



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

**Emissions Reduction Incentive Grants Program
Technical Supplement No. 2
Non-Road Equipment**

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**Texas Commission on Environmental Quality (TCEQ)
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Technical Supplement No. 2
Non-Road Equipment**

SUMMARY

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

Non-road equipment that is 25 horsepower (hp) or greater are eligible for grants under this program for new purchases and leases, replacement, repower, and retrofit/add-ons. Most of the non-road engines eligible under this program will be powered by diesel-fueled compression-ignition (CI) engines. However, engines powered by other fuels may also be eligible, subject to decisions by the TCEQ.



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

Use the Non-Road-1 (NR-1) worksheet provided at the end of this supplement to calculate the emission reductions and the cost-effectiveness based on annual hours of operation of the activities proposed for your project. You may also go to www.terpgrants.org and download the non-road equipment calculator for an estimate of your possible grant amounts.

This workbook is divided into four major steps:

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

Step 2: Calculate the Total NO_x Emissions Reductions.

Step 3: Calculate the Cost per Ton

Refer to the instructions included below, and use the NR-1 Worksheet to complete the calculations.

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:

$$\text{Percent Baseline NO}_x \text{ Emission Rate Reduction} = \frac{[(\text{Baseline Emission Rate} - \text{Reduced Emission Rate}) / \text{Baseline Emission Rate}] \times 100\%}{}$$

Use Worksheet NR-1 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, non-road diesel engine to operate under a dual-fuel configuration that uses natural gas and diesel fuel. The 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 and horsepower 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. For NO_x emissions standards listed in units of grams per kilowatt-hour (g/kW-hr), the TCEQ will use a fraction of 0.7457 of the NO_x-only standard to convert the standard into units of grams per break horsepower-hour (g/bhp-hr). See the example below.

Note: If the model year of the equipment and the model year of the engine are different, the model year of the engine should be used for determining the standard to apply.

See **Appendix A** for a list of federal NO_x emission standards by engine horsepower and model year.

Calculate NO_x-only standard:

$$\text{NO}_x + \text{NMHC} = 6.6 \text{ (g/kW-hr)}$$

$$\text{NO}_x\text{-only} = 6.6 \times 0.95 = 6.27 \text{ (g/kW-hr)}$$

Convert to g/bhp-hr:

$$\text{NO}_x\text{-only} = 6.27 \times 0.7457 = 2.8 \text{ (g/bhp-hr)}$$

b) Determine the Reduced NO_x Emission Rate

The new NO_x emission rate will normally be the federal NO_x emission standard for the engine model year and horsepower of the reduced emission engine 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 horsepower and 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 for the calculations.

c) Calculate the difference in NO_x 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 new non-road 60-hp piece of equipment.

- Current model year engine emission standard: 3.325 g/bhp-hr
- New engine certified NO_x emissions: 2.85 g/bhp-hr

Calculation of baseline emission rate reduction:

$$[(3.325 \text{ g/bhp-hr} - 2.85 \text{ g/bhp-hr}) / 3.325 \text{ g/bhp-hr}] \times 100 \% = 14.3 \% \text{ baseline emission rate reduction}$$

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

Repower

Activity: Repower of a 2006 550-hp non-road piece of equipment with a 2016 engine.

- Baseline engine NOX emission standard: 2.85 g/bhp-hr
- New engine NOX emission standard: 0.3 g/bhp-hr

Calculation of baseline emission rate reduction:

$$[(2.85 \text{ g/bhp-hr} - 0.3 \text{ g/bhp-hr}) / 2.85 \text{ g/bhp-hr}] \times 100 \% = 89.5 \% \text{ baseline emission rate reduction}$$

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

Replacement

Activity: Replacement of a 2010 750-hp piece of equipment with a 2017 model.

- Baseline engine NOX emission standard: 4.56 g/bhp-hr
- New engine NOX emission standard: 2.6 g/bhp-hr

Calculation of baseline emission rate reduction:

$$[(4.56 \text{ g/bhp-hr} - 2.6 \text{ g/bhp-hr}) / 4.56 \text{ g/bhp-hr}] \times 100 \% = 43.0\% \text{ baseline emission rate reduction}$$

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

Retrofit

Activity: Retrofitting a 1995 450-hp piece of equipment with a device that reduces the NO_x emissions.

- Baseline engine NOX emission standard without retrofit: 9.5 g/bhp-hr
- Retrofitted engine certified NOX emissions: 5.6 g/bhp-hr

Calculation of baseline emission rate reduction:

$$[(9.5 \text{ g/bhp-hr} - 5.6 \text{ g/bhp-hr}) / 9.5 \text{ g/bhp-hr}] \times 100 \% = 41.05\% \text{ baseline emission rate reduction}$$

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

STEP 2: CALCULATE THE NO_x EMISSIONS FACTORS

Emissions reduction represents the difference in the emission level of a baseline (old) engine and a newer, reduced-emission engine. Because correction factors and the activity levels may be expressed in different units for the existing and replacement engines, 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 non-road activities in the applicable counties (does not include El Paso County), a correction factor of **0.93** should be applied when calculating the baseline and/or reduced emissions for diesel engines, regardless of when the grant-funded equipment 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 equipment, the NO_x emission reduction factors should be based on annual hours of operation. 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.

