEL, the TCEQ may use the FEL for the new NO_X emissions rate.

See Appendix A for a list of federal NO_X emission standards by engine model year.

Retrofit/Add-on. Use the verified or certified emission standard (g/bhp-hr) or emission reduction percentage for the retrofit or add-on device. The emission reductions must be verified or certified by the EPA or CARB, or otherwise accepted by the TCEQ. For a system to convert an existing heavy-duty non-road diesel engine to operate under a dual-fuel configuration that uses natural gas and diesel fuel, the manufacturer may request TCEQ consideration of alternative information, in addition to the emission standard to which an engine is certified by the EPA or CARB, to determine appropriate NO_X emission reduction factors.

If the TCEQ has accepted a dual-fuel conversion system under this alternative approach, a letter of acceptance will have been sent to the system manufacturer listing the TCEQ's accepted emissions reduction percentage for the retrofit system on specific engine makes, models, model years, and engine families. If an acceptance letter has been issued by the TCEQ for a particular dual-fuel conversion system, the accepted emission reduction percentage may be used in the calculations.

c) Calculate the difference in NOX Emission Rates

See the example calculations below for determining if an Activity meets the 25% baseline emission rate reduction requirement by Project Category:

New Purchase/ Lease

Activity: Purchase of a 2018 model heavy-duty diesel vehicle.

- Current Model Year (2018) Engine Emission Standard: 0.2 g/bhp-hr
- New engine certified NO_x emissions: 0.2 g/bhp-hr

Calculation of baseline emission rate reduction:
[(0.2 g/bhp-hr – 0.2 g/bhp-hr) / 0.2 g/bhp-hr] x 100 % = 0 %

Note: *This project **does not** meet the 25% baseline emission rate reduction requirement.*

Repower

Activity: Repower of a 2006 heavy-duty vehicle with a 2018 model engine.

- Baseline engine NO_x emission standard: 2.375 g/bhp-hr
- New engine NO_x emission standard: 0.2 g/bhp-hr

Calculation of baseline emission rate reduction:
[(2.375 g/bhp-hr – 0.2 g/bhp-hr) / 2.375 g/bhp-hr] x 100 % = 91.5%

Note: *This project **does** meet the 25% baseline emission rate reduction requirement.*

Replacement

Activity: Replacement of a 1990 heavy-duty vehicle with a 2017 model.

- Baseline engine NO_x emission standard: 6.0 g/bhp-hr
- New engine NO_x emission standard: 0.2 g/bhp-hr

Calculation of baseline emission rate reduction:
[(6.0 g/bhp-hr – 0.2 g/bhp-hr) / 6.0 g/bhp-hr] x 100 % = 96.6%

Note: *This project **does** meet the 25% baseline emission rate reduction requirement.*

STEP 2: CALCULATE THE REDUCTIONS IN NOX EMISSIONS

The reductions in NOX emissions represents the difference in the emission level of a baseline vehicle or engine and a reduced-emissions vehicle or engine. The emission levels for the baseline and reduced-emission engines should be calculated separately and then the differences taken to determine emission reductions.

This step is divided into three main parts:

- Part A: Determine the TxLed Correction Factor
- Part B: Calculate the NO_x Emission Factors
- Part C: Calculate the NO_x Emission Reductions

Part A: Determine the TxLED Correction Factor

The TCEQ has adopted rules (30 TAC §114.312 - §114.319) requiring that beginning on October 1, 2005, diesel fuel produced for use in compression-ignition engines in certain counties in Texas must meet new low emission diesel (TxLED) standards.

The counties affected by the new TxLED requirements currently include all of the counties eligible for TERP incentive funding, as listed in the *Guidelines*, **except for El Paso County.** The new requirements set a maximum aromatic hydrocarbon content standard of 10% by volume per gallon. The requirements also set a minimum cetane number for TxLED of 48.

The TxLED requirements are intended to result in reductions in NO_x emissions from diesel engines. Currently, a reduction factor of **5.7%** (0.057) for on-road use and **7.0%** (0.07) for non-road use and has been accepted as an estimate for use of TxLED. However, this reduction estimate is subject to change, based on the standards accepted by the EPA for use in the Texas State Implementation Plan (SIP).

For on-road activities in the applicable counties (does not include El Paso County), a correction factor of 0.943 should be applied when calculating the baseline and/or reduced emissions for diesel engines, regardless of when the grant-funded vehicle began or will begin operation.

