ENERGY SYSTEMS LABORATORY
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Texas A&M University System
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December 10, 2007

Chairman H. S. Buddy Garcia
Texas Council on Environmental Quality
P. O. Box 13087
Austin, TX 78711-3087

Dear Chairman Garcia:

The Energy Systems Laboratory (Laboratory) at the Texas Engineering Experiment Station of the Texas A&M University System is pleased to provide its fifth 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 Laboratory is required to annually report the energy savings from statewide adoption of the Texas Building Energy Performance Standards in Senate Bill 5 (SB 5), as amended, and the relative impact of proposed local energy code amendments in the Texas non-attainment and near-non-attainment counties as part of the Texas Emissions Reduction Plan (TERP).

Please contact me at (979) 862-1280 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 reduction from energy efficiency and renewable energy measures as a result of the TERP implementation.

Sincerely,

David E. Claridge, Ph.D., P.E.
Director

Enclosure

cc: Commissioner Larry R. Soward
Commissioner Bryan Shaw
Executive Director Glenn Shankle

Disclaimer

VOLUME II – TECHNICAL REPORT

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

1 EXECUTIVE SUMMARY

The Energy Systems Laboratory (Laboratory), at the Texas Engineering Experiment Station of the Texas A&M University System, in fulfillment of its responsibilities under Texas Health and Safety Code Ann. § 388.003 (e), Vernon Supp. 2002, submits its fifth 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 I – Summary Report – provides an executive summary and overview;
- 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 counties included in the analysis.

Accomplishments:

1. Energy Code Amendments

The Laboratory was requested by several municipalities to analyze the stringency of several proposed residential and commercial energy code amendments, including: the 2003 and 2006 IECC and the ASHRAE Standards 90.1-2001 and 90.1-2004. Results of the analysis are included in the Vol II Technical Report.

2. Technical Assistance

The Laboratory provided technical assistance to the TCEQ, PUCT, SECO, ERCOT, and several political subdivisions, as well as Stakeholders participating in improving the compliance of the Texas Building Energy Performance Standards (TBEPS). The Laboratory also worked closely with the TCEQ to refine the integrated NOx emissions reduction calculation procedures that provide the TCEQ with a standardized, creditable NOx emissions reduction from energy efficiency and renewable energy (EE/RE) programs, which are acceptable to the US EPA. These activities have improved the accuracy of the creditable NOx emissions reduction from EE/RE initiatives contained in the TERP and have assisted the TCEQ, local governments, and the building industry with effective, standardized implementation and reporting.

3. NOx Emissions Reduction

Under the TERP legislation, the Laboratory 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.

Figure 1 shows the cumulative NOx emissions reduction through 2020 for the electricity and natural gas savings from the various EE/RE programs. In 2006, the cumulative NOx emissions reduction were calculated to be 17.52 tons/Ozone-Season-Day. By 2013, the cumulative NOx emissions reduction are projected to be 40.86 tons/Ozone-Season-Day.

4. Technology Transfer

The Laboratory, along with the TCEQ, is host to the annual Clean Air Through Energy Efficiency (CATEE) conference, which is attended by top experts and policy makers in Texas and from around the country. At the conference the latest educational programs and technology is presented discussed, including efforts by the Laboratory, and others to reduce air pollution in Texas through energy efficiency and renewable energy. These efforts have produced significant success in bringing EE/RE closer to US EPA acceptance in the Texas SIP. The Laboratory will continue to provide superior technology to the State of Texas through such efforts with the TCEQ and the US EPA.

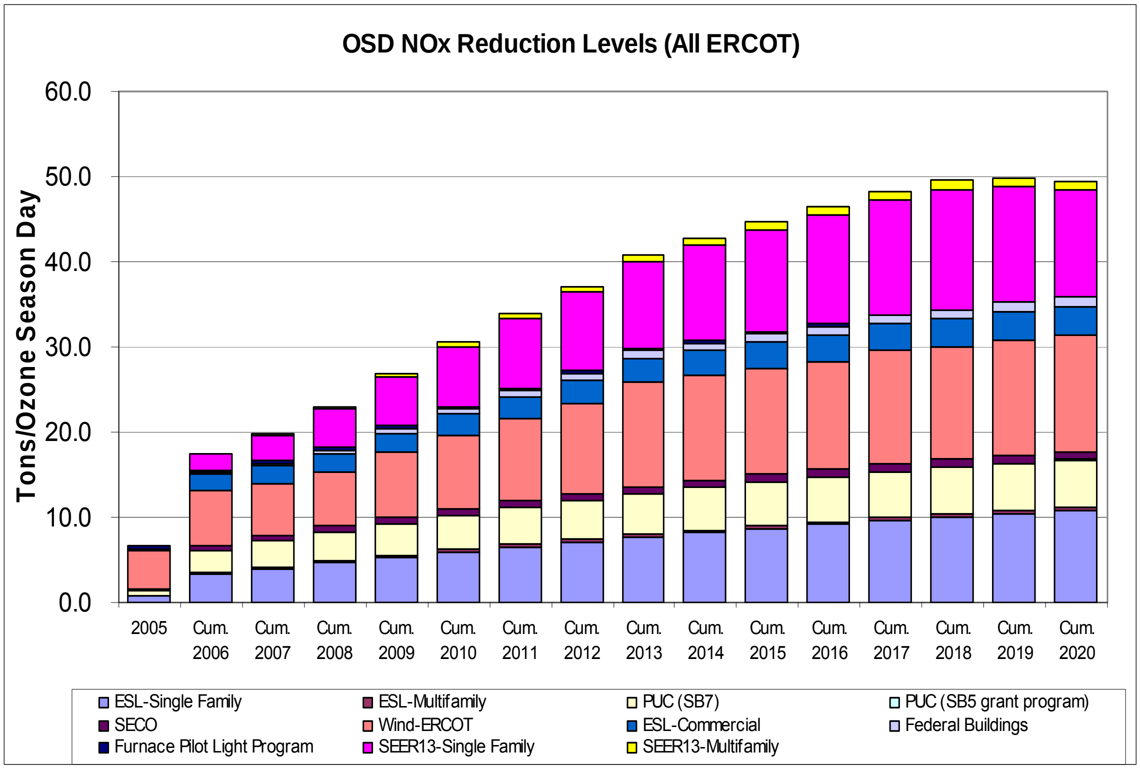

Figure 1: Cumulative OSD NOx Emissions Reduction Projections through 2020.

To accelerate the transfer of technology developed as part of the TERP, the Laboratory has also made presentations at national, state and local meetings and conferences, which includes the publication of peer-reviewed papers. The Laboratory will continue to provide technical assistance to the TCEQ, counties and communities working toward obtaining full SIP credit for the energy efficiency and renewable energy projects that are lowering emissions and improving the air quality for all Texans.

These efforts have been recognized nationally by the US EPA. In 2007, the Laboratory was awarded a National Center of Excellence on Displaced Emissions Reduction (CEDER) by the US EPA so that these accomplishments could be rapidly disseminated to other states for their use. The benefits of CEDER include: reducing the financial, technical, and administrative costs of determining the emissions reduction from EE/RE measures; continuing to accelerate implementation of EE/RE strategies as a viable clean air effort in Texas and other states; helping other states better identify and prioritize cost-effective clean air strategies from EE/RE;, and communicating the results of quantification efforts through case-studies and a clearinghouse of information.

The Energy Systems Laboratory provides the fifth annual report, Energy Efficiency/Renewable Energy (EE/RE) 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.

If any questions arise, please contact us by phone at 979-458-0675, or by email at SB5info@esl.tamu.edu.

2 ACKNOWLEDGEMENTS

This work has been completed as a fulfillment of the requirements in Texas Health Code, Senate Bill 5, Section 388.003, and through Senate Bill 20, House Bill 2481 and House Bill 2129, which requires the Laboratory to assist TCEQ in quantifying emissions reductions credits from energy efficiency and renewable energy programs, through a contract with the Texas Environmental Research Consortium (TERC). Similarly, selected Code training workshops were funded by the US DOE through the Texas State Energy Conservation Office (SECO). Partial funding on the Texas Climate Vision project, a joint project with the City of Austin was also provided by the US DOE through SECO.

The authors are also grateful for the timely input provided by the following individuals, and agencies: Mr. Art Diem, US EPA, for providing the eGRID database; Mr. Steve Anderson, TCEQ, for contributing helpful insight about improvement to the Emissions Reduction Calculator, and the integrated emissions calculations, and Dr.Akin Olubiyi.

Numerous additional individuals at the Laboratory contributed significantly to this report, including: Dr. Dan Turner, Kyle Marshall, Robert Stackhouse, Jason Cordes, Ms. Sherrie Hughes, Ms. Angie Shafer, Mr. Stephen O’Neal, Mr. Piljae Im, Mr. Soolyeon Cho, Ms. Mini Malhotra, and Mr. Eduardo Rameriez.

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3 OVERVIEW

The Energy Systems Laboratory (Laboratory), at the Texas Engineering Experiment Station of the Texas A&M University System, is pleased to provide our fifth 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 NOx reductions from energy code compliance in new residential construction in all ERCOT counties;
- Provides an estimate of the standardized, cumulative, integrated energy savings and NOx reductions from the TERP programs implemented by the Laboratory, SECO, the PUC and ERCOT in all ERCOT Texas;
- 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 reduction calculator; and
- Outlines progress in advancing EE/RE strategies for credit in the Texas State Implementation Plan (SIP).

The report is organized in three volumes.

Volume I – Summary Report – provides an executive summary and overview;
Volume II – Technical Report – provides a detailed report of activities, methodologies and findings;
Volume III – Technical Appendix – contains detailed data from simulations for all ERCOT counties in Texas included in the analysis.

3.1 Legislative Background

The TERP was established in 2001 by the 77th 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 NOx emissions in non-attainment and near-non-attainment counties through mandatory and voluntary programs, including the implementation of energy efficiency and renewable energy programs (EE/RE).

To achieve the clean air and emissions reduction goals of the TERP, Senate Bill 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 contaminant reductions from utility-sponsored programs established under Senate Bill 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 near-non-attainment counties from 2002 through 2007; and
- Requires the Laboratory to report annually 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 78th Legislature (2003), through HB 1365 and HB 3235, amended TERP to enhance its effectiveness with additional energy efficiency initiatives, and includes:

- Requires the TCEQ to conduct outreach to non-attainment and near-non-attainment 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 reduction 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.

The 79th Legislature (2005), through SB 20, HB 2481 and HB 2129, amended Senate Bill 5 to enhance its effectiveness by adding the following additional energy efficiency initiatives:

- Requires 5,880 MW of generating capacity from renewable energy technologies by 2015;
- Includes 500 MW from non-wind renewables;
- Requires the PUCT to establish a target of 10,000 megawatts of installed renewable capacity by 2025;
- Requires the TCEQ to develop methodology for computing emissions reduction from renewable energy initiatives and the associated credits;
- Requires the Laboratory to assist the TCEQ in quantifying emissions reduction credits from energy efficiency and renewable energy programs;
- Requires the Texas Environmental Research Consortium (TERC) to contract with the Laboratory to develop and annually calculate creditable emissions reduction from wind and other renewable energy resources for the state’s SIP; and
- Requires the Laboratory to develop at least three alternative methods for achieving a 15 % greater potential energy savings in residential, commercial and industrial construction.

The 80th Legislature (2007), through SB 12, and HB 3693 amended Senate Bill 5 to enhance its effectiveness by adding the following additional energy efficiency initiatives:

- Requires the Laboratory to provide written recommendations to the State Energy Conservation Office (SECO) about whether or not the energy efficiency provisions of latest published edition of the International Residential Code (IRC) or the International Energy Conservation Code (IECC) are equivalent to or better than the energy efficiency and air quality achievable under the editions adopted under the 2001 IRC/IECC. The Laboratory shall make its recommendations no later than six months after publication of new editions at the end of each three-year code development cycle of the International Residential Code and the International Energy Conservation Code.
- Requires the Laboratory to consider comments made by persons who have an interest in the adoption of the energy codes in the recommendations made to SECO.
- Requires the Laboratory to develop a standardized report format to be used by providers of home energy ratings, including different report formats for rating newly constructed residences from those for existing residences. The form must be designed to give potential buyers information on a structure's energy performance, including: insulation; types of windows; heating and cooling equipment; water heating equipment; additional energy conserving features, if any; results of performance measurements of building tightness and forced air distribution; and an overall rating of probable energy efficiency relative to the minimum requirements of the International Energy Conservation Code or the energy efficiency chapter of the International Residential Code, as appropriate.
- Encourages the Laboratory to cooperate with an industry organization or trade association to: develop guidelines for home energy ratings; provide training for individuals performing home energy ratings and providers of home energy ratings; and provide a registry of completed ratings

- Requires the Laboratory to include information on the benefits attained from this program in an annual report to the commission.

3.2 Laboratory Funding for the TERP

The Laboratory received $182,000 in FY 2002; $285,000 in FY 2003; $950,421 in FY 2004; $952,019 in FY 2005; and $952,019 in FY 2006. 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 to provide technical assistance to cities and counties in helping them implement adoption of the legislated energy efficiency codes, and an award from the US EPA in the Spring of 2007 to establish a Center of Excellence for the Determination of Emissions Reduction (CEDER) which will help to enhance the EE/RE emissions calculations.

3.3 Accomplishments Since January 2006

Since January of 2006, the Laboratory accomplished the following:

- Calculated energy and resultant NOx reductions from implementation of the Texas Building Energy Performance Standards (IECC/IRC codes) to new residential and commercial construction for all non-attainment and near-non-attainment counties;
- Enhanced the web-based "Emissions Reduction Calculator - eCalc" 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 development and testing of key procedures for validating simulations of building energy performance;
- Provided energy code training workshops, including: 12 residential, 4 commercial IECC/IRC energy code training sessions, 13 code-compliant software sessions, 3 ASHRAE Standard 62.1 sessions, and 9 ASHRAE Standard 90.1 workshops throughout the State of Texas;
- Maintained and updated the Laboratory's Senate Bill 5 website;
- 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;
- Analyzed the stringency of several residential and commercial energy codes, including the 2006 IECC and ASHRAE Standard 90.1-2001 and Standard 90.1-2004;
- Presented an invited presentation about Texas' NOx emissions reduction calculations at the US EPA's Air Innovations Conference in September 2006, in Denver, Colorado;
- Hosted the Energy Leadership and Emissions Reduction Conference in November 2006, in Houston, Texas. Conference sessions included key talks by the TCEQ, EPA, DOE and the Laboratory about quantifying emissions reduction from EE/RE opportunities and guidance on key energy efficiency and renewable energy topics;
- Provided technical assistance to the TCEQ regarding specific issues, including:
    - Enhancement of the standardized, integrated NOx emissions reduction reporting procedures[1] to the TCEQ for ESL, PUCT, SECO and ERCOT EE/RE projects;
    - Enhancement of the procedures for weather normalizing NOx emissions reduction from power provided by wind energy providers to base-year calculations;
    - Quantified emissions reduction from the new, Federally-mandated SEER 13 air conditioner standard (starting in January 2006).
- Enhanced the web-based emissions reduction calculator, including:

[1] These procedures are currently under review by the USDOE, through the National Renewable Energy Laboratory (NREL).

  - Expanded the emissions reduction calculator to include all counties in ERCOT;
  - Gathered, cleaned and posted weather data archive for 17 NOAA stations in Texas;
  - Expanded emissions reduction to include SEER 13 air conditioners;
  - Continued the enhancement of the new computer architecture to allow for synchronous calculations, user accounts, and code-compliance;
- Developed 15% above code recommendations for residential buildings;
- Developed 15% above code recommendations for commercial and industrial buildings; and
- Continued the development of verification procedures, including:
  - Completion of calibrated simulation of a high-efficiency office building in Austin, TX;
  - Worked towards a calibrated simulation of an office building;
  - Worked towards a calibrated simulation of a K-12 school; and
  - Completed the calibrated simulation of a Habitat for Humanities residence.

3.4 Technology Transfer

To accelerate the transfer of technology developed as part of the Senate Bill 5 program, the Laboratory:

- Delivered "Statewide Air Emissions Calculations from Wind and Other Renewables," to the Texas Commission on Environmental Quality in August 2006, including Stakeholder's meetings to gather input from the industry and the review incorporation of information from ERCOT's Renewable Energy Credit Program site www.texasrenewables.com.
- Developed a method to predict on-site wind speeds using Artificial Neural Networks (ANN) and developed improvements to the daily modeling procedures using ANN-derived hourly wind speeds.
- Developed degradation analysis to determine if degradation could be observed in the measured power from Texas wind farms.
- Developed empirical curtailment analysis of the measured power production from a wind farm and applied to the Indian Mesa wind farm.
- Developed a database of other renewable projects in Texas, including: solar photovoltaic, geothermal, hydroelectric, and Landfill Gas-fired Power Plants.
- Developed estimation techniques for hourly solar radiation from limited data sets.
- Along with the TCEQ and the US EPA, is host to the annual Clean Air Through Energy Efficiency (CATEE) Conference attended by top Texas experts and policy makers and national experts.
- Was granted a National Center of Excellence on Displaced Emissions Reduction (CEDER) by the US EPA. The benefits of CEDER include:
  - reducing the financial, technical, and administrative costs of determining the emissions reduction from EE/RE measures;
  - continuing to accelerate implementation of EE/RE strategies as a viable clean air effort in Texas and other states;
  - helping other states identify and prioritize cost-effective clean air strategies from EE/RE; and;
  - communicating the results of quantification efforts through case-studies and a clearinghouse of information.

In addition to the tasks listed above, the Laboratory delivered presentations regarding the Senate Bill 5 related work, including:

- Presentation at the US EPA Air Innovations Conference, Denver, Colorado, September 2006.
- Presentation at Rice University, Civil Engineering Department, September 2006.
- Presentation at Clean Air Conference, University of Houston, October 11-12.
- Presentation at the American Waste Management Association Meeting, Austin, February 2007.
- Presentation at Baylor University, Mechanical Engineering Department, February 2007.
- Presentation at U.S. Congress about Texas NOx emissions reduction for ASHRAE Tech Briefing, March 2007.
- Presentation at ASHRAE Carbon Toolkit Workshop, March, 2007 (by phone).

- Presentation at EPRI Conference, April 2007 (by phone).
- Presentation of seven papers at the 15th Symposium on Improving Building Systems in Hot and Humid Climates, in Orlando, Florida, July 2006, including:
    - *Malhotra, M., Haberl, J. 2006. "An Analysis of Maximum Residential Energy Efficiency in Hot and Humid Climates," Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).*
    - *Cho, S., Haberl, J. 2006. "A Survey of High-performance Office Buildings for Hot and Humid Climates," Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).*
    - *Im, P., Haberl, J. 2006. "A Survey of High-performance Schools for Hot and Humid Climates," Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).*
    - *Ahmed, M., Im, P., Mukhopadhyay, J., Malhotra, M., Haberl, J., Culp, C., Yazdani, B. 2006. "Impact of the Implementation of the 2000/2001 IECC on Residential Energy use in Texas: Analysis of Residential Savings," Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).*
    - *Ahmed, M., Kim, S., Im, P., Chongcharoensuk, C., Haberl, J., Culp, C., Yazdani, B. 2006. "Impact of the Implementation of the 2000/2001 IECC on Commercial Energy use in Texas: Analysis of Commercial Savings," Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).*
    - *Mukhopadhyay, J., Haberl, J. 2006. "Comparison of Simulation Methods for Evaluating Improved Fenestration Using the DOE-2.1e Building Energy Simulation Program," Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).*
    - *Baltazar-Cervantes, J.C., Haberl, J., Culp, C., Yazdani, B. 2006. "Impact of the Implementation of the 2000/2001 on Residential Energy use in Texas: Verification of Residential Energy Savings," Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).*
- Presented two papers at the 2nd SimBuild Conference, Boston, MA, August 2006:
    - *Mukhopadhyay, J., Haberl, J. 2006. "Comparing the Performance of High-performance Glazing in IECC Compliant Building Simulation Model," Proceedings of the 2nd SimBuild Conference, Boston, MA, published on CD ROM (August).*
    - *Malhotra, M., Haberl, J. 2006. "An Analysis of Building Envelope Upgrades for Residential Energy Efficiency in Hot and Humid Climates," Proceedings of the 2nd SimBuild Conference, Boston, MA, published on CD ROM (August).*
- Presented one Paper at the ACEEE Summer Study on Energy Efficiency, Asilomar, California, August 2006:
    - *Verdict, M., Haberl, J., Culp, C., Yazdani, B., Fitzpatrick, T., Gilman, D., Ahmed, M., Liu, B., Baltazar, J. C, Muns, S., and Turner, D. 2006. "Quantification of NO_x Emissions Reduction for SIP Credits from Energy Efficiency and Renewable Energy Projects in Texas," 2006 ACEEE Summer Study on Energy Efficiency in Buildings, American Council for an Energy Efficient Economy, Washington, D.C., published on CD ROM (August).*
- Presented one Paper at the 6th International Conference for Enhanced Building Operations, Shenzhen, China, October 2006:
    - *Liu, Z., Haberl, J., Gilman, D., Culp, C., Yazdani, B. 2006. "Development of a Web-based Emissions Reduction Calculator for Storm Water/Infiltration Sanitary Sewage Separation," Proceedings of the 6th International Conference for Enhanced Building Operations, Shenzhen, China, published on CD ROM (October).*

The Laboratory has and will continue to provide leading-edge technical assistance to the TCEQ, counties and communities working toward obtaining full SIP credit for the energy efficiency and renewable energy projects that are lowering emissions and improving the air quality 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. These activities were designed to more accurately calculate the creditable NOx emissions reduction from EE/RE initiatives contained in the TERP and to assist the TCEQ, local governments, and the building industry with standardized, effective implementation and reporting.

3.5 Energy and NOx Reductions From New Residential and Commercial Construction

State adoption of the energy efficiency provisions of the International Residential Code (IRC) and International Energy Conservation Code (IECC) 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, based on a requirement of HB 3235, 78th 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.

In the counties served by ERCOT, the resultant *annual* NOx reductions in 2006 were calculated to be 361 tons NOx/year[2] , which include:

- 274 tons NOx/year from single-family and multi-family residential (409,025 MWh/year saved);
- 61 tons NOx/year from commercial construction (89,557 MWh/year saved); and
- 26 tons NOx/year from natural gas savings from single-family, multi-family residential and commercial construction (576,680 MBtu/year saved).

For the *peak ozone season day (OSD),* the NOx emissions reduction in 2006 are calculated to be 2.23 tons of NOx/peak-OSD, which represents:

- 1.70 tons NOx/day from single-family and multi-family residential (2,564 MWh/day saved);
- 0.38 tons NOx/day from commercial (568 MWh/day saved); and
- 0.15 tons NOx/day from natural gas savings from single-family, multi-family and commercial construction (3,266 MBtu/day saved).

3.6 Integrated NOx Emissions Reductions Reporting Across State Agencies

Beginning in 2005, the Laboratory worked with the TCEQ to develop a standardized, integrated NOx emissions reduction across state agencies implementing EE/RE programs so that the results can be evaluated consistently. As required by the legislation, the TCEQ receives reports: from the Laboratory on savings from code compliance and renewables; from the Laboratory, in cooperation with the Electric Reliability Council of Texas (ERCOT), on the savings from electricity generated from wind power; from the Public Utilities Commission of Texas (PUCT) on the impacts of the utility-administered programs designed to meet the mandated energy efficiency goals of SB7 and SB5; and from the State Energy Conservation Office (SECO) on the impacts of energy conservation in state agencies and political subdivisions.

- In 2006, *total cumulative annual energy savings*[3] from code-compliant residential and commercial construction is calculated to be 1,428,464 MWh/year (17.0% of the total electricity savings); savings from retrofits to Federal buildings is 109,073 MWh/year (1.3%); savings from

[2] These NOx emissions reduction were calculated with the US EPA's 2007 eGRID for annual (25% capacity factor) and Ozone Season Day OSD.
[3] This includes the savings from 2001 through 2006.

furnace pilot light retrofits is 2,548,904 MBtu/year; savings from the PUC's Senate Bill 5 and Senate Bill 7 programs is 1,376,334 MWh/year (16.3%); savings from SECO's Senate Bill 5 program is 293,763 MWh/year (3.5%); electricity savings from green power purchases (wind) is 4,782,508 MWh/year (56.9%); and savings from residential air conditioner retrofits[4] is 405,879 MWh/year (4.8%). The total savings from all programs is 8,396,023 MWh/year. The *total cumulative OSD energy savings* from code-compliant residential and commercial construction is calculated to be 7,703 MWh/day (29.9%); savings from retrofits to Federal buildings is 299 MWh/day (1.2%); savings from furnace pilot light retrofits is 5,819 MBtu/day; savings from the PUC's Senate Bill 5 and Senate Bill 7 programs is 3,770 MWh/day (14.6%); savings from SECO's Senate Bill 5 program is 804 MWh/day (3.1%); electricity savings from green power purchases (wind) are 10,305 MWh/day (40.0%); and savings from residential air conditioner retrofits are 2,879 MWh/day (11.1%). The total savings from all programs is 25,760 MWh/day, which would be a 1,073 MW average hourly load reduction during the OSD period.