For calculations based on annual hours of operation, the NO_x emission factor will be in **grams per hour (g/hr)**. If given in g/bhp-hr, the engine NO_x emission standard is converted to a NO_x emission factor expressed in g/hr by multiplying it by the engine horsepower (hp). This conversion must be applied to the NO_x emission standard for the baseline engine and for the reduced emission engine.

A default **load factor** must also be included in the calculation to account for the fraction of available engine's power actually used.

Appendix C provides load factors by type of equipment and engine horsepower.

Note: For the *reduced emission engine* a default horsepower value equal to 110% of the baseline engine horsepower is used for the conversion rather than the rated maximum brake horsepower of the new engine. An example calculation is provided below the following table.

Example NO_x Emission Factor Calculation

Activity: Replacement of a 1988 500-hp diesel crawler tractor with a new 2018 model.

- Baseline Equipment horsepower: 500 hp
- New Equipment horsepower: 550 hp (500 x 1.1)
- Original engine emission standard: 9.5 g/bhp-hr
- Replacement engine emission standard: 0.3 g/bhp-hr
- TxLED Correction factor: 0.93
- Load factor: 0.59

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

$$9.50 \text{ g/bhp-hr} \times 0.93 = 8.84 \text{ g/bhp-hr}$$

↓

$$8.84 \text{ g/bhp-hr} \times 0.59 = 5.22 \text{ g/bhp-hr}$$

↓

$$5.22 \text{ g/bhp-hr} \times 500 \text{ hp} = 2,607.80 \text{ g/hr}$$

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

$$0.3 \text{ g/bhp-hr} \times 0.93 = 0.28 \text{ g/bhp-hr}$$

↓

$$0.28 \text{ g/bhp-hr} \times 0.59 = 0.16 \text{ g/bhp-hr}$$

↓

$$0.16 \text{ g/bhp-hr} \times 550 \text{ hp} = 90.54 \text{ g/hr}$$

Part C: Calculate the NO_x Emission Reductions

Use the factors determined in Part B to calculate the NO_x emission reduction for the activity.

To complete the calculations, you will need to determine the usage rate for your equipment, which is typically calculated as **annual hours of operation**.

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.

Standard usage rates for heavy-duty non-road and stationary equipment are listed in Appendix B. The list includes usage rates by fuel type. You should select the default usage rate which applies to the fuel type of the old/existing equipment. For example, if you are applying to replace a diesel forklift with a forklift powered by liquefied petroleum gas (LPG), you would use the default usage value listed under diesel engines.

You must also enter the **percentage of annual usage** that will occur within the eligible counties. To qualify, at least 75% 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 will need to designate a grant **Activity Life**. This will be the number of years used to calculate the emission reductions. If awarded the grant, you must commit to operating the equipment within the eligible counties for this time period, and to track and report the use to the TCEQ.

Activity life may not exceed the life of the piece of equipment. Refer to the table below for information on the maximum acceptable activity life for different types of activities. The minimum activity life must be five years, including leases.

Maximum Grant Activity Life Non-Road Equipment Activities

	Minimum	Maximum *
New	5 years	10 years
Replacement	5 years	7 years
Repowers	5 years	7 years
Retrofit/Add-on (maximum life for dual-fuel conversions is 7 years)	5 years	10 years

*If an applicant feels that a longer activity life is warranted, 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 these types of vehicles by the applicant.

Example NO_x emission rate reduction calculation

Activity: Replacement of a 1988 500-hp diesel crawler tractor with a new 2018 model.

- Equipment horsepower: 500 hp
- Baseline NO_x emission factor: 2,606.3 g/hr
- Reduced NO_x emission factor: 142.7 g/hr
- Annual hours of operation: 399 hr/yr
- Percent time in affected counties: 100 %

NO_x emission rate reduction calculation

$$2,603.3 \text{ g/hr} - 142.7 \text{ g/hr} = 2460.6 \text{ g/hr}$$

↓

$$2460.6 \text{ g/hr} \times 399 \text{ hr/yr} = 981,779.4 \text{ g/yr}$$

↓

$$981,779.4 \text{ g/yr} / 907,200 \text{ g/ton} = 1.0822 \text{ ton/yr}$$

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.

$$\begin{aligned} & \text{Requested Grant Amount} / \text{Total NO}_x \text{ Emission Reductions} \\ & = \text{Cost Per Ton of NO}_x \text{ Reduced} \end{aligned}$$

Example Cost Per Ton of NO_x Reduced Calculation

Activity: Replacement of a 1988 500-hp diesel crawler tractor with a new 2018 model.