Part B: Calculate the NO_x Emission Factors

To complete the calculation of the NO_x emission reductions for the activity, you must convert the NO_x emission rates (g/bhp-hr) to **a NO_x emission factor**. For most types of vehicles, the NO_x emission reduction factors should be based on annual miles of operation. However, refuse vehicles, street sweepers, and other vehicles with power take-off uses of the propulsion engine operating predominantly in stop-and-go applications accrue low mileage, yet intermittently operate at high load during compaction or sweeping mode. Therefore, annual fuel use is a more appropriate emission factor to use for these vehicles, although an applicant may base the emission reductions on annual mileage for these types of vehicle uses, provided sufficient supporting documentation is submitted as determined by the TCEQ. You should consult with the TCEQ to determine the factors to use for non-diesel engines, or if you wish to use a different conversion factor.

Usage based on mileage (OR-1). For calculations based on annual miles of operation, a conversion factor (bhp-hr/mi) is provided to convert the NO_x emission rate (g/bhp-hr) to g/mile. This conversion factor must be applied to the NO_x emission rates (g/bhp-hr) for the baseline vehicle/engine and for the reduced emission vehicle/engine.

Usage based on fuel consumption (OR-2). For calculations based on annual fuel use (OR-2), the NO_x emission factor will be in grams per year (g/year). The energy consumption factor (ECF) should be used to convert the NO_x emission rate from g/bhp-hr to g/gal. As shown on the worksheet, because the estimated annual fuel use of the baseline vehicle/engine and the reduced emission vehicle/engine may differ, the g/gal factor is then multiplied by the number of gallons used per year, to determine the estimated g/year to be emitted by both the baseline and the reduced emission vehicle/engine.

Refer to Appendix B for conversion factors and energy consumption factors by gross vehicle weight rating (GVWR) and engine model year.

Tip: The GVWR is the total allowable or recommended vehicle weight, including the loaded weight of the vehicle, driver, passengers, and cargo. The rated weight is usually found on a label affixed to the inside of the door or other area of the vehicle and may also be listed on the vehicle title and registration documents.

If the vehicle is normally operated in combination with a trailer, such as an 18-wheel semi-tractor and trailer rig, use the combined GVWR of both the vehicle and the trailer. However, if a trailer is only attached occasionally, use the GVWR for the vehicle only. Check with TCEQ staff if you are unsure as to which GVWR to use.

Example NO_x Emission Factor Calculation Based on Annual Miles

Activity: Replacement of a 1988 heavy-duty vehicle with a 2018 model.

- TxLED Correction factor: 0.943
- Vehicle Weight Rating: 80,000 lbs.
- Baseline engine emission standard: 10.7 g/bhp-hr
- Baseline engine conversion factor: 3.26 bhp-hr/mile
- Replacement engine emission standard: 0.2 g/bhp-hr
- Replacement engine conversion factor: 3.03

Calculation of TxLED and Baseline NO_x Emission Factor (g/mile)

10.7 g/bhp-hr x 0.943 = 10.09 g/bhp-hr

↓

10.09 g/bhp-hr x 3.26 bhp-hr/mile = 32.89 g/mile

Calculation of TxLED and Reduced NO_x Emission Factor (g/mile)

0.2 g/bhp-hr x 0.943 = 0.19 g/bhp-hr

↓

0.19 g/bhp-hr x 3.03 bhp-hr/mile = 0.57 g/mile

Example NO_x Emission Factor Calculation Based on Annual Fuel Use

Activity: Replacement of a 1988 heavy-duty vehicle with a 2018 model.

- TxLED Correction factor: 0.943
- Vehicle Weight Rating: 54,000 lbs.
- Baseline engine emission standard: 10.7 g/bhp-hr
- Baseline Energy Consumption Factor: 17.80 bhp-hr/gal
- Replacement engine emission standard: 0.2 g/bhp-hr
- Replacement Energy Consumption Factor: 19.30 bhp-hr/gal

Calculation of TxLED and Baseline NO_x Emission Factor (g/gal)

10.7 g/bhp-hr x 0.943 = 10.09 g/bhp-hr

↓

10.09 g/bhp-hr x 17.80 bhp-hr/gal = 179.60 g/gal

Calculation of TxLED and Reduced NO_x Emission Factor (g/gal)

0.2 g/bhp-hr x 0.943 = 0.19 g/bhp-hr

↓

0.19 g/bhp-hr x 19.30 bhp-hr/gal = 3.67 g/gal

Part C: Calculate the NO_x Emission Reductions

If you choose to base your calculations on fuel use, you must estimate the annual fuel use. For calculations that use fuel use as the factor, the annual fuel use determination is in Part B.

The TCEQ may provide the option of using standard usage rates for some types of projects in lieu of determining the usage specific to each particular vehicle or piece of equipment. Refer to the RFGA for instructions and requirements on the usage rate options.

