

## **RESEARCH SUMMARY AND RECOMMENDATIONS**

### **Project H42.2004.T1**

TERP ON-ROAD AND NONROAD EMISSION REDUCTIONS AND PROJECTIONS TO 2007 AND 2010 FOR THE HOUSTON-GALVESTON (HGA) AND DALLAS-Ft. WORTH (DFW) NONATTAINMENT AREAS  
A PROJECT OF THE TEXAS ENVIRONMENTAL RESEARCH CONSORTIUM (TERC)

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December 13, 2004

### **INTRODUCTION**

In 2001, the Texas Legislature established the Texas Emission Reduction Plan (TERP) primarily to reduce emissions of nitrogen oxides (NO<sub>x</sub>) through voluntary economic incentive programs. TERP replaced emission reductions that would have been achieved by two prior SIP mandatory measures: (1) time restrictions on the use of construction and industrial equipment and (2) requirements for replacing older nonroad equipment with new equipment. These two measures would have achieved 15 to 20 tons per day of NO<sub>x</sub> reductions in both the HGA and DFW areas. Over time the SIP commitment for TERP increased to its present level totaling a minimum of 49.2 tons per day (tpd) for the HGA and DFW non-attainment areas.

TERP is a complex program that the Texas Commission on Environmental Quality (TCEQ) has proceeded to implement effectively and efficiently. Once program start-up issues were resolved, TERP grew rapidly in FY04 to make significant strides in NO<sub>x</sub> emission reductions from on-road and nonroad sources. These reductions are estimated to already total 10 tons per day in the two nonattainment areas studied in this project. Additionally, there is a backlog of projects interested in future TERP funding.

The Texas Legislature established \$13,000 per ton of NO<sub>x</sub> eliminated as the maximum level for TERP projects. The program has succeeded in keeping costs well below this maximum. To date, average cost per ton has been only \$5,853, less than half of the established maximum. Experience in NO<sub>x</sub> reducing technologies and programs suggests that TERP is one of the most cost-effective currently known ways of reducing diesel NO<sub>x</sub> emissions from on-road and nonroad sources

In 2003, the Texas Environmental Research Consortium (TERC) initiated an analysis of TERP to determine its effectiveness in reaching SIP goals for the HGA region. Based on the results of this analysis and requests from the TERC Board of Directors, additional analyses were initiated that included: (1) a similar study of the DFW region and (2) consideration of emission reduction needs beyond the current TERP program end date of August 31, 2008. The following are results from these analyses.<sup>1</sup>

### **SUMMARY OF ANALYSIS**

#### **TERP Activities 2002-2004**

TERP has funded 240 projects in the HGA and DFW areas that include more than 2,000 vehicles, pieces of equipment or other emission reducing activities. For these projects, \$94.2 million has been committed to reduce NO<sub>x</sub> emissions by 10 tons per day (tpd) for the HGA and DFW regions. The cost effectiveness of these projects averaged \$5,853 per ton of NO<sub>x</sub> reduced. TERP has achieved 20% of the minimum SIP goal for the two nonattainment areas with 2.25 years remaining to reach the full goal (FY05, FY06, and FY07/1<sup>st</sup> Q). Table 1 summarizes TERP activities through the 2<sup>nd</sup> round of funding in 2004.

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<sup>1</sup> A copy of the final report can be downloaded at: <http://www.harc.edu/harc/Projects/AirQuality/Projects/Status/H42.T1.aspx>  
Information in this report is based on a project memorandum, "Preliminary Results for Project Entitled On-Road and Non-Road Emissions Reductions from TERP in 2010", ENVIRON, November 8, 2004.

Table 1  
**TERP Summary of Activities FY02 – FY 04**

	HGA	DFW	HGA&DFW
<b>NOx Emissions Reductions (tpd)</b>			
FY 02	0.158	1.168	1.326
FY 03	0.619	0.327	0.945
FY 04	4.732	2.974	7.706
Total to Date	5.509	4.468	9.977
<b>2007 SIP Goal</b>	<b>32.900</b>	<b>16.300</b>	<b>49.200</b>
<b>Other Program Measures</b>			
Expenditures (millions)	\$60.4	\$33.7	\$94.2
No. of Projects	121	119	240
No. of Activities	1,090	920	2,010
<b>Average Cost-Effectiveness</b>			
FY 02	\$10,005	\$4,367	\$5,101
FY 03	8,104	3,009	6,792
FY 04	6,218	5,210	5,832
Avg. to Date	\$6,675	\$4,795	\$5,853

**TERP-Eligible Emissions Inventories – HGA and DFW**

**On-road heavy duty diesel (HDDV)** vehicle NOx emissions (not including TERP) are projected to decline 31% to 142 tpd by 2010 as newer, cleaner vehicles enter the market (see Table 2).