- The *total cumulative annual NOx emissions reduction* from code-compliant residential and commercial construction is calculated to be 1,010 tons-NOx/year (17.0% of the total NOx savings); savings from retrofits to Federal buildings is 84 tons-NOx/year (1.5%); savings from furnace pilot light retrofits is 117 tons-NOx/year (2.0%); savings from the PUC's Senate Bill 5 and Senate Bill 7 programs is 1,045 tons-NOx/year (18.2%); savings from SECO's Senate Bill 5 program is 224 tons-NOx/year (3.9%); electricity savings from green power purchases (wind) is 2,978 tons-NOx/year (51.9%); and savings from residential air conditioner retrofits is 280 tons-NOx/year (4.9%). The total NOx emissions reduction from all programs is 5,738 tons-NOx/year. The *total cumulative OSD NOx emissions reduction* from code-compliant residential and commercial construction is calculated to be 5.35 tons-NOx/day (30.5%); savings from retrofits to Federal buildings is 0.22 tons-NOx/day (1.3%); savings from furnace pilot light retrofits is 0.32 tons-NOx/day (1.8%); savings from the PUC's Senate Bill 5 and Senate Bill 7 programs is 2.63 tons-NOx/day (15.0%); savings from SECO's Senate Bill 5 program is 0.62 tons-NOx/day (3.4%); electricity savings from green power purchases (wind) are 6.44 tons-NOx/day (36.7%); and savings from residential air conditioner retrofits are 1.96 tons-NOx/day (11.2%). The total NOx emissions reduction from all programs is 17.52 tons-NOx/day.
- In 2013, the *total cumulative annual energy savings* from code-compliant residential and commercial construction is calculated to be 3,024,261 MWh/year (16.8% of the total electricity savings); savings from retrofits to Federal buildings will be 402,732 MWh/year (2.2%); savings from furnace pilot light retrofits will remain at 2,548,904 MBtu/year; savings from the PUC's Senate Bill 5 and Senate Bill 7 programs will be 2,544,432 MWh/year (14.2%); savings from SECO's Senate Bill 5 program will be 407,940 MWh/year (2.3%); electricity savings from green power purchases (wind) will be 9,273,739 MWh/year (51.7%); and savings from residential air conditioner retrofits will be 2,286,232 MWh/year (12.7%). The total savings from all programs will be 17,939,336 MWh/year. The *total cumulative OSD energy savings* from code-compliant residential and commercial construction is calculated to be 15,544 MWh/day (25.5%); savings from retrofits to Federal buildings will be 1103 MWh/day (1.8%); savings from furnace pilot light retrofits will remain at 5,819 MBtu/day; savings from the PUC's Senate Bill 5 and Senate Bill 7 programs will be 6,971 MWh/day (11.4%); savings from SECO's Senate Bill 5 program will be 1,117 MWh/day (1.8%); electricity savings from green power purchases (wind) will be 20,088 MWh/day (32.9%); and savings from residential air conditioner retrofits will be 16,216 MWh/day (26.6%). The total savings from all programs will be 61,039 MWh/day, which would be a 2,543 MW average hourly load reduction during the OSD period.
- The *total cumulative annual NOx emissions reduction* from code-compliant residential and commercial construction is calculated to be 2,121 tons-NOx/year (17.8% of the total NOx savings); savings from retrofits to Federal buildings will be 308 tons-NOx/year (2.6%); savings from furnace pilot light retrofits will be 117 tons-NOx/year (0.9%); savings from the PUC's Senate Bill 5 and Senate Bill 7 programs will be 1,784 tons-NOx/year (15.0%); savings from SECO's Senate Bill 5 program will be 311 tons-NOx/year (2.6%); electricity savings from green power purchases (wind) will be 5,652 tons-NOx/year (47.6%); and savings from residential air

[4] This assumes air conditioners in existing homes are replaced with the more efficient SEER 13 units, versus an average of SEER 11, which is slightly more efficient than the previous minimum standard of SEER 10.

conditioner retrofits will be 1,574 tons-NOx/year (13.3%). The total NOx emissions reductions from all programs will be 11,868 tons-NOx/year. The *total cumulative OSD NOx emissions reduction* from code-compliant residential and commercial construction is calculated to be 10.75 tons-NOx/day (26.3%); savings from retrofits to Federal buildings will be 0.81 tons-NOx/day (1.9%); savings from furnace pilot light retrofits will be 0.32 tons-NOx/day (0.8 %); savings from the PUC's Senate Bill 5 and Senate Bill 7 programs will be 4.78 tons-NOx/day (11.7%); savings from SECO's Senate Bill 5 program will be 0.84 tons-NOx/day (2.0%); electricity savings from green power purchases (wind) will be 12.32 tons-NOx/day (30.1%); and savings from residential air conditioner retrofits will be 11.03 tons-NOx/day (26.9%). The total NOx emissions reduction from all programs will be 40.86 tons-NOx/day.

Figure 2 shows the cumulative NOx emissions reduction through 2020 for the electricity and natural gas savings from all TERP programs reporting to the TCEQ. Table 1 provides the details regarding the annual degradation, transmission and distribution losses, discount factors and growth factors that were used in the analysis[5]. Additional details of the analysis are reported in Volume II of this report.

Table 1: Adjustment Factors used for the Calculation of the Annual and OSD NOx Savings for the Different Programs.

	ESL-Single Family[16]	ESL-Multifamily[16]	ESL-Commercial[16]	Federal Buildings[15]	Furnace Pilot Light Program[15]	PUC (SB7)[15]	PUC (SB5 Grant Program)[15]	SECO[15]	Wind-ERCOT[8]	SEER13 Single Family
Annual Degradation Factor [11]	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
T&D Loss [9]	7.00%	7.00%	7.00%	7.00%	0.00%	7.00%	7.00%	7.00%	0.00%	7.00%
Initial Discount Factor [12]	20.00%	20.00%	20.00%	20.00%	20.00%	25.00%	25.00%	60.00%	25.00%	20.00%
Growth Factor	3.25%	1.54%	3.25%	0.00%	0.00%	0.00%	0.00%	0.00%	According to SB 20, section 39.904	N.A.

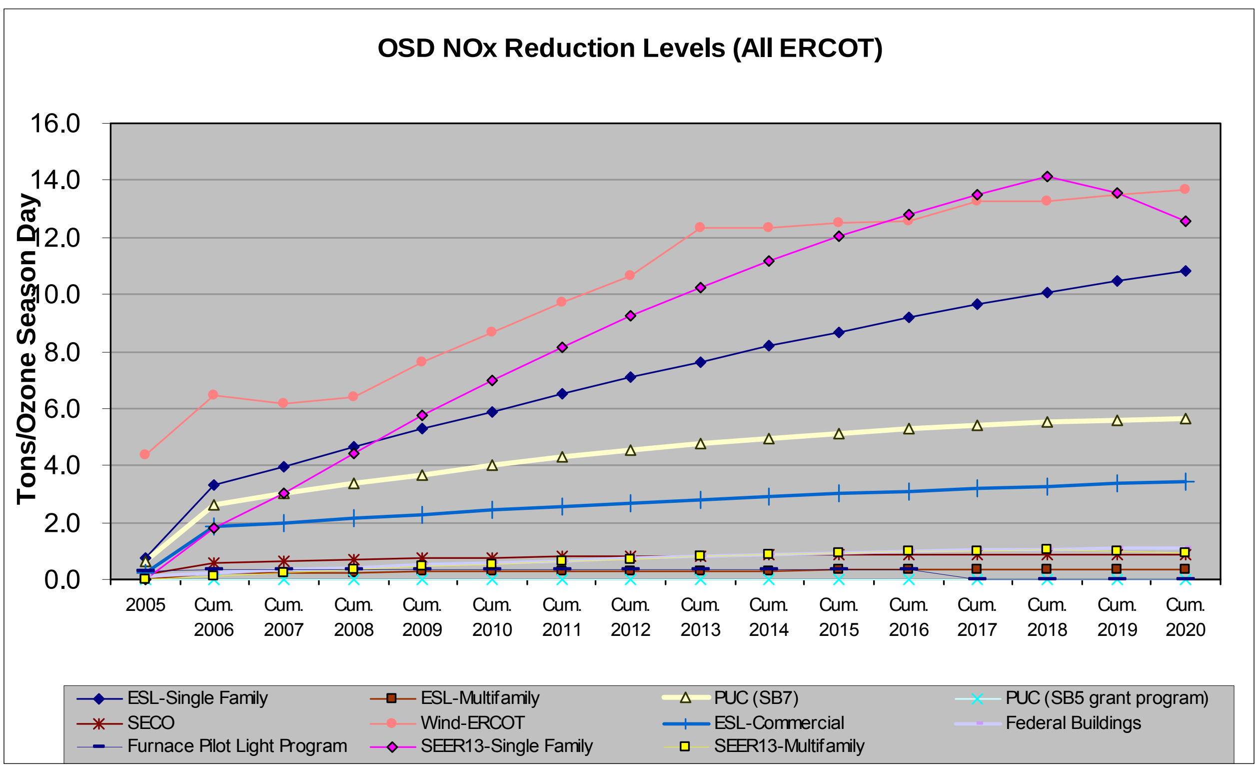


Figure 2: Cumulative OSD NOx Emissions Reduction Projected through 2020.

[5] These factors were determined by TCEQ.

3.7 Technology for Calculating and Verifying Emissions Reduction from Energy Used in Buildings

In 2004 and 2005, the Laboratory developed a web-based Emissions Reduction Calculator, known as "*eCalc*," which contains the underlying technology for determining NOx emissions reduction from power plants that generate the electricity for the user[6]. The emissions reduction calculator is being used to calculate emissions reduction for consideration for SIP credits from energy efficiency and renewable energy programs in the TERP.

In 2006, the Laboratory enhanced the calculator to provide additional functions and usability, including:

- Enhanced the 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;
- Enhanced web-based emissions reduction calculator, including:
    - Expanded emissions reduction calculator to include all counties in ERCOT;
    - Gathered, cleaned and posted weather data archive for 17 NOAA stations;
    - Expanded emissions reduction to include SEER 13 air conditioners for new and existing homes;
    - Continued the enhancement of the new computer architecture to allow for synchronous calculations, user accounts, and code-compliance;
- Continued the development of verification procedures, including:
    - Completion of calibrated simulation of a high-efficiency office building in Austin, Texas;
    - Worked towards a calibrated simulation of an office building;
    - Worked towards a calibrated simulation of a K-12 school; and
    - Completed the calibrated simulation of a Habitat for Humanities residence.
- Expanding the calculator to be able to analyze energy efficiency improvement to K-12 schools;
- Completing the new modules for municipal water and waste-water calculations; and
- Developing verification procedures for the savings including a utility bill analysis of representative residences built before and after the implementation of the State-wide building code.

3.8 Planned Focus for 2007/2008

In FY 2007, the Energy Systems Laboratory is continuing 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. In FY 2007 the Laboratory team will:

- Continue to 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 near-non-attainment county using the TCEQ/US EPA approved technology;
- Assist the PUCT with determining emissions reduction credits from energy efficiency programs funded by SB 7 and SB 5;
- Assist political subdivisions and Councils of Governments with calculating emissions reduction from local code changes and voluntary EE/RE programs reported to SECO for SIP inclusion;
- Continue to develop additional low-cost methods and techniques to implement 15% above code energy efficiency in low-priced and moderately-priced residential housing and commercial construction;

[6] eCalc reports NOx, SOx and CO2 emissions reduction from the US EPA eGRID database for power providers in the ERCOT region.

- With support from the US DOE and SECO, continue the development of a web-based code-compliance calculator in Austin, Texas (TCV project), and expand the use of such a calculator in other areas of Texas (i.e., the International Code Compliance Calculator – ICCC for Texas);
- Continue to develop creditable procedures for calculating NOx emissions reduction from green renewable technologies, including wind power, solar energy and geothermal energy systems;
- Continue development of the standardized, integrated NOx emissions reduction methodologies for calculating and reporting NOx reductions, including a unified database framework for required reporting to the TCEQ of potentially creditable measures from the ESL, PUCT, and SECO Senate Bill 5 initiatives;
- Complete the analysis of the stringency of several residential and commercial energy codes, including ASHRAE Standard 90.1-2004, and the 2006 IECC; and
- With the assistance of the TCEQ and EPA, expand all analysis to include all counties in Texas;
- With the assistance of the US EPA, expand the analysis to include new base year calculations;
- Continue its role as the National Center of Excellence on Displaced Emissions Reduction (CEDER) as designated by the US EPA; and
- Host the 2008 Clean Air Through Energy Efficiency (CATEE) conference to be held in Dallas, Texas.

The Laboratory will continue to provide technical assistance to the TCEQ, counties and communities working toward obtaining full SIP credit for the energy efficiency and renewable energy projects that are lowering emissions and improving the air quality for all Texans.

3.9 Code Adoption

State adoption of the Residential Code energy provisions and International Energy Conservation Code became effective September 1, 2001, although anecdotal evidence in the form of telephone queries reported observations and training workshop interactions through 2002 and, to a lesser extent, 2003, indicated a rolling start rather than an overnight implementation.

Our emphasis in 2006 has been on the continued delivery of training aimed at assisting municipal inspectors to become certified energy inspectors (in one of several designations maintained by the International Energy Code Council) and supporting code officials with guidance on interpretations as needed. This effort, begun in 2003 and based on a requirement of HB 3235 of the 78th Texas Legislature, is designed to support a more uniform interpretation and application of energy codes throughout the state. In general, the State has enjoyed a true market transformation in the supply of certain products, such as Low Solar Gain windows, and in builder participation in “above-code” code programs, which previously had no state baseline and almost no participation.

In the Houston area in particular, participation in above-code programs was driven by state acceptance of a program certification, such as Energy Star, as an acceptable demonstration of code compliance outside of municipal jurisdictions and availability of utility-based marketing support. The basic code adoption and implementation, jurisdiction by jurisdiction, remains a little uneven.

In 2006, efforts were made to work with the Laboratory’s Stakeholders to determine the most effective path toward the transition to the IECC 2006, which includes SEER 13 air conditioners. This includes several meetings and discussion about how to accomplish this.

3.9.1 Technology for Calculation and Verifying Emissions Reductions from Energy Used in Buildings

In 2004, the Laboratory developed a web-based Emissions Reduction Calculator, know as “eCalc,” which contains the underlying technology for determining emissions reductions from power plants that generate the electricity for the user. The Emissions Reduction Calculator is being used to calculate emissions reductions for consideration for SIP credits from energy efficiency programs in the TERP. The TCEQ and the US EPA continue to review the Laboratory's technology and recent refinements for estimating NOx emissions reductions from additional energy efficiency and renewable energy (EE/RE) measures.

In 2006, the Laboratory enhanced the calculator to provide additional functions and usability. 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 using the specially prepared 2007 version of eGRID.
- How to weather-normalize NOx emissions estimates for renewable sources, such as wind and solar.

In 2006, the Laboratory's Emissions Reduction Calculator used a specially prepared 2007 version of the US EPA's eGRID database to identify where emissions are produced. The Laboratory has also enhanced the previously developed emissions calculator by:

- expanding the capabilities to include all counties in ERCOT; including the collection and assembly of weather from 1999 to the present from 17 NOAA weather stations;
- expanding the calculator to be able to analyze energy efficiency improvement to K-12 schools;
- enhancing the underlying computer platform for the calculator;
- added calculations to account for the increased energy savings from the new SEER 13 air conditioners, introduced in 2006 as part of the new Federal regulations, and
- developing verification procedures for the savings currently calculated and reported by the Laboratory, including calibrated simulations for a two office buildings, one residence and one K-12 school.

3.9.2 Evaluation of Additional Technologies for Reducing Energy Use in Existing Buildings

The Laboratory provided technical assistance to the TCEQ, the PUCT, SECO and ERCOT, as well as Stakeholders participating in the Energy Code and Renewables programs.

- In 2005, the Laboratory worked closely with the TCEQ to develop an integrated NOx emissions reductions calculation that provided the TCEQ with a creditable NOx emissions reductions from energy efficiency and renewable energy (EE/RE) programs reported to the TCEQ in 2005 by the Laboratory, PUCT, SECO, and ERCOT (i.e., wind).
- At the request of the TCEQ, the Laboratory also developed procedures for quantifying NOx emissions reductions from wind turbines that includes weather normalization and the quantification of NOx emissions reductions from the new Federal regulations for SEER 13 air conditioners.
- At the request of the North Central Texas Council of Governments, the Laboratory developed recommendations for adopting the 2006 IECC, which are based, in part, on several meetings held with the SB5 stakeholders to determine how adopt the 2006 IECC, which was determined by the Laboratory to be less stringent than the 2000/2001 IECC for many counties and housing types in Texas.

3.10 Planned Focus for 2006/2007

In FY 2007, the Energy Systems Laboratory is continuing 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;
- Continue to refine the cost-effective techniques to implement 15% above code energy efficiency in low-priced and moderately-priced residential housing;
- Continue to refine the cost-effective methods and techniques to implement 15% above code energy efficiency in low-priced and moderately-priced commercial buildings;
- Continue to develop creditable procedures for calculating NOx emissions reductions from green renewable technologies, including wind power, solar energy and geothermal energy systems;
- Continue development of well-documented, integrated Nox emissions reductions 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;
- Upon request, provide written recommendations to the State Energy Conservation Office (SECO) about whether or not the energy efficiency provisions of latest published edition of the International Residential Code (IRC), or the International Energy Conservation Code (IECC), are equivalent to or better than the energy efficiency and air quality achievable under the editions adopted under the 2001 IRC/IECC. This will consider comments made by persons who have an interest in the adoption of the energy codes in the recommendations made to SECO.
- Develop a standardized report format to be used by providers of home energy ratings, including different report formats for rating newly constructed residences from those for existing residences.
- Continue to cooperate with an industry organization or trade association to: develop guidelines for home energy ratings; provide training for individuals performing home energy ratings and providers of home energy ratings; and provide a registry of completed ratings for newly constructed residences and residential improvement projects for the purpose of computing the energy savings and emissions reductions benefits of the home energy ratings program.
- Include all benefits attained from this program in an annual report to the commission.

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 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.

4 INTRODUCTION

4.1 Background

In 2001, the Texas Legislature adopted the Texas Emissions Reduction Plan, identifying thirty-eight counties in Texas where a focus on air quality improvements was deemed critical to public health and economic growth. Sixteen were designated by the US EPA as non-attainment areas, twenty-two others were designated by Senate Bill 5 as affected areas. These areas are shown on the map in Figure 3 as non-attainment (dark-shaded) and affected (shaded). The sixteen counties designated as non-attainment counties include: Brazoria, Chambers, Collin, Dallas, Denton, El Paso, Fort Bend, Hardin, Harris, Jefferson, Galveston, Liberty, Montgomery, Orange, Tarrant, and Waller Counties. The twenty-two counties designated as affected counties include: Bastrop, Bexar, Caldwell, Comal, Ellis, Gregg, Guadalupe, Harrison, Hays, Johnson, Kaufman, Nueces, Parker, Rockwall, Rusk, San Patricio, Smith, Travis, Upshur, Victoria, Williamson, and Wilson County. In 2003, three additional counties were classified as affected counties, including: Henderson, Hood and Hunt counties, bringing the total to forty-one counties (sixteen non-attainment and twenty-five affected counties).

These counties represent several geographic areas of the state, which have been assigned to different climate zones by the 2001 IECC[7] as shown in Figure 4, based primarily on Heating Degree Days (HDD). These include climate zone 5 or 6 (i.e., 2,000 to 2,999 HDD_{65}) for the Dallas-Ft. Worth and El Paso areas, and climate zones 3 and 4 (i.e., 1,000 to 1,999 HDD_{65}) for the Houston-Galveston-Beaumont-Port Author-Brazoria areas. Also shown on Figure 4 are the locations of the various weather data sources, including the Typical Meteorological Year (TMY2) (NREL 1995) stations, the Weather Year for Energy Calculations (WYEC2) (Stoffel 1995) weather stations, the National Weather Service weather stations, (NWS) (NOAA 1993) weather stations, the ASHRAE 90.1 1989 weather locations[8], the ASHRAE 90.1 1999 weather locations, the solar stations measured by the National Renewable Energy Laboratory (NREL)[9], the solar stations measured by the TCEQ[10], and F-CHART and PV F-CHART weather locations[11].

[7] The "2000 IECC" notation is used to signify the 2000 International Residential Code (IRC), which includes the International Energy Conservation Code (IECC) as modified by the 2001 Supplement (IECC 2001), published by the ICC in March of 2001, as required by Senate Bill 5.

[8] The ASHRAE 90.1-1989 and 90.1-1999 weather stations are used in the emissions calculator for determining the building characteristics.

[9] The NREL stations were the primary source of the 1999 global horizontal, direct normal and diffuse solar radiation used to determine the 1999 peak-day and annual emissions for the DOE-2 simulations for code-compliant housing and commercial buildings.

[10] The TCEQ stations were used as the secondary source for global horizontal solar radiation when the NREL sites were missing data or no NREL site was nearby.

[11] The F-Chart and PV F-Chart weather locations are used to determine the solar thermal or electricity produced by the systems specified by the use in the emissions calculation. The monthly energy or electricity production from F-Chart or PV F-Chart is then weather-normalized using ASHRAE's Inverse Model Toolkit to develop coefficients that are then used to determine the 1999 annual and peak day energy or electricity production for emissions calculations.

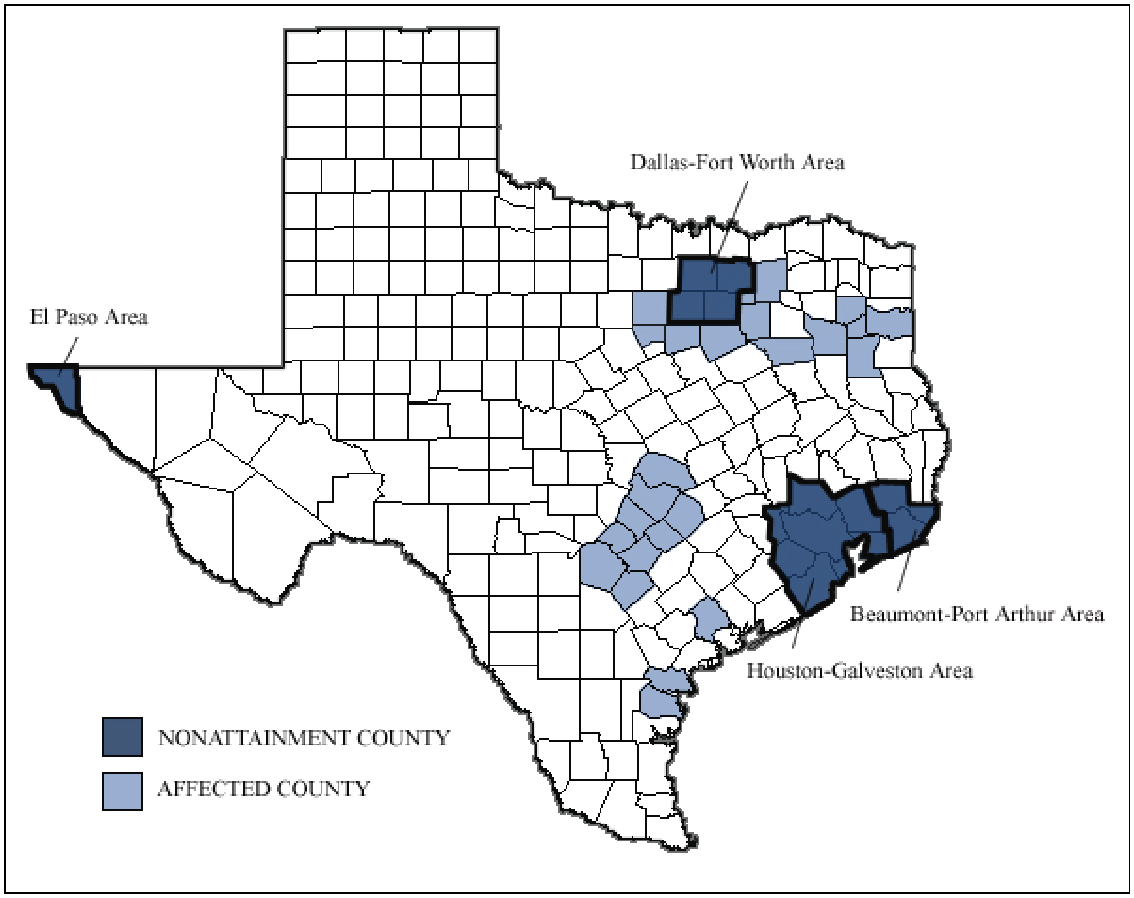
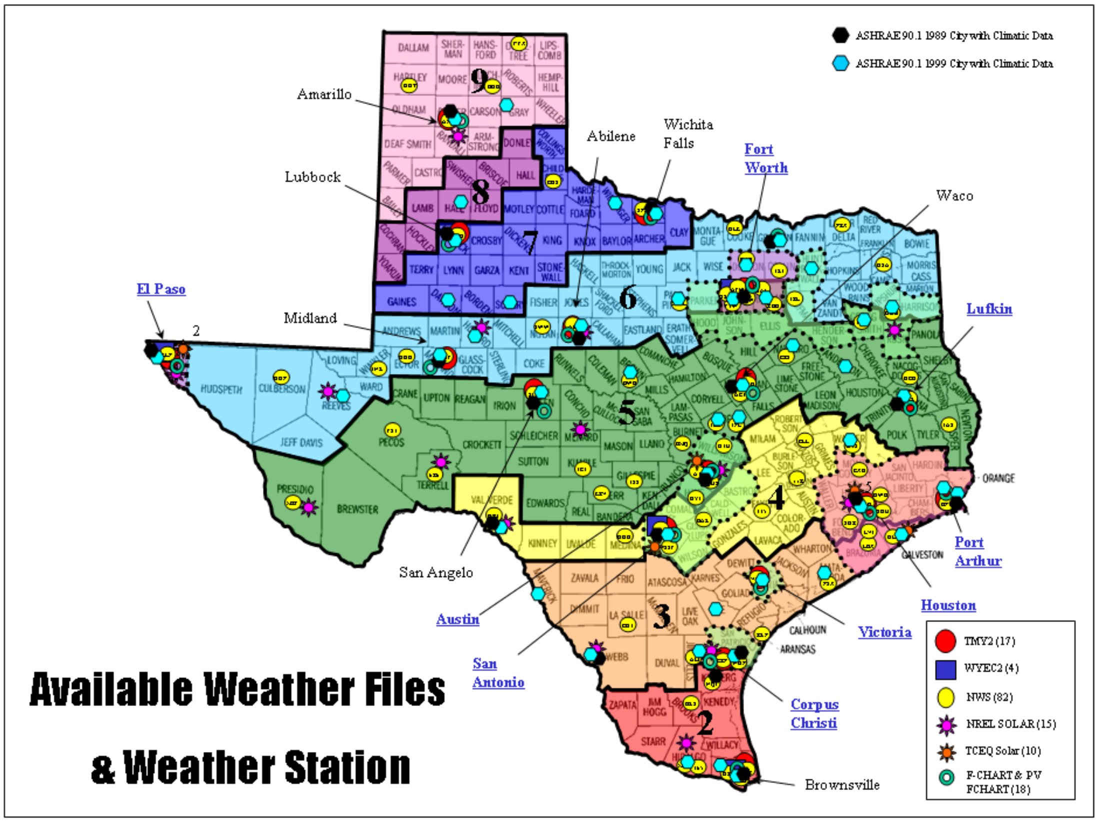


Figure 3: US EPA Non-attainment (dark shade) and affected counties (light shade).