Where a standard usage rate option is used, the applicable standard usage rate should be used for the emissions reduction calculations. Where a standard usage rate is not used, refer to the instructions in the RFGA for determining the usage rate to enter in the application and use for the emissions reduction calculations.

Refer to Appendix C for standard usage rates for heavy-duty on-road vehicles.

You must also enter the percentage of annual usage that will occur within the eligible counties. To qualify, at least 25% of the annual usage must be projected to occur within those counties. A primary area will need to be identified in the project application form. Activities to be operated in different primary areas will need to be submitted in separate applications.

Finally, to complete the calculations, you must commit to an activity life. This will be the number of years used to calculate the emission reductions. If selected for grant award, you must commit to operating the vehicle within the eligible counties for this time period and to track and report on that use. The activity life may not exceed the life of the vehicle.

Refer to Appendix D for information on the maximum acceptable activity life for different types of activities.

Example NO_x Emission Rate Reduction Calculation Based on Annual Miles

Activity: Replacement of a 1988 Heavy-Duty Vehicle with a 2018 model.

- Vehicle Weight Rating: 80,000 lbs.
- Baseline NO_x emission factor: 32.89 g/mile
- Reduced NO_x emission factor: 0.57 g/mile
- Annual hours of operation: 60,000 miles
- Percent time in affected counties: 75%
- Project Activity Life: 7 Years

NO_x emission rate reduction calculation

32.89 g/mile – 0.57 g/mile = 32.32 g/mile

↓

32.32 g/mile x 60,000 miles/yr = 1,939,200 g/yr

↓

1,939,200 g/yr x .75= 1,454,400 g/yr

↓

1,454,400 g/yr / 907,200 g/ton = 1.60 tons/yr

↓

1.60 tons/yr x 7 yrs = 11.20 total tons

Example NO_x Emission Rate Reduction Calculation Based on Annual Fuel Use

Activity: Replacement of a 1988 Heavy-Duty Vehicle with a 2018 model.

- Vehicle Weight Rating: 54,000 lbs.
- Baseline NO_x emission factor: 179.60 g/gal
- Reduced NO_x emission factor: 3.64 g/gal
- Annual Fuel Use: 5,000 gallons
- Percent time in affected counties: 75%
- Project Activity Life: 7 Years

NO_x emission rate reduction calculation

179.60 g/gal – 3.64 g/gal = 175.96 g/gal

↓

175.96 g/gal x 5,000 gal/yr = 879,800 g/yr

↓

879,800 x .75= 659,850 g/yr

↓

659,850 g/yr / 907,200 g/ton = 0.73 tons/yr

↓

0.73 tons/yr x 7 yrs = 5.11 tons

STEP 3: CALCULATE THE COST PER TON

The cost per ton for an activity is determined by dividing the requested grant amount for that activity by the total NO_x emission reductions for that activity.

For multi-activity projects, the cost per ton of the complete project is determined by dividing the requested grant amount for the entire project by the total NO_x emission reductions for all of the activities included in that project.

Requested Grant Amount / Total NO_x Emission Reductions
= Cost Per Ton of NO_x Reduced

Example Cost Per Ton of NO_x Reduced Calculation

Activity: Replacement of a 1988 heavy-duty vehicle with a 2018 model.

- Requested Grant Amount: $120,000.00
- Total NO_x Emission Reduction: 11.20 tons

Cost Per Ton of NO_x Reduced Calculation
$120,000.00 / 11.20 tons = $10,714.29/ton

WORKSHEET OR-1 ANNUAL MILEAGE AND OR-2 ANNUAL FUEL USE

Use the worksheets provided below to calculate the emissions reductions and the cost effectiveness of the activities proposed for your project. Use OR-1 to do the calculations based on annual miles of operation. Use OR-2 for calculations based on annual fuel use. An interactive version of the calculators is available on the TERP website at: www.terpgrants.org.

OR-1 Annual Mileage.

Activity Information

Type of project	
☐ New Purchase/Lease ☐ Repower ☐ Replacement ☐ Retrofit/Add-on	
What is the activity life, in years?	
How many miles will the vehicle travel annually?	
What is the requested grant amount?	

