TEXAS EMISSIONS REDUCTION PLAN (TERP)
Emissions Reduction Incentive Grants Program

Technical Supplement No. 2
Non-Road Equipment

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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 equal to or greater than 25 horsepower (hp) are eligible for grants under this program for new purchases and leases, replacement, repowers, and retrofits/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 for particular funding periods and geographic areas. **If the project being proposed involves a gasoline, LPG, or CNG powered equipment contact TCEQ for eligibility.**

Use the 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 Microsoft Office non-road equipment (hours) calculator found under Supplemental Activity Application Forms.

This workbook is divided into three major steps.

a) Step 1: Determining that the activity meets the 25% NO_X emissions reduction requirement.

b) Step 2: Calculating the NO_X Emission Reductions.

c) Step 3: Calculating the Cost Per Ton.

These steps are explained in the following instructions. You should refer to the applicable worksheet and use the instructions to complete each step of the calculations.

Step 1: Determining that the activity meets the 25% NO_X emissions reduction requirement.

All new purchase or lease, replacement, repower, retrofit, and add-on activities must achieve at least a 25% reduction in x emissions when compared to a baseline emission rate. Use Worksheet NR-1 hour calculator 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 Request for Grant Applications (RFGA) will include any alternative percentage reduction requirements.

Baseline NO_X Emission Rate

For these calculations, 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. The federal NO_X emission standards for non-road equipment are presented in Table 3.1. In situations where 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.

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 for diesel engines and 0.80 for alternative fuel engines to determine the NO_X-only emissions based on the combined standards.

TABLE 3.1 NON-ROAD DIESEL (CI) ENGINES NO_X EMISSION STANDARDS BY MODEL YEAR

ENGINE POWER EQUAL TO OR GREATER THAN 25 HP (19 KW) BUT LESS THAN 50 HP (37 KW)

Tier	Model Year	Emissions (NO_X) g/bhp-hr	Emissions (NO_X + NMHC) g/bhp-hr
Tier 0 (uncontrolled)	pre-1999	7.2	N/A
Tier 1	1999-2003	6.745	7.1
Tier 2	2004-2012	5.32	5.6
Tier 4	2013+	3.325	3.5

ENGINE POWER EQUAL TO OR GREATER THAN 50 HP (37 KW) BUT LESS THAN 75 HP (56 KW)

Tier	Model Year	Emissions (NO_X) g/bhp-hr	Emissions (NO_X + NMHC) g/bhp-hr
Tier 0 (uncontrolled)	pre-1998	8.8	N/A
Tier 1	1998-2003	6.9	N/A
Tier 2	2004-2007	5.32	5.6
Tier 3	2008-2013	3.325	3.5
Tier 4	2013+	3.325	3.5

ENGINE POWER EQUAL TO OR GREATER THAN 75 HP (56 KW) BUT LESS THAN 100 HP (75 KW)

Tier	Model Year	Emissions (NO_X) g/bhp-hr	Emissions (NO_X + NMHC) g/bhp-hr
Tier 0 (uncontrolled)	pre-1998	8.8	N/A
Tier 1	1998-2003	6.9	N/A
Tier 2	2004-2007	5.32	5.6
Tier 3	2008-2012	3.325	3.5
Tier 4 (Phase-In)	2012-2013	0.30-3.325[1]	N/A
Tier 4	2014+	0.30	N/A

ENGINE POWER EQUAL TO OR GREATER THAN 100 HP (75 KW) BUT LESS THAN 175 HP (130 KW)

Tier	Model Year	Emissions (NO_X) g/bhp-hr	Emissions (NO_X + NMHC) g/bhp-hr
Tier 0 (uncontrolled)	pre - 1997	9.5	N/A
Tier 1	1997-2002	6.9	N/A
Tier 2	2003-2006	4.655	4.9
Tier 3	2007-2011	2.85	3.0
Tier 4 (Phase-In)	2012-2013	0.30-2.85[1]	N/A
Tier 4	2014+	0.30	N/A

ENGINE POWER EQUAL TO OR GREATER THAN 175 HP (130 KW) BUT LESS THAN 300 HP (225 KW)

Tier	Model Year	Emissions (NO_X) g/bhp-hr	Emissions (NO_X + NMHC) g/bhp-hr
Tier 0 (uncontrolled)	pre-1996	9.3	N/A
Tier 1	1996-2002	6.9	N/A
Tier 2	2003-2005	4.655	4.9
Tier 3	2006-2010	2.85	3.0
Tier 4 (Phase-In)	2011-2013	0.30-2.85[1]	N/A
Tier 4	2014+	0.30	N/A

ENGINE POWER EQUAL TO OR GREATER THAN 300 HP (225 KW) BUT LESS THAN 600 HP (450 KW)

Tier	Model Year	Emissions (NO_X) g/bhp-hr	Emissions (NO_X + NMHC) g/bhp-hr
Tier 0 (uncontrolled)	pre-1996	9.5	N/A
Tier 1	1996-2000	6.9	N/A
Tier 2	2001-2005	4.56	4.8
Tier 3	2006-2010	2.85	3.0
Tier 4 (Phase-In)	2011-2013	0.30-2.85[1]	N/A
Tier 4	2014+	0.30	N/A