- Requested Grant Amount: \$120,000.00
- Total NO_x Emission Reduction: 8.80 tons

Cost Per Ton of NO_x Reduced Calculation

$$\$120,000.00 / 8.0 \text{ tons} = \$15,000/\text{ton}$$

WORKSHEET NR-1 ANNUAL HOURS OF OPERATION

Please fill in the following information. This information will help you with your calculations. An interactive version of the purchase, replace, repower, and retrofit calculators is available on the TERP website at: www.terpgrants.org

Activity Information

Type of activity			
<input type="checkbox"/> New Purchase/Lease	<input type="checkbox"/> Repower	<input type="checkbox"/> Replacement	<input type="checkbox"/> Retrofit/Add-on

What is the activity life in years? (yr)	
Annual hours of operation for this piece of equipment? (hp)	
What is the percent time the equipment is operated in the eligible counties? (%)	
What is the requested grant amount for the activity? (\$)	

Baseline Engine Information

Model Year	
Fuel Type	
Equipment Type	
Horsepower (hp)	
Emissions Standard (g/bhp-hr)	
Load Factor (See Appendix C)	

Reduced Engine Emission Information

Model Year	
Fuel Type	
Equipment Type	
Horsepower (Use 110% of the baseline hp for this number)	
Emissions Standard (g/bhp-hr)	
Load Factor (See Appendix C)	
*If the activity is a retrofit/add-on, what is the verified percentage NO _x emission reduction?	%

Step 1: Does this project meet the 25% NO_x baseline emission rate reduction requirements?

Baseline Engine Emission Standard (g/bhp-hr)	
- New 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 TxLED Correction Factor (all areas except for El Paso)

Non Road TxLED Correction Factor 1 - (0.07)	0.93
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PART B: Determine the NO_x Emission Factor

Determine Baseline NO_x Emission Factor (g/hr)	
baseline engine NO _x emission standard (g/bhp-hr)	
x TxLED correction factor (diesel engines only)	
= corrected NO _x emission factor (g/bhp-hr)	
x load factor	
x horsepower (hp)	
= baseline NO _x emission factor (g/hr)	
Determine Reduced NO_x Emission Factor (g/hr)	
Option A. Reduced-emission engine certified to a specific emissions standard	
reduced engine NO _x emissions (g/bhp-hr)	
x TxLED correction factor (diesel engines only)	
= corrected NO _x emission factor (g/bhp-hr)	
x load factor	
x horsepower (hp)	
=reduced NO _x emission factor (g/hr)	

Option B. Reduced-emission technology certified/verified to achieve a percentage reduction from the baseline.

baseline NO _x emission factor (g/hr)	
x [1- certified percentage NO _x emission reduction from baseline] (%)	
= reduced NO _x emission factor (g/hr)	

PART C: Calculate the NO_x Emission Reduction Using Annual Hours of Operation

baseline NO _x emission factor (g/hr)	
- new reduced NO _x emission factor (g/hr)	
= grams per hour reduced (g/hr)	
x annual hours of operation	
x percent within affected counties (%)	
= grams per year reduced (g/yr)	
/ 907,200 (g/ton)	
= estimated annual NO _x emission reduction (tons/yr)	
x grant activity life (years)	
= estimated grant activity life NO _x emission reduction (ton)	

Step 3: What is the activity cost per ton?

Grant activity amount (\$):	
/ NO _x emission reductions (ton):	
= cost per ton (\$/ton)	

APPENDIX A: NON-ROAD ENGINE EMISSION STANDARDS

Non-Road Diesel Compression Ignition Engine NO_x Emission Standards By Model Year

Engine Power (hp)	Tier Phase	Model Year	Emission Standards (g/hp-hr)		
			NO _x	For Reference	
				NO _x +NMHC	PM
25 hp - 49 hp (19 kW - 36 kW)	Tier 0 (Uncontrolled)	Pre-1998	7.2	N/A	1.44
	Tier 1	1999-2003	6.745	7.1	0.60
	Tier 2	2004-2007	5.32	5.6	0.45
	Tier 4	2008-2012	5.32	5.6	0.22
		2013+	3.325	3.5	0.02
50 hp - 74 hp (37 Kw - 55 Kw)	Tier 0 (Uncontrolled)	Pre-1997	8.8	N/A	1.50
	Tier 1	1998-2003	6.9	N/A	0.72
	Tier 2	2004-2007	5.32	5.6	0.30
	Tier 3	2008-2012	3.325	3.5	0.02-0.30
	Tier 4	2013+	3.325	3.5	0.02
75 hp - 99 hp (56 Kw - 74 Kw)	Tier 0 (Uncontrolled)	Pre-1997	8.8	N/A	1.50
	Tier 1	1998-2003	6.9	N/A	0.72
	Tier 2	2004-2007	5.32	5.6	0.30
	Tier 3	2008-2011	3.325	3.5	0.30
	Tier 4 (Phase-In)	2012-2013	0.30-3.325	N/A	0.01
	Tier 4	2014+	0.30	N/A	0.01
100 hp - 174 hp (75 kW - 129 kW)	Tier 0 (Uncontrolled)	Pre-1996	9.5	N/A	1.19
	Tier 1	1997-2002	6.9	N/A	0.40
	Tier 2	2003-2006	4.655	4.9	0.22
	Tier 3	2007-2011	2.85	3.0	0.22
	Tier 4 (Phase-In)	2012-2013	0.30-2.85	N/A	0.01
	Tier 4	2014+	0.30	N/A	0.01