Annual Usage Information

(a) What is the percent of time the vehicle will travel in the eligible counties?	
(b) What is the percent of time the vehicle will spend on the designated highways and roadways?	
What is the total percent of time? (a+b)	
What is the percent of time the vehicle will travel in the eligible counties?(a)	

Baseline Engine Information

Model Year	
Fuel Type	
Gross Vehicle Weight Rating (GVWR)	
Baseline Emission Standard (g/bhp-hr)	
Conversion Factor (bhp-hr/mile)	

Reduced Emission Engine Information

Model Year	
Fuel Type	
Gross Vehicle Weight Rating (GVWR)	
Reduced Emission Standard (g/bhp-hr)	
Conversion Factor (bhp-hr/mile)	
If the activity is a retrofit/add-on, is there a verified percentage NOx emission reduction?	%

STEP 1. DOES THIS PROJECT MEET THE 25% NO_X BASELINE EMISSION RATE REDUCTION REQUIREMENTS?

Baseline Engine Emissions (g/bhp-hr)	
- Reduced Engine Emissions (g/bhp-hr)	
= Difference (g/bhp-hr)	
/ Baseline Engine Emissions (g/bhp-hr)	
x	100
= Emission Rate Reduction	

*The RFGA may authorize a lower percentage reduction requirement for retrofits with dual-fuel conversion systems.

STEP 2. CALCULATE THE NO_X EMISSION REDUCTIONS

PART A. CALCULATE THE TxLED CORRECTION FACTOR

On Road TxLED Correction Factor *1 - (0.057)*	0.943

PART B. DETERMINE THE NO_X EMISSION FACTOR

DETERMINE BASELINE NOx EMISSION FACTOR (g/mile)	
baseline engine NOx emission standard (g/bhp-hr)	
x TxLED correction factor (diesel engines only)	
= corrected NOx emission factor (g/bhp-hr)	
x conversion factor (bhp-hr/mile)	
= baseline NOx emission factor (g/mile)	
DETERMINE REDUCED NOx EMISSION FACTOR (g/mile)	
OPTION A. REDUCED-EMISSION ENGINE CERTIFIED TO A SPECIFIC EMISSIONS STANDARD (G/BHP-HR)	
reduced engine NOx emissions standard (g/bhp-hr)	
x TxLED correction factor (diesel engines only)	
= corrected NOx emission factor (g/bhp-hr)	
x conversion factor (bhp-hr/mile)	
=reduced NOx emission factor (g/mile)	
OPTION B. REDUCED-EMISSION TECHNOLOGY CERTIFIED/VERIFIED TO ACHIEVE A PERCENTAGE REDUCTION FROM THE BASELINE.	
Baseline NOx emission factor (g/mile)	
x [1-certified/verified percentage reduction from baseline] (%)	
= reduced NOx emission factor (g/mile)	

PART C. CALCULATE THE NOX EMISSION REDUCTION USING ANNUAL MILEAGE

baseline NOx emission factor (g/mile)	
- reduced NOx emission factor (g/mile)	
= grams per mile reduced (g/mile)	
x annual miles of operation	
x percent within affected counties (%)	
= grams per year reduced (g/yr)	
/ 907,200 (g/ton)	
= estimated annual NOx emission reduction (ton/yr)	
x activity life (yr)	
= estimated activity life NOx emission reduction (ton)	

STEP 3: WHAT IS THE ACTIVITY COST PER TON?

requested grant amount for activity ($):	
/ NOx emissions reduction (ton):	
= cost per ton ($/ton)	

OR-2 Annual Fuel Use

Type of project

☐ New Purchase/Lease ☐ Repower ☐ Replacement ☐ Retrofit/Add-on

What is the activity life, in years? (See table 1.3)	
What is the percent time the vehicle will travel is in the eligible counties?	
What is the requested grant amount for the activity?	

Annual Usage Information

(a) What is the percent of time the vehicle will travel in the eligible counties?	
(b) What is the percent of time the vehicle will spend on the designated highways and roadways?	
What is the total percent of time? (a+b)	
What is the percent of time the vehicle will travel in the eligible counties? (a)	

Baseline Engine Information

Model Year	
Fuel Type	
Gross Vehicle Weight Rating (GVWR)	
Baseline Emission Standard (g/bhp-hr)	
Annual Fuel Consumption in Gallons (gal/yr)	
Energy Consumption Factor (bhp-hr/gal)	

Reduced Emission Engine Information

Model Year	
Fuel Type	
Gross Vehicle Weight Rating (GVWR)	
Reduced Emission Standard (g/bhp-hr)	
Annual Fuel Consumption in Gallons (gal/yr)	
Energy Consumption Factor (bhp-hr/gal)	
If the activity is a retrofit/add-on, is there a verified percentage NOx emission reduction?	%

STEP 1: DOES THIS PROJECT MEET THE 25% NOX BASELINE EMISSION RATE REDUCTION REQUIREMENTS?

