

# **ENERGY EFFICIENCY/RENEWABLE ENERGY IMPACT IN THE TEXAS EMISSIONS REDUCTION PLAN (TERP)**

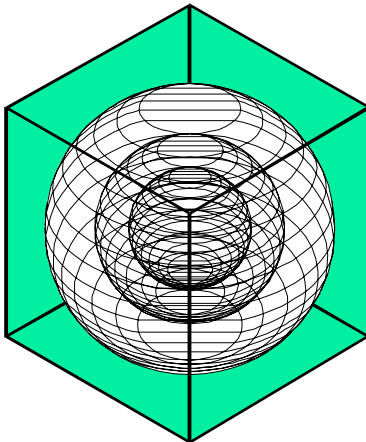
## **VOLUME I – SUMMARY REPORT**

**Annual Report to the  
Texas Commission on Environmental Quality  
September 2003 – August 2004**



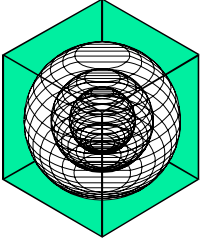
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**December 2004**



## **ENERGY SYSTEMS LABORATORY**

**Texas Engineering Experiment Station  
Texas A&M University System**



## **ENERGY SYSTEMS LABORATORY**

Texas Engineering Experiment Station  
Texas A&M University System

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February 10, 2005

Chairman Kathleen Hartnett White  
Texas Commission on Environmental Quality  
P. O. Box 13087  
Austin, TX 78711-3087

Dear Chairman White:

The Energy Systems Laboratory (ESL) at the Texas Engineering Experiment Station of the Texas A&M University System is pleased to provide its third annual report, "Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP)," as required under Texas Health and Safety Code Ann. § 388.003 (e), Vernon Supp. 2002 (Senate Bill 5, 77R as amended 78 R & 78S).

The ESL is required to annually report the energy savings from statewide adoption of the Texas Building Energy Performance Standards in SB 5, as amended, and the relative impact of proposed local energy code amendments in the 41 Texas non-attainment and affected counties as part of the Texas Emissions Reduction Plan (TERP).

Please contact me at (979) 862-8480 should you or any of the TCEQ staff have any questions concerning this report or any of the work presently being done to quantify emissions reductions from energy efficiency and renewable energy measures as a result of the TERP implementation.

Sincerely,

A handwritten signature in black ink that reads "Dan Turner". The signature is written in a cursive, flowing style.

W. Dan Turner, P.E.  
Director

Enclosure

cc: Commissioner R. B. "Ralph" Marquez  
Commissioner Larry R. Soward

### Disclaimer

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## **VOLUME I – SUMMARY REPORT**

### **Energy Efficiency/Renewable Energy Impact In The Texas Emissions Reduction Plan**

#### **Executive Summary**

The Energy Systems Laboratory, in fulfillment of its responsibilities under Texas Health and Safety Code Ann. § 388.003 (e), Vernon Supp. 2002, submits its third annual report, Energy Efficiency/Renewable Energy (EE/RE) Impact in the Texas Emissions Reduction Plan to the Texas Commission on Environmental Quality.

The report is organized in three volumes.

- Volume 1 – Summary Report, provides an executive summary with key areas summarized;
- Volume II – Technical Report, provides a detailed report of activities, methodologies and findings;
- Volume III – Technical Appendix, contains detailed data from simulations for each of the forty-one counties included in the analysis.

#### **Legislative Background**

The Texas Emissions Reduction Plan (TERP), established by the 77<sup>th</sup> Texas Legislature with the enactment of Senate Bill 5 (SB 5), identified that EE/RE measures may make an important contribution for meeting the minimum federal ambient air quality standards. The 78<sup>th</sup> Legislature further enhanced the use of EE/RE programs for meeting TERP goals by requiring the Texas Commission on Environmental Quality (TCEQ) to promote the use of EE/RE as a way of meeting the federal air quality standards and to develop a methodology for computing emissions reduction for the State Implementation Plan (SIP) from EE/RE programs.

#### **NOx Emissions Reductions**

The TERP legislation adopted the energy efficiency provisions of the International Residential Code (IRC) and the International Energy Conservation Code (IECC) for residential, commercial and industrial buildings. Under the TERP legislation, the Energy Systems Laboratory (Laboratory) at the Texas Engineering Experiment Station of the Texas A&M University System must determine the energy savings from energy code adoption and, when applicable, from more stringent local codes or above-code performance ratings and must report these reductions annually to the TCEQ.