**Non-road vehicles and equipment** (excluding TERP, locomotives and commercial marine vessels) NOx emissions would decline 9.5% from 116 tpd to 105 tpd by 2010. **Locomotive** NOx emissions would increase by 29% from 2007 to 2010. When locomotive emissions are included, non-road emissions would remain roughly the same in 2007 and 2010 (without TERP).

**Commercial marine vessels** NOx emissions in HGA are projected to be 39 tpd in 2007 (excluding TERP reductions). No projections were available for 2010.

Table 2  
**NOx Emissions Inventories in Tons per Day**  
(not including TERP reductions or Commercial Marine Vessels\*\*)

Source/Region	2007			2010			Change 2007-2010
	Area TPD	Total TPD	%	Area TPD	Total TPD	%	
<b>On-Road HDDV</b>		<b>206</b>	56.6%		<b>142</b>	47.2%	-31.1%
HGA	103			74			
DFW	103			68			
<b>Non-Road*</b>		<b>116</b>	31.9%		<b>105</b>	34.9%	-9.5%
HGA	53			48			
DFW	63			57			
<b>Locomotives</b>		<b>42</b>	11.5%		<b>54</b>	17.9%	28.6%
HGA	20			26			
DFW	22			28			
<b>Total HGA</b>	<b>176</b>			<b>148</b>			
<b>Total DFW</b>	<b>188</b>			<b>153</b>			
<b>Total HGA and DFW</b>		<b>364</b>	100.0%		<b>301</b>	100.0%	-17.3%

\*Not including locomotives.

\*\*Commercial Marine Vessel emissions projections not available for 2010. 2007 emissions not including TERP are 38 tpd for HGA and 0 for DFW.

## CONCLUSIONS

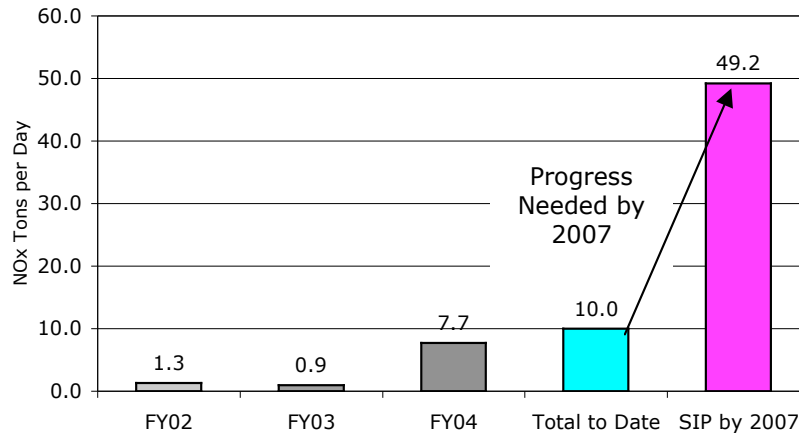
The Texas Emissions Reduction Plan has been successful in its rapid growth in 2004 and in keeping costs well within levels established by the Texas Legislature. TERP projects are providing a very cost-effective means of reducing NOx emissions from a wide range of on-road and non-road sources. TERP will continue to be challenged with target vehicles and equipment that have slow equipment turnover rates, vehicle and equipment markets that are difficult to penetrate, and federal preemption of certain sources. These challenges will require the TERP program to remain aggressive in implementing its goals over the next few years.

Economic incentive programs, like TERP, are the only measures available to reduce emissions from certain federally preempted sources. This preemption greatly restricts TCEQ's or the State's ability to restrict emissions from these sources, which include heavy-duty diesel vehicles, non-road vehicles and equipment, locomotives, and commercial marine vessels. All of these sources, however, are eligible for TERP support.

**1. Significant Progress by 2007:** TERP must make substantial progress in FY2005 and 2006 to meet the 2007 SIP goal by almost doubling 2004 levels of activity (see Figures 1 and 2).