List of Available Weather Files and Weather Stations of Texas

Texas Weather Stations (NOAA)

1 Abilene Regional Airport (ABI)
2 Alice International Airport (ALI)
3 Amarillo International Airport (AMA)
4 Angleton / Lake Jackson Brazori (LBX)
5 Arlington Municipal Airport (GKY)
6 Austin - Bergstrom International (AUS)
7 Austin Camp Mabry (ATT)
8 Borger Hutchinson County Airport (BGD)
9 BRENHAM: BRENHAM MUNICIPAL AIRPORT (11R)
10 Brownsville S Padre Isl International (BRO)
11 BROWNWOOD: BROWNWOOD REGIONAL AIRPORT (BWD)
12 Burnet Municipal Airport (BMQ)
13 Childress Municipal Airport (CDS)
14 College Station (CLL)
15 Conroe Montgomery County Airport (CXO)
16 Corpus Christi International Airport (CRP)
17 CORPUS CHRISTI: CORPUS CHRISTI NAS/TRUAX FIELD ARPT (NGP)
18 Corsicana Campbell Field (CRS)
19 Cotulla La Salle Co Airport (COT)
20 Dalhart Municipal Airport (DHT)
21 Dallas - Fort Worth International Airport (DFW)
22 Dallas Love Field (DAL)
23 Dallas Redbird Airport (RBD)
24 Del Rio International Airport (DRT)
25 Denton Municipal Airport (DTO)
26 Dryden Terrell County Airport (6R6)
27 El Paso International Airport (ELP)
28 FALFURRIAS: BROOKS COUNTY AIRPORT (BKS)
29 Fort Stockton Pecos County Airport (FST)
30 Fort Worth Alliance Airport (AFW)
31 Fort Worth Meacham (FTW)
32 FREDERICKSBURG: GILLESPIE COUNTY AIRPORT (T82)
33 GAINESVILLE: GAINESVILLE MUNICIPAL AIRPORT (GLE)
34 Galveston Scholes Field (GLS)
35 GEORGETOWN: GEORGETOWN MUNICIPAL AIRPORT (GTU)
36 Harlingen Rio Grande Valley I (HRL)
37 Hondo Municipal Airport (HDO)
38 Houston Bush Intercontinental (IAH)
39 Houston Clover Field (LVJ)
40 Houston Hooks Memorial Airport (DWH)
41 Houston Sugarland Mem (SGR)
42 Houston William P Hobby Airport (HOU)
43 Huntsville Municipal Airport (UTS)
44 JASPER: JASPER COUNTY-BELL FIELD AIRPORT (JAS)
45 Junction Kimble County Airport (JCT)
46 KERRVILLE: KERRVILLE MUNI/LOUIS SCHREINER FLD AIRPORT (ERV)
47 KILLEEN: KILLEEN MUNICIPAL AIRPORT (ILE)
48 KINGSVILLE: KINGSVILLE NAS AIRPORT (NQI)
49 LA GRANGE: FAYETTE REGIONAL AIR CENTER AIRPORT (3T5)
50 Longview E Tx Rgnl Airport (GGG)
51 Lubbock International Airport (LBB)
52 Lufkin Angelina Cty Airport (LFK)
53 MARFA: MARFA MUNICIPAL AIRPORT (MRF)
54 McAllen Miller International Airport (MFE)
55 McKinney Municipal Airport (TKI)
56 Midland International Airport (MAF)
57 Mineral Wells Airport (MWL)
58 MOUNT PLEASANT: MOUNT PLEASANT REGIONAL AIRPORT (OSA)
59 NACOGDOCHES: A L MANGHAM JR REGIONAL AIRPORT (OCH)
60 New Braunfels Municipal Airport (BAZ)
61 Odessa Schlemeyer Field (ODO)
62 Palacios Municipal Airport (PSX)
63 PARIS: COX FIELD AIRPORT (PRX)
64 PERRYTON: PERRYTON OCHILTREE COUNTY AIRPORT (PYX)
65 Pine Springs Guadalupe Mounta (GDP)
66 Port Arthur Se Tx Rgnl Airport (BPT)
67 Port Isabel Cameron County Airport (PIL)
68 Rockport Aransas Co Airport (RKP)
69 San Angelo Mathis Field (SJT)
70 San Antonio International Airport (SAT)
71 San Antonio Stinson Municipal Airport (SSF)
72 SAN MARCOS: SAN MARCOS MUNICIPAL AIRPORT (HYI)
73 SWEETWATER: AVENGER FIELD AIRPORT (SWW)
74 TEMPLE: DRAUGHON-MILLER CNTRL TEXAS REGIONAL ARPT (TPL)
75 Terrell Municipal Airport (TRL)
76 Tyler Pounds Field (TYR)
77 Victoria Regional Airport (VCT)
78 WACO: MC GREGOR EXECUTIVE AIRPORT (PWG)
79 Waco Regional Airport (ACT)
80 WESLACO: MID VALLEY AIRPORT (T65)
81 Wichita Falls Municipal Airport (SPS)
82 Wink Winkler Co Airport (INK)

Texas TMY2 Weather Files

1 Abilene
2 Amarillo
3 Austin
4 Brownsville
5 Corpus Christi
6 El Paso
7 Fort Worth
8 Houston
9 Lubbock
10 Lufkin
11 Midland
12 Port Arthur
13 San Angelo
14 San Antonio
15 Victoria
16 Waco
17 Wichita Falls

Texas WYEC2 Weather Files

1 El Paso
2 Brownsville
3 Fort Worth
4 San Antonio

NREL Solar Stations

1 Abilene
2 Austin
3 Big Spring
4 Canyon
5 Clear Lake
6 Corpus Christi
7 Del Rio
8 Edinburg
9 El Paso
10 Laredo
11 Menard
12 Overton
13 Pecos
14 Presidio
15 Sanderson

TCEQ Solar Stations

1 Bexar
2 Travis
3 El Paso (2)
4 Galveston
5 Harris (5)

FCHART and PV FCHART (New Weather File)

1 ABILENE
2 AMARILLO
3 AUSTIN
4 BROWNSVILLE
5 CORPUS CHRISTI
6 EL PASO
7 FORT WORTH
8 HOUSTON
9 LUBBOCK
10 LUFKIN
11 MIDLAND-ODESSA
12 PORT ARTHUR
13 SAN ANGELO
14 SAN ANTONIO
15 SHERMAN
16 VICTORIA
17 WACO
18 WICHITA FALLS

Figure 4: Available NWS, TMY2 and WYEC2 weather files compared to IECC / IRC weather zones for Texas.

4.2 Energy Systems Laboratory's Responsibilities in the TERP.

In 2001, Texas Senate Bill 5 outlined the following responsibilities for the Energy Systems Laboratory (ESL) within the TERP:

- Sec. 386.205. Evaluation of State Energy Efficiency Programs.
- Sec. 388.003. Adoption of Building Energy Efficiency Performance Standards.
- Sec. 388.004. Enforcement of Energy Standards Outside of Municipality.
- Sec. 388.007. Distribution of Information and Technical Assistance.
- Sec. 388.008. Development of Home Energy Ratings.

These responsibilities were updated in 2003:

1) with House Bill 1365, including modifications to:

- Sec. 388.004. Enforcement of Energy Standards Outside of Municipality.
- Sec. 388.009. Energy-Efficient Building Program.

2) with House Bill 3235, including modifications to:

- Sec. 388.009. Certification of Municipal Building Inspectors.

These responsibilities were updated in 2005:

- with Senate Bill 20, House Bill 2481, and 2129.

These responsibilities were further updated in 2007:

- with Senate Bill 12 and House Bill 3693.

In the following sections each of these tasks is further described.

4.2.1 (SB 5) Section 386.205. Evaluation of State Energy Efficiency Programs (w/PUCT).

The Laboratory is instructed to assist the Public Utility Commission of Texas (PUCT) and provide an annual report that quantifies by county the reductions of energy demand, peak loads, and associated emissions of air contaminants achieved from the programs implemented under this subchapter and from those implemented under Section 39.905, Utilities Code (i.e., Senate Bill 7).(SB 5) Sec. 388.003. Adoption of Building Energy Efficiency Performance Standards.

Senate Bill 5 adopts the energy efficiency chapter of the 2001 International Residential Code (2001 IRC) as an energy code for single-family residential construction, and the 2001 International Energy Conservation Code (2001 IECC) for all other residential, commercial and industrial construction in the state. It requires that municipalities establish procedures for administration and enforcement, and ensure that code-certified inspectors perform inspections.

Senate Bill 5 provides that local amendments, in non-attainment areas and affected counties, may not result in less stringent energy efficiency requirements. The Laboratory is to review local amendments, if requested, and submit an annual report of savings impacts to the TCEQ. The Laboratory is also authorized to collect fees for certain of its tasks in Sections 388.004, 388.007 and 388.008.

4.2.3 (SB 5) Sec. 388.004. Enforcement of Energy Standards Outside of Municipality.

For construction outside of the local jurisdiction of a municipality, Senate Bill 5 provides for a building to comply if:

a) a building certified by a national, state, or local accredited energy efficiency program shall be considered in compliance;
b) a building with inspections from private code-certified inspectors using the energy efficiency chapter of the International Residential Code or International Energy Conservation Code shall be considered in compliance; and
c) a builder who does not have access to either of the above methods for a building shall certify compliance using a form provided by the Laboratory, enumerating the code-compliance features of the building.

4.2.4 (SB 5) Sec. 388.007. Distribution of Information and Technical Assistance.

The Laboratory is required to make available to builders, designers, engineers, and architects code implementation materials that explain the requirements of the International Energy Conservation Code and the energy efficiency chapter of the International Residential Code. Senate Bill 5 authorizes the Laboratory to develop simplified materials to be designed for projects in which a design professional is not involved. It also authorizes the Laboratory to provide local jurisdictions with technical assistance concerning implementation and enforcement of the International Energy Conservation Code and the energy efficiency chapter of the International Residential Code.(SB 5) Sec. 388.008. Development of Home Energy Ratings.

Senate Bill 5 requires the Laboratory to develop a standardized report format to be used by providers of home energy ratings (HERs). The form must be designed to give potential buyers information on a structure's energy performance, including certain equipment. Senate Bill 5 requires the Laboratory to establish a public information program to inform homeowners, sellers, buyers, and others regarding home energy ratings.

4.2.6 (HB 1365) Sec. 388.004. Enforcement of Energy Standards Outside of Municipality.

In 2003, House Bill 1365 modified Section 388.004 of Senate Bill 5 to include the following new requirements:

- That builders shall retain for three years documentation which shows their building is in compliance with the Texas Building Energy Performance Standards, and that builders shall provide a copy of the compliance documentation to homeowners.
- That single-family residences built in unincorporated areas of counties, which were completed on or after September 1, 2001, but not later than August 31, 2003, are considered in compliance with the Texas Building Energy Performance Standards.

To help builders comply with these requirements, the Laboratory will enhance the current form, which is posted on the Laboratory's Senate Bill 5 website.

4.2.7 (HB 1365) Sec. 388.009. Energy-Efficient Building Program.

In 2003, House Bill 1365 modified the TERP, adding a new Section 388.009. In this section the General Land Office, the TCEQ and the Laboratory, working with an advisory committee, may develop an energy-efficient building accreditation program for buildings that exceed the building energy performance standards under Section 388.003 by 15% or more. This program shall be updated annually to include best available energy-efficient building practices. This program shall use a checklist system to produce an energy-efficient building scorecard to help: (1) home buyers compare potential homes and, by providing a copy of the completed scorecard to a mortgage lender, qualify for energy-efficient mortgages under the National Housing Act; and (2) communities qualify for emissions reduction credits by adopting codes that meet or exceed the energy-efficient building or energy performance standards established under this chapter. This effort may include a public information program to inform homeowners, sellers, buyers, and others regarding energy-efficient building ratings. The Laboratory shall establish a system to measure the reduction in energy and emissions produced under the energy-efficient building program and report those savings to the commission.

4.2.8 (HB 3235) Sec. 388.009. Certification of Municipal Inspectors.

Also in 2003, House Bill 3235 modified the TERP to add the new Section 388.009. In this section the Laboratory is required to develop and administer a state-wide training program for municipal building inspectors who seek to become code-certified inspectors. To accomplish this, the Laboratory will work with national code organizations to assist participants in the certification program and is allowed to collect a reasonable fee from participants in the program to pay for the costs of administering the program. This program is required to be developed no later than January 1, 2004, with state-wide training sessions starting no later than March 1, 2004.

4.2.9 (SB 20, HB 2481, HB 2129). Additional Energy-Efficiency Initiatives.

The 79th Legislature, through SB 20, HB 2481 and HB 2129, amended SB 5 to enhance its effectiveness by adding the following additional energy-efficiency initiatives, including requiring 5,880 MW of generating capacity from renewable energy technologies by 2015, and 500 MW from non-wind renewables.

This legislation also requires PUCT to establish a target of 10,000 MW of installed renewable capacity by 2025, and requires TCEQ to develop a methodology for computing emissions reductions from renewable energy initiatives and the associated credits. The Laboratory is to assist TCEQ in quantifying emissions reductions credits from energy-efficiency and renewable-energy programs, through a contract with the Texas Environmental Research Consortium (TERC) to develop and annually calculate creditable emissions reductions from wind and other renewable energy resources for the state's SIP.

Finally, this legislation requires the Laboratory to develop at least 3 alternative methods for achieving a 15 % greater potential energy savings in residential, commercial and industrial construction. To accomplish this, the Laboratory will be using the code-compliance calculator to ascertain which measures are best suited for reducing energy use without requiring substantial investments.

4.2.10 (SB 12, HB 3693). Additional Energy-Efficiency Initiatives.

The 80th Legislature (2007), through SB 12, and HB 3693 amended SB 5 to enhance its effectiveness by adding several new energy efficiency initiatives. First, it requires the Laboratory to provide written recommendations to the State Energy Conservation Office (SECO) about whether or not the energy efficiency provisions of latest published edition of the International Residential Code (IRC), or the International Energy Conservation Code (IECC), are equivalent to or better than the energy efficiency and air quality achievable under the editions adopted under the 2001 IRC/IECC. The laboratory shall make its recommendations not later than six months after publication of new editions at the end of each three-year code development cycle of the International Residential Code and the International Energy Conservation Code. As part of this work with SECO, the Laboratory is required to consider comments made by persons who have an interest in the adoption of the energy codes in the recommendations made to SECO.

In addition, it requires the Laboratory to develop a standardized report format to be used by providers of home energy ratings, including different report formats for rating newly constructed residences from those for existing residences. The form must be designed to give potential buyers information on a structure's energy performance, including: insulation; types of windows; heating and cooling equipment; water heating equipment; additional energy conserving features, if any; results of performance measurements of building tightness and forced air distribution; and an overall rating of probable energy efficiency relative to the minimum requirements of the International Energy Conservation Code or the energy efficiency chapter of the International Residential Code, as appropriate.

It also encourages the Laboratory to cooperate with an industry organization or trade association to: develop guidelines for home energy ratings; provide training for individuals performing home energy ratings and providers of home energy ratings; and provide a registry of completed ratings for newly constructed residences and residential improvement projects for the purpose of computing the energy savings and emissions reductions benefits of the home energy ratings program. Finally, it requires the Laboratory shall to include information on the benefits attained from this program in an annual report to the commission.

5 PROGRESS: JANUARY 2006 TO JUNE 2007

5.1 (SB 5) Section 386.205. Evaluation of State Energy-Efficiency Programs (w/PUCT).

5.1.1 Implemented Procedures for Evaluating State Energy-Efficiency Programs

In 2004 the Laboratory held several meetings with the Public Utility Commission of Texas to discuss the development of a framework for reporting emissions reduction from the State Energy Efficiency Programs administered by the PUCT. The State Energy-Efficiency Programs administered by the PUCT include programs under Senate Bill 7 (i.e., Section 39.905 Utilities Code) and Senate Bill 5.

In 2003 and 2004, the Laboratory worked with the TCEQ to identify a method to help the PUCT more accurately report their deemed savings as peak-day savings in 1999, using the Laboratory's new emissions reductions calculator. In 2005, this method was implemented in the TCEQ's Integrated Emissions Calculations, which was reported in the 2005 annual report, and in this 2006 annual report.

5.2 (SB 5) Sec. 388.003. Adoption of Building Energy-Efficiency Performance Standards.

5.2.1 Provide Code Training Sessions

During the 77th Legislature, Senate Bill 5 (SB 5) adopted the 2000 International Residential Code (IRC) as the energy code for single-family residential construction and the 2000 edition of the International Energy Conservation Code (IECC), with the 2001 Supplement for all other residential, commercial and industrial construction in the state. It requires that municipalities establish procedures for administration and enforcement, and ensure that code-certified inspectors perform inspections.

These codes are published by the International Code Council (ICC), which publishes a new edition every three years and a supplement in the intervening years. The 2003 Codes have been reviewed and determined to be no less stringent than the editions currently adopted by SB 5. Transition to the 2003 IRC and IECC can be easily accomplished.

Section 388.009 requires the Laboratory to develop and administer a state-wide training program for municipal building inspectors who seek to become code-certified inspectors. To accomplish this, the Laboratory developed the Energy Code Workshops which are based on the 2003 International Energy Conservation Code (IECC) as published by the International Code Council (ICC) for residential and commercial buildings. In addition, three more workshops were developed that offered software training, ASHRAE Standard 62.1 and ASHRAE Standard 90.1.

The Residential Energy Code Training Workshop and Commercial Requirements of the International Energy Conservation Workshop both include an overview of Senate Bill 5 (SB 5) and extensive instruction on all chapters of the IECC, which include the General requirements, definitions, and design conditions. The Residential Workshop also includes detailed instruction on Chapters 4, 5 and 6, which are the specific regulations relating to residential construction, in addition to a comparison of the IECC and the energy provisions of the International Residential Code (IRC). The Commercial Workshop includes detailed instruction on Chapters 7 and 8, which relate to commercial regulations and a summary of the relationship between ASHRAE 90.1 and the commercial provisions of the IECC.

The ASHRAE 90.1 Workshop includes a brief overview of SB 5 and a summary of the relationship between ASHRAE 90.1 and the Commercial provisions of the IECC. ASHRAE Standard 62.1 workshops provide training concerning ASHRAE commercial building ventilation rates. Software workshops were also developed to begin the training of the use of software for calculating code compliance.

Table 2: IECC / IRC Residential and ASHRAE 90.1 Commercial Building Code Workshops for Senate Bill 5 during the Period September 2004 to August 2005.

	RESIDENTIAL	COMMERCIAL	SOFTWARE	ASHRAE 62.1	ASHRAE 90.1
LOCATION					
Houston (BPI)	01/26/06				
Houston (BPI)	01/25/06				
San Antonio					02/16/06
San Antonio				04/18/06	
Arlington (BPI)	05/22/06				
Arlington (BPI)		05/23/06			
Arlington (BPI)			05/24/06		
Houston		07/11/06			
Houston					07/12/06
Amarillo	08/09/06				
Amarillo		08/10/06			
Amarillo			08/11/06		
Houston		10/10/06			
Houston					10/13/06
Dallas				01/25/07	
Dallas					02/13/07
Dallas	02/13/07				
Austin	02/15/07				
Houston	03/13/07				
Houston					03/13/07
Dallas					03/14/07
Austin	03/15/07				
Austin					03/15/07
Dallas				04/10/07	
Dallas					04/11/07
Lubbock	04/17/07				

San Antonio	04/19/07				
Arlington (BPI)			05/16/07		
Longview			05/31/07		
Longview			05/31/07		
Fort Worth			09/14/07		
Forney	09/08/07				
Wichita Falls			09/06/07		
Wichita Falls	09/05/07				
Austin					07/11/07
College Station			06/22/07		
College Station			06/22/07		
Waco			06/21/07		
Waco			06/21/07		
Nacogdoches			06/01/07		
Nacogdoches			06/01/07		

5.2.2 Provide Recommendations on Code Upgrades.

During the 77th Legislature Senate Bill 5 (SB 5) adopted the 2000 International Residential Code (IRC) as the energy code for single-family residential construction, and the 2000 edition of the International Energy Conservation Code (IECC), with the 2001 Supplement for all other residential, commercial and industrial construction in the state. It requires that municipalities establish procedures for administration and enforcement, and ensure that code-certified inspectors perform inspections.

These codes are published by the International Code Council (ICC), which publishes a new edition every three years and a supplement in the intervening years. The 2003 Codes have been reviewed and determined to be no less stringent that the editions currently adopted by SB 5. Transition to the 2003 IRC and IECC can be easily accomplished.

The 2006 Codes have been reviewed and information regarding their stringency is presented in a later section.

5.2.2.1 Provided Updated Duct-R6/SEER-14 Tradeoff Recommendations.

The Energy Systems Laboratory was requested by a stakeholder group consisting of building officials, residential builders, air conditioning contractors, product suppliers, and home energy raters to provide guidance on how new Federal standards for residential air conditioners and heat pumps under the National Appliance Energy Conservation Act (NAECA) may impact allowable trade-offs involving equipment efficiency and duct insulation in attics, especially during a transition period during which time new lines of higher efficiency equipment may not be readily available.

This memo revises an earlier edition published December 28, 2005. The primary changes are:
1. Revision of a table in the “improved windows” option, which will result in a larger number of available window products being eligible for this trade-off in some zones; and
2. Clarification of a note on electric resistance heating in the “SEER 14/R6, R6” option.

A copy of the letter to stakeholders from the Laboratory is provided in Figure 5 to Figure 8.

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March 15, 2006

To: Stakeholders in Residential Energy Code Compliance
From: Energy Systems Laboratory,
Bahman Yazdani, P.E., Associate Director
Re: Revised Compliance Options for Insulating Ducts in Unconditioned Attics for Projects Permitted On or After Jan. 23, 2006

This memo revises an earlier edition published December 28, 2005. The primary changes are:

1. Revision of a table in the "improved windows" option, which will result in a larger number of available window products being eligible for this trade-off in some zones; and
2. Clarification of a note on electric resistance heating in the "SEER 14/R6, R6" option.

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NAECA provides that Federal standards for certain products preempt standards for those same products in state and local codes under certain conditions. The new NAECA standards for residential central air conditioners and heat pumps became effective January 23, 2006. Details of the new standards are available in the Federal Register FR/Vol. 69, No. 158, Aug. 17, '2004, and in a December 20, 2005 notice clarifying the preemption issue on the Department of Energy's website for Building Codes & Standards

http://www.energycodes.gov/residential_ac_hp.stm.

Products manufactured to the older standards existing prior to January 23, 2006 may be sold and installed after this date. To the extent that NAECA preempts a

Figure 5: March 15, 2006 Stakeholders Letter Regarding Duct Tradeoff for Projects Permitted on or after Jan 23rd, 2006.

standard in a state or locally adopted building code, it does not affect previously permitted projects. Please consult your local building official for all issues of code interpretation and procedures for local administration and enforcement.

This guidance focuses on compliance with energy code requirements in Texas for insulating the air conditioning ducts in unconditioned attics and on alternative methods of achieving equal or better energy performance, assuming all other code requirements have been satisfied prior to addressing equipment efficiency and duct insulation levels. Options shown in the following table are briefly described below.

Options	After Jan. 23, 2006
1	SEER 13/R-8, R-4
2	SEER 14/R-6, R-6
3	Energy Star (see below)
4	SEER 13/R-6, R-6/ and improved windows
5	IECC Chapter 4 Systems Analysis, SEER 13
6	SEER 10 or higher (mfd. before 1/23/06) /R-8, R-4 (no trade-offs)
7	IRC Chapter 11, where applicable, SEER 10 or higher (mfd. before 1/23/06) or SEER 13, prescriptive requirements.

The codes being referenced are the International Residential Code (IRC) and International Energy Conservation Code (IECC) 2000 editions as modified by the 2001 Supplement published in March 2001 . Unless the IRC is expressly noted, these options relate to the 2001 IECC.

SEER 13/R-8, R-4:

For air conditioners, SEER 13 (and HSPF 7.7, if applicable) with R-8 insulation on supply ducts and R-4 on return ducts meet energy code requirements.

SEER 14/R-6, R-6:

A SEER 14/R-6 Trade-Off (and HSPF 7.7 for heat pumps, if applicable) will be allowed as an alternative compliance approach, with the following restrictions, based on analysis of the energy impact by the ESL.

A) For Gas or Electric Heating Systems:

1) For heating-degree-days (HDDs) less than 3,000 HDDs, the SEER14/R6 Trade-Off.
2) For heating-degree-days (HDDs) greater than or equal to 3,000 HDDs, the SEER14/R6 Trade-Off may be used if the heating system, other than electric resistance heating, has an AFUE rating greater than or equal to 80%.

Note: The SEER14/R-6 Trade-Off may not be used in zones with HDD greater than or equal to 3000 if the primary heating system uses electric resistance heating *(This note was revised 3-15-06.)*

Figure 6: March 15, 2006 Stakeholders Letter Regarding Duct Tradeoff for Projects Permitted on or after Jan 23rd, 2006.

Energy Systems Laboratory
Compliance Options for Insulating Ducts in Unconditioned Attics

B) For Heat Pump Heating Systems:

1) For heating-degree-days (HDDs) less than 3,000 HDDs, the SEER14/R-6 Trade-Off may be used if the heat pump has an HSPF rating greater than or equal to 7.7.
2) For heating-degree-days (HDDs) greater than or equal to 3,000 HDDs, the SEER14/R-6 Trade-Off may be used if the heat pump has an HSPF rating greater than or equal to 7.9.

Energy Star:

The Energy Systems Laboratory does not make compliance determinations concerning the Environmental Protection Agency's (EPA) Energy Star Program. Texas Health & Safety Code Section 388.003(i) provides that the EPA's Energy Star Program certification of energy code compliance equivalence is considered evidence of compliance under Texas law.

SEER 13/R-6, R-6 and improved windows:

R-6 insulation on both supply and return may be used in combination with a SEER 13 air conditioner and windows that exceed the base code prescriptive requirements by achieving labeled U-factors and solar heat gain coefficients (SHGC) at or below those in the following table.

Climate zone	HDD	Maximum U-factor WWR* ≤15%	WWR* ≤20%	WWR* ≤25%	Max SHGC	Min. Duct Insul. Supply	Min. Duct Insul. Return
2	500-999	0.83	0.72	0.64	0.35	R-6	R-6
3	1000-1499	0.68	0.66	0.53	0.35	R-6	R-6
4	1500-1999	0.68	0.56	0.49	0.35	R-6	R-6
5	2000-2499	0.59	0.47	0.46	0.40	R-6	R-6
6	2500-2999	0.55	0.46	0.42	0.40	R-6	R-6
7	2000-3499	0.50	0.42	0.41	0.40	R-6	R-6
8	3500-3999	0.46	0.38	0.38	NR	R-6	R-6
9	4000-4999	0.41	0.34	0.34	NR	R-6	R-6

**WWR: Window to Wall Ratio*
(Table revised 3-15-06)

IECC Chapter 4 Systems Analysis:

Any "proposed design" (no prescriptive limits on components) may demonstrate compliance by a systems analysis that meets the criteria in Chapter 4 of the 2000 IECC with 2001 Supplement. The inputs for the "standard design" should include

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Figure 7: March 15, 2006 Stakeholders Letter Regarding Duct Tradeoff for Projects Permitted on or after Jan 23rd, 2006.