Baseline Engine Emission Standard (g/bhp-hr)	
- Reduced Engine Emission Standard (g/bhp-hr)	
= Difference (g/bhp-hr)	
/ Baseline Engine Emission Standard (g/bhp-hr)	
x	100
= Emission Rate Reduction	

STEP 2: WHAT ARE YOUR NO_X EMISSION REDUCTIONS?

PART A. CALCULATE THE TXLED CORRECTION FACTOR

On Road TxLED Correction Factor *1 - (0.057)*	0.943

PART B. DETERMINE THE NO_X EMISSION FACTOR

Determine Baseline NO_X Emission Factor (g/year)	
baseline NO_X emission standard (g/bhp-hr)	
x TxLED correction factor (diesel engines only)	
= corrected NO_X emission factor (g/bhp-hr)	
x energy consumption factor (bhp-hr/gal)	
x annual fuel consumption (gal/yr)	
= baseline NO_X emission factor (g/yr)	
Determine Reduced NO_X Emission Factor (g/year)	
OPTION A. REDUCED-EMISSION ENGINE CERTIFIED TO A SPECIFIC EMISSIONS STANDARD (G/BHP-HR)	
reduced NO_X emissions standard (g/bhp-hr)	
x TxLED correction factor (diesel engines only)	
= corrected NO_X emission factor (g/bhp-hr)	
x energy consumption factor (bhp-hr/gal)	
x annual fuel consumption (gal/yr)	
= reduced NO_X emission factor (g/yr)	
OPTION B. REDUCED-EMISSION TECHNOLOGY CERTIFIED/VERIFIED TO ACHIEVE A PERCENTAGE REDUCTION FROM THE BASELINE.	
Baseline NO_X emission factor (g/yr)	
x certified/verified percentage reduction from baseline	
= reduced NO_X emission factor (g/yr)	

PART C. CALCULATE THE NO_X EMISSION REDUCTION USING ANNUAL FUEL USE

baseline NO_X emission factor (g/yr)	
- reduced NO_X emission factor (g/yr)	
= grams per year reduced (g/yr)	
x percent within affected counties (%)	
= grams per year reduced (g/yr)	
/ 907,200 (g/ton)	907200
= estimated annual NO_X emission reduction (ton/yr)	
x activity life (yr)	
= estimated activity life NO_X emission reduction (ton)	

STEP 3: WHAT IS THE ACTIVITY COST PER TON?

Requested grant amount activity ($):	
/ NO_X emissions reductions (ton):	
= cost per ton ($/ton):	

APPENDIX A: ON-ROAD HEAVY-DUTY CI ENGINE EMISSION STANDARDS BY MODEL YEAR

Model Year	Diesel Engines Emission Standard	
	NO_x Only (g/bhp-hr)	NO_x+NMHC (g/bhp-hr)
1989 and earlier	10.7	
1990	6.0	
1991-1997	5.0	
1998-2001	4.0	
2002	4.0	
2003*	4.0	
2004 -2006	2.375	2.5
2007-2009*	0.2-2.375	
2010+	0.2	

*Some manufacturers were producing 2003 engines that met the more stringent 2.375 g/bhp-hr standard. Any application request for the consideration of a 2003 engine must include a copy of the official engine certification for the specific engine model or engine family code.

*The 2007 NO_x emission standard is 0.20 g/bhp-hr. Manufacturers phased in their compliance with this new standard over a three-year period. Therefore, it is not guaranteed that a 2007 model year vehicle and engine met the lower standard. Any application request for the consideration of a 2007-2009 engine must include a copy of the official engine certification for the specific engine model or engine family code.