Engine Power (hp)	Tier Phase	Model Year	Emission Standards (g/hp-hr)		
			NO _x	For Reference	
				NO _x +NMHC	PM
175 hp - 299 hp (130 kW - 224 kW)	Tier 0 (Uncontrolled)	Pre-1995	9.3	N/A	1.11
	Tier 1	1996-2002	6.9	N/A	0.40
	Tier 2	2003-2005	4.655	4.9	0.15
	Tier 3	2006-2010	2.85	3.0	0.15
	Tier 4 (Phase-In)	2011-2013	0.30-2.85	N/A	0.01
	Tier 4	2014+	0.30	N/A	0.01
300 hp - 599 hp (225 kW - 449 kW)	Tier 0 (Uncontrolled)	Pre-1995	9.5	N/A	1.08
	Tier 1	1996-2000	6.9	N/A	0.40
	Tier 2	2001-2005	4.56	4.8	0.15
	Tier 3	2006-2010	2.85	3.0	0.15
	Tier 4 (Phase-In)	2011-2013	0.30-2.85	N/A	0.01
	Tier 4	2014+	0.30	N/A	0.01
600 hp - 749 hp (450 kW - 559 kW)	Tier 0 (Uncontrolled)	Pre-1995	9.7	N/A	0.98
	Tier 1	1996-2001	6.9	N/A	0.40
	Tier 2	2002-2005	4.56	4.8	0.15
	Tier 3	2006-2010	2.85	3.0	0.15
	Tier 4 (Phase-In)	2011-2013	0.30-2.85	N/A	0.01
	Tier 4	2014+	0.30	N/A	0.01
750 hp - (560 kW -)	Tier 0 (Uncontrolled)	Pre-1999	9.1	N/A	1.02
	Tier 1	2000-2005	6.9	N/A	0.40
	Tier 2	2006-2010	4.56	4.8	0.15
	Tier 4 (Phase-In)	2011-2014	2.6/0.50	N/A	0.075
	Tier 4	2015+	2.6/0.50 ⁴	N/A	.03/.02

APPENDIX B: DEFAULT HOURS OR STANDARD USAGE RATE

DIESEL ENGINES

Source Classification Code (SCC)	Equipment Type	Classification	Annual Hours
2270001060	Specialty Vehicle Carts	Recreational Equipment	437
2270002003	Pavers	Construction and Mining Equipment	81
2270002006	Tampers/Rammers	Construction and Mining Equipment	462
2270002009	Plate Compactors	Construction and Mining Equipment	486
2270002015	Rollers	Construction and Mining Equipment	213
2270002018	Scrapers	Construction and Mining Equipment	732
2270002021	Paving Equipment	Construction and Mining Equipment	412
2270002024	Surfacing Equipment	Construction and Mining Equipment	566
2270002027	Signal Boards/Light Plants	Construction and Mining Equipment	521
2270002030	Trenchers	Construction and Mining Equipment	1171
2270002033	Bore/Drill Rigs	Construction and Mining Equipment	594
2270002036	Excavators	Construction and Mining Equipment	1200
2270002039	Concrete/Industrial Saws	Construction and Mining Equipment	444
2270002042	Cement & Mortar Mixers	Construction and Mining Equipment	271
2270002045	Cranes	Construction and Mining Equipment	1251
2270002048	Graders	Construction and Mining Equipment	1200
2270002051	Off-Highway Trucks	Construction and Mining Equipment	1417
2270002054	Crushing/Proc. Equipment	Construction and Mining Equipment	959
2270002057	Rough Terrain Forklifts	Construction and Mining Equipment	878
2270002060	Rubber Tire Loaders	Construction and Mining Equipment	1200