ENGINE POWER EQUAL TO OR GREATER THAN 600 HP (450 KW) BUT LESS THAN 750 HP (560 KW)

Tier	Model Year	Emissions (NO_X) g/bhp-hr	Emissions (NO_X + NMHC) g/bhp-hr
Tier 0 (uncontrolled)	pre-1996	9.7	N/A
Tier 1	1996-2001	6.9	N/A
Tier 2	2002-2005	4.56	4.8
Tier 3	2006-2010	2.85	3.0
Tier 4 (Phase-In)	2011-2013	0.30-2.85[1]	N/A
Tier 4	2014+	0.30	N/A

ENGINE POWER EQUAL TO OR GREATER THAN 750 HP (560 KW)

Tier	Model Year	Emissions (NO_X) g/bhp-hr	Emissions (NO_X + NMHC) g/bhp-hr
Tier 0 (uncontrolled)	pre-2000	9.1	N/A
Tier 1	2000-2005	6.9	N/A
Tier 2	2006-2010	4.56	4.8
Tier 4 (Phase-In)	2011-2014	2.6/0.50[2]	N/A
Tier 4	2015+	2.6/0.50[3]	N/A

Note: For calculations use the NO_X g/bhp-hr column. NO_X + NMHC g/bhp-hr column is listed for reference only.

1. These standards are phased-in during the indicated years. At least 50% of a manufacturer's engine production must meet these standards during each year of the phase-in. Therefore, it is not guaranteed that a Tier 4 (Phase-In) equipment and/or engine will meet the lower standard. If an applicant proposes to purchase a Tier 4 (Phase-In) equipment and/or engine, the applicant must certify, in the application, the emission level that the new equipment and/or engine will meet. Copies of the form certifying the engine family to the lower emission standard must be provided. If it is not yet known what emission standard to which the engine will be certified, then use the Tier 3 standard.

2. The 0.50g/bhp-hr standard applies to gensets to over 1200 hp

3. Applies to all gensets

Reduced NO_X Emission Rate

The reduced NO_X emission rate will normally be the federal NO_X certified or verified emissions standard in the model years and horsepower of the reduced-emission equipment or engine (see Table 3.1).

- **New Purchase or Lease.** Use the certified emission standard (g/bhp-hr) of the new equipment. Certified means certified by the EPA or CARB, or otherwise accepted by the TCEQ.
- **Replacement.** Use the certified emission standard (g/bhp-hr) of the replacement equipment and engine.
- **Repower.** Use the certified emission standard (g/bhp-hr) of the engine installed on the replacement equipment. Certified means certified by the EPA or CARB, or otherwise accepted by the TCEQ.
- **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.

[(Baseline Engine - Reduced Engine) / Baseline Engine]
x 100 = Baseline Emission Rate Reduction

EXAMPLE CALCULATIONS

Example calculation for determining if activity meets 25% baseline emission rate reduction for new purchase/lease

Activity: Purchase of a new non-road 125-hp piece of equipment.

Engine emission standard for current year model: 4.655 g/bhp-hr
New engine certified NO_X emissions: 2.85 g/bhp-hr

Calculation of baseline emission rate reduction:
[(4.655 g/bhp-hr - 2.85 g/bhp-hr) / 4.655 g/bhp-hr] x 100 % = 38.78 % baseline emission rate reduction

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

Example calculation for determining if activity meets 25% baseline emission rate reduction for repowers

Activity: Repower of a 1991 550-hp non-road piece of equipment with 1997 engine.

Original engine emission standard: 9.5 g/bhp-hr
Replacement engine emission standard: 6.9 g/bhp-hr

Calculation of baseline emission rate reduction:
[(9.5 g/bhp-hr - 6.9 g/bhp-hr) / 9.5 g/bhp-hr] x 100 % = 27.37 % baseline emission rate reduction

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

Example calculation for determining if activity meets 25% baseline emission rate reduction for replacements

Activity: Replacement of a 1979 750-hp piece of equipment with a 2001 model.

Original engine emission standard: 9.1 g/bhp-hr
Replacement engine emission standard: 6.9 g/bhp-hr

Calculation of baseline emission rate reduction:
[(9.1 g/bhp-hr - 6.9 g/bhp-hr) / 9.1 g/bhp-hr] x 100 % = 24.18% baseline emission rate reduction

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

Example calculation for determining if activity meets 25% baseline emission rate reduction for retrofit/add-on device

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

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

Calculation of baseline emission rate reduction:
[(9.5 g/bhp-hr - 5.6 g/bhp-hr) / 9.5 g/bhp-hr] x 100 % = 41.05% baseline emission rate reduction

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

Step 2: Calculate the NO_X Emission Reductions

This step is divided into three main parts:

- Part A: Determine the TxLED Correction Factor
- Part B: Determine the NO_X emission factors
- Part C: Calculate the NO_X emission reductions

Points to remember when performing Emission Reduction Calculations

- Use Worksheet NR-1 for calculations where usage is based in hours of operation.
- Emission reduction represents the difference in the emission level of a baseline engine and a reduced-emission engine.
- The emission level is calculated by multiplying an emission factor, an activity level, and a conversion factor, if necessary.
- In situations where the model year of the equipment chassis and the model year of the existing engine are different, the model year of the engine shall be used to determine the baseline emissions for benefit calculations.
- Because conversion 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 differences taken to determine emission reductions.
- For most non-road applications, the activity level should be established by the annual hours of operation.
- Usage amounts for the emission reduction calculations should be consistent with the anticipated grant life of each activity.
- If the equipment operates in a county or counties that is in the TxLED region the TxLED conversion factor must be determined

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 NOX 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. Determine 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.