APPENDIX B: ON-ROAD HEAVY-DUTY DIESEL VEHICLE CONVERSION FACTORS BY MODEL YEAR

Vehicle Class HDD2b (8,501-10,000 lb GVWR)			Vehicle Class HDDV3 (10,001-14,000 lb GVWR)		
Model Year	Conversion Factor (bhp-hr/mile)	Energy Consumption Factor (ECF) (bhp-hr/gal)	Model Year	Conversion Factor (bhp-hr/mile)	Energy Consumption Factor (ECF) (bhp-hr/gal)
2018	1.09	17.4	2018	1.25	18.5
2017	1.09	17.4	2017	1.25	18.5
2016	1.09	17.3	2016	1.25	18.2
2015	1.09	17.1	2015	1.25	18.0
2014	1.09	16.9	2014	1.25	17.8
2013	1.09	16.7	2013	1.25	17.6
2012	1.09	16.6	2012	1.25	17.4
2011	1.09	16.4	2011	1.25	17.2
2010	1.09	16.3	2010	1.25	17.0
2009	1.09	16.1	2009	1.25	16.8
2008	1.09	15.9	2008	1.25	16.7
2007	1.09	15.8	2007	1.25	16.5
2006	1.09	15.6	2006	1.25	16.3
2005	1.09	15.5	2005	1.25	16.1
2004	1.09	15.3	2004	1.25	15.9
2003	1.09	15.2	2003	1.25	15.8
2002	1.09	15.0	2002	1.25	15.6
2001	1.09	14.9	2001	1.25	15.4
2000	1.09	14.7	2000	1.25	15.2
1999	1.09	14.6	1999	1.25	15.1
1998	1.09	14.4	1998	1.25	14.9
1997	1.09	14.3	1997	1.25	14.7
1996	1.09	14.1	1996	1.25	14.6
1995	1.09	14.0	1995	1.25	14.4
1994	1.09	13.9	1994	1.25	14.3
1993	1.09	13.7	1993	1.25	14.1
1992	1.10	13.6	1992	1.25	13.9
1991	1.10	13.4	1991	1.25	13.8
1990	1.10	13.3	1990	1.25	13.6
1989	1.10	13.2	1989	1.25	13.5
1988	1.10	13.0	1988	1.25	13.3
1987	0.92	12.9	1987	1.76	13.2
1986	0.92	12.8	1986	1.76	13.0
1985	0.92	12.7	1985	1.76	12.9
1984	0.92	12.5	1984	1.76	12.8
1983	0.92	12.4	1983	1.76	12.6
1982	0.92	12.3	1982	1.76	12.5
1981	0.94	12.2	1981	1.76	12.3
1980	0.94	12.0	1980	1.76	12.2

Vehicle Class HDDV4 (14,001-16,000 lb GVWR)			Vehicle Class HDDV5 (16,001-19,500 lb GVWR)		
Model Year	Conversion Factor (bhp-hr/mile)	Energy Consumption Factor (ECF) (bhp-hr/gal)	Model Year	Conversion Factor (bhp-hr/mile)	Energy Consumption Factor (ECF) (bhp-hr/gal)
2018	1.46	16.1	2018	1.57	15.8
2017	1.46	16.1	2017	1.57	15.8
2016	1.46	16.0	2016	1.57	15.8
2015	1.46	16.0	2015	1.57	15.8
2014	1.46	15.9	2014	1.57	15.7
2013	1.46	15.8	2013	1.57	15.7
2012	1.46	15.8	2012	1.57	15.7
2011	1.46	15.7	2011	1.57	15.7
2010	1.46	15.7	2010	1.57	15.7
2009	1.46	15.6	2009	1.57	15.7
2008	1.46	15.6	2008	1.57	15.7
2007	1.46	15.5	2007	1.57	15.7
2006	1.46	15.4	2006	1.57	15.7
2005	1.46	15.4	2005	1.57	15.6
2004	1.46	15.3	2004	1.57	15.6
2003	1.46	15.3	2003	1.57	15.6
2002	1.46	15.2	2002	1.57	15.6
2001	1.46	15.2	2001	1.57	15.6
2000	1.46	15.1	2000	1.57	15.6
1999	1.46	15.0	1999	1.57	15.6
1998	1.46	15.0	1998	1.57	15.6
1997	1.46	14.9	1997	1.57	15.6
1996	1.46	14.9	1996	1.57	15.5
1995	1.46	14.8	1995	1.59	15.5
1994	1.47	14.8	1994	1.60	15.5
1993	1.47	14.7	1993	1.61	15.5
1992	1.48	14.6	1992	1.62	15.5
1991	1.48	14.6	1991	1.64	15.5
1990	1.49	14.5	1990	1.65	15.5
1989	1.49	14.5	1989	1.66	15.5
1988	1.50	14.4	1988	1.68	15.4
1987	1.76	14.4	1987	1.76	15.4
1986	1.76	14.3	1986	1.76	15.4
1985	1.76	14.2	1985	1.76	15.4
1984	1.76	14.2	1984	1.76	15.4
1983	1.76	14.1	1983	1.76	15.4
1982	1.76	14.1	1982	1.76	15.4
1981	1.76	14.0	1981	1.76	15.3
1980	1.76	13.9	1980	1.76	15.3