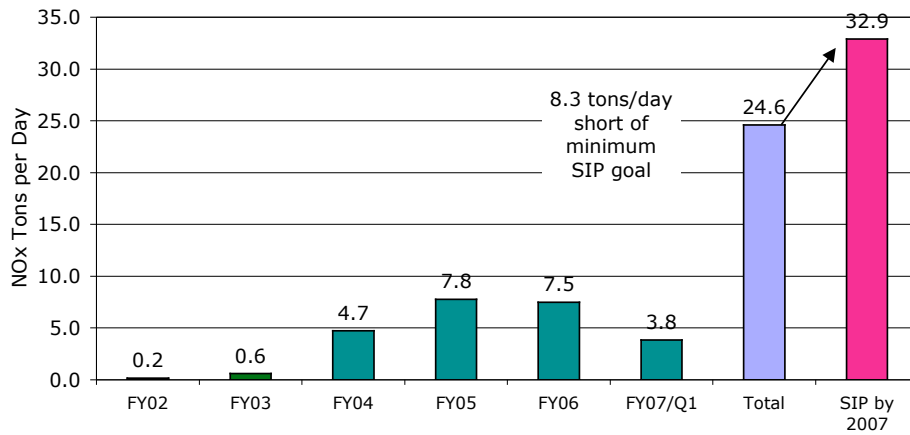
The availability of additional revenues beyond those initially projected for TERP will help to reach TERP's goals. However, aggressive actions must continue to ensure that target fleets and equipment are reached, and that sufficient applicants are available for these funds.

Figure 1  
**TERP Progress FY02-FY04**



**2. SIP Goals for 2007:** If the average TERP project cost effectiveness continues at its current level, the HGA may fall short of the current TERP SIP goal of 32.9 tpd by 8.3 tpd (Figure 2). The DFW area would meet its minimum SIP goal of 16.3 tpd. The availability of additional TERP funds and funding of projects with these funds could offset this potential shortfall.

Figure 2  
**Projection of Yearly HGA TERP NOx Reductions**  
 (based on average cost-effectiveness to date)

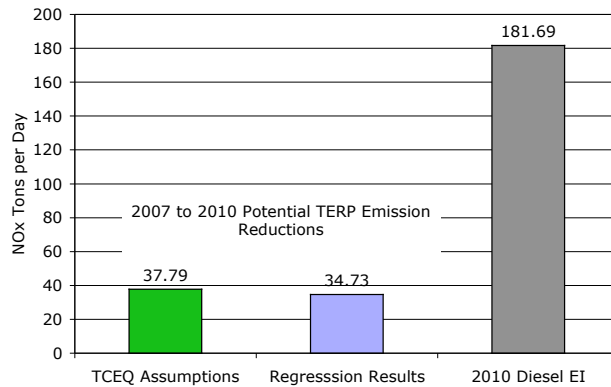


**3. TERP Cost Effectiveness Trends:** Total cost effectiveness averages for DFW and the HGA have shown no general trend up or down, but varied above TCEQ’s goal of \$5,000 per ton for an average of \$5,853 per ton of NOx reduced (see Table 1). Since FY04 projects account for 72% of TERP expenditures, they may provide the best indication of future cost effectiveness levels. The cost effectiveness average for FY04 projects is \$5,832.

**4. Distortion of DFW Averages by Large Projects:** Railroad projects account for the lower average cost effectiveness for the DFW region TERP projects (see Figure 19 in Appendix). With lower cost effectiveness levels of \$3,388, these projects represent over 30% of NOx emission reductions and thus lower the DFW average considerably. Care is needed in projection of future TERP cost effectiveness to account for such possible distortions.

**5. TERP Importance in 2010:** TERP can continue to produce significant benefits to emission reduction efforts. It is projected that TERP could produce 34.7 to 37.8 tpd reductions in NOx by 2010 (Figure 3) if funding approximating current levels is maintained through that year. This will amount to a 19 to 21% reduction that will be needed from on-road and nonroad sources to meet the 8-hour ozone standard.

Figure 3  
**2010 TERP Emission Reductions**



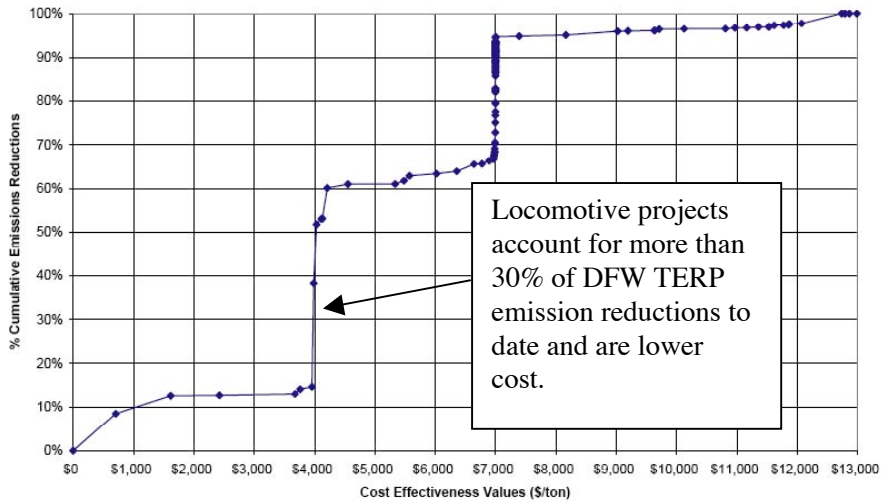
NOTE: “Regression Results” use actual TERP cost effectiveness averages to date. “TCEQ Assumptions” use an assumed \$5,000 per ton cost effectiveness. “2010 Diesel EI” is the total diesel emissions in 2010 that could be affected by TERP.