Usage based on hours of operation (NR-1)

For calculations based on annual hours of operations (NR-1), 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). A default load factor must also be included in the calculation to account for the fraction of available engine's power actually used. This conversion must be applied to the NO_X emission standard for the baseline engine and for the reduced emission engine as illustrated in the calculation example below. Table 2.2 provides load factors by type of equipment and engine horsepower.

TABLE 2.2 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

SCC Definition	HPMIN	HPMAX	Load Factor	ECF (gal/hp-hr)
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
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 Equipment	25	100	0.43	17.4
Diesel Other General Industrial Equipment	100	750	0.43	19.3
Diesel Other Material Handling Equipment	40	100	0.21	14.8
Diesel Other Material Handling Equipment	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
Diesel Commercial Turf Equipment (Commercial)	25	100	0.43	17.4

SCC Definition	HPMIN	HPMAX	Load Factor	ECF (gal/hp-hr)
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 Compressors	25	100	0.43	17.4
Diesel Light Commercial Air Compressors	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
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/Skidders	25	100	0.59	17.2
Diesel Logging Equip Fell/Bunch/Skidders	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

Example calculation for determining NO_x emission factor based on annual hours

Activity: Replacement of a 1988 500-hp diesel crawler tractor with a new 2002 model.

Equipment horsepower: 500 hp
Original engine emission standard: 9.5 g/bhp-hr
Replacement engine emission standard: 4.56 g/bhp-hr
Load factor: 0.59
Annual hours of operation: 700 hr/yr
TxLED Correction factor: 0.93 (based of off an activity life of 5 years)

TxLED and Baseline NO_X Emission Factor (g/hr)
9.5 g/bhp-hr x 0.93 = 8.835 g/bhp-hr
8.835 g/bhp-hr x 0.59 = 5.2126 g/bhp-hr
5.2126 g/bhp-hr x 500 hp = **2,606.3 g/hr**

Reduced NO_X Emission Factor (g/hr)
4.56 g/bhp-hr x 0.93 = 4.2408 g/bhp-hr
4.2408 g/bhp-hr x 0.59 = 2.502 g/bhp-hr
2.502 g/bhp-hr x 500 hp = **1,251 g/hr**

Part C. Calculate the NO_X Emission Reductions

Use the factors determined in Part B to calculate the NO_X emission reductions for the activity. To complete the calculations, you will need to determine the estimated annual hours of operation.

The TCEQ may provide the option of using default 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 Request for Grant Applications (RFGA) for instructions and requirements on the default usage options.

Where a default usage rate option is used, the applicable default usage rates should be used for the emissions reduction calculations. Where a default 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.

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 Table 2.3 below, for information on the maximum acceptable activity life for different types of activities. The minimum activity life must be seven years, including leases.

TABLE 2.3 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 (7 years for dual-fuel conversions)

*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 calculation for determining NO_X emission rate reduction based on annual hours of operation

Activity: Replacement of a 1988 500-hp diesel crawler tractor with a new 2002 model.

Equipment horsepower: 50 hp
Baseline NO_X emission factor: 2,606.3 g/hr
Reduced NO_X emission factor: 1,251 g/hr
Annual hours of operation: 700 hr/yr
Percent time in affected counties: 100 %

2,603.3 g/hr - 1,251 g/hr = 1,352.3 g/hr
1,352.3 g/hr x 700 hr = 946,610 g/yr
946,610 g/yr x 1.00 = 946,610 g/yr
946,610 g/yr / 907,200 g/ton = **1.0434 ton/yr**

Step 3: Calculate the Cost Per Ton

The cost per ton for an activity is then 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

Worksheet NR-1

Annual Hours of Operation

Please fill in the following information. This information will help you with your calculations.

Activity Information

Type of activity			
☐ New Purchase/Lease	☐ Repower	☐ Replacement	☐ Retrofit/Add-on

What is the activity life in years? (yr)	
What are/how many hours of annual 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	

Reduced Emission Engine Information

Model Year	
Fuel Type	
Equipment Type	
Horsepower (hp)	
Emissions Standard (g/bhp-hr)	
Load Factor	
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)	
- Reduced Engine Emission Standard (g/bhp-hr)	
= Difference (g/bhp-hr)	
/ Baseline Engine Emission Standard (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: 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

PART B. DETERMINE THE NO_X EMISSION FACTOR

Determine Baseline NOX 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 NOX Emission Factor (g/hr)	
Option A. Reduced-emission engine certified to a specific emissions standard (g/bhp-hr)	
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/verified 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)	
- 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)	