SCC Code	Equipment Type	Classification	Annual Hours
2270002066	Tractors/Loaders/Backhoes	Construction and Mining Equipment	714
2270002069	Crawler Tractor/Dozers	Construction and Mining Equipment	399
2270002072	Skid Steer Loaders	Construction and Mining Equipment	780
2270002075	Off-Highway Tractors	Construction and Mining Equipment	858
2270002078	Dumpers/Tenders	Construction and Mining Equipment	568
2270002081	Other Construction Equipment	Construction and Mining Equipment	384
2270003010	Aerial Lifts	Industrial Equipment	385
2270003020	Forklifts	Industrial Equipment	1706
2270003030	Sweepers/Scrubbers	Industrial Equipment	1224
2270003040	Other General Industrial Equipment	Industrial Equipment	881
2270003050	Other Material Handling Equipment	Industrial Equipment	423
2270003060	AC\Refrigeration	Industrial Equipment	1347
2270003070	Terminal Tractors	Industrial Equipment	1261
NA	Container Handlers	Industrial Equipment	1200
2270004031	Leaf Blowers/Vacuums	Lawn and Garden Equipment (Com)	120
2270004046	Front Mowers	Lawn and Garden Equipment (Com)	482
2270004066	Chippers/Stump Grinders	Lawn and Garden Equipment (Com)	467
2270004071	Commercial Turf Equipment	Lawn and Garden Equipment (Com)	1072
2270004076	Other Lawn & Garden Equipment.	Lawn and Garden Equipment (Com)	435
2270005010	2-Wheel Tractors	Agricultural Equipment	1022
2270005015	Agricultural Tractors	Agricultural Equipment	600
2270005020	Combines	Agricultural Equipment	459

SCC	Equipment Type	Classification	Annual Hours
2270005025	Balers	Agricultural Equipment	334
2270005030	Agricultural Mowers	Agricultural Equipment	363
2270005035	Sprayers	Agricultural Equipment	352
2270005040	Tillers > 6 HP	Agricultural Equipment	452
2270005045	Swathers	Agricultural Equipment	384
2270005055	Other Agricultural Equipment	Agricultural Equipment	765
2270005060	Irrigation Sets	Agricultural Equipment	1533
2270006005	Generator Sets	Commercial Equipment	339
2270006010	Pumps	Commercial Equipment	404
2270006015	Air Compressors	Commercial Equipment	818
2270006025	Welders	Commercial Equipment	645
2270006030	Pressure Washers	Commercial Equipment	145
2270006035	Hydro Power Units	Commercial Equipment	793
2270007015	Forest Equipment - Feller/Bunch/Skidder	Logging Equipment	1279
2270008005	Airport Support Equipment	Airport Ground Support Equipment	732

NATURAL GAS ENGINES

Source Classification Code (SCC)	Equipment Type	Classification	Annual Hours
2268002081	Other Construction Equipment	Construction and Mining Equipment	371
2268003020	Forklifts	Industrial Equipment	1800
2268003030	Sweepers/Scrubbers	Industrial Equipment	516
2268003040	Other General Industrial Equipment	Industrial Equipment	713

SCC	Equipment Type	Classification	Annual Hours
2268003060	AC\Refrigeration	Industrial Equipment	605
2268003070	Terminal Tractors	Industrial Equipment	827
2268005055	Other Agricultural Equipment	Agricultural Equipment	403
2268005060	Irrigation Sets	Agricultural Equipment	2935
2268006005	Generator Sets	Commercial Equipment	115
2268006010	Pumps	Commercial Equipment	221
2268006015	Air Compressors	Commercial Equipment	484
2268006020	Gas Compressors	Commercial Equipment	6000
2268006035	Hydro Power Units	Commercial Equipment	450
2268008005	Airport Support Equipment	Airport Ground Support Equipment	681

LIQUEFIED PETROLEUM (LPG) ENGINES

Source Classification Code (SCC)	Equipment Type	Classification	Annual Hours
2267001060	Specialty Vehicle Carts	Recreational Equipment	65
2267002003	Pavers	Construction and Mining Equipment	392
2267002015	Rollers	Construction and Mining Equipment	621
2267002021	Paving Equipment	Construction and Mining Equipment	175
2267002024	Surfacing Equipment	Construction and Mining Equipment	488
2267002030	Trenchers	Construction and Mining Equipment	402
2267002033	Bore/Drill Rigs	Construction and Mining Equipment	107
2267002039	Concrete/Industrial Saws	Construction and Mining Equipment	610

SCC	Equipment Type	Classification	Annual Hours
2267002045	Cranes	Construction and Mining Equipment	415
2267002054	Crushing/Proc. Equipment	Construction and Mining Equipment	241
2267002057	Rough Terrain Forklifts	Construction and Mining Equipment	413
2267002060	Rubber Tire Loaders	Construction and Mining Equipment	512
2267002066	Tractors/Loaders/Backhoes	Construction and Mining Equipment	870
2267002072	Skid Steer Loaders	Construction and Mining Equipment	310
2267002081	Other Construction Equipment	Construction and Mining Equipment	371
2267003010	Aerial Lifts	Industrial Equipment	361
2267003020	Forklifts	Industrial Equipment	1334
2267003030	Sweepers/Scrubbers	Industrial Equipment	516
2267003040	Other General Industrial Equipment	Industrial Equipment	713
2267003050	Other Material Handling Equipment	Industrial Equipment	386
2267003070	Terminal Tractors	Industrial Equipment	827
2267005055	Other Agricultural Equipment	Agricultural Equipment	403
2267005060	Irrigation Sets	Agricultural Equipment	2935
2267006005	Generator Sets	Commercial Equipment	115
2267006010	Pumps	Commercial Equipment	221
2267006015	Air Compressors	Commercial Equipment	484
2267006025	Welders	Commercial Equipment	408
2267006030	Pressure Washers	Commercial Equipment	115