Using data available from the TCEQ and the U.S. Environmental Protection Agency (US EPA) with procedures developed by the Laboratory, the following results were

determined for energy-code compliant new residential single and multi-family construction in both non-attainment and affected counties built in 2004:

- The annual savings in 2004 amounted to 233,806 megawatt hours (MWh) of electricity and 667,945 million Btus of natural gas. The resultant annual NOx reductions were 346 tons.
- On the peak day (August 19, 1999, baseline in the historical air quality model), the savings would have been 1,317 MWh/day and 1,148 million Btus of natural gas, resulting in peak-day NOx emissions reductions of 1.89 tons.
- Cumulative NOx reductions, projected to 2007 and 2012, from energy efficiency savings from code-compliant new construction in single-family and multi-family residences were determined to be: 824 tons/year, and 3.83 tons/peak-day in 2007; and 1,416 tons/year with 6.58 tons/peak-day in 2012.

### **Energy Code Amendments**

The Laboratory was requested to review proposed code amendments from the City of Houston and the North Central Texas Council of Governments (NCTCOG). In both cases, the stringency of proposed amendments was determined to be substantially equal to the state standards; this information was conveyed to the requesting code authorities. In addition, the Laboratory quantified energy reductions for the Alamo Area Council of Governments (AACOG) for their Early Action Compact as part of our technical assistance efforts.

The Laboratory has and will continue to provide leading edge technical assistance to counties and communities working toward obtaining full SIP credit for the energy efficiency and renewable energy projects that are lowering the emissions and improving the air for all Texans. The Laboratory will continue to provide superior technology to the State of Texas through efforts with the TCEQ and US EPA. The efforts taken by the Laboratory have produced significant success in bringing EE/RE closer to US EPA acceptance in the SIP.

## VOLUME I – SUMMARY REPORT

### Energy Efficiency/Renewable Energy Impact In The Texas Emissions Reduction Plan

#### Overview

The Energy Systems Laboratory (Laboratory) is pleased to provide our third annual report, Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP), to the Texas Commission on Environmental Quality (TCEQ) in fulfillment of its responsibilities under Texas Health and Safety Code Ann. § 388.003 (e), Vernon Supp. 2002. This annual report:

- Provides an estimate of the energy savings and NO<sub>x</sub> reductions from energy code compliance in new residential construction in 41 counties,
- Describes the technology developed to enable the TCEQ to substantiate energy and emissions reduction credits from energy efficiency and renewable energy initiatives (EE/RE) to the U.S. Environmental Protection Agency (US EPA), including the development of a web-based emissions calculator, and
- Outlines progress in advancing EE/RE strategies for credit in the State Implementation Plan (SIP).

The report is organized in three volumes.

Volume 1 – Summary Report, provides an executive summary with key areas summarized;

Volume II – Technical Report, provides a detailed report of activities, methodologies and findings;

Volume III – Technical Appendix, contains detailed data from simulations for each of the forty-one counties included in the analysis.

#### Legislative Background

The TERP was established in 2001 by the 77<sup>th</sup> Legislature through the enactment of Senate Bill 5 to:

- Ensure that Texas air meets the Federal Clean Air Act requirements (Section 707, Title 42, United States Code), and
- Reduce NO<sub>x</sub> emissions through mandatory and voluntary programs, including the implementation of energy efficiency and renewable energy programs (EE/RE) in non-attainment and affected counties.

To achieve the clean air and emissions reduction goals of the TERP, SB 5 created a number of EE/RE programs for credit in the SIP:

- Adopts statewide Texas Building Energy Performance Standards (TBEPS) as the building energy code for all residential and commercial buildings,
- Provides that a municipality or county may request the Laboratory to determine the energy impact of proposed energy code changes,
- Provides for an annual evaluation by the Public Utility Commission of Texas (PUCT), in cooperation with the Laboratory, of the emissions reduction of energy demand, peak electric loads and the associated air contaminants from utility-sponsored programs established under SB 5 and utility-sponsored programs established under the electric utility restructuring act (Section 39.905 Utilities Code),
- Establishes a 5% per year electricity reduction goal each year for facilities of political subdivisions in non-attainment and affected counties from 2002 through 2007, and
- Requires the Laboratory to report to the TCEQ the energy savings (and resultant emissions reduction) from implementation of building energy codes and to identify the municipalities and counties whose codes are more or less stringent than the unamended code.

The 78<sup>th</sup> Legislature, through HB 1365 and HB 3235, amended TERP to enhance its effectiveness by adding additional energy efficiency initiatives, including:

- Requires the TCEQ to conduct outreach to non-attainment and affected counties on the benefits of implementing energy efficiency measures as a way to meet the air quality goals under the federal Clean Air Act,
- Requires the TCEQ develop a methodology for computing emissions reductions from energy efficiency initiatives,
- Authorized a voluntary Energy-Efficient Building Program at the General Land Office (GLO), in consultation with the Laboratory, for the accreditation of buildings that exceed the state energy code requirements by 15% or more,
- Authorizes municipalities to adopt an optional, alternate energy code compliance mechanism through the use of accredited energy efficiency programs determined to be code-compliant by the Laboratory, as well as the US EPA's Energy Star New Homes program, and
- Requires the Laboratory to develop and administer a statewide training program for municipal building inspectors seeking to become code-certified inspectors for enforcement of energy codes.