Vehicle Class HDDV6 (19,501-26,000 lb GVWR)			Vehicle Class HDDV7 (26,001-33,000 lb GVWR)		
Model Year	Conversion Factor (bhp-hr/mile)	Energy Consumption Factor (ECF) (bhp-hr/gal)	Model Year	Conversion Factor (bhp-hr/mile)	Energy Consumption Factor (ECF) (bhp-hr/gal)
2018	1.94	18.4	2018	2.41	19.0
2017	1.94	18.4	2017	2.41	19.0
2016	1.94	18.3	2016	2.41	18.9
2015	1.94	18.3	2015	2.41	18.8
2014	1.94	18.2	2014	2.41	18.8
2013	1.94	18.1	2013	2.41	18.8
2012	1.94	18.0	2012	2.41	18.8
2011	1.94	18.0	2011	2.41	18.7
2010	1.94	17.9	2010	2.41	18.7
2009	1.94	17.8	2009	2.41	18.7
2008	1.94	17.8	2008	2.41	18.6
2007	1.94	17.7	2007	2.41	18.6
2006	1.94	17.6	2006	2.41	18.5
2005	1.94	17.6	2005	2.41	18.5
2004	1.94	17.5	2004	2.41	18.5
2003	1.94	17.4	2003	2.41	18.4
2002	1.94	17.3	2002	2.41	18.4
2001	1.94	17.3	2001	2.41	18.3
2000	1.94	17.2	2000	2.41	18.3
1999	1.94	17.1	1999	2.41	18.3
1998	1.94	17.1	1998	2.41	18.2
1997	1.94	17.0	1997	2.41	18.2
1996	1.94	16.9	1996	2.41	18.1
1995	1.95	16.8	1995	2.41	18.1
1994	1.95	16.8	1994	2.41	18.1
1993	1.96	16.7	1993	2.40	18.0
1992	1.96	16.6	1992	2.40	18.0
1991	1.96	16.6	1991	2.40	17.9
1990	1.97	16.5	1990	2.40	17.9
1989	1.97	16.4	1989	2.39	17.8
1988	1.98	16.3	1988	2.39	17.8
1987	1.87	16.3	1987	2.13	17.8
1986	1.87	16.2	1986	2.13	17.7
1985	1.88	16.1	1985	2.14	17.7
1984	1.89	16.0	1984	2.16	17.6
1983	1.91	16.0	1983	2.18	17.6
1982	1.93	15.9	1982	2.19	17.5
1981	1.99	15.8	1981	2.23	17.5
1980	2.06	15.7	1980	2.25	17.4

Vehicle Class HDDV8a (33,001-60,000 lb GVWR)			Vehicle Class HDDV8b (Greater than 60,000 lb GVWR)		
Model Year	Conversion Factor (bhp-hr/mile)	Energy Consumption Factor (ECF) (bhp-hr/gal)	Model Year	Conversion Factor (bhp-hr/mile)	Energy Consumption Factor (ECF) (bhp-hr/gal)
2018	2.76	19.3	2018	3.03	21.4
2017	2.76	19.3	2017	3.03	21.4
2016	2.76	19.3	2016	3.03	21.3
2015	2.76	19.2	2015	3.03	21.2
2014	2.76	19.2	2014	3.03	21.1
2013	2.76	19.1	2013	3.03	20.9
2012	2.76	19.1	2012	3.03	20.8
2011	2.76	19.0	2011	3.03	20.7
2010	2.76	19.0	2010	3.03	20.6
2009	2.76	18.9	2009	3.03	20.5
2008	2.76	18.9	2008	3.03	20.4
2007	2.76	18.8	2007	3.03	20.3
2006	2.76	18.8	2006	3.03	20.2
2005	2.76	18.7	2005	3.03	20.1
2004	2.76	18.6	2004	3.03	20.0
2003	2.76	18.6	2003	3.03	19.9
2002	2.76	18.5	2002	3.03	19.8
2001	2.76	18.5	2001	3.03	19.6
2000	2.76	18.4	2000	3.03	19.5
1999	2.76	18.4	1999	3.03	19.4
1998	2.76	18.3	1998	3.03	19.3
1997	2.76	18.3	1997	3.03	19.2
1996	2.76	18.2	1996	3.03	19.1
1995	2.78	18.2	1995	3.06	19.0
1994	2.81	18.1	1994	3.09	18.9
1993	2.83	18.0	1993	3.11	18.8
1992	2.85	18.0	1992	3.14	18.7
1991	2.87	17.9	1991	3.17	18.6
1990	2.90	17.9	1990	3.20	18.5
1989	2.92	17.8	1989	3.23	18.4
1988	2.95	17.8	1988	3.26	18.3
1987	2.99	17.7	1987	3.13	18.1
1986	2.99	17.6	1986	3.13	18.0
1985	3.01	17.6	1985	3.14	17.9
1984	3.04	17.5	1984	3.14	17.8
1983	3.06	17.5	1983	3.15	17.7
1982	3.09	17.4	1982	3.15	17.6
1981	3.11	17.3	1981	3.26	17.5
1980	3.06	17.3	1980	3.33	17.4