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Compliance Options for Insulating Ducts in Unconditioned Attics

a SEER 13 air conditioner, and meet all other prescriptive requirements of the IECC. If a heat pump is used, the HSPF in the standard design must be 7.7. The analysis shall state in its output report: "this home meets the annual energy consumption requirements of Chapter 4 of the 2001 International Energy Conservation Code based on _____ Heating Degree Days."

SEER 10 or higher (manufactured before 1/23/06)/R-8, R-4:

SEER 10 or higher air conditioners and HSPF 6.8 or higher heat pumps which meet the NAECA standards in effect at the time of manufacture may continue to be used in prescriptive compliance approaches. Pursuant to the DOE notice of December 20, 2005, no Trade-Offs are allowed with this option.

IRC Chapter 11, where applicable, SEER 10 or higher (mfd. before 1/23/06) or SEER 13, with prescriptive duct insulation requirements.

Meeting the requirements of the 2000 International Residential Code with the 2001 Supplement, Chapter 11, for buildings with glazing area that does not exceed 15 percent of the gross area of exterior wall, provides compliance using a SEER 13/HSPF 7.7 or higher or SEER 10 or higher (manufactured before 1-23-2006).

> *"All portions of the air distribution system shall be installed in accordance with Section M1601 and be insulated to an installed R-5 when system components are located within the building but outside of conditioned space, and R-8 when located outside of the building. When located within a building envelope assembly, at least R-8 shall be applied between the duct and that portion of the assembly furthest from conditioned space."*

THIS COMMUNICATION IS INTENDED TO PROVIDE GENERAL GUIDANCE ON A SPECIFIC TOPIC. IT IS NOT INTENDED TO BE NOR SHOULD IT BE RELIED UPON AS LEGAL ADVICE. - 4 -

Figure 8: March 15, 2006 Stakeholders Letter Regarding Duct Tradeoff for Projects Permitted on or after Jan 23rd, 2006.

5.2.3 Summary of ASHRAE Standard 90.1 Standards Committee Activities during 2006, and Ongoing Subcommittee Actions.

This segment reports on the activities of the ASHRAE 90.1 Standards Committee with regard to subcommittee actions and recommendations on addenda items for the next cycle of the Standard. Information presented is from the 2006 ASHRAE meetings in Chicago (January) and in Quebec (June) as well as work done in between these main meetings by the subcommittees. Most of the Standard 90.1 subcommittees' work has involved updates to the 2004 version of ASHRAE 90.1 that will result in the 2007 version. The 90.1 Standards Subcommittee work is presented in order of: ECB (Energy Cost Budget), Envelope, Lighting and Mechanical. What will be revealed in all of the reporting of committee work will be recommended or approved updates for the 2007 (and sometimes 2010) version of the 90.1 Standard.

5.2.3.1 Summary comment on the status of the 90.1 Standard.

In 2006, ASHRAE set forth a new strategic plan focused toward sustainability. It is directed toward leading a drive toward "Net-Zero Energy buildings" over the next several years. The hallmark group that is being relied upon to help achieve this goal is the SSPC 90.1, whose members are diligently working through practical paths to enhance the chances of making the goal a reality. ASHRAE has begun to publish a series of "Advanced Energy Guidelines" that are targeted at energy reductions of 30% beyond the base standard of 90.1-1999. The first issue was on small office buildings (2004) and the second, on small retail buildings (2006.) Subsequent issues are being developed for K-12 schools, warehouses, and more. The 90.1 committee has been asked to produce the foundation for these documents. The documents address improvements in envelope design, interior lighting, and HVAC equipment that is sensitive to its respective climate zone. Simulation runs so far would suggest that these guides are likely to save between 30 and 44% over Standard 90.1-1999, depending on the climate zone of the building site.

More requests are being placed on the SSPC 90.1 committee. They've been asked by the Standards Committee to target the stringency of 90.1-2007 to achieve a 5% energy savings over the 2004 version. They've been requested to maintain a connection to, and a participation in, the development of the Advanced Energy Guidelines series. The committee has also been given the task of maintaining a closer collaboration with the IECC code developments and giving consensus-based, formal, feedback to the ICC in that regard. Another role being asked of SSPC 90.1 is to be cognizant of developments in a newly proposed ASHRAE Standard, 189P. This is a standard for the design of high-performance green buildings, and is being developed in conjunction with the Illuminating Engineering Society of North America (IESNA) and the U.S. Green Building Council (USGBC). This is the first such green building standard in the United States.

Significant work by the SSPC 90.1 has also been directed toward the new Appendix G, the Performance Rating Method, which parallels much of the Energy Cost Budget (ECB) method in Section 11. At this time, this appendix is informative and does not contain requirements necessary for conformance; however, discussion is afoot about making this appendix normative, i.e., a mandatory requirement. It presents a methodology to rate the "efficiency" (rather than energy cost) of building designs to exceed the requirements of the standard. It enables designers to make credits toward advanced LEED ratings. This work has necessitated the 90.1 committee's closer collaboration with the USGBC by interacting with its committees and setting of goals.

The 2004 version of ASHRAE 90.1 Standard has been determined to have an increased level of stringency that will net energy savings in the buildings to which it is applied. Of all changes from the 2001 version, the reduced lighting power densities account for around 75% of the overall energy savings.

The ASHRAE Standards Committee has also requested SSPC 90.1 to seriously evaluate the size of the task of creating a "Performance Standard" by 2010.

5.2.3.2 Reported work of the SSPC 90.1 full committee.

The main committee, and its subcommittees, spent a significant amount of time in 2006 evaluating and reacting to proposed changes in the IECC. The changes involve chiller efficiency requirements, commissioning requirements, envelope requirements, and new designations for the climate zones. These were debated at length at SSPC 90.1, resulting in responses of around 50% concurrence and 50% opposition. SSPC 90.1 is asked to react to the new IECC changes.

Other areas considered by the SSPC 90.1 main committee throughout the year were:

(1) potential impacts of the new IRS tax credits of 2006-2007
(2) addressing of radiant cooling in the standard
(3) consideration of an alternative to prescriptive requirements in the standard, the Linked Criteria Selection method that would have pre-simulated "comparative" buildings for an array of climates and building types. This is akin to a performance approach. Supporting documents can be viewed on a web site at: http://www.gard.com/lcs.zip
(4) changes in envelope requirements for metal roof buildings
(5) cool roof prescriptive requirements – deleting the credit for vegetative roofs
(6) updating of opaque envelope requirements
(7) updating the cost and frame U-factors for fenestration systems
(8) correction fixes for SHGC exceptions for overhangs and latitudes
(9) consideration of limiting west-facing fenestration in the prescriptive compliance option
(10) establishing minimum VLT in the prescriptive compliance option

5.2.3.3 Reported work of the ECB Subcommittee.

The USGBC has approved Appendix G for LEED rating. The ECB subcommittee addressed several issues that bring clarity and fairness when applying this appendix. Included were modifications to chiller types in Table G3.1.3.7 as well as economizers in Table G3.1.2.6A (which are to be replaced with Table G3.1.2.6B.)

Other issues addressed by the ECB subcommittee were:

(1) Fuel pricing: Consistency was determined to be highly desirable. It was decided to use a consistent scalar ratio to determine energy costs and establish a fuel rates based on energy consumption and not demand charges. Demand charges are incorporated but are then averaged out in terms of energy consumption.
(2) Changes in base system types in Appendix G for laboratory spaces.
(3) Naturally ventilated building credit: Addition of part (e) to Table G3.1 – HVAC Systems. This would set the rules for simulating the baseline building and proposed building for naturally ventilated buildings. The added text would be: Where no mechanical cooling system exists and the space is conditioned by natural ventilation, ASHRAE Standard 55-2004 conditions for naturally conditioned space shall be followed. The simulation must maintain those conditions for 95% of occupied hours. The simulation software must include air pressure based effects in each zone and exterior surface including wind and stack effects in buildings.
(4) ECB issues relating to displacement ventilation systems: Section 11.3.2 d requires that *minimum outdoor air ventilation rates shall be the same for both the budget building design and the proposed building.* Displacement ventilation is given credit for a ventilation effectiveness of 1.2 (compared to a ventilation effectiveness of 1.0 for a mixed ventilation system) in Standard 62.1, LEED and CHPS (Comprehensive High Performance Schools). The ECB committee proposal is that lower ventilation rates for displacement ventilation

should be permitted in the cooling mode than is required for the budget design. The ECB is debating submitting a proposal to recommend that means be developed to incorporate a partitioning procedure into Appendix G (2.5) and/or the Design Model Section of Table 11.3.1. The partitioning would be based on the following table.

Table 1: Percent of the Cooling Load Entering the Conditioned Space

Load Component	Percent to Occupied Space	Percent to Plenum
People	67%	33%
Lights	50%	50%
Equipment	50%	50%

In support of further developments toward making Appendix part of the Standard, the ECB has developed a table to contrast the baseline characteristics of Section 11 (ECB) to Appendix G (Performance Method):

Baseline Building Characteristics		
Parameter	ECB	Appendix G
Building Orientation	Same as Proposed Design	Neutral
Window Distribution	Same as Proposed Design	Neutral
Building Mass	Same as Proposed Design	Light Frame Construction
HVAC System Type	Based on Proposed Design – System Map.	Based on Building Size and Function
Demand Controlled Ventilation	Minimum Ventilation Same as Proposed	Minimum Ventilation May Be Greater Than Proposed (DCV)
Equipment Sizing	Same as Proposed	Typical over sizing factors
Fan and Pump Energy Use	Same as Proposed (up to max)	Highest Allowed By Standard
Natural Ventilation	Proposed Requires Fans to Run and Cooling Provided.	Proposed Building Can Take Credit (fans cycling, no cooling)

The ECB proposed rewording to G3.1.2.6 Economizers are: *Outdoor air* economizers shall not be included in *baseline* HVAC Systems 1 and 2. *Outdoor air* economizers shall be included in *baseline* HVAC Systems 3 through 8 based on climate as specified in Table G3.1.2.6.

Exceptions to G3.1.2.6: Economizers shall not be included for systems meeting one or more of the exceptions listed below.

(a) Systems that include gas-phase air cleaning to meet the requirements of 6.1.2 of ANSI/ASHRAE Standard 62. This exception shall be used only if the system in the *proposed design* does not match *building design*.

(b) Where the use of *outdoor air* for cooling will affect supermarket open refrigerated casework systems. This exception shall only be used if the system in the *proposed design* does not use an economizer. If the exception is used, an economizer shall not be included in the *baseline building design.*

5.2.3.4 Reported work of the ENVelope Subcommittee.

Vestibules in climate zones 1 and 2: The envelope subcommittee debated a proposal from a hot-humid area of the U.S. to make the vestibule requirements more stringent and not allow the exemptions in zones 1 and 2 and also buildings of less than 4 stories. The ENV subcommittee, however, rejected this proposal based on lack of economic justification or economic evidence. They also rejected a related proposal to increase the insulation requirements in mass walls in zone 1.

Continuous air barriers: One of the continuing debates in the ENV subcommittee is over continuous air barriers. To this date, Standard 90.1 does not require continuous air barriers, though it does require sealing of joints that could possibly leak air. Making continuous air barriers a requirement appears to be a possibility in the next versions of the standard, though the committee voted to exempt tall buildings over 7 stories. This issue will still be debated at future meetings.

Louvered overhangs: The ENV committee is considering a section that deals with window WWR and SHGC requirements when under overhangs that are louvered.

The ENV committee made updates to the eight (8) Envelope Requirements tables in Section 5 (Table 5.5-1 through Table 5.5-8). The two tables that cover most of Texas (5.5-1 and 5.5-2) are included as an appendix with this segment. In all cases, the required U-Factor and SHGC limits have been reduced (stringency increased) but not to the point of causing much burden on designers. (See Appendix.)

5.2.3.5 Reported work of the Lighting Subcommittee.

The Lighting UPD (uniform power density) requirements in the 90.1 Standard changed significantly between the 90.1-2001 and 2004 versions, adding about 26% more stringency in the LPDs (lighting power densities.) This was significant in that it accounted for about 75% of all savings between those two standards. Subsequent work by the lighting subcommittee has not been an attempt to reduce the LPDs further; rather, it has focused more on issues that are listed below:

(1) exterior lighting
(2) interior added lighting power allowances for accent lighting, sales areas, etc.
(3) task lighting
(4) motion sensors for hotel rooms

These have or will be appearing in addenda and/or continuous maintenance proposals sent out for public review.

There was substantial collaboration between the Lighting and ECB committees in regard to what should go into the new Appendix G. In Table G.3.1, part 6, under the proposed building performance column, the committee is proposing that lighting power shall be determined as follows:

(1) Where a complete lighting system exists, the actual lighting power *for each thermal block* shall be used in the model.
(1) Where a lighting system has been designed, lighting power shall be determined in accordance with 9.1.3 and 9.1.4.
(2) Where lighting neither exists nor is specified, lighting power shall be determined in accordance with the Building Area Method for the appropriate building type.
(3) Lighting system power shall include all lighting system components shown or provided for on the plans (including lamps and ballasts and task and furniture-mounted fixtures). Exception: For multifamily living units, hotel/motel guest rooms, and other spaces in which lighting systems are connected via receptacles and are not shown or provided for on building plans, assume identical lighting power for the proposed and baseline building designs in the simulations, but exclude these loads when calculating the baseline building Performance and proposed building performance.
(4) Lighting power for parking garages and building facades shall be modeled.
(5) Credit may be taken for the use of automatic controls for daylight utilization but only if their operation is either modeled directly in the building simulation or modeled in the building simulation through schedule adjustments determined by a separate daylighting analysis approved by the rating authority.
(6) For automatic lighting controls in addition to those required for minimum code compliance under 9.4.1 credit may be taken for automatically controlled systems by reducing the connected lighting power by the applicable percentages listed in Table G3.2. Alternatively, credit may be taken for these devices by modifying the lighting schedules used for the proposed design, provided that credible technical documentation for the modifications are provided to the rating authority.

5.2.3.6 Reported work of the Mechanical Subcommittee.

The committee continues to work on continuous maintenance proposals relating to condenser heat recovery, gas boiler efficiencies, interaction with other ASHRAE Standards such as 55 (Comfort) and 62 (Ventilation), exhaust air energy recovery, and centrifugal water-cooled chiller efficiencies.

The working group (WG) on Fan Motors spent significant time on determining the requirements for fan power limitations, especially for laboratories. One person who spawned much debate over this was, Jack Esmond from Houston, explaining the large ventilation requirements for animals in vivariums that cannot comply with the code requirements. The committee passed a response to Mr. Esmond that will address this issue in a satisfactory way, but has not yet been published. In addition, and again because of animal laboratories, the committee was obliged to address possible exceptions in the exhaust heat recovery requirement. This issue had already been under study by the WG for 1.5 years, so it was decided that a solid proposal for a change in requirements (or exceptions) would be made for consideration in the 2007 year.

The issues addressed by the Mechanical committee were varied and numerous and not without much debate. Some of the various proposals addressed involved the following:

(1) using brake h.p. in place of nameplate h.p.
(2) occupancy sensors in hotel/motel rooms
(3) power venting and flue dampers
(4) reducing fan power limitation from 15 h.p. to 10 h.p.
(5) off-hour controls
(6) minimum fan and pump efficiencies
(7) spot coolers
(8) commercial gas boiler efficiencies
(9) changing of efficiency trade-offs for economizer requirements
(10) duct leak testing
(11) fractional horsepower motors and small fans

5.2.3.7 Appendix: Envelope Requirements Revisions

In this section the proposed new table in ASHRAE Standard 90.1 are presented as distributed to the committee.

Table 3: ASHRAE TABLE 5.5-2 (South Texas Region: up through Waco)
Building Envelope Requirements For Climate Zone 2 (A,B)

		Nonresidential		Residential		Semiheated	
		Assembly	Insulation Min.	Assembly	Insulation Min.	Assembly	Insulation Min.
	Opaque Elements	Maximum	R-Value	Maximum	R-Value	Maximum	R-Value
Roofs							
	Insulation Entirely above Deck	U-0.063	R-15.0 ci	~~U-0.063~~ U-0.048	~~R-15.0 ci~~ R-20.0 ci	U-0.218	R-3.8 ci
	Metal Building *(w/R-5 thermal block)*	U-0.065	R-19.0	U-0.065	R-19.0	~~U-0.167~~ U-0.097	~~R-6.0~~ R-10.0
	Attic and Other	U-0.034	R-30.0	U-0.027	R-38.0	U-0.081	R-13.0
Walls, Above Grade							
	Mass	~~U-0.580~~ U-0.151[a]	~~NR~~ R-5.7 ci[a]	~~U-0.151[a]~~ U-0.123	~~R-5.7 ci[a]~~ R-7.6 ci	U-0.580	NR
	Metal Building	U-0.113	R-13.0	U-0.113	R-13.0	~~U-0.184~~ U-0.113	~~R-6.0~~ R-13.0
	Steel Framed	U-0.124	R-13.0	~~U-0.124~~ U-0.064	~~R-13.0~~ R-13.0 + R-7.5 ci	~~U-0.352~~ U-0.124	~~NR~~ R-13.0
	Wood Framed and Other	U-0.089	R-13.0	U-0.089	R-13.0	~~U-0.292~~ U-0.089	~~NR~~ R-13.0
Wall, Below Grade							
	Below Grade Wall	C-1.140	NR	C-1.140	NR	C-1.140	NR
Floors							
	Mass	~~U-0.137~~ U-0.107	~~R-4.2 ci~~ R-6.3 ci	~~U-0.107~~ U-0.087	~~R-6.3 ci~~ R-8.3 ci	U-0.322	NR
	Steel Joist	U-0.052	R-19.0	U-0.052	R-19.0	~~U-0.350~~ U-0.069	~~NR~~ R-13.0
	Wood Framed and Other	U-0.051	R-19.0	~~U-0.051~~ U-0.033	~~R-19.0~~ R-30.0	U-0.282	NR
Slab-On-Grade Floors							
	Unheated	F-0.730	NR	F-0.730	NR	F-0.730	NR
	Heated	F-1.020	R-7.5 for 12 in.	F-1.020	R-7.5 for 12 in.	F-1.020	R-7.5 for 12 in.
Opaque Doors							
	Swinging	U-0.700		U-0.700		U-0.700	
	Non-Swinging	U-1.450		~~U-1.450~~ U-0.500		U-1.450	
		Assembly	Assembly Max.	Assembly	Assembly Max.	Assembly	Assembly Max.
		Max. U	SHGC (All	Max. U	SHGC (All	Max. U	SHGC (All
		(Fixed/	Orientations/	(Fixed/	Orientations/	(Fixed/	Orientations/
	Fenestration	Operable)	North-Oriented)	Operable)	North-Oriented)	Operable)	North-Oriented)
Vertical Glazing,% of Wall							
	0-10.0%	~~^{U}fixed$^{-1.22}$~~ ^{U}fixed$^{-0.57}$	^{SHGC}all$^{-0.25}$	~~^{U}fixed$^{-1.22}$~~ ^{U}fixed$^{-0.57}$	^{SHGC}all$^{-0.39}$	^{U}fixed$^{-1.22}$	^{SHGC}all^{-NR}
		~~^{U}oper$^{-1.27}$~~ ^{U}oper$^{-0.67}$	^{SHGC}north$^{-0.61}$	~~^{U}oper$^{-1.27}$~~ ^{U}oper$^{-0.67}$	^{SHGC}north$^{-0.61}$	^{U}oper$^{-1.27}$	^{SHGC}north^{NR}
	10.1-20.0%	~~^{U}fixed$^{-1.22}$~~ ^{U}fixed$^{-0.57}$	^{SHGC}all$^{-0.25}$	~~^{U}fixed$^{-1.22}$~~ ^{U}fixed$^{-0.57}$	^{SHGC}all$^{-0.25}$	^{U}fixed$^{-1.22}$	^{SHGC}all^{-NR}
		~~^{U}oper$^{-1.27}$~~ ^{U}oper$^{-0.67}$	^{SHGC}north$^{-0.61}$	~~^{U}oper$^{-1.27}$~~ ^{U}oper$^{-0.67}$	^{SHGC}north$^{-0.61}$	^{U}oper$^{-1.27}$	^{SHGC}north^{NR}
	20.1-30.0%	~~^{U}fixed$^{-1.22}$~~ ^{U}fixed$^{-0.57}$	^{SHGC}all$^{-0.25}$	~~^{U}fixed$^{-1.22}$~~ ^{U}fixed$^{-0.57}$	^{SHGC}all$^{-0.25}$	^{U}fixed$^{-1.22}$	^{SHGC}all^{-NR}
		~~^{U}oper$^{-1.27}$~~ ^{U}oper$^{-0.67}$	^{SHGC}north$^{-0.61}$	~~^{U}oper$^{-1.27}$~~ ^{U}oper$^{-0.67}$	^{SHGC}north$^{-0.61}$	^{U}oper$^{-1.27}$	^{SHGC}north^{NR}
	30.1-40.0%	~~^{U}fixed$^{-1.22}$~~ ^{U}fixed$^{-0.57}$	^{SHGC}all$^{-0.25}$	~~^{U}fixed$^{-1.22}$~~ ^{U}fixed$^{-0.57}$	^{SHGC}all$^{-0.25}$	^{U}fixed$^{-1.22}$	^{SHGC}all^{-NR}

		~~^{U}oper$^{-1.27}$~~ ^{U}oper$^{-0.67}$	^{SHGC}north$^{-0.61}$	~~^{U}oper$^{-1.27}$~~ ^{U}oper$^{-0.67}$	^{SHGC}north$^{-0.61}$	^{U}oper$^{-1.27}$	^{SHGC}north^{NR}
	(wood/vinyl/fiberglass frame *metal fr. curtainwall/storefront* *metal fr. entrance door* *metal fr. operable/fixed/other)*	*(U-0.75* *U-0.70* *U-1.10* *U-0.75)*	*(SHGC-0.25 all)*				
	40.1-50.0%	~~^{U}fixed$^{-1.22}$~~ ^{U}fixed$^{-0.57}$	^{SHGC}all$^{-0.17}$	~~^{U}fixed$^{-1.22}$~~ ^{U}fixed$^{-0.57}$	^{SHGC}all$^{-0.17}$	^{U}fixed$^{-0.98}$	^{SHGC}all^{-NR}
		~~^{U}oper$^{-1.27}$~~ ^{U}oper$^{-0.67}$	^{SHGC}north$^{-0.44}$	~~^{U}oper$^{-1.27}$~~ ^{U}oper$^{-0.67}$	^{SHGC}north$^{-0.43}$	^{U}oper$^{-1.02}$	^{SHGC}north^{NR}
Skylight with Curb, Glass,% of Roof							
	0-2.0%	^{U}all$^{-1.98}$	^{SHGC}all$^{-0.36}$	^{U}all$^{-1.98}$	^{SHGC}all$^{-0.19}$	^{U}all$^{-1.98}$	^{SHGC}all^{-NR}
	2.1-5.0%	^{U}all$^{-1.98}$	^{SHGC}all$^{-0.19}$	^{U}all$^{-1.98}$	^{SHGC}all$^{-0.19}$	^{U}all$^{-1.98}$	^{SHGC}all^{-NR}
Skylight with Curb, Plastic,% of Roof							
	0-2.0%	^{U}all$^{-1.90}$	^{SHGC}all$^{-0.39}$	^{U}all$^{-1.90}$	^{SHGC}all$^{-0.27}$	^{U}all$^{-1.90}$	^{SHGC}all^{-NR}
	(0-3%)	*(^{U}all$^{-1.90}$)*	*(^{SHGC}all$^{-0.35}$)*				
	2.1-5.0%	^{U}all$^{-1.90}$	^{SHGC}all$^{-0.34}$	^{U}all$^{-1.90}$	^{SHGC}all$^{-0.27}$	^{U}all$^{-1.90}$	^{SHGC}all^{-NR}
Skylight without Curb, All,% of Roof							
	0-2.0%	^{U}all$^{-1.36}$	^{SHGC}all$^{-0.36}$	^{U}all$^{-1.36}$	^{SHGC}all$^{-0.19}$	^{U}all$^{-1.36}$	^{SHGC}all^{-NR}
	(0-3%)	*(^{U}all$^{-1.05}$)*	*(^{SHGC}all$^{-0.40}$)*				
	2.1-5.0%	^{U}all$^{-1.36}$	^{SHGC}all$^{-0.19}$	^{U}all$^{-1.36}$	^{SHGC}all$^{-0.19}$	^{U}all$^{-1.36}$	^{SHGC}all^{-NR}
A	Exception to A3.1.3.1 applies.						