### **Laboratory Funding for the TERP**

The Laboratory received \$182,000 in FY 2002, \$285,000 in FY 2003, and \$950,421 in FY 2004. The Laboratory has also supplemented these funds with competitively awarded federal grants to provide the needed statewide training for the new mandatory energy

codes and provide technical assistance to cities and counties in helping them implement adoption of the legislated energy efficiency codes, and a critically important grant from the US EPA for the development of the web-based EE/RE emissions calculator.

### **Progress In FY 2004**

Since September 2003, the Energy Systems Laboratory has accomplished the following activities in fulfillment of its responsibilities under SB 5:

- Estimated energy and resultant NO<sub>x</sub> reductions from implementation of the Texas Building Energy Performance Standards (IECC/IRC codes) to new residential construction for all non-attainment and affected counties,
- Developed a web-based “Emissions Reduction Calculator” for determining emissions reduction from energy efficiency improvements in residential and commercial construction, municipal projects and renewable energy projects,
- Enhanced the Laboratory’s IECC/IRC Code-Traceable Test Suite for determining emissions reduction due to code and above-code programs,
- Continued the development and testing key of procedures for validating simulations of building energy performance,
- Provided 34 IECC/IRC energy code training sessions throughout the State of Texas,
- Maintained and updated the Laboratory’s Senate Bill 5 web site,
- Maintained a builder’s residential energy code Self-Certification Form (Ver.1.3) for use by builders outside municipalities,
- Responded to hundreds of phone and email inquiries on code implementation and verification issues,
- Continued with the evaluation of proposed energy code changes requested by the North Central Texas Council of Governments (NCTCOG) and the City of Houston,
- Hosted, with San Antonio’s Metropolitan Partnership for Energy, an Emissions Reduction and Energy Leadership Summit, December 14-17, 2004, at the Henry B. Gonzalez Convention Center in San Antonio, with over 250 participants. Conference sessions explained EE/RE opportunities and progress in the TERP and guidance on key energy efficiency and sustainable building topics,
- Provided technical assistance to the TCEQ regarding specific issues, including:
  - Development of a data input capability for SECO reporting requirements;
  - Analysis of potential emissions benefits and policy considerations of elimination of gas pilot lights in certain equipment; and
  - Projections of cumulative emissions for attainment demonstration dates,
- Developed procedures and documentation of EE/RE SIP credits for Alamo Area Council of Governments Early Action Compact SIP to quantify emissions from voluntary energy efficiency programs in their Clean Air Plan, and
- Provided technical assistance to the PUCT and the TCEQ for calculating the creditable emissions reductions from energy demand programs funded under SB 5 and SB 7 as required by TERP.



These activities were designed to enhance the impact of EE/RE initiatives contained in SB 5 and assist the TCEQ, local governments, and the building industry with effective implementation and reporting.

### **Energy and NO<sub>x</sub> Reductions From New Residential Construction**

State adoption of the energy efficiency provisions of the International Residential Code and International Energy Conservation Code became effective September 1, 2001. The Laboratory has developed and delivered training to assist municipal inspectors to become certified energy inspectors. The Laboratory also supported code officials with guidance on interpretations as needed. This effort, begun in 2003 and based on a requirement of HB 3235, 78<sup>th</sup> Texas Legislature, supports a more uniform interpretation and application of energy codes throughout the state. In general, the State is experiencing a true market transformation from low energy efficiency products to high energy efficiency products. These include Low Solar Heat Gain windows, higher efficiency appliances, increased insulation, lower thermal loss ducts and in builder participation in “above-code” code programs such as Energy Star New Homes, which previously had no state baseline and almost no participation.

Energy savings from energy code-compliant, new residential construction in 2004 amounted to 233,806 MWh/year of electricity and 667,945 MBtu/year of natural gas in the 41 non-attainment and affected counties. The resultant *annual* NO<sub>x</sub> reductions in 2004 were calculated to be 346 tons NO<sub>x</sub>/year which include:

- 301.67 tons NO<sub>x</sub>/year (87.1%) from single-family residential (222,045 MWh/year saved),
- 14.09 tons NO<sub>x</sub>/year (4.1%) from multi-family residential (11,761 MWh/year saved), and
- 30.73 tons NO<sub>x</sub>/year (8.8%) from natural gas savings from single-family and multifamily residential (667,945 MBtu/year saved).