SCC	Equipment Type	Classification	Annual Hours
2267006035	Hydro Power Units	Commercial Equipment	450
2267008005	Airport Support Equipment	Airport Ground Support Equipment	681

2-STROKE AND 4-STROKE ENGINES (GASOLINE)

Source Classification Code (SCC)	Equipment Type	Classification	2-Stroke or 4-Stroke	Annual Hours
2260001060	Specialty Vehicles/Carts	Recreational Equipment	2 Stroke	65
2260002006	Tampers/Rammers	Construction and Mining Equipment	2 Stroke	160
2260002009	Plate Compactors	Construction and Mining Equipment	2 Stroke	166
2260002021	Paving Equipment	Construction and Mining Equipment	2 Stroke	175
2260002027	Signal Boards/Light Plants	Construction and Mining Equipment	2 Stroke	318
2260002054	Crushing/Proc. Equipment	Construction and Mining Equipment	2 Stroke	241
2260003030	Sweepers/Scrubbers	Industrial Equipment	2 Stroke	516
2260003040	Other General Industrial Equipment	Industrial Equipment	2 Stroke	713
2260004025	Trimmers/Edgers/Brush Cutter	Lawn and Garden Equipment (Res)	2 Stroke	9
2260004026	Trimmers/Edgers/Brush Cutter	Lawn and Garden Equipment (Com)	2 Stroke	137
2260005035	Sprayers	Agricultural Equipment	2 Stroke	138
2260006005	Generator Sets	Commercial Equipment	2 Stroke	115
2260006010	Pumps	Commercial Equipment	2 Stroke	221
2260006015	Air Compressors	Commercial Equipment	2 Stroke	484
2260006035	Hydro Power Units	Commercial Equipment	2 Stroke	450

SCC	Equipment Type	Classification	2-Stroke or 4-Stroke	Annual Hours
2260008005	Airport Support Equipment	Airport Ground Support Equipment	2 Stroke	681
2265001060	Specialty Vehicles/Carts	Recreational Equipment	4 Stroke	65
2265002003	Pavers	Construction and Mining Equipment	4 Stroke	392
2265002006	Tampers/Rammers	Construction and Mining Equipment	4 Stroke	160
2265002009	Plate Compactors	Construction and Mining Equipment	4 Stroke	166
2265002015	Rollers	Construction and Mining Equipment	4 Stroke	621
2265002021	Paving Equipment	Construction and Mining Equipment	4 Stroke	175
2265002024	Surfacing Equipment	Construction and Mining Equipment	4 Stroke	488
2265002027	Signal Boards/Light Plants	Construction and Mining Equipment	4 Stroke	318
2265002030	Trenchers	Construction and Mining Equipment	4 Stroke	402
2265002033	Bore/Drill Rigs	Construction and Mining Equipment	4 Stroke	107
2265002039	Concrete/Industrial Saws	Construction and Mining Equipment	4 Stroke	610
2265002042	Cement & Mortar Mixers	Construction and Mining Equipment	4 Stroke	84
2265002045	Cranes	Construction and Mining Equipment	4 Stroke	415
2265002054	Crushing/Proc. Equipment	Construction and Mining Equipment	4 Stroke	241
2265002057	Rough Terrain Forklifts	Construction and Mining Equipment	4 Stroke	413
2265002060	Rubber Tire Loaders	Construction and Mining Equipment	4 Stroke	512
2265002066	Tractors/Loaders/Backhoes	Construction and Mining Equipment	4 Stroke	870
2265002072	Skid Steer Loaders	Construction and Mining Equipment	4 Stroke	310