Table 4: ASHRAE TABLE 5.5-3 (Central Texas: DFW – Lubbock – El Paso Region)
Building Envelope Requirements For Climate Zone 3 (A,B,C)

		Nonresidential		Residential		Semiheated	
		Assembly	Insulation Min.	Assembly	Insulation Min.	Assembly	Insulation Min.
	Opaque Elements	Maximum	R-Value	Maximum	R-Value	Maximum	R-Value
Roofs							
	Insulation Entirely above Deck	U-0.063	R-15.0 ci	~~U-0.063~~ U-0.048	~~R-15.0 ci~~ R-20.0 ci	U-0.218	R-3.8 ci
	Metal Building *(w/R-5 thermal block)*	U-0.065	R-19.0	U-0.065	R-19.0	U-0.097	R-10.0
	Attic and Other	U-0.034	R-30.0	U-0.027	R-38.0	~~U-0.081~~ U-0.053	~~R-13.0~~ R-19.0
Walls, Above Grade							
	Mass	~~U-0.151[a]~~ U-0.123	~~R-5.7 ci[a]~~ R-7.6 ci	~~U-0.123~~ U-0.104	~~R-7.6 ci~~ R-9.5 ci	U-0.580	NR
	Metal Building	U-0.113	R-13.0	~~U-0.113~~ U-0.057	~~R-13.0~~ R-13.0 + R-13.0	~~U-0.184~~ U-0.113	~~R-6.0~~ R-13.0
	Steel Framed	U-0.124	R-13.0	~~U-0.084~~ U-0.064	~~R-13.0 + R-3.8 ci~~ R-13.0 + R-7.5 ci	~~U-0.352~~ U-0.124	~~NR~~ R-13.0
	Wood Framed and Other	U-0.089	R-13.0	U-0.089	R-13.0	U-0.089	R-13.0
Wall, Below Grade							
	Below Grade Wall	C-1.140	NR	C-1.140	NR	C-1.140	NR
Floors							
	Mass	U-0.107	R-6.3 ci	U-0.087	R-8.3 ci	U-0.322	NR
	Steel Joist	U-0.052	R-19.0	U-0.052	R-19.0	U-0.069	R-13.0
	Wood Framed and Other	U-0.051	R-19.0	U-0.033	R-30.0	U-0.282	NR
Slab-On-Grade Floors							
	Unheated	F-0.730	NR	F-0.730	NR	F-0.730	NR
	Heated	F-1.020	R-7.5 for 12 in.	F-1.020	R-7.5 for 12 in.	F-1.020	R-7.5 for 12 in.
Opaque Doors							
	Swinging	U-0.700		U-0.700		U-0.700	
	Non-Swinging	U-1.450		U-0.500		U-1.450	
		Assembly	Assembly Max.	Assembly	Assembly Max.	Assembly	Assembly Max.
		Max. U	SHGC (All	Max. U	SHGC (All	Max. U	SHGC (All
		(Fixed/	Orientations/	(Fixed/	Orientations/	(Fixed/	Orientations/
	Fenestration ~~(for Zones 3A and 3B; see next page for Zone 3C)~~	Operable)	North-Oriented)	Operable)	North-Oriented)	Operable)	North-Oriented)
Vertical Glazing,% of Wall							
	0-10.0%	$^{U}fixed^{-0.57}$	$^{SHGC}all^{-0.39}$	$^{U}fixed^{-0.57}$	$^{SHGC}all^{-0.39}$	$^{U}fixed^{-1.22}$	$^{SHGC}all^{-NR}$
		$^{U}oper^{-0.67}$	$^{SHGC}north^{-0.49}$	$^{U}oper^{-0.67}$	$^{SHGC}north^{-0.49}$	$^{U}oper^{-1.27}$	$^{SHGC}north^{NR}$
	10.1-20.0%	$^{U}fixed^{-0.57}$	$^{SHGC}all^{-0.25}$	$^{U}fixed^{-0.57}$	$^{SHGC}all^{-0.39}$	$^{U}fixed^{-1.22}$	$^{SHGC}all^{-NR}$
		$^{U}oper^{-0.67}$	$^{SHGC}north^{-0.49}$	$^{U}oper^{-0.67}$	$^{SHGC}north^{-0.49}$	$^{U}oper^{-1.27}$	$^{SHGC}north^{NR}$
	20.1-30.0%	$^{U}fixed^{-0.57}$	$^{SHGC}all^{-0.25}$	$^{U}fixed^{-0.57}$	$^{SHGC}all^{-0.25}$	$^{U}fixed^{-1.22}$	$^{SHGC}all^{-NR}$
		$^{U}oper^{-0.67}$	$^{SHGC}north^{-0.39}$	$^{U}oper^{-0.67}$	$^{SHGC}north^{-0.39}$	$^{U}oper^{-1.27}$	$^{SHGC}north^{NR}$
	30.1-40.0%	$^{U}fixed^{-0.57}$	$^{SHGC}all^{-0.25}$	$^{U}fixed^{-0.57}$	$^{SHGC}all^{-0.25}$	$^{U}fixed^{-1.22}$	$^{SHGC}all^{-NR}$
		$^{U}oper^{-0.67}$	$^{SHGC}north^{-0.39}$	$^{U}oper^{-0.67}$	$^{SHGC}north^{-0.39}$	$^{U}oper^{-1.27}$	$^{SHGC}north^{NR}$
	(wood/vinyl/fiberglass frame metal fr. curtainwall/storefront metal fr. entrance door metal fr. operable/fixed/other)	*(U-0.65 U-0.60 U-0.90 U-0.65)*	*(SHGC-0.25 all)*				
	40.1-50.0%	$^{U}fixed^{-0.46}$	$^{SHGC}all^{-0.19}$	$^{U}fixed^{-0.46}$	$^{SHGC}all^{-0.19}$	$^{U}fixed^{-0.98}$	$^{SHGC}all^{-NR}$
		$^{U}oper^{-0.47}$	$^{SHGC}north^{-0.26}$	$^{U}oper^{-0.47}$	$^{SHGC}north^{-0.26}$	$^{U}oper^{-1.02}$	$^{SHGC}north^{NR}$
Skylight with Curb, Glass,% of Roof							
	0-2.0%	$^{U}all^{-1.17}$	$^{SHGC}all^{-0.39}$	$^{U}all^{-1.17}$	$^{SHGC}all^{-0.36}$	$^{U}all^{-1.98}$	$^{SHGC}all^{-NR}$
	2.1-5.0%	$^{U}all^{-1.17}$	$^{SHGC}all^{-0.19}$	$^{U}all^{-1.17}$	$^{SHGC}all^{-0.19}$	$^{U}all^{-1.98}$	$^{SHGC}all^{-NR}$
Skylight with Curb, Plastic,% of Roof							
	0-2.0%	$^{U}all^{-1.30}$	$^{SHGC}all^{-0.65}$	$^{U}all^{-1.30}$	$^{SHGC}all^{-0.27}$	$^{U}all^{-1.90}$	$^{SHGC}all^{-NR}$
	(0-3%)	*($^{U}all^{-1.30}$)*	*($^{SHGC}all^{-0.35}$)*				
	2.1-5.0%	$^{U}all^{-1.30}$	$^{SHGC}all^{-0.34}$	$^{U}all^{-1.30}$	$^{SHGC}all^{-0.27}$	$^{U}all^{-1.90}$	$^{SHGC}all^{-NR}$
Skylight without Curb, All,% of Roof							
	0-2.0%	$^{U}all^{-0.69}$	$^{SHGC}all^{-0.39}$	$^{U}all^{-0.69}$	$^{SHGC}all^{-0.36}$	$^{U}all^{-1.36}$	$^{SHGC}all^{-NR}$
	(0-3%)	*($^{U}all^{-0.90}$)*	*($^{SHGC}all^{-0.40}$)*				
	2.1-5.0%	$^{U}all^{-0.69}$	$^{SHGC}all^{-0.19}$	$^{U}all^{-0.69}$	$^{SHGC}all^{-0.19}$	$^{U}all^{-1.36}$	$^{SHGC}all^{-NR}$
~~A~~	~~Exception to A3.1.3.1 applies.~~						
~~b.~~	~~Insulation is not required for non-residential mass walls in Climate Zone 3A located below the "Warm-Humid" line, and in Zone 3B.~~						

Table 5: ASHRAE TABLE 5.5-4 (Texas Panhandle Region) Building Envelope Requirements For Climate Zone 4 (A,B,C)

		Nonresidential		Residential		Semiheated	
		Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value
	Opaque Elements						
Roofs							
	Insulation Entirely above Deck	~~U-0.063~~ U-0.048	~~R-15.0 ci~~ R-20.0 ci	~~U-0.063~~ U-0.048	~~R-15.0 ci~~ R-20.0 ci	~~U-0.218~~ U-0.173	~~R-3.8 ci~~ R-5.0 ci
	Metal Building *(w/R-5 thermal block)*	U-0.065	R-19.0	~~U-0.065~~ U-0.055	~~R-19.0~~ R-13.0 + R-13.0	U-0.097	R-10.0
	Attic and Other	~~U-0.034~~ U-0.027	~~R-30.0~~ R-38.0	U-0.027	R-38.0	~~U-0.081~~ U-0.053	~~R-13.0~~ R-19.0
Walls, Above Grade							
	Mass	~~U-0.151[a]~~ U-0.104	~~R-5.7 ci[a]~~ R-9.5 ci	~~U-0.104~~ U-0.090	~~R-9.5 ci~~ R-11.4 ci	U-0.580	NR
	Metal Building	U-0.113	R-13.0	~~U-0.113~~ U-0.057	~~R-13.0~~ R-13.0 + R-13.0	~~U-0.134~~ U-0.113	~~R-10.0~~ R-13.0
	Steel Framed	~~U-0.124~~ U-0.064	~~R-13.0~~ R-13.0 + R-7.5 ci	U-0.064	R-13.0 + R-7.5 ci	U-0.124	R-13.0
	Wood Framed and Other	U-0.089	R-13.0	~~U-0.089~~ U-0.064	~~R-13.0~~ R-13.0 + R-3.8 ci	U-0.089	R-13.0
Wall, Below Grade							
	Below Grade Wall	C-1.140	NR	~~C-1.140~~ C-0.119	~~NR~~ R-7.5 ci	C-1.140	NR
Floors							
	Mass	~~U-0.107~~ U-0.087 *(U-0.076)*	~~R-6.3 ci~~ R-8.3 ci *(R-10 ci)*	~~U-0.087~~ U-0.074	~~R-8.3 ci~~ R-10.4 ci	~~U-0.322~~ U-0.137	~~NR~~ R-4.2 ci
	Steel Joist	~~U-0.052~~ U-0.038	~~R-19.0~~ R-30.0	U-0.038	R-30.0	U-0.069	R-13.0
	Wood Framed and Other	~~U-0.051~~ U-0.033	~~R-19.0~~ R-30.0	U-0.033	R-30.0	U-0.066	R-13.0
Slab-On-Grade Floors							
	Unheated	F-0.730	NR	~~F-0.730~~ F-0.540	~~NR~~ R-10 for 24 in.	F-0.730	NR
	Heated	F-0.950	R-7.5 for 24 in.	~~F-0.840~~ F-0.780	~~R-10 for 36 in.~~ R-10 for 48 in.	F-1.020	R-7.5 for 12 in.
Opaque Doors							
	Swinging	U-0.700		U-0.700		U-0.700	
	Non-Swinging	~~U-1.450~~ U-0.500		U-0.500		U-1.450	
		Assembly	Assembly Max.	Assembly	Assembly Max.	Assembly	Assembly Max.
		Max. U	SHGC (All	Max. U	SHGC (All	Max. U	SHGC (All
		(Fixed/	Orientations/	(Fixed/	Orientations/	(Fixed/	Orientations/
	Fenestration	Operable)	North-Oriented)	Operable)	North-Oriented)	Operable)	North-Oriented)
Vertical Glazing,% of Wall							
	0-10.0%	~~U_{fixed}-0.57~~ U_{fixed}-0.43	~~$SHGC_{all}$-0.39~~ $SHGC_{all}$-0.36	~~U_{fixed}-0.57~~ U_{fixed}-0.43	~~$SHGC_{all}$-0.39~~ $SHGC_{all}$-0.36	U_{fixed}-1.22	$SHGC_{all}$-NR
		~~U_{oper}-0.67~~ U_{oper}-0.44	~~$SHGC_{north}$-0.49~~ $SHGC_{north}$-0.46	~~U_{oper}-0.67~~ U_{oper}-0.44	~~$SHGC_{north}$-0.49~~ $SHGC_{north}$-0.46	U_{oper}-1.27	$SHGC_{north}$NR
	10.1-20.0%	~~U_{fixed}-0.57~~ U_{fixed}-0.43	~~$SHGC_{all}$-0.39~~ $SHGC_{all}$-0.36	~~U_{fixed}-0.57~~ U_{fixed}-0.43	~~$SHGC_{all}$-0.39~~ $SHGC_{all}$-0.36	U_{fixed}-1.22	$SHGC_{all}$-NR
		~~U_{oper}-0.67~~ U_{oper}-0.44	~~$SHGC_{north}$-0.49~~ $SHGC_{north}$-0.46	~~U_{oper}-0.67~~ U_{oper}-0.44	~~$SHGC_{north}$-0.49~~ $SHGC_{north}$-0.46	U_{oper}-1.27	$SHGC_{north}$NR
	20.1-30.0%	~~U_{fixed}-0.57~~	~~$SHGC_{all}$-0.39~~	~~U_{fixed}-0.57~~	~~$SHGC_{all}$-0.39~~	U_{fixed}-1.22	$SHGC_{all}$-NR

		^{U}fixed$^{-0.43}$	^{SHGC}all$^{-0.36}$	^{U}fixed$^{-0.43}$	^{SHGC}all$^{-0.36}$		
		~~^{U}oper$^{-0.67}$~~ ^{U}oper$^{-0.44}$	~~^{SHGC}north$^{-0.49}$~~ ^{SHGC}north$^{-0.46}$	~~^{U}oper$^{-0.67}$~~ ^{U}oper$^{-0.44}$	~~^{SHGC}north$^{-0.49}$~~ ^{SHGC}north$^{-0.46}$	^{U}oper$^{-1.27}$	^{SHGC}north^{NR}
	30.1-40.0%	~~^{U}fixed$^{-0.57}$~~ ^{U}fixed$^{-0.43}$	~~^{SHGC}all$^{-0.39}$~~ ^{SHGC}all$^{-0.31}$	~~^{U}fixed$^{-0.57}$~~ ^{U}fixed$^{-0.43}$	~~^{SHGC}all$^{-0.39}$~~ ^{SHGC}all$^{-0.31}$	^{U}fixed$^{-1.22}$	^{SHGC}all^{-NR}
		~~^{U}oper$^{-0.67}$~~ ^{U}oper$^{-0.44}$	~~^{SHGC}north$^{-0.49}$~~ ^{SHGC}north$^{-0.46}$	~~^{U}oper$^{-0.67}$~~ ^{U}oper$^{-0.44}$	~~^{SHGC}north$^{-0.49}$~~ ^{SHGC}north$^{-0.46}$	^{U}oper$^{-1.27}$	^{SHGC}north^{NR}
	(wood/vinyl/fiberglass frame *metal fr. curtainwall/storefront* *metal fr. entrance door* *metal fr. operable/fixed/other)*	*(U-0.40* *U-0.50* *U-0.85* *U-0.55)*	*(SHGC-0.40 all)*				
	40.1-50.0%	~~^{U}fixed$^{-0.46}$~~ ^{U}fixed$^{-0.TBD}$	~~^{SHGC}all$^{-0.25}$~~ ^{SHGC}all$^{-0.TBD}$	~~^{U}fixed$^{-0.46}$~~ ^{U}fixed$^{-0.TBD}$	~~^{SHGC}all$^{-0.25}$~~ ^{SHGC}all$^{-0.TBD}$	^{U}fixed$^{-0.98}$	^{SHGC}all^{-NR}
		~~^{U}oper$^{-0.47}$~~ ^{U}oper$^{-0.TBD}$	~~^{SHGC}north$^{-0.36}$~~ ^{SHGC}north$^{-0.TBD}$	~~^{U}oper$^{-0.47}$~~ ^{U}oper$^{-0.TBD}$	~~^{SHGC}north$^{-0.36}$~~ ^{SHGC}north$^{-0.TBD}$	^{U}oper$^{-1.02}$	^{SHGC}north^{NR}
Skylight with Curb, Glass,% of Roof							
	0-2.0%	^{U}all$^{-1.17}$	^{SHGC}all$^{-0.49}$	^{U}all$^{-0.98}$	^{SHGC}all$^{-0.36}$	^{U}all$^{-1.98}$	^{SHGC}all^{-NR}
	2.1-5.0%	^{U}all$^{-1.17}$	^{SHGC}all$^{-0.39}$	^{U}all$^{-0.98}$	^{SHGC}all$^{-0.19}$	^{U}all$^{-1.98}$	^{SHGC}all^{-NR}
Skylight with Curb, Plastic,% of Roof							
	0-2.0%	^{U}all$^{-1.30}$	^{SHGC}all$^{-0.65}$	^{U}all$^{-1.30}$	^{SHGC}all$^{-0.62}$	^{U}all$^{-1.90}$	^{SHGC}all^{-NR}
	(0-3%)	*(^{U}all$^{-1.30}$)*	*(^{SHGC}all$^{-0.62}$)*				
	2.1-5.0%	^{U}all$^{-1.30}$	^{SHGC}all$^{-0.34}$	^{U}all$^{-1.30}$	^{SHGC}all$^{-0.27}$	^{U}all$^{-1.90}$	^{SHGC}all^{-NR}
Skylight without Curb, All,% of Roof							
	0-2.0%	^{U}all$^{-0.69}$	^{SHGC}all$^{-0.49}$	^{U}all$^{-0.58}$	^{SHGC}all$^{-0.36}$	^{U}all$^{-1.36}$	^{SHGC}all^{-NR}
	(0-3%)	*(^{U}all$^{-0.60}$)*	*(^{SHGC}all$^{-0.40}$)*				
	2.1-5.0%	^{U}all$^{-0.69}$	^{SHGC}all$^{-0.39}$	^{U}all$^{-0.58}$	^{SHGC}all$^{-0.19}$	^{U}all$^{-1.36}$	^{SHGC}all^{-NR}
a	Exception to A3.1.3.1 applies.						

5.2.4 Laboratory's Senate Bill 5 Web Site "eslsb5.tamu.edu".

Since the Fall of 2001, the Laboratory has maintained a Senate Bill 5 webpage (http://eslsb5.tamu.edu), where information is provided to builders, code officials, the design community and homeowners about Senate Bill 5, including:

- The Emissions calculator
    - Opening page: this page directs the visitor to four choices, including:
        - The calculator: This is the emissions calculator that the Laboratory developed for the State of Texas, which contains procedures for calculating NOx, Sox and CO2 emissions calculations from new building models, community projects, and renewables.
        - The kWh-NOx emissions calculator: This is the synchronous NOx emissions calculator for projects where the kWh savings are known for a particular county.
        - The ICCC: This is the entry page for the Laboratory's International Code Compliance Calculator, which was developed at the request of several municipalities for calculating code compliance with the 2000/2001 IECC with SEER 13.
        - The Senate Bill 5 Main page: This is the main page for the Senate Bill 5 project.
- The Senate Bill 5 Main Page
    - About page: This pages contains general information about the project.
    - SB5 Reports: This contains the Laboratory's reports to the TCEQ and the Legislature since 2001, as well as conference paper and other presentations about the effort.
    - 2007 CATEE Conference page: This is the Laboratory's web site for the Clean Air through Energy Efficiency (CATEE), to be held in San Antonio in December 2007.
    - 2007 ICEBO Conference page: This is the Laboratory's web page for the International Conference on Enhanced Building Operation (ICEBO) Conference, held in San Francisco.
    - 2007 IETC Conference page: This is the Laboratory's web page for the 2007 Industrial Energy Technology Conference, held in New Orleans, LA.
    - 2006 Air Quality Conference: This contains information about the Laboratory's 2006 Air Quality Conference held in Houston, Texas.
    - 2006 Hot and Humid conference page: This is the Laboratory's web page for the 2006 Hot and Humid Conference, held in Orlando, Florida.
    - More about Senate Bill 5: This page contains additional information about the Senate Bill 5 program.
    - Testimony page: This contains several testimonies that the Laboratory has delivered to the Legislature and legislative committees.
    - Links page: This page contains links to other pages and State Agencies participating in the Senate Bill 5 program.
    - Weather data page: This page is the link to the Laboratory's on-line weather data depository for the hourly/daily weather data gathered as part of the Senate Bill 5 program.
        - Weather data navigation page: This is the main navigation page for find different types of weather data for the 17 sites listed, including:
            - Daily spreadsheet format example
            - Hourly spreadsheet format example
            - Example daily weather data graphs
            - Example hourly weather data graphs

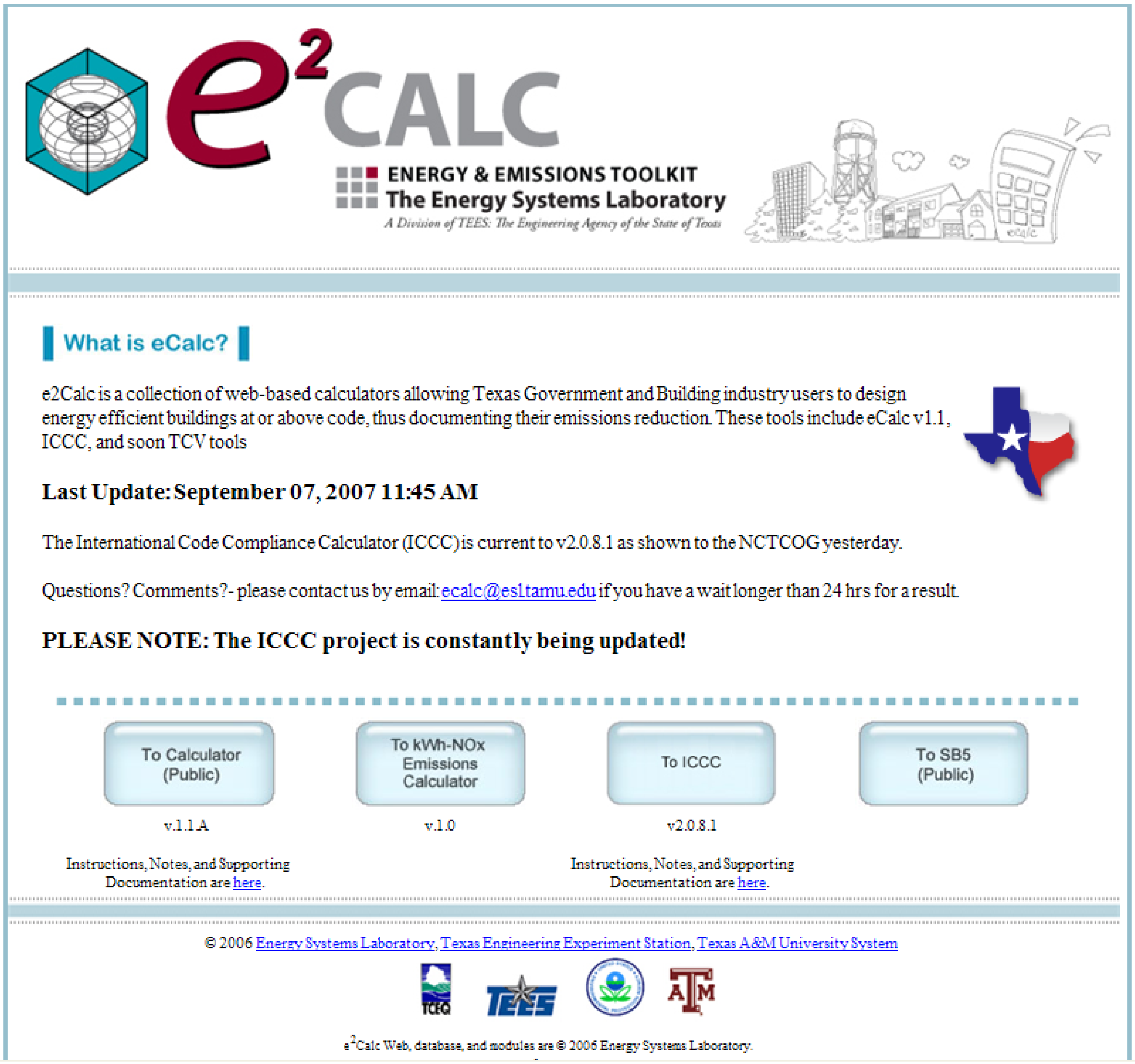


Figure 9: Opening page for the Laboratory's e2CALC Energy and Emissions Toolkit.

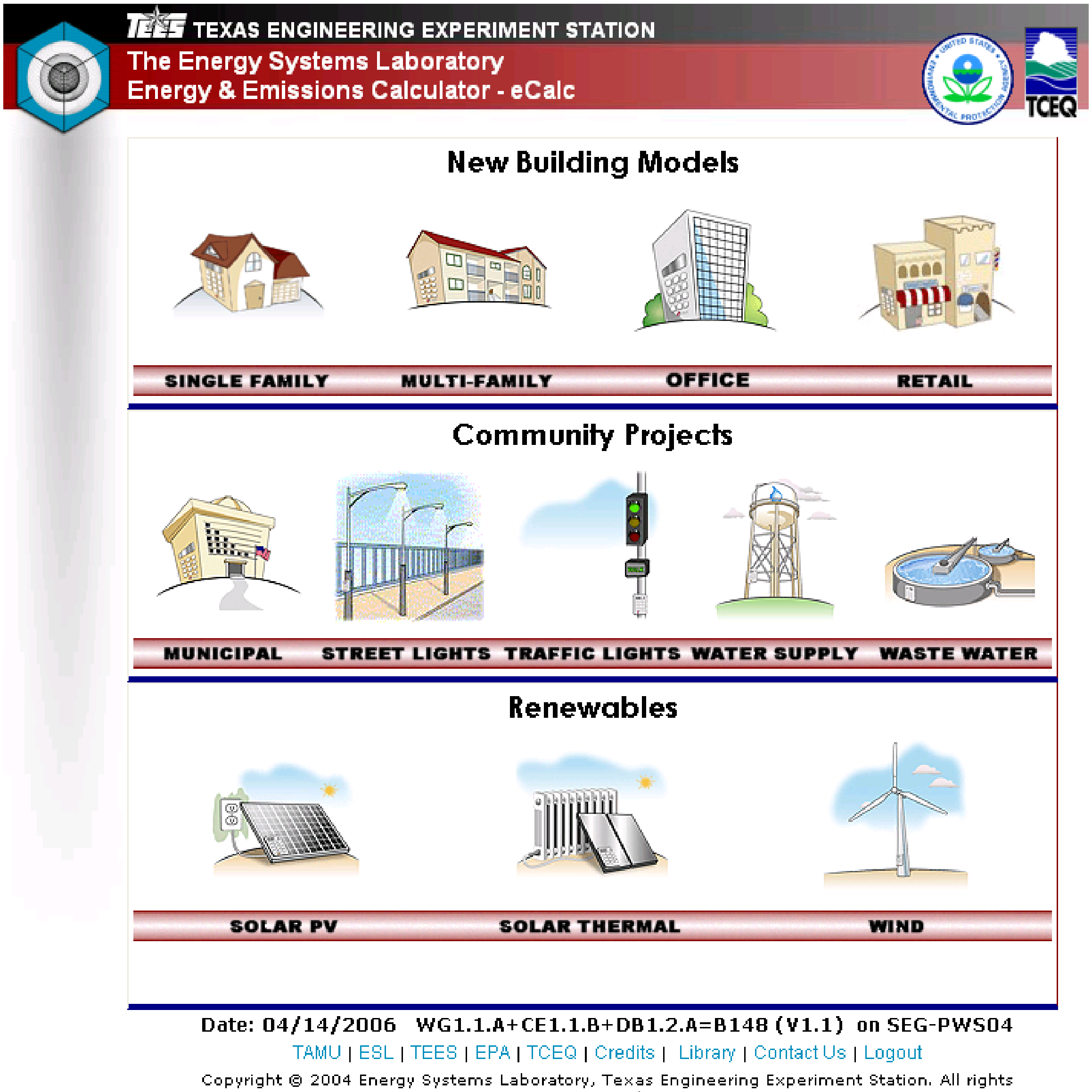


Figure 10: Web Page Providing Access to the Laboratory's eCALC Energy and Emissions Calculator.

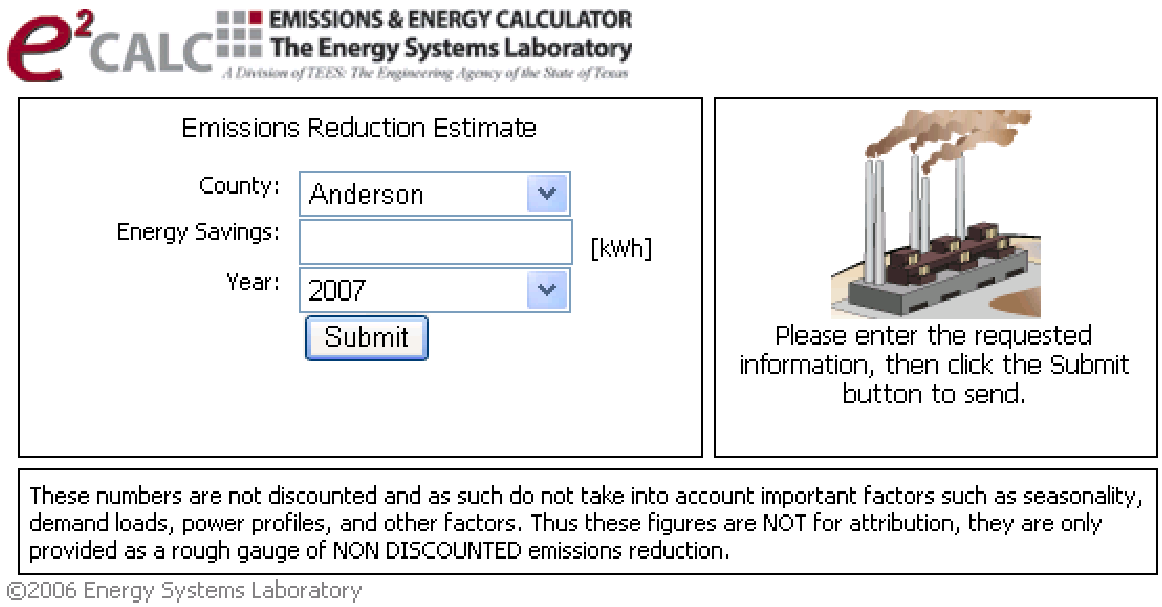


Figure 11: Web Page Providing Access to the Laboratory's Synchronous Emissions Calculator.

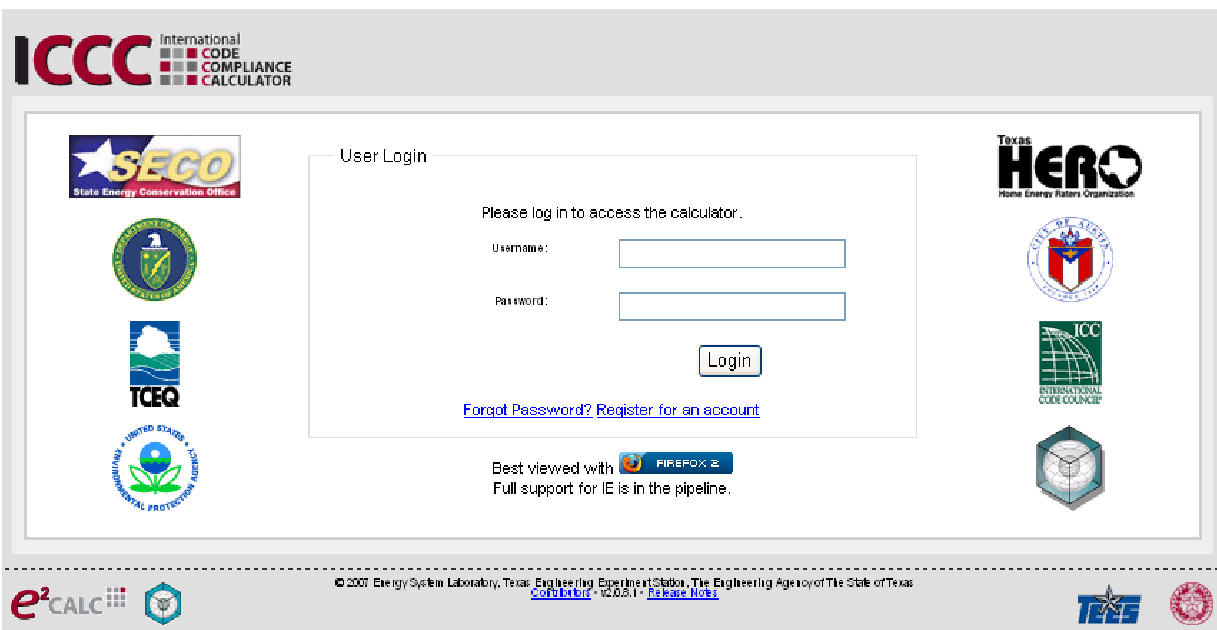


Figure 12: Web Page Providing Access to the Laboratory's International Code Compliance Calculator (ICCC).

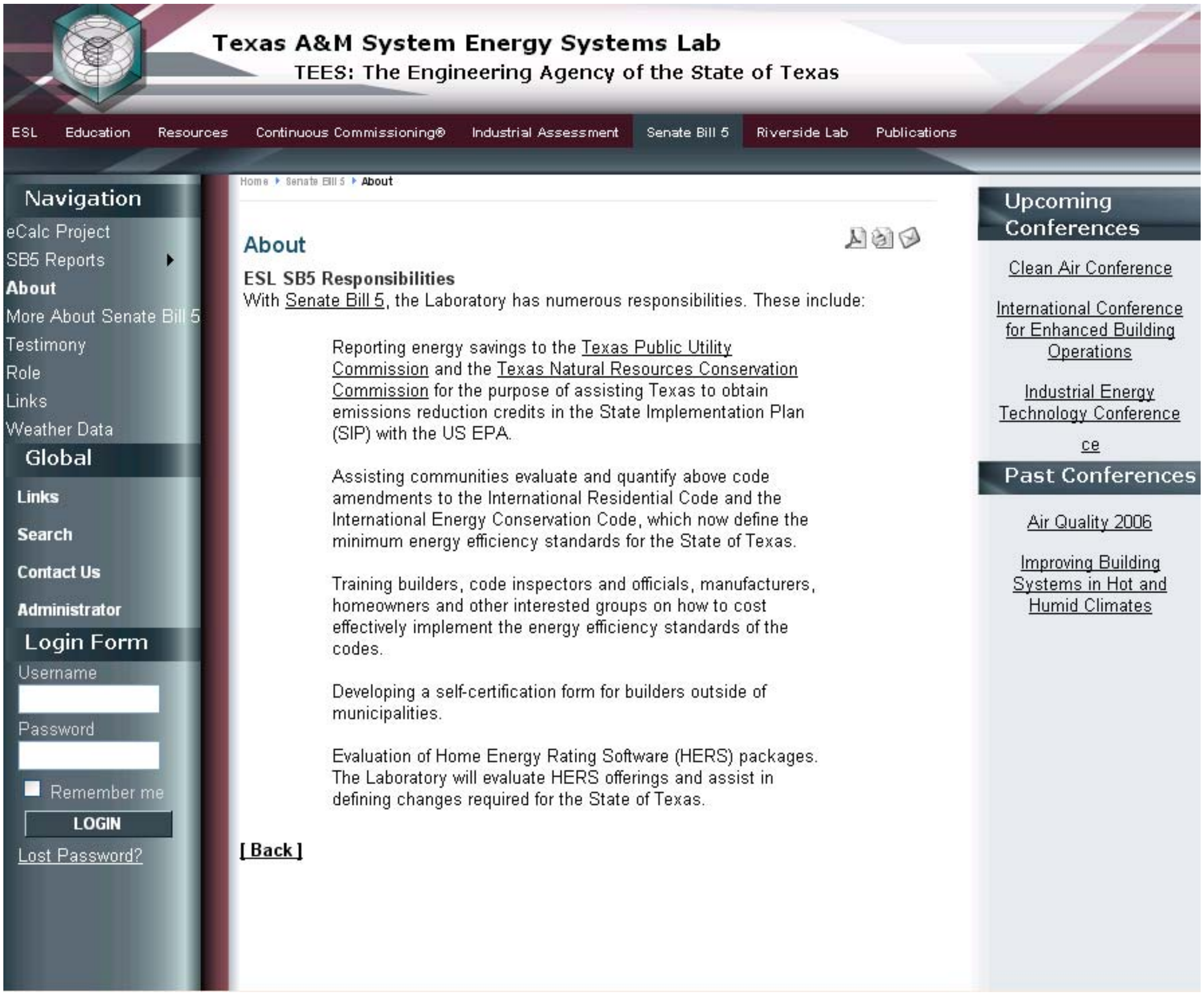


Figure 13: Web Page Providing Information About the Laboratory’s Senate Bill Responsibilities.

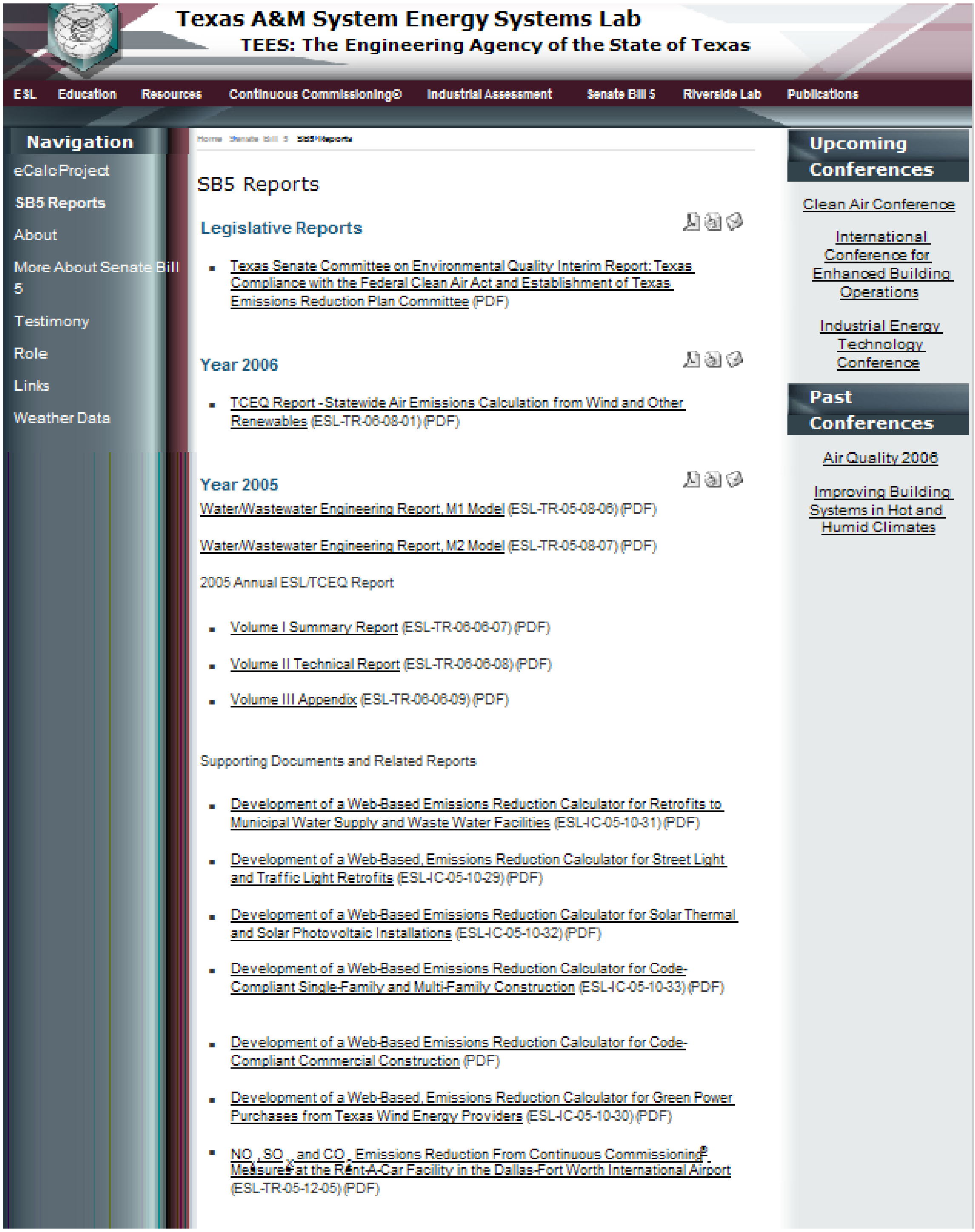


Figure 14: SB5 Public opening page for the Laboratory Senate Bill 5 effort.

Figure 15: Web Page Providing Information About the Laboratory's 2007 Clean Air Through Energy Efficiency (CATEE) Conference.

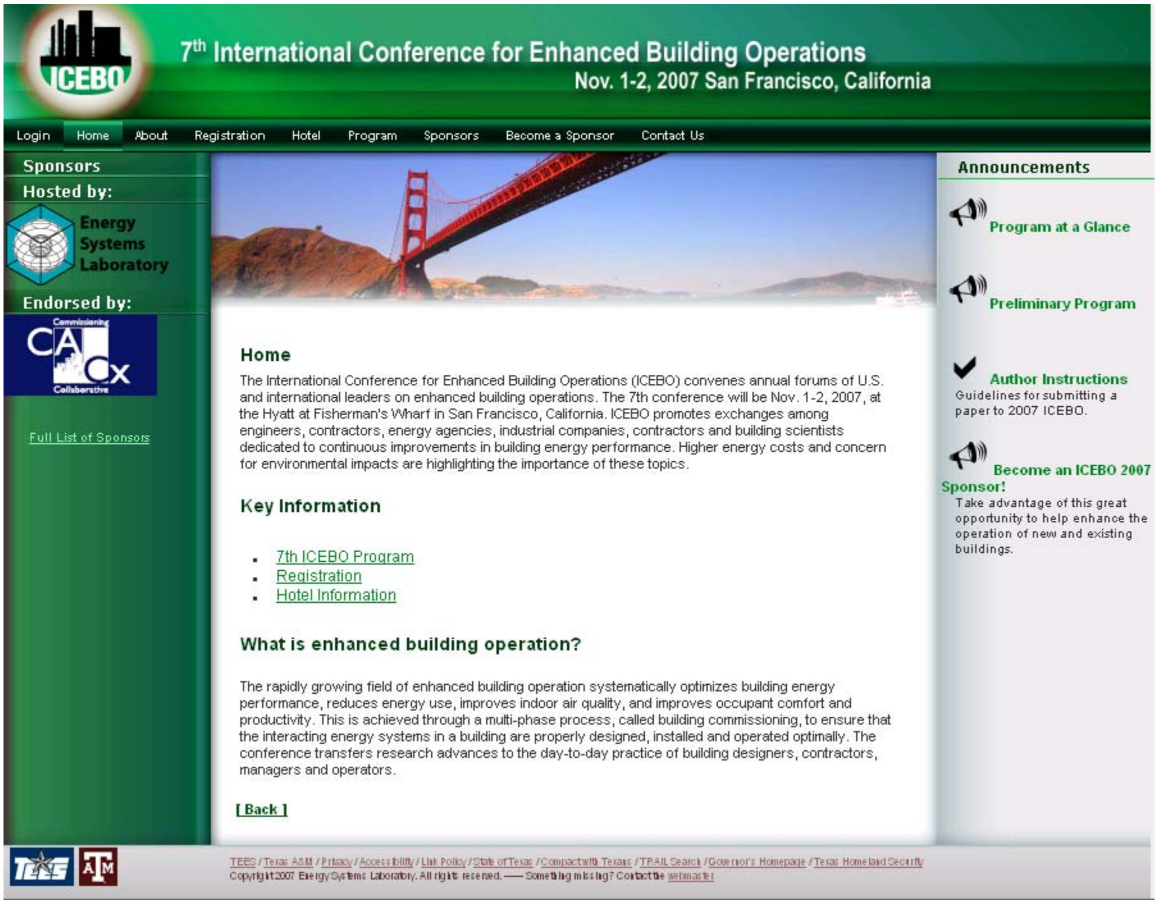


Figure 16: Web Page Providing Information About the Laboratory's 7th Annual International Conference for Enhanced Building Operations (ICEBO) Conference.

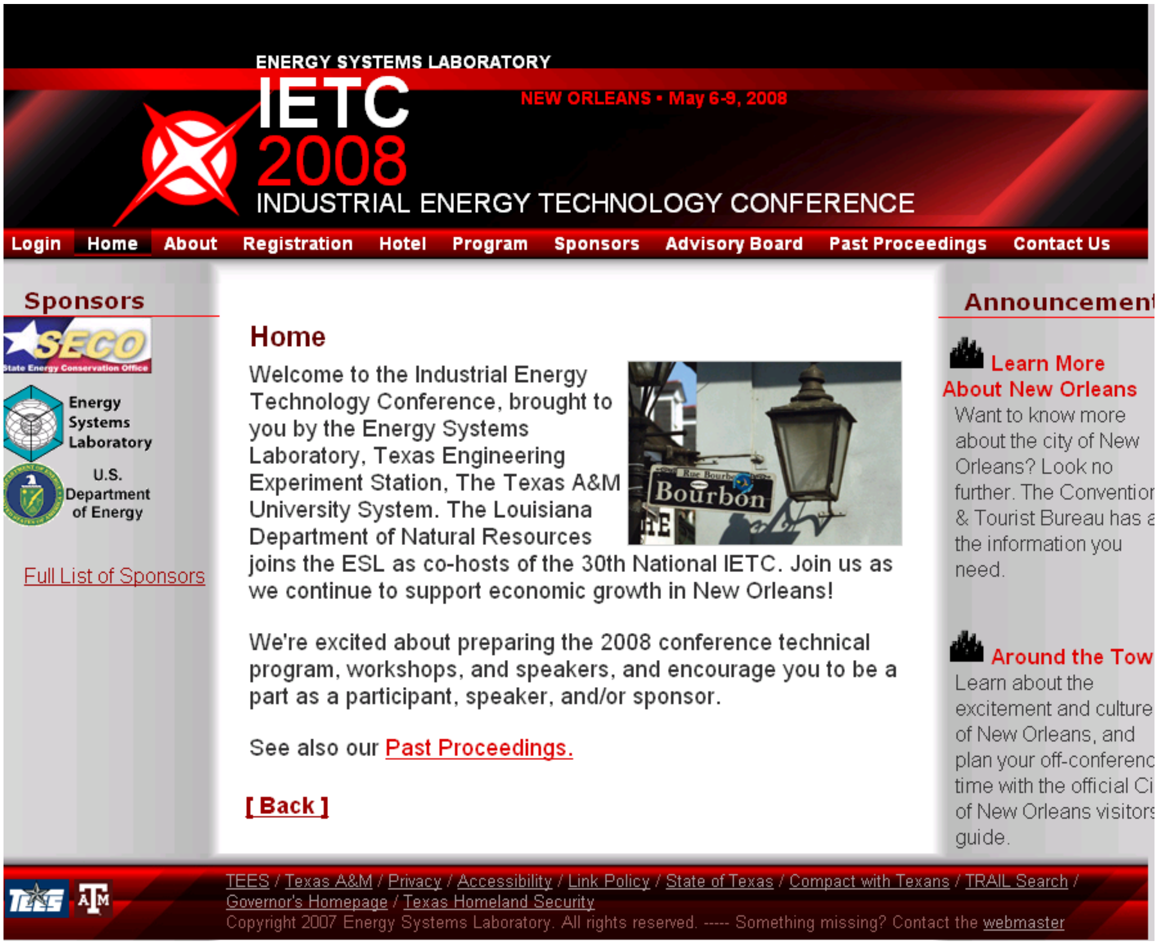


Figure 17: Web Page Providing Information About the Laboratory's Industrial Energy Technology Conference (IETC).

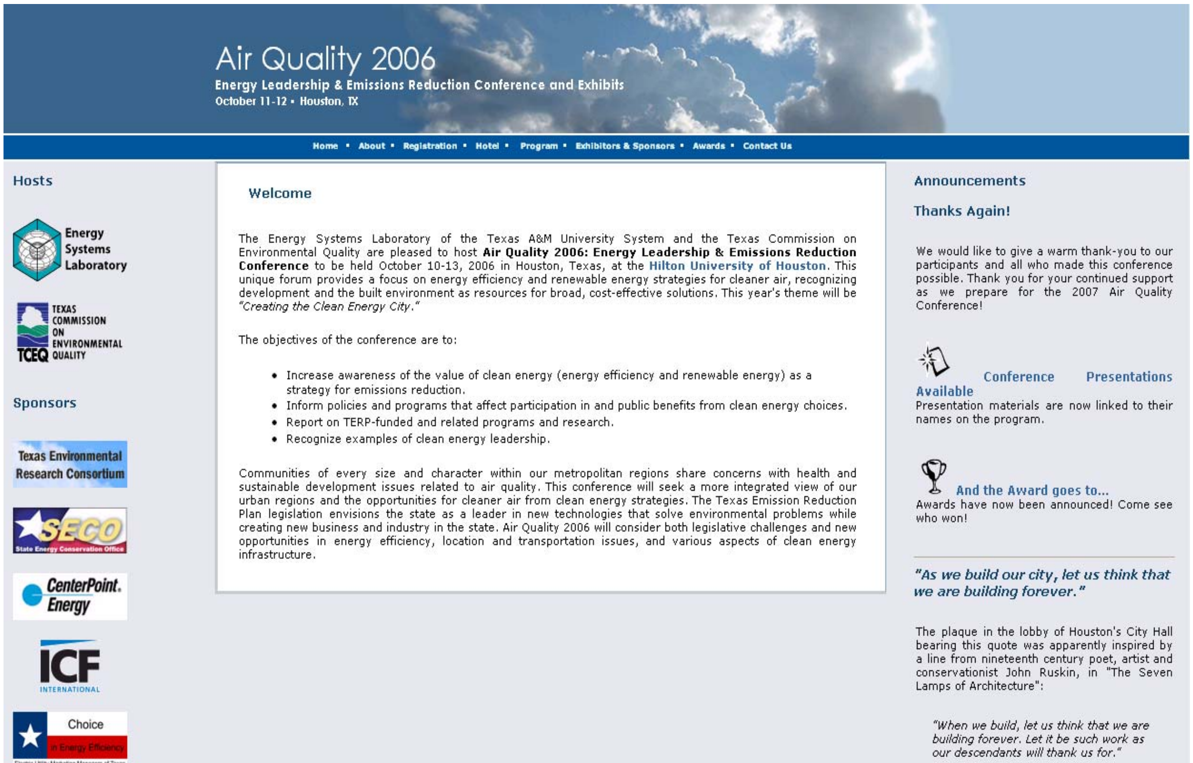


Figure 18: Web Page Providing Information About the Laboratory's 2006 Air Quality: Energy Leadership and Emissions Reduction Conference and Exhibits.

Figure 19: Web Page Providing Information About the Laboratory's 15th Symposium on Improving Building Systems in Hot and Humid Climates Conference.