On a *peak summer day*, the NO<sub>x</sub> reductions in 2004 are calculated to be 1.89 tons of NO<sub>x</sub>/day, which represents:

- 1.77 tons NO<sub>x</sub>/day (93.7%) from single-family residential (1,265.47 MWh/day saved),
- 0.07 tons NO<sub>x</sub>/day (3.7%) from multi-family residential (51.29 MWh/day saved), and
- 0.05 tons NO<sub>x</sub>/day (2.6%) from natural gas savings from single-family and multifamily residential (1,148 MBtu/day saved).

Cumulative NO<sub>x</sub> emissions reductions for the 38 counties reported in the 2003 report, projected to 2007 and 2012, from energy efficiency savings from code-compliant new construction in single-family and multi-family residences were estimated to be:

- 2007 cumulative NOx emission reductions:  
Annual: 824 Tons  
Peak-day: 3.83 Tons
- 2012 cumulative NOx emission reductions:  
Annual: 1,416 Tons  
Peak-day: 6.58 Tons

Details of the analysis are reported in Volume II of this report.

### **Technology For Calculating And Verifying Emissions Reduction From Energy Used In Buildings**

The Laboratory has developed a web-based, enhanced Emissions Reduction Calculator, know as “**eCalc**,” which contains the underlying technology for determining emissions from power plants that generate the electricity for the user. The Emissions Reduction Calculator is used to obtain SIP credits from energy efficiency programs in the TERP. The TCEQ and the US EPA are currently reviewing the Laboratory’s proposed technology and recent refinements for estimating NOx emissions from additional energy efficiency and renewable energy (EE/RE) measures. This enhanced engineering analysis software addressed major challenges:

- How to quantify and validate the persistence of energy savings from EE/RE energy measures.
- How to transform electricity reductions into spatial (location) and temporal (time-of-day) distributions of emissions reductions from electric utility power plants.
- How to quantify cumulative multi-year emissions reductions that account for reduced emissions from the associated power plants according to the US EPA’s eGRID database.

The Laboratory’s Emissions Reduction Calculator uses the US EPA’s eGRID database to identify where emissions are produced. In 2004, the Laboratory further developed and documented methodologies to calculate the electricity and natural gas savings from commercial buildings, solar thermal, solar photovoltaic, and municipal energy conservation projects (i.e., traffic lights, street lights, water and waste-water systems, and wind energy systems). A complete description of the technology and procedures for calculation emissions reduction are contained in Volume II of this report. The Laboratory initiated input and critical analysis by federal and state regulatory agencies on this approach to help ensure accuracy and ease of use for eCalc. The Laboratory is working with the US EPA to assure full acceptance of the Laboratory’s methods implemented in eCalc.

## **Evaluation of Additional Technologies For Reducing Energy Use In Existing Buildings**

Evaluation of additional technologies for further reducing energy use in existing buildings and community-based energy efficiency programs are covered in Volume II of this report, including:

- Use of HVAC equipment and domestic water heaters that function without pilot lights.

### **Planned Focus for 2005/2006**

In FY 2005, the Energy Systems Laboratory will continue its cooperative efforts with the TCEQ, PUCT, SECO, US EPA and others to ensure EE/RE measures remain a cost-effective solution to clean air, and continue to support the energy efficiency and renewable energy opportunities of the TERP. The Laboratory team will:

- Assist the TCEQ to obtain SIP credits from energy efficiency and renewable energy using the Laboratory's Emissions Reduction Calculator technology,
- Verify, document and report energy efficiency and renewable energy savings in all TERP EE/RE programs for the SIP in each non-attainment and affected county using the TCEQ/US EPA approved technology,
- Assist the PUCT with determining emissions reductions credits from energy efficiency programs funded by SB 7 and SB 5,
- Assist political subdivisions and Councils of Governments with calculating emissions reductions from local code changes and voluntary EE/RE programs for SIP inclusion,
- Develop low-cost methods and techniques to implement above code energy efficiency in low-priced and moderately-priced residential housing,
- Continue development of well-documented, standardized methodologies for calculating and reporting NOx reductions, including a unified database framework for required reporting to TCEQ of potentially creditable measures from the ESL, PUCT, and SECO SB 5 initiatives, and
- Identify maximum, cost-effective NOx emissions reduction in existing residential, commercial and industrial buildings for possible integration into the SIP.

The Laboratory has and will continue to provide leading edge technical assistance to counties and communities working toward obtaining full SIP credit for the energy efficiency and renewable energy projects that are lowering the emissions and improving the air for all Texans. The Laboratory will continue to provide superior technology to the State of Texas through efforts with the TCEQ and US EPA. The efforts taken by the Laboratory have produced significant success in bringing EE/RE closer to US EPA acceptance in the SIP.

If any questions arise, please contact us by phone at 979-862-2804 or by email at [SB5info@esl.tamu.edu](mailto:SB5info@esl.tamu.edu).