Vehicle Class HDDBT (Diesel Transit or Urban Bus)			Vehicle Class HDDBS (Diesel School Buses)		
Model Year	Conversion Factor (bhp-hr/mile)	Energy Consumption Factor (ECF) (bhp-hr/gal)	Model Year	Conversion Factor (bhp-hr/mile)	Energy Consumption Factor (ECF) (bhp-hr/gal)
2018	4.03	23.6	2018	2.99	25.1
2017	4.03	23.6	2017	2.99	25.1
2016	4.03	23.3	2016	2.99	24.7
2015	4.03	23.0	2015	2.99	24.3
2014	4.03	22.6	2014	2.99	23.9
2013	4.03	22.3	2013	2.99	23.5
2012	4.03	22.0	2012	2.99	23.2
2011	4.03	21.7	2011	2.99	22.8
2010	4.03	21.4	2010	2.99	22.5
2009	4.03	21.1	2009	2.99	22.1
2008	4.03	20.8	2008	2.99	21.8
2007	4.03	20.5	2007	2.99	21.5
2006	4.03	20.3	2006	2.99	21.2
2005	4.03	20.0	2005	2.99	20.8
2004	4.03	19.7	2004	2.99	20.5
2003	4.03	19.5	2003	2.99	20.2
2002	4.03	19.2	2002	2.99	19.9
2001	4.03	18.9	2001	2.99	19.7
2000	4.03	18.7	2000	2.99	19.4
1999	4.03	18.4	1999	2.99	19.1
1998	4.03	18.2	1998	2.99	18.8
1997	4.03	18.0	1997	2.99	18.6
1996	4.03	17.7	1996	2.99	18.3
1995	4.02	17.5	1995	2.93	18.0
1994	4.02	17.3	1994	2.88	17.8
1993	4.02	17.0	1993	2.82	17.5
1992	4.01	16.8	1992	2.77	17.3
1991	4.01	16.6	1991	2.71	17.0
1990	4.01	16.4	1990	2.70	16.8
1989	4.01	16.2	1989	2.69	16.6
1988	4.01	16.0	1988	2.67	16.3
1987	3.07	15.8	1987	1.62	16.1
1986	3.07	15.6	1986	1.62	15.9
1985	3.07	15.4	1985	1.62	15.7
1984	3.07	15.2	1984	1.62	15.5
1983	3.07	15.0	1983	1.62	15.3
1982	3.07	14.8	1982	1.62	15.0
1981	3.01	14.6	1981	1.61	14.8
1980	2.91	14.4	1980	1.60	14.6

APPENDIX C: STANDARD USAGE RATES

To determine the standard usage rate for a heavy-duty on-road vehicle, you will need to determine its gross vehicle weight rating (GVWR). This number may be found on the vehicle registration, title, and/or label affixed inside the door.

If the vehicle normally operates in combination with a trailer, such as an 18-wheeler semi-tractor and trailer rig, the gross combined weight rating should be reported as the GVWR. However, if a trailer is attached occasionally, only the weight of the vehicle should be used.

Vehicle Class	**Annual Miles**
HDV2b (8,501-10,000 GVWR)	15,000
HDV3 (10,001-14,000 GVWR)	15,000
HDV4 (14,001-16,000 GVWR)	20,000
HDV5 (16,001-19,500 GVWR)	20,000
HDV6 (19,501-26,000 GVWR)	20,000
HDV7 (26,001-33,000 GVWR)	20,000
HDV8a (33,001-60,000 GVWR)	40,000
HDV8b (Greater than 60,000 GVWR; and including tractor-trailer haul trucks greater than 60,000 Gross Combined Weight Rating)	60,000
HDBT (Transit or Urban Bus)	35,000
HDBS (School Bus)	10,000

APPENDIX D: ACTIVITY LIFE BY PROJECT TYPE

	Minimum	Maximum
School buses 33,000 GVWR (new purchase or lease category only)	5 years (including lease)	20 years
Other buses 33,000 GVWR (new purchase or lease category only)	5 years (including lease)	12 years
New Purchase or Lease	5 years (including lease)	10 years
Replacement	5 years	7 years
Repowers	5 years	7 years
Retrofit/Add-On (The maximum life for dual-fuel conversions is 7 years)	5 years	10 years

a. * If an applicant feels that a longer activity life for a new purchase or lease is warranted for school buses or other buses, they should contact the TCEQ to discuss. Any request to use a longer activity life will need to be submitted in writing, and should include complete documentation and records of the historical use of similar vehicles by the applicant.