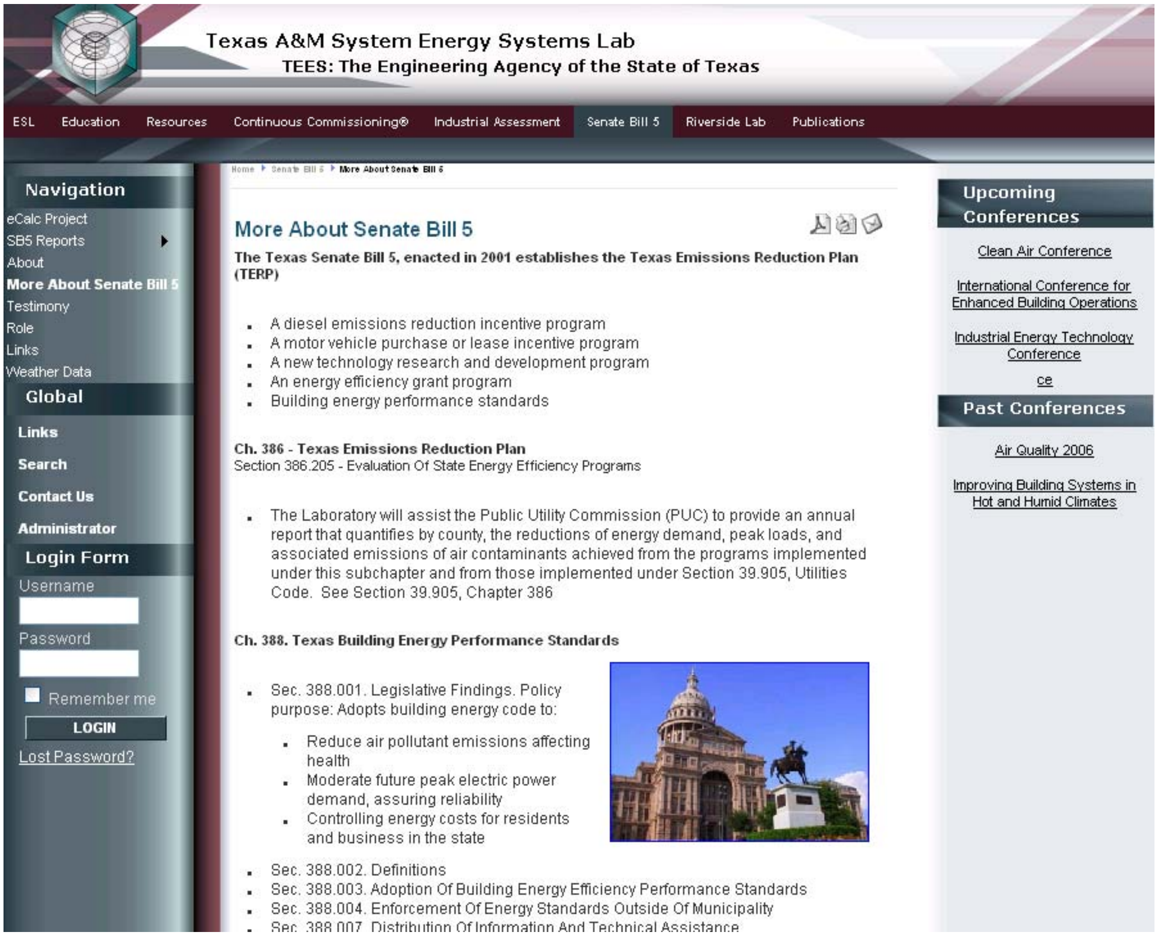
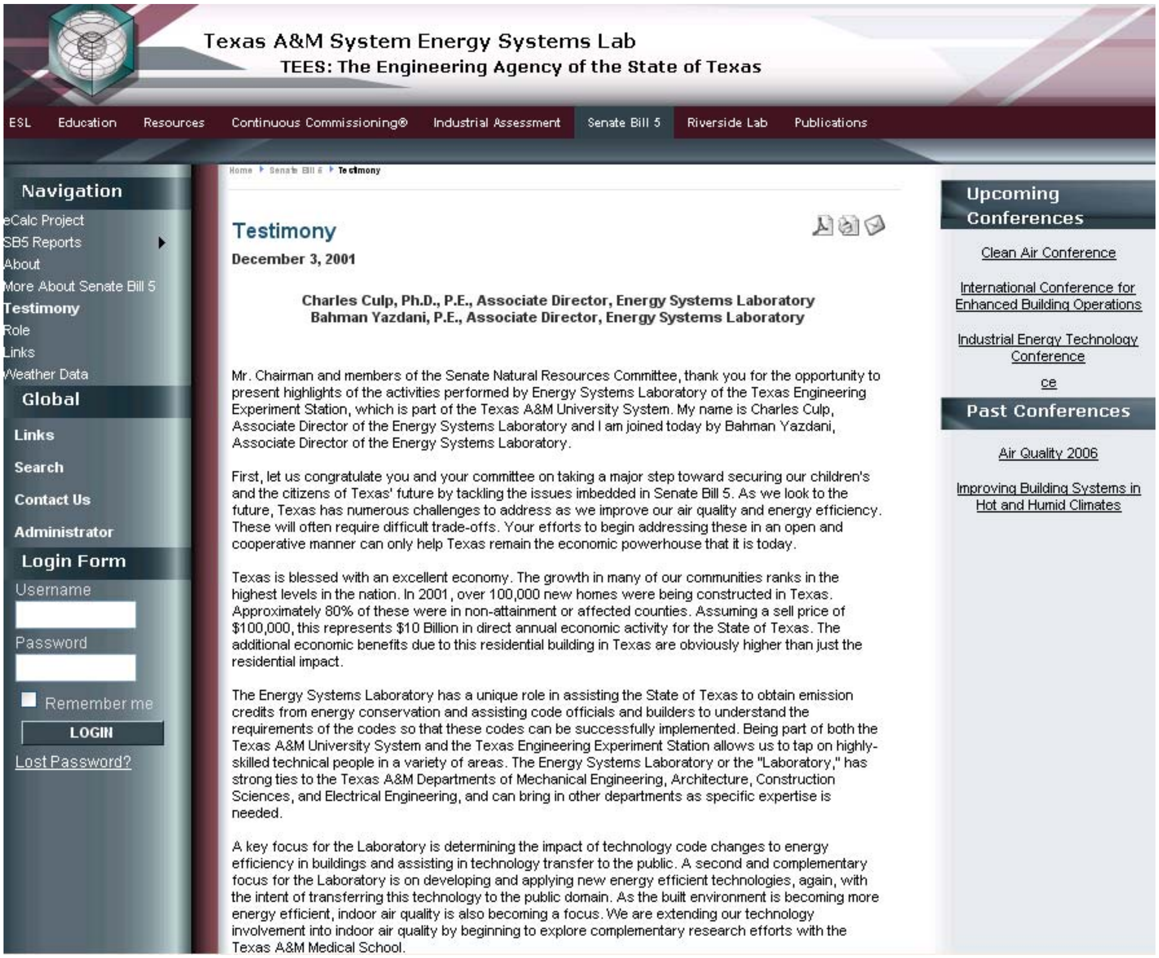


Figure 20: Web Page Providing Additional Information About the Laboratory's Senate Bill 5 Program.



Texas A&M System Energy Systems Lab
TEES: The Engineering Agency of the State of Texas

ESL | Education | Resources | Continuous Commissioning® | Industrial Assessment | Senate Bill 5 | Riverside Lab | Publications

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Testimony

December 3, 2001

Charles Culp, Ph.D., P.E., Associate Director, Energy Systems Laboratory
Bahman Yazdani, P.E., Associate Director, Energy Systems Laboratory

Mr. Chairman and members of the Senate Natural Resources Committee, thank you for the opportunity to present highlights of the activities performed by Energy Systems Laboratory of the Texas Engineering Experiment Station, which is part of the Texas A&M University System. My name is Charles Culp, Associate Director of the Energy Systems Laboratory and I am joined today by Bahman Yazdani, Associate Director of the Energy Systems Laboratory.

First, let us congratulate you and your committee on taking a major step toward securing our children's and the citizens of Texas' future by tackling the issues imbedded in Senate Bill 5. As we look to the future, Texas has numerous challenges to address as we improve our air quality and energy efficiency. These will often require difficult trade-offs. Your efforts to begin addressing these in an open and cooperative manner can only help Texas remain the economic powerhouse that it is today.

Texas is blessed with an excellent economy. The growth in many of our communities ranks in the highest levels in the nation. In 2001, over 100,000 new homes were being constructed in Texas. Approximately 80% of these were in non-attainment or affected counties. Assuming a sell price of $100,000, this represents $10 Billion in direct annual economic activity for the State of Texas. The additional economic benefits due to this residential building in Texas are obviously higher than just the residential impact.

The Energy Systems Laboratory has a unique role in assisting the State of Texas to obtain emission credits from energy conservation and assisting code officials and builders to understand the requirements of the codes so that these codes can be successfully implemented. Being part of both the Texas A&M University System and the Texas Engineering Experiment Station allows us to tap on highly-skilled technical people in a variety of areas. The Energy Systems Laboratory or the "Laboratory," has strong ties to the Texas A&M Departments of Mechanical Engineering, Architecture, Construction Sciences, and Electrical Engineering, and can bring in other departments as specific expertise is needed.

A key focus for the Laboratory is determining the impact of technology code changes to energy efficiency in buildings and assisting in technology transfer to the public. A second and complementary focus for the Laboratory is on developing and applying new energy efficient technologies, again, with the intent of transferring this technology to the public domain. As the built environment is becoming more energy efficient, indoor air quality is also becoming a focus. We are extending our technology involvement into indoor air quality by beginning to explore complementary research efforts with the Texas A&M Medical School.

Upcoming Conferences
Clean Air Conference
International Conference for Enhanced Building Operations
Industrial Energy Technology Conference
ce

Past Conferences
Air Quality 2006
Improving Building Systems in Hot and Humid Climates

Figure 21: Web Page Providing Information About the Laboratory's Senate Bill 5 Testimony to the Senate Natural Resources Committee.

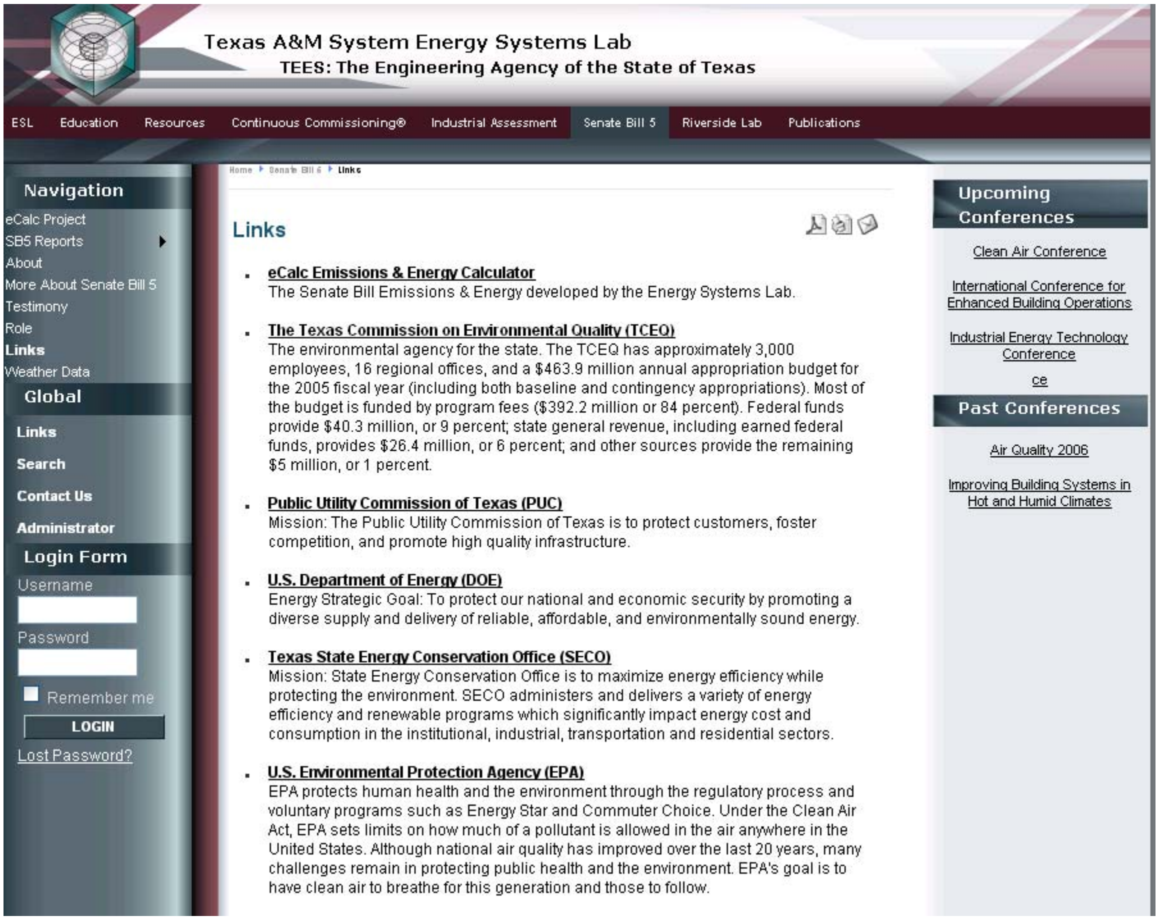


Figure 22: Web Page Providing Information About the Laboratory's Links to Other Government Agencies.

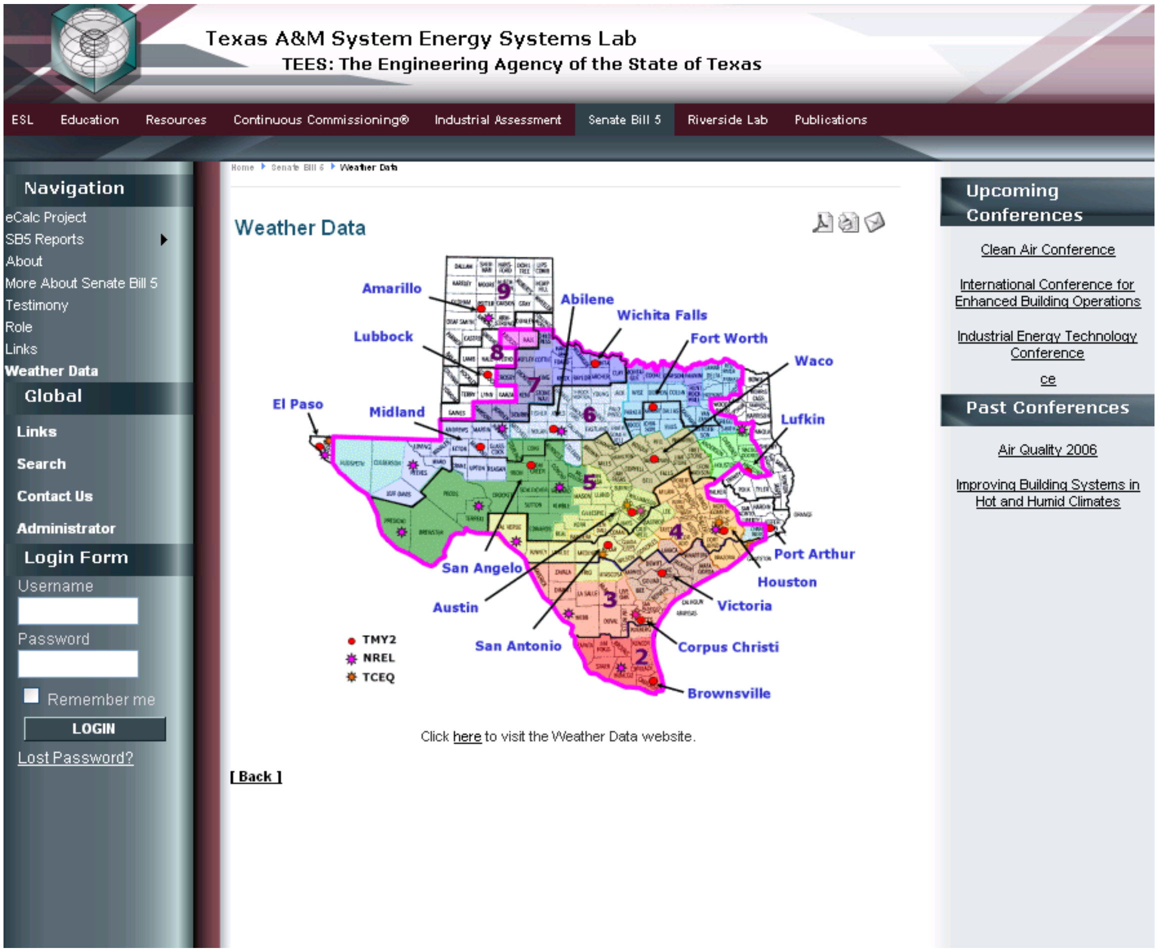


Figure 23: Web Page Providing Information About the Laboratory's Senate Bill 5 Weather Data Collection Effort.

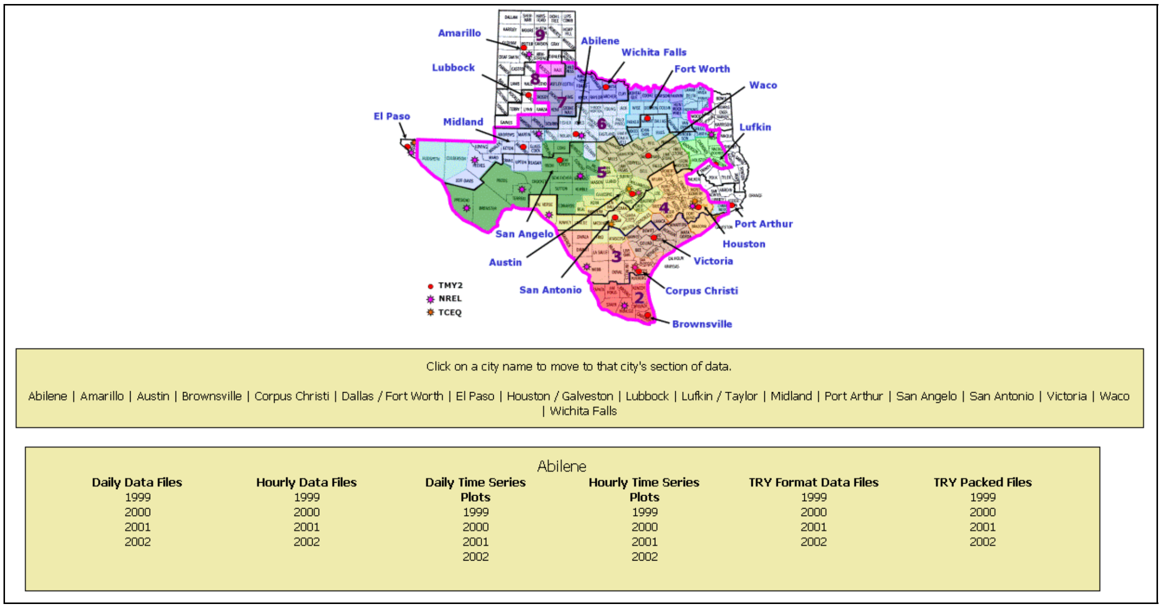


Figure 24: Web Page Providing Site-by-site Weather Data From the Laboratory's Senate Bill 5 Effort.

	A	B	C	D	E	F	G	H	I
1	Date	Average Di	Average W	Average Di	Average W	Total Glob	Total Norm	Total Precipitation (in)	
2	1/1/1999	55.8	49.8	44.4	14.8	505.4	62.1	0	
3	1/2/1999	35.3	29.3	18	14.1	986.1	1428.1	0	
4	1/3/1999	26.4	20.6	4.6	10.6	1022.2	1509.9	0	
5	1/4/1999	29.8	23.3	8.7	7.7	1179.2	2503.3	0	
6	1/5/1999	45.8	34.9	17.5	14.4	1185.2	2581.3	0	
7	1/6/1999	45.5	36.3	23.3	5	1179.5	2591.4	0	
8	1/7/1999	44.3	40.6	36.3	5.2	1181.4	2548.9	0	
9	1/8/1999	32.1	30.8	28.4	11.3	266.7	2.5	0	
10	1/9/1999	27.8	23.4	14.3	8.4	1203.3	2522.6	0	
11	1/10/1999	42.8	33.9	19.9	8.7	1197.9	2534	0	
12	1/11/1999	48.5	39.9	29.4	14.2	1191.9	2391	0	
13	1/12/1999	58.9	48.5	37.8	12.8	827.5	665.2	0	
14	1/13/1999	39.5	35.2	29.1	8	845	952.8	0	
15	1/14/1999	35.4	30.3	21.9	7.4	1225.2	2519.7	0	
16	1/15/1999	52.1	40	24.3	14.3	1263.5	2728.7	0	
17	1/16/1999	52.5	41.3	26.6	9.3	1232.4	2434.8	0	
18	1/17/1999	59.5	43.6	23	10.6	1225.5	2434.4	0	
19	1/18/1999	50.2	39	22.7	6.3	1222.9	2420.8	0	
20	1/19/1999	63.4	47.6	30.5	11.2	1239.1	2334.6	0	
21	1/20/1999	62.8	49.4	35.5	8.1	1123.7	1800.9	0	
22	1/21/1999	61.1	48.4	35	12.6	924.3	1174.1	0	
23	1/22/1999	42.3	38.2	32.3	13	153.1	3.8	0.1	
24	1/23/1999	45.8	38.9	30.3	7.2	1352	2865.3	0	
25	1/24/1999	60.3	45.3	27.8	9.2	1227.7	2216.6	0	
26	1/25/1999	48.1	41.2	32.9	6.2	1350.4	2326.6	0	
27	1/26/1999	60.3	51	42.5	16.9	1256.9	2140.8	0	
28	1/27/1999	59.9	53.9	49	10.5	817.7	650.3	0	
29	1/28/1999	54.1	50.9	48.3	10.8	587.5	162	0	
30	1/29/1999	37	36.9	36	10.2	116	0.6	1.8	
31	1/30/1999	40.2	37.6	34.4	11.8	595.1	236.2	0	

Figure 25: Spreadsheet Showing Daily Weather Data for Abiline, 1999.

	A	B	C	D	E	F	G	H
1	Date time	Dry-Bulb T	Wet-Bulb T	Dew-Point	Wind Spee	Global Sol	Normal Dre	Precipitatio
2	1/1/1999 0:00	47	43	39	9	0	0	0
3	1/1/1999 1:00	47	45	43	16	0	0	0
4	1/1/1999 2:00	48	47	46	11	0	0	0
5	1/1/1999 3:00	49	48	48	14	0	0	0
6	1/1/1999 4:00	49	48	48	9	0	0	0
7	1/1/1999 5:00	49	48	48	11	0	0	0
8	1/1/1999 6:00	51	50	50	11	0	0	0
9	1/1/1999 7:00	54	53	52	15	0	0	0
10	1/1/1999 8:00	56	54	53	15	0.3	0	0
11	1/1/1999 9:00	60	56	53	15	13	1.3	0
12	1/1/1999 10:00	61	57	54	14	69.4	42.8	0
13	1/1/1999 11:00	62	57	54	19	53	0.6	0
14	1/1/1999 12:00	68	59	52	22	57.7	1.3	0
15	1/1/1999 13:00	68	58	50	19	95.4	7	0
16	1/1/1999 14:00	71	58	48	16	84.3	1.9	0
17	1/1/1999 15:00	71	56	44	7	73.2	0.6	0
18	1/1/1999 16:00	69	51	32	5	35.2	0.3	0
19	1/1/1999 17:00	64	49	33	6	20.6	6	0
20	1/1/1999 18:00	67	48	26	14	3.2	0.3	0
21	1/1/1999 19:00	56	50	44	25	0	0	0
22	1/1/1999 20:00	49	45	41	16	0	0	0
23	1/1/1999 21:00	45	43	41	23	0	0	0
24	1/1/1999 22:00	40	38	35	21	0	0	0
25	1/1/1999 23:00	38	35	31	23	0	0	0
26	1/2/1999 0:00	37	34	30	15	0	0	0
27	1/2/1999 1:00	35	32	27	22	0	0	0
28	1/2/1999 2:00	34	31	26	22	0	0	0
29	1/2/1999 3:00	33	30	24	26	0	0	0
30	1/2/1999 4:00	31	28	22	25	0	0	0
31	1/2/1999 5:00	30	27	21	22	0	0	0
32	1/2/1999 6:00	30	27	21	23	0	0	0
33	1/2/1999 7:00	29	26	21	16	0	0	0
34	1/2/1999 8:00	32	28	20	14	1.6	5.7	0
35	1/2/1999 9:00	33	28	18	16	38	176.9	0
36	1/2/1999 10:00	37	30	18	17	81.8	165.8	0
37	1/2/1999 11:00	39	31	17	19	140.5	282.8	0
38	1/2/1999 12:00	42	33	16	16	176.3	296.8	0
39	1/2/1999 13:00	43	33	17	16	179.8	257.1	0

Figure 26: Spreadsheet Showing Hourly Weather Data for Abiline, 1999.

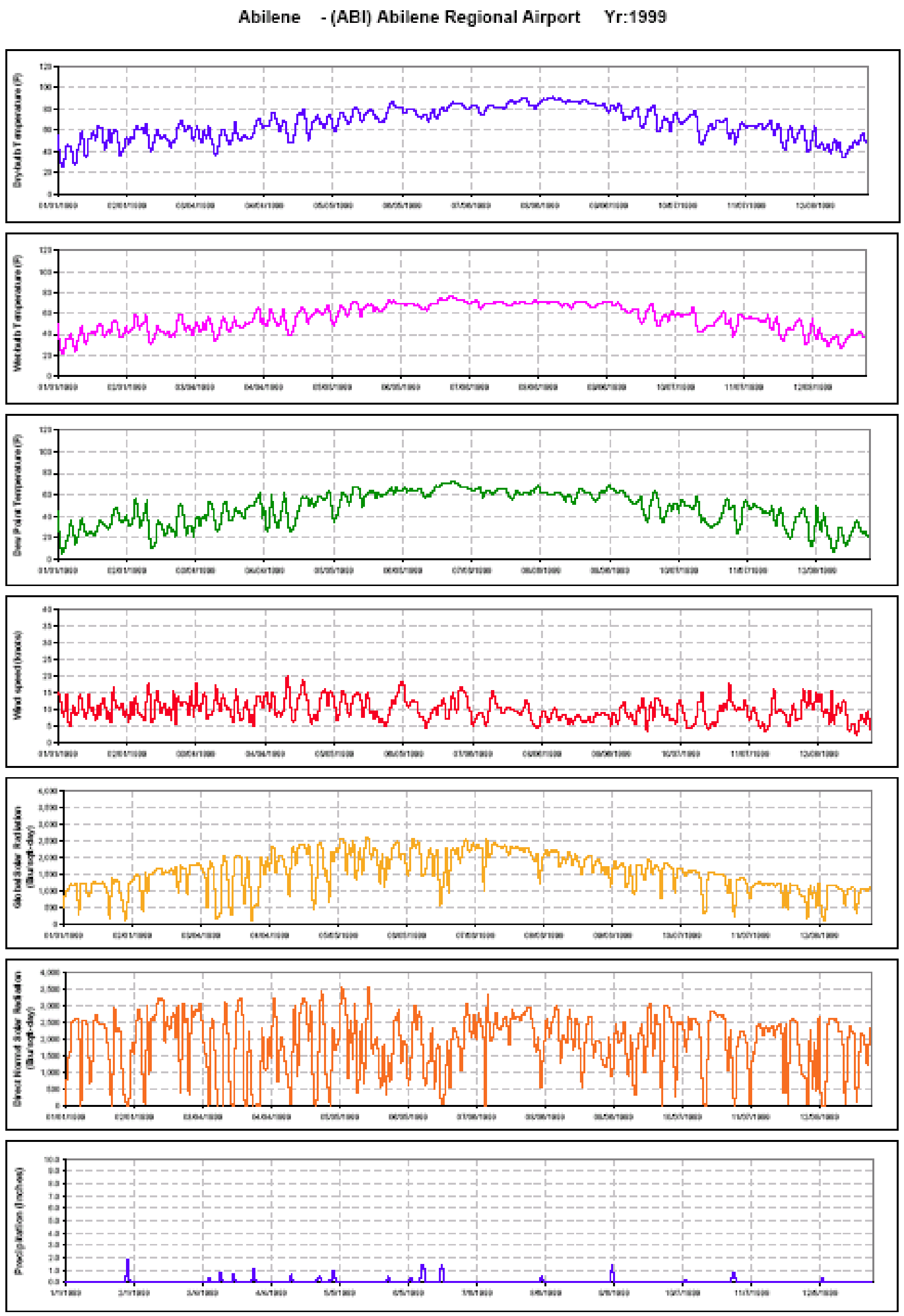


Figure 27: Time Series Graphs Showing Daily Weather Data for Abiline, 1999.