SCC	Equipment Type	Classification	2-Stroke or 4-Stroke	Annual Hours
2265002078	Dumpers/Tenders	Construction and Mining Equipment	4 Stroke	127
2265002081	Other Construction Equipment	Construction and Mining Equipment	4 Stroke	371
2265003010	Aerial Lifts	Industrial Equipment	4 Stroke	361
2265003020	Forklifts	Industrial Equipment	4 Stroke	1800
2265003030	Sweepers/Scrubbers	Industrial Equipment	4 Stroke	516
2265003040	Other General Industrial Equipment	Industrial Equipment	4 Stroke	713
2265003050	Other Material Handling Equipment	Industrial Equipment	4 Stroke	386
2265003060	AC\Refrigeration	Industrial Equipment	4 Stroke	605
2265003070	Terminal Tractors	Industrial Equipment	4 Stroke	827
2265004040	Rear Engine Riding Mowers	Lawn and Garden Equipment (Res)	4 Stroke	36
2265004041	Rear Engine Riding Mowers	Lawn and Garden Equipment (Com)	4 Stroke	569
2265004046	Front Mowers	Lawn and Garden Equipment (Com)	4 Stroke	86
2265004055	Lawn & Garden Tractors	Lawn and Garden Equipment (Res)	4 Stroke	45
2265004066	Chippers/Stump Grinders	Lawn and Garden Equipment (Com)	4 Stroke	488
2265004071	Commercial Turf Equipment	Lawn and Garden Equipment (Com)	4 Stroke	682
2265004075	Other Lawn & Garden Equipment	Lawn and Garden Equipment (Res)	4 Stroke	61
2265004076	Other Lawn & Garden Equipment	Lawn and Garden Equipment (Com)	4 Stroke	61
2265005010	2-Wheel Tractors	Agricultural Equipment	4 Stroke	373
2265005015	Agricultural Tractors	Agricultural Equipment	4 Stroke	362
2265005020	Combines	Agricultural Equipment	4 Stroke	78
2265005025	Balers	Agricultural Equipment	4 Stroke	90
2265005030	Agricultural Mowers	Agricultural Equipment	4 Stroke	174

SCC	Equipment Type	Classification	2-Stroke or 4-Stroke	Annual Hours
2265005035	Sprayers	Agricultural Equipment	4 Stroke	138
2265005040	Tillers > 6 HP	Agricultural Equipment	4 Stroke	29
2265005045	Swathers	Agricultural Equipment	4 Stroke	45
2265005055	Other Agricultural Equipment	Agricultural Equipment	4 Stroke	403
2265005060	Irrigation Sets	Agricultural Equipment	4 Stroke	2935
2265006005	Generator Sets	Commercial Equipment	4 Stroke	115
2265006010	Pumps	Commercial Equipment	4 Stroke	221
2265006015	Air Compressors	Commercial Equipment	4 Stroke	484
2265006025	Welders	Commercial Equipment	4 Stroke	408
2265006030	Pressure Washers	Commercial Equipment	4 Stroke	115
2265006035	Hydro Power Units	Commercial Equipment	4 Stroke	450
2265007010	Shredders > 6 HP	Logging Equipment	4 Stroke	50
2265007015	Forest Equipment - Feller/Bunch/Skidde	Logging Equipment	4 Stroke	350
2265008005	Airport Support Equipment	Airport Ground Support Equipment	4 Stroke	681

APPENDIX C: FACTORS FOR NON-ROAD EQUIPMENT

SCC Definition	HPMIN	HPMAX	Load Factor	ECF (gal/hp-hr)
Diesel Specialty Vehicle Carts	25	100	0.21	14.8
Diesel Specialty Vehicle Carts	100	1500	0.21	16.4
Diesel Pavers	25	100	0.59	17.2
Diesel Pavers	100	600	0.59	19.1
Diesel Rollers	25	100	0.59	17.2
Diesel Rollers	100	600	0.59	19.1
Diesel Scrapers	50	100	0.59	17.2
Diesel Scrapers	100	750	0.59	19.1
Diesel Paving Equipment	25	100	0.59	17.2
Diesel Paving Equipment	100	600	0.59	19.1
Diesel Surfacing Equipment	25	100	0.59	17.2
Diesel Surfacing Equipment	100	600	0.59	19.1
Diesel Signal Boards	25	100	0.43	17.4
Diesel Signal Boards	100	300	0.43	19.3
Diesel Trenchers	25	100	0.59	17.2
Diesel Trenchers	100	1500	0.59	19.1
Diesel Bore/Drill Rigs	25	100	0.43	17.4
Diesel Bore/Drill Rigs	100	1500	0.43	19.3
Diesel Excavators	25	100	0.59	17.2
Diesel Excavators	100	3000	0.59	19.1
Diesel Concrete/Industrial Saws	25	100	0.59	17.2
Diesel Concrete/Industrial Saws	100	175	0.59	19.1
Diesel Cement & Mortar Mixers	25	100	0.43	17.4
Diesel Cement & Mortar Mixers	100	750	0.43	19.3
Diesel Cranes	25	100	0.43	17.4
Diesel Cranes	100	1000	0.43	19.3
Diesel Graders	50	100	0.59	17.2
Diesel Graders	100	750	0.59	19.1
Diesel Off-highway Trucks	175	3000	0.59	19.1
Diesel Crushing/Proc. Equipment	25	100	0.43	17.4
Diesel Crushing/Proc. Equipment	100	750	0.43	19.3
Diesel Rough Terrain Forklifts	25	100	0.59	17.2