## SUMMARY POLICY CONCLUSIONS

1. TERP must continue to aggressively strive to meet its 2007 SIP goals, particularly in the HGA region, through more aggressive activities to ensure an adequate number of applicants and cost effective projects. (Several recommendations are provided in TERC reports on TERP toward meeting this goal.)
2. Cost effectiveness levels that are projected into the future must be realistic and account for distortions that might occur from large projects.
3. As shown in emissions inventories, emphasis must continue on nonroad emission reduction projects (particularly diesel construction equipment) and on-road heavy duty diesel vehicles (particularly heavy HDDVs).
4. TERP's role will continue to be important beyond 2007 to meet the diesel emission reduction requirements for the 8-hour ozone standard, unless federal regulations are changed to allow the state to address preempted sources.
5. TERP is one of the most cost-effective currently known ways of reducing diesel NOx emissions from on-road and nonroad sources, and will most likely be essential in 2010 in meeting the difficult 8-hour ozone standard.

## APPENDIX

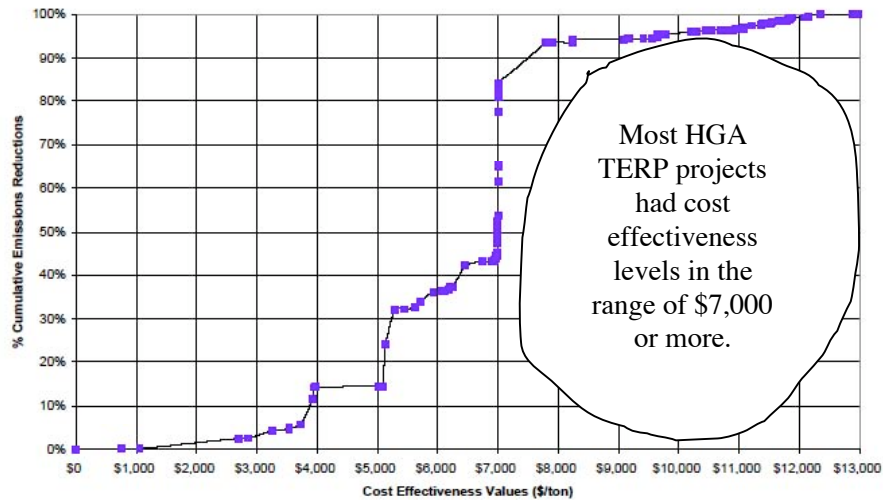
**Cumulative Distribution of NOx Emissions Reductions as a Function of Cost Effectiveness Values for TERP Funded Projects to Date in DFW Area (TERP FYs 02, 03 & 04 Data as of November 02, 2004)**



**Figure 19.** Cumulative distribution of NOx emissions reductions as a function of cost-effectiveness values for TERP funded and recommended projects in the DFW area.

NOTE: Figure 19 plots NOx emission reductions in the DFW region by cost effectiveness for each project. Locomotive projects account for more than 30% of reductions. If omitted, the average cost effectiveness of TERP DFW projects is substantially higher. Future emission reduction projects may not be as cost effective or as large.<sup>2</sup>

**Cumulative Distribution of NOx Emissions Reductions as a Function of Cost Effectiveness Values for TERP Funded Projects to Date in HGA (TERP FYs 02, 03 & 04 Data as of November 02, 2004)**



**Figure 18.** Cumulative distribution of NOx emissions reductions as a function of cost-effectiveness values for TERP funded and recommended projects in the HGA area.

NOTE: Figure 18 plots NOx emission reductions in the HGA region by cost effectiveness for each project. Most TERP projects in the HGA area were in the range from \$7,000 to \$13,000, the maximum level. Many projects were grouped at the \$7,000 level.

<sup>2</sup> Technical Memo: "Preliminary Results for Project Entitled On-Road and Non-Road Emissions Reductions from TERP in 2010", ENVIRON, November 8, 2004, p. 28.