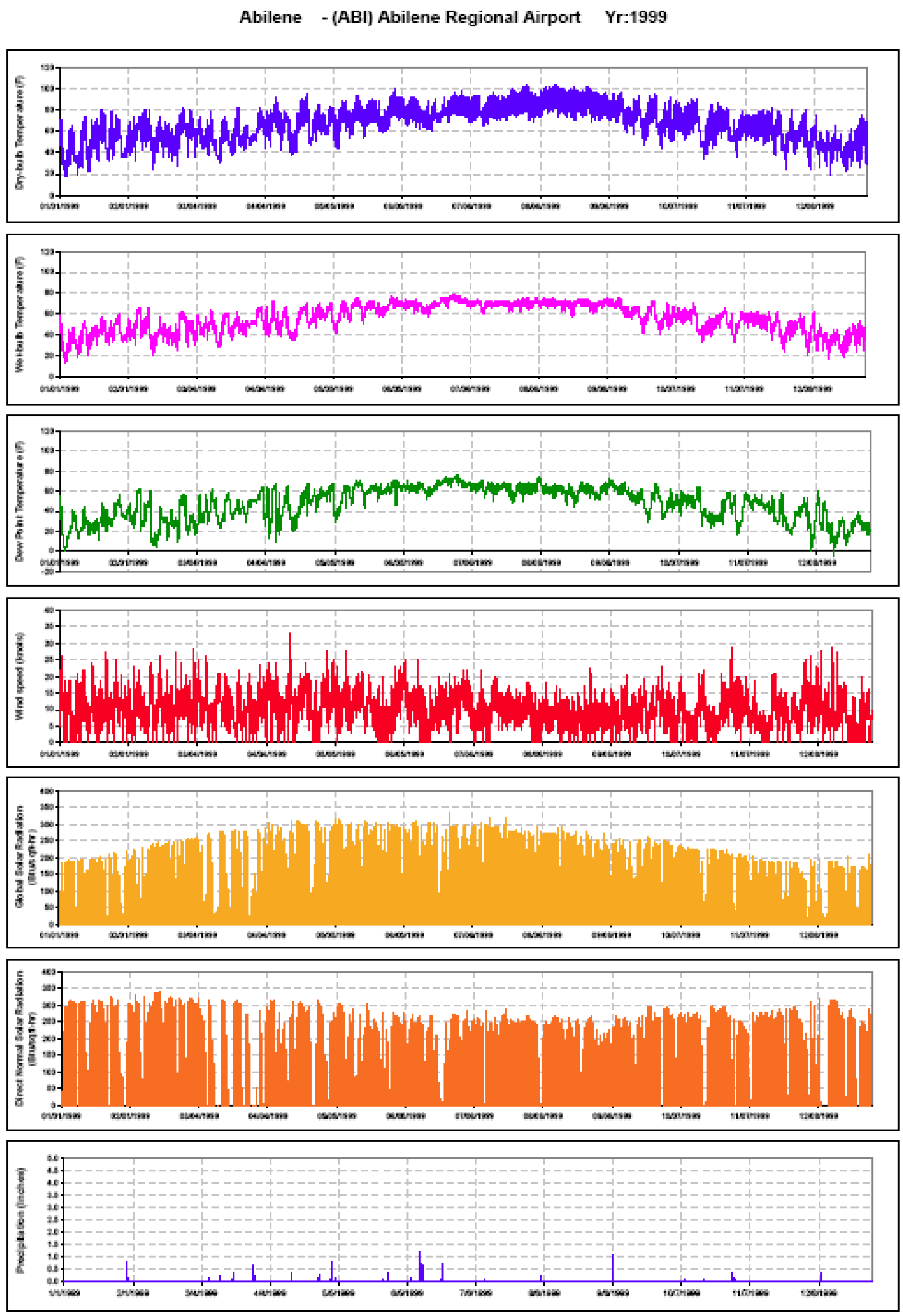


Figure 28: Time Series Graphs Showing Hourly Weather Data for Abiline, 1999.

5.2.5 Provide Technical Assistance to the TCEQ.

The Laboratory received approximately 15 to 25 calls per week from code officials, builders, home owners and municipal officials regarding the building code and emissions calculations. A complete file of these transactions is maintained at the Laboratory. Specific Technical Assistance responses are contained in the related sections of this report.

5.2.6 Delivered "Statewide Air Emissions Calculations from Wind and Other Renewables," to the Texas Commission on Environmental Quality in August 2006.

NOTE: This section contains material from the Laboratory's report "Statewide Air Emissions Calculations From Wind and Other Renewables", filed in August 2006 with the TCEQ. **Error! Reference source not found.** shows the cover page for this report, which can be found on the Laboratory's web site.

The Energy Systems Laboratory, in fulfillment of its responsibilities under this Legislation, submitted its first annual report, "Statewide Air Emissions Calculations from Wind and Other Renewables," to the Texas Commission on Environmental Quality in August 2006.

The report was organized in several deliverables:

- A Summary Report, which details the key areas of work;
- Supporting Documentation, including the Quality Assurance Project Plan;
- Supporting data files, including weather data, and wind production data, which have been assembled as part of the first year's effort.

This executive summary in the report provided summaries of the key areas of accomplishment this year, including:

- development of stakeholder's meetings;
- reporting of NOx emissions reductions from renewable energy generation in the 2005 report to the TCEQ;
- results of preliminary literature search of previous methods;
- proposed weather normalization procedure for a single wind turbine;
- proposed weather normalization procedure for a wind farm containing multiple wind turbines;
- testing of the models;
- weather data collection efforts, and
- proposed modifications to the Laboratory's Quality Assurance Project Plan.

5.2.6.1 Development of Stakeholder's meetings.

Legislation passed during the regular session of the 79^{th} Legislature directed the Energy Systems Laboratory to work with the TCEQ to develop a methodology for computing emissions reductions attributable to renewable energy and for the Laboratory to quantify the emissions reductions attributable to renewables for inclusion in the State Implementation Plan annually. HB 2921 directed the Texas Environmental Research Consortium (TERC) to engage the Texas Engineering Experiment Station for the development of this methodology.

To initiate this effort, the TERC and Texas A&M held a Stakeholder's meeting at the Texas State Capitol on Tuesday, August 30, 2005. At this meeting the draft scope of work, schedule and deliverables were discussed.

On May 30, 2006, a second Stakeholder's meeting was held at the Texas State Capitol. At this meeting the draft scope of work was reviewed and the preliminary analysis of a single wind turbine was presented.

5.2.6.2 Reporting of NOx emissions reductions from renewable energy generation in the 2005 report 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.

Total cumulative NOx reductions were determined to be 5,738.58 tons/year, and 15.43 tons/peak-OSD in 2009, and 6,034.93 tons/year and 17.13 tons/peak-OSD in 2013, which contain the following contributions from the Laboratory, the Public Utilities Commission (PUC), the State Energy Conservation Office (SECO), and green power provided by wind turbines[12]renewable energy sources Wind/ERCOT programs:

- from energy efficiency savings from code-compliant new construction: 900.52 tons/year, and 4.47 tons/peak-OSD in 2009; and 1,167.49 tons/year with 5.75 tons/peak-OSD in 2013 (2007 eGRID),
- from the PUC SB7 and SB5 programs: 1,483.22 tons/year, and 3.98 tons/peak-day-OSD in 2009, and 1,981.05 tons/year, and 5.31 tons/peak-OSD in 2013 (2007 eGRID),
- from the SECO program, 447.10 tons/year, and 1.29 tons/OSD in 2009, and 699.86 tons/year, and 1.76 tons/peak-OSD in 2013, and
- from the Wind-ERCOT program: 2,880.74 tons/year and 5.69 tons/peak-OSD in 2009 and 2,186.33 tons/year and 4.32 tons/peak-OSD in 2013.

5.2.6.3 Results of preliminary literature search of previous methods.

Results from a preliminary search of the literature on weather data synthesis, and data filling techniques is included. These results show that there are previous studies regarding the filling-in of missing data using a variety of techniques. However, there appear to be no previous attempts to synthesize on-site wind data from published NOAA records. Additional references will be searched to look for previous papers in this area.

A preliminary search was also performed on the literature regarding the synthesis of solar radiation data. This search located a number of procedures that have been proposed for synthesizing solar radiation data in locations where only non-solar weather data are collected. Based on the results of this search, a procedure has been chosen for use. In addition, results from a recent ASHRAE project has shown new procedures have been developed that may improve the proposed model. The results from the ASHRAE project will be further investigated to determine if these will prove useful for Texas.

Finally, a review of ASHRAE's Inverse Model Toolkit (IMT) analysis method, which uses linear, and change-point linear algorithms is presented. This includes a analysis of the accuracy of IMT and its algorithms versus other well-accepted statistical analysis tools, such as SAS. Also, included is a review of the history of the IMT, and the linear and change-point linear models, and a review of the published comparisons of the IMT and other analysis software, which was part of the accuracy testing that was performed as part of ASHRAE's Research Project 1050-RP.

5.2.6.4 Proposed weather normalization procedure for a single wind turbine.

To investigate the proposed weather normalization procedures for the wind power generation of a single wind turbine, an actual wind electricity generator with a 44-ft rotor diameter, installed in the Southern Great Plains at the USDA Conservation and Production Research Laboratory in 1982 in Randall County, Texas was analyzed. This analysis includes a description of the on-site and NOAA wind data, electricity

[12] The green power provided by wind turbine installations is currently monitored by the Electric Reliability Council of Texas (ERCOT).

production data, modeling of the power production using the IMT, analysis of the ability of the model to forecast wind power for other years, and an analysis of the capacity factors generated using the model.

5.2.6.5 Proposed weather normalization procedure for a wind farm containing multiple wind turbines, and testing of the models.

To investigate the proposed weather normalization procedures for the wind power generation of a wind farm with multiple wind turbines, the Indian Mesa Wind Farm located in Pecos County, TX was used. This project was completed in 2001. One hundred and twenty-five Vestas V-47 wind turbines produce up to 82.5 Megawatts of electricity. Electricity produced by the project is purchased by the Lower Colorado River Authority, Austin, Texas, and TXU Energy Trading Company, Dallas, Texas. The project is connected to the transmission lines of American Electric Power subsidiary West Texas Utilities. This analysis includes a description of the on-site and NOAA wind data, electricity production data, modeling of the power production using the IMT, analysis of the ability of the model to forecast wind power for other years, and an analysis of the capacity factors generated using the model.

5.2.6.6 Weather data collection efforts.

An analysis is presented regarding the expansion of the weather data collection efforts for wind and renewables. In 2005, in cooperation with the TCEQ, the 9 weather stations, which had been assembled for calculating emissions from the non-attainment and affected counties were expanded to include all counties in ERCOT. To accomplish this, 8 additional weather stations were added to the original 9 stations for a total of 17 weather stations. Assignment of weather stations was then performed, and data collection efforts initiated, including the synthesis of solar radiation for sites where no solar data have been collected since 2003, when the USDOE ceased funding the NREL solar radiation network in Texas.

5.2.6.7 Proposed modifications to the Laboratory’s Quality Assurance Project Plan.

Modifications to the Laboratory’s Quality Assurance Project Plan (QAPP) have been outlined for the 2006/2007 effort. These modifications include expansion of the QAPP to include the new weather sites, expansion of the dataset to include ERCOT electric power from wind generators, and other renewables data.

5.2.7 Delivered "Statewide Air Emissions Calculations from Wind and Other Renewables," to the Texas Commission on Environmental Quality in August 2007

NOTE: This section contains material from the Laboratory's report "Statewide Air Emissions Calculations From Wind and Other Renewables", filed in August 2007 with the TCEQ. Figure 29 shows the cover page for this report, which can be found on the Laboratory's web site.

The 79th Legislature, through Senate Bill 20, House Bill 2481 and House Bill 2129, amended Senate Bill 5 to enhance its effectiveness by adding 5,880 MW of generating capacity from renewable energy technologies by 2015, and 500 MW from non-wind renewables.

This legislation also requires PUC to establish a target of 10,000 megawatts of installed renewable capacity by 2025, and requires TCEQ to develop methodology for computing emissions reductions from renewable energy initiatives and the associated credits. In this Legislation the Laboratory is to assist TCEQ in quantifying emissions reductions credits from energy efficiency and renewable energy programs, through a contract with the Texas Environmental Research Consortium (TERC) to develop and annually calculate creditable emissions reductions from wind and other renewable energy resources for the state's SIP.

The Energy Systems Laboratory, in fulfillment of its responsibilities under this Legislation, submits its second annual report, "Statewide Air Emissions Calculations from Wind and Other Renewables," to the Texas Commission on Environmental Quality.

The report is organized in several deliverables:

- A Summary Report, which details the key areas of work;
- Supporting Documentation;
- Supporting data files, including weather data, and wind production data, which have been assembled as part of the first year's effort.

This executive summary provides summaries of the key areas of accomplishment this year, including:

- continuation of stakeholder's meetings;
- review of electricity savings reported by ERCOT;
- analysis of wind farms using 2005 data;
- preliminary reporting of NOx emissions savings in the 2006 Integrated Savings report to TCEQ;
- prediction of on-site wind speeds using Artificial Neural Networks (ANN);
- improvements to the daily modeling using ANN derived wind speeds;
- development of a degradation analysis;
- development of a curtailment analysis;
- analysis of other renewables, including: PV, solar thermal, hydroelectric, geothermal and landfill gas;
- estimation of hourly solar radiation from limited data sets;

5.2.7.1 Development of Stakeholder's meetings.

Legislation passed during the regular session of the 79th Legislature directed the Energy Systems Laboratory to work with the TCEQ to develop a methodology for computing emissions reductions attributable to renewable energy and for the Laboratory to quantify the emissions reductions attributable to renewables for inclusion in the State Implementation Plan annually. HB 2921 directed the Texas Environmental Research Consortium (TERC) to engage the Texas Engineering Experiment Station for the development of this methodology.

During the 2006-2007 period Texas A&M held continuing Stakeholder's meetings. A presentation of the overheads used in these meetings is contained in this report.

5.2.7.2 Review of Electricity Savings Reported by ERCOT

In this report, the information posted on ERCOT's Renewable Energy Credit Program site www.texasrenewables.com is reviewed. In particular, information posted under the "Public Reports" tab was downloaded and assembled into an appropriate format for review. This includes ERCOT's 2001 through 2006 reports to the Legislature, and information from ERCOT's listing of REC generators.

5.2.7.3 Analysis of wind farms using 2005 data.

In this report the weather normalization procedures developed together with the Stakeholders[13] were applied to several additional wind farms that reported their data to ERCOT during the 2005 measurement period, together with wind data from the nearby NOAA weather stations. In the 2006 Wind and Renewables report to the TCEQ (Haberl et al. 2006) weather normalization analysis methods were reviewed, and an analysis was shown for a single wind turbine in Randall, Texas, as well as an analysis of a wind farm containing multiple turbines at the Indian Mesa facility in Pecos, Texas.

In this report, an analysis of wind data is shown for the Sweetwater I wind farm in Nolan County, Texas is provided. In addition, an analysis was performed to determine whether or not any degradations in capacity factor could be observed in the data. Finally, an analysis of electric power production in 1999 is presented for all the wind sites, including an uncertainty analysis of the data.

In addition, in this report, the processing of weather and power generation data, modeling of daily power generation versus daily wind speed using the ASHRAE Inverse Model Toolkit (IMT) (Haberl et al. 2003; Kissock et al. 2003), prediction of 1999 wind power generation using developed coefficients from 2005 daily model, and the analysis on monthly capacity factors generated using the model.

Finally, a summary of total predicted wind power production in the base year (1999) for all the wind farms in the ERCOT region using this procedure is presented to show the improved accuracy of using this weather normalization procedure compared to the non-weather normalization procedure reported in the 2006 integrated savings report to the TCEQ (Haberl et al. 2006). This includes an uncertainty analysis that was performed on all the daily regression models and included in this report to show the accuracy of applying the linear regression models to predict the wind power generation that the wind farms would have had in the base year of 1999. The detailed analysis for each wind farm is provided in the Appendix to this report. The original data used in the analysis is included in the accompanying CD-ROM with this report.

5.2.7.4 Preliminary reporting of NOx emissions savings in the 2006 Integrated Savings report to TCEQ;

In this report, the preliminary 2006 cumulative NOx emissions savings are reported. These values represent the electricity and NOx emissions savings that are reported to the TCEQ through the integrated NOx emissions savings reporting procedures, which contain growth, discount, and degradation factors.

[13] See the previous section that describes the conference calls held with the Wind Energy Stakeholder's group to develop the methodologies.

5.2.7.5 Prediction of on-site wind speeds using Artificial Neural Networks (ANN).

Electricity produced by wind farms in Texas reduces the emission of air pollutants which would otherwise have been produced by burning fossil fuels to generate the same electricity. As more wind farms are commissioned (and some turbines decommissioned), proper accounting of pollution credits for wind energy requires normalization of the generation to a standard year, because year-to-year variations from the long term mean are significant.

In this report, we first discuss extrapolation to a reference year using an advanced Artificial Neural Network (ANN) model. Such a model is needed since we cannot expect to have wind data at the site of the turbine/farm for the reference year. The main question is: is it possible to use available hourly NOAA data, hourly site wind data, and hourly power generation data for a period of a few months bracketing the ozone season for any given year to develop an hourly model relating power generation to site wind, and site wind to NOAA data. If so we can extrapolate the hourly wind farm performance to the ozone season of the reference year. A secondary question addressed is: how to account for non-utilization of available wind power due to transmission constraints. Actually, two data sets are analyzed: one for a single wind turbine in Randall county, and a second set for Indian Mesa I wind farm in Pecos county.

5.2.7.6 Improvements to the daily modeling using ANN derived wind speeds.

In this report, the ANN model is shown to substantially improve the on-site wind data predictions using NOAA data as a measure of the site wind. In the analysis, the Indian Mesa wind farm was used again as an example to show that using ANN-derived, on-site wind speed in the daily regression model can provide more accurate prediction on monthly and Ozone Season Period (OSP) power generation. If this procedure could be used across all the wind farms in the ERCOT region, it is felt that substantial improvements could be made to reduce the uncertainty of the predictions of the power produced in the base year, and therefore the reductions in NOx emissions from electricity derived from wind energy. In the report the procedure developed to compare the ANN daily model using ANN derived on-site wind and the NOAA daily model.

5.2.7.7 Development of a degradation analysis.

This report contains an analysis to determine what amounts of degradation could be observed in the measured power from Texas wind farms. Currently, the TCEQ uses a very conservative 5% degradation per year for the power output from a wind farm when making future projections from existing wind farms. Accordingly, the TCEQ asked the Laboratory to evaluate any observed degradation from the measured data for Texas wind farms. To accomplish this, nine wind farms (14 sites) in Texas from 2002 to 2005 were evaluated. These wind farms were built before Jan 2002, with a total capacity of 1,010 MW.

In this analysis, a sliding statistical index was established for each site that uses 10^{th}, 25^{th}, 50^{th}, 75^{th}, 90^{th}, 99^{th} percentiles of the hourly power generation over a 12-month sliding period[14], as well as mean, minimum and maximum hourly power generation of the same 12-month period. These indices are then displayed using one data symbol for each 12-month slide, beginning from the first 12-month period (i.e., January 2002 to December 2002) until the last 12-month period (January 2005 to December 2005) for each of the wind farms.

5.2.7.8 Development of a curtailment analysis.

During the analysis of the measured power production from the Indian Mesa wind farm, and the subsequent discussions with the wind stakeholders, group, including representatives from ERCOT, it became clear that the dataset contained substantial amounts of data that represented periods when the wind farm owners were

[14] To calculate this hourly data for the 12 month period is converted into quartiles, and those quartiles are recorded in a table. Then, the oldest month is dropped from the dataset and a new month is added, and the quartiles recalculated and recorded, etc.

instructed to curtail their power production because of constraints on the electric transmission lines. Unfortunately, it was determined that there was no electronic record of the amount of curtailment for this site[15]. As the analysis progressed, it became clear that an hourly analysis that used a manufacturer's wind power curve, multiplied times the prevailing on-site wind speed, and scaled for the number of turbines at the site, presented the possibility of empirically determining the curtailment for the site. Therefore, the TCEQ requested that the Laboratory perform a proof-of-concept analysis to empirically determine the curtailment at the Indian Mesa site.

In this report, the measured power production for the period July 2002 to January 2003 from the Indian Mesa wind farm was analyzed using the on-site wind speed and manufacturer's power curves. Significant curtailment was observed during this period due to the power constraints in the McCamey power transmission area.

5.2.7.9 Analysis of other renewables.

In this report other renewable energy projects throughout the state of Texas were located to determine the NOx emissions reduction. Searches were conducted on four specific categories: solar photovoltaic, geothermal, hydroelectric, and Landfill Gas-fired Power Plants, and information assembled for inclusion in this report.

5.2.7.10 Estimation of hourly solar radiation from limited data sets.

One of the important tasks performed as part of the Laboratory's Senate Bill 5 effort has been the assembly and use of measured weather data for all Texas NOAA sites that correspond to the TMY2 sites for the years 1999 to 2006. Unfortunately, many of these sites have had discontinuous solar data, which requires the use of synthetic solar radiation to fill-in missing records. Therefore, this report contains information about the synthesis procedures used to generate the solar radiation data for those sites where data are missing.

[15] This would appear to be true for other sites in ERCOT.

ESL-TR-07-08-01

STATEWIDE AIR EMISSIONS CALCULATIONS FROM WIND AND OTHER RENEWABLES

SUMMARY REPORT

**A Report to the
Texas Commission on Environmental Quality
For the Period September 2006 – August 2007**

TCEQ

**Jeff Haberl, Ph.D., P.E.; Zi Liu, Ph.D.; Juan-Carlos Baltazar-Cervantes, Ph.D.
Kris Subbarao, Ph.D.; Don Gilman, P.E.; Charles Culp, Ph.D., P.E.
Bahman Yazdani, P.E.; Dan Turner, Ph.D., P.E.**

August 2007

ENERGY SYSTEMS LABORATORY

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

Figure 29: Cover page of “Statewide Air Emissions Calculations From Wind and Other Renewables”, August 2007.

5.2.8 Developed Database of Other Renewable Projects for Texas

Renewable energy projects throughout the state of Texas were located to determine the NOx emissions reduction. Searches were conducted on four specific categories: solar photovoltaic, geothermal, hydroelectric, and Landfill Gas-fired Power Plants. The criteria for each project included in the data collection were: 1) the installation date was after the year 2000, and 2) the project was installed within the state of Texas. In order to provide a complete record, however, projects reported prior to 2000 were also included in the "Statewide Air Emissions Calculations From Wind and Other Renewables", August 2007.

An initial search on the internet was conducted to find solar photovoltaic, hydroelectric, geothermal, and landfill gas projects. Following these preliminary searches a more thorough investigation was conducted on specific websites that were deemed credible. Unfortunately, most of the project descriptions did not include system specifications data. To find this information, the corresponding companies, organizations, or government entities that were mentioned in the article were contacted via email or phone. Unfortunately, these efforts were productive in only a small number of cases. In addition to these efforts to find individual projects, manufacturers and contractors of the various systems were contacted about project installations following the determined criteria.

After the necessary information was obtained, the annual power production was calculated by entering the project specifics into the Laboratory's eCALC program to calculate the energy savings and emissions reduction for each of the projects. Since eCALC relies on county designations, it was necessary to find the nearest geographical county, since not all of the counties in Texas are available in eCalc.

5.2.8.1 Other Renewables Sources

5.2.8.1.1 Solar Photovoltaic

One of the primary sources of information proved to be the website maintained by the Soltrex company. Soltrex is a company that provides data servers, websites, and data loggers to track the performance of PV systems. Within the Soltrex website, several hundred schools across the nation provided the energy output of their PV system, the installation date, and the system specifications.

Another noteworthy source of information was the website for Meridian Energy Systems, Inc., a company located in Austin, Texas. Their website provided a portfolio that included information about multiple projects completed within the last five to ten years. However, specific information was not provided. Therefore, further information regarding all these projects will be provided in a future report.

The Electric Reliability Council of Texas (ERCOT) and State Energy Conservation Office (SECO) also provided information for several projects. Their websites described the use of solar panels at school crossings throughout the state. There were some instances where only partial information was listed. So, efforts were made to locate more specific information on some of these, such as the Sheldon Lake and Environmental Learning Center. At this site, the superintendent, Mr. Robert Comstock, was contacted for specific information about their PV system. Hensley Field was another project where the project manager, Mr. Michael Kawecki, was contacted and replied with a presentation containing more specific information.

After the above sources were assembled, additional manufacturers and contractors were contacted to find additional installations. A major contributor for projects was found on one distributor's website, the Southwest Photovoltaic Systems, Inc. (SWPV), an international distributor of BP Solar Panels. Their website provides a snapshot of installed projects throughout the United States, so the company was contacted to gain further information about their Texas projects. When asked about the slope of their products used in the qualifying projects, the company could not respond in detail to each one due to time constraints. However, they did inform us that the average solar panel used was 12.5 square feet (5 feet by

2.5 feet). This figure was then used for calculations, and an appropriate assumption was made about the azimuth and slope.

For both of these sources, the corresponding websites cited the type of solar panel installed as well as the number of modules. Unfortunately, the square footage of each module was not always available. Since eCalc requires the area of the solar panels for each project, it was necessary to find this data for each site. Therefore, an additional search was performed by contacting the individual manufacturers of these products or were found on the web.

eCalc includes the photovoltaic option for high- or low-end systems. A high-end PV system was assumed for all of the projects based on the average efficiency of the photovoltaic cells in the last decade, which is 11% or higher.

A summary of the different projects and their outputs from eCalc can be found in “Statewide Air Emissions Calculations From Wind and Other Renewables”, August 2007. This report includes: the location of the projects in Texas, the annual electric savings per county for the projects, and Ozone Season Day savings. The respective annual and ozone season day emissions reductions are also included. For the projects identified, a total potential of 386,487 kWh/year were calculated, which translates to 567 lbs-NOx/year, 380 lbs-SOx/year, and 483,511 lbs-CO2/year using the 2007 eGRID values. During the Ozone Season Period, the total savings were 1,206 kWh/day, which translates to translates to 1.75 lbs-NOx/OSD, 0.66 lbs-SOx/OSD, and 1,413 lbs-CO2/OSD using the 2007 eGRID.

5.2.8.1.2 Solar Thermal

Information regarding the solar thermal projects was obtained from a joint survey issued by the Laboratory and the Texas Renewable Energy Industries Association sent to various companies. In addition, information was obtained from several manufacturer’s web sites. This survey revealed that Techsun Solar, Inc. is responsible for eight out of the nine projects documented in this report. The ninth project is presented as a special project since there is no methodology currently available to obtain these values. This special project is a Roof Mounted Parabolic Trough collector located at Fort Sam Houston in the San Antonio, Texas, area.

A summary of the different projects and their electricity and emissions reductions using eCalc can be found in “Statewide Air Emissions Calculations From Wind and Other Renewables”, August 2007. For the projects identified, a total potential of 40,518 kWh/year were calculated, which translates to 65 lbs-NOx/year, 56 lbs-SOx/year, and 19,365 lbs-CO2/year using the 2007 eGRID values. During the