SCC Definition	HPMIN	HPMAX	Load Factor	ECF (gal/hp-hr)
Diesel Rough Terrain Forklifts	100	600	0.59	19.1
Diesel Rubber Tire Loaders	25	100	0.59	17.2
Diesel Rubber Tire Loaders	100	3000	0.59	19.1
Diesel Tractors/Loaders/Backhoes	25	100	0.21	14.8
Diesel Tractors/Loaders/Backhoes	100	300	0.21	16.4
Diesel Crawler Tractors	50	100	0.59	17.2
Diesel Crawler Tractors	100	1500	0.59	19.1
Diesel Skid Steer Loaders	25	100	0.21	14.8
Diesel Skid Steer Loaders	100	175	0.21	16.4
Diesel Off-Highway Tractors	175	3000	0.59	19.1
Diesel Dumpers/Tenders	25	100	0.21	14.8
Diesel Dumpers/Tenders	100	175	0.21	16.4
Diesel Other Construction Equipment	25	100	0.59	17.2
Diesel Other Construction Equipment	100	1000	0.59	19.1
Diesel Aerial Lifts	25	100	0.21	14.8
Diesel Aerial Lifts	100	175	0.21	16.4
Diesel Forklifts	40	100	0.59	17.2
Diesel Forklifts	100	600	0.59	19.1
Diesel Sweepers/Scrubbers	25	100	0.43	17.4
Diesel Sweepers/Scrubbers	100	300	0.43	19.3
Diesel Other General Industrial	25	100	0.43	17.4
Diesel Other General Industrial	100	750	0.43	19.3
Diesel Other Material Handling	40	100	0.21	14.8
Diesel Other Material Handling	100	600	0.21	16.4
Diesel AC\Refrigeration	25	100	0.43	17.4
Diesel Terminal Tractors	50	100	0.59	17.2
Diesel Terminal Tractors	100	600	0.59	19.1
Diesel Front Mowers (Commercial)	25	100	0.43	17.4
Diesel Lawn & Garden Tractors (Commercial)	40	100	0.43	17.4
Diesel Chippers/Stump Grinders (Commercial)	25	100	0.43	17.4
Diesel Chippers/Stump Grinders (Commercial)	100	1000	0.43	19.3

SCC Definition	HPMIN	HPMAX	Load Factor	ECF (gal/hp-hr)
Diesel Commercial Turf Equipment (Commercial)	25	100	0.43	17.4
Diesel Commercial Turf Equipment (Commercial)	100	600	0.43	19.3
Diesel Other Lawn & Garden Equipment (Commercial)	40	100	0.43	17.4
Diesel Other Lawn & Garden Equipment (Commercial)	100	175	0.43	19.3
Diesel Agricultural Tractors	25	100	0.59	17.2
Diesel Agricultural Tractors	100	750	0.59	19.1
Diesel Combines	50	100	0.59	17.2
Diesel Combines	100	600	0.59	19.1
Diesel Balers	40	100	0.59	17.2
Diesel Balers	100	300	0.59	19.1
Diesel Sprayers	25	100	0.59	17.2
Diesel Sprayers	100	600	0.59	19.1
Diesel Switchers	50	100	0.59	17.2
Diesel Switchers	100	175	0.59	19.1
Diesel Hydro Power Units	25	100	0.43	17.4
Diesel Hydro Power Units	100	600	0.43	19.3
Diesel Other Agricultural Equipment	25	100	0.59	17.2
Diesel Other Agricultural Equipment	100	600	0.59	19.1
Diesel Irrigation Sets	25	100	0.43	17.4
Diesel Irrigation Sets	100	600	0.43	19.3
Diesel Light Commercial Generator Sets	25	100	0.43	17.4
Diesel Light Commercial Generator Sets	100	600	0.43	19.3
Diesel Light Commercial Pumps	25	100	0.43	17.4
Diesel Light Commercial Pumps	100	600	0.43	19.3
Diesel Light Commercial Air	25	100	0.43	17.4
Diesel Light Commercial Air	100	600	0.43	19.3
Diesel Light Commercial Gas Compressors	50	100	0.43	17.4
Diesel Light Commercial Welders	25	100	0.21	14.8
Diesel Light Commercial Welders	100	175	0.21	16.4

SCC Definition	HPMIN	HPMAX	Load Factor	ECF (gal/hp-hr)
Diesel Light Commercial Pressure Washer	25	100	0.43	17.4
Diesel Light Commercial Pressure Washer	100	750	0.43	19.3
Diesel Logging Equip Fell/Bunch/Skidlers	25	100	0.59	17.2
Diesel Logging Equip Fell/Bunch/Skidlers	100	750	0.59	19.1
Diesel Airport Support Equipment	25	100	0.59	17.2
Diesel Airport Support Equipment	100	750	0.59	19.1
Diesel Other Oil Field Equipment	25	100	0.43	17.4
Diesel Other Oil Field Equipment	100	3000	0.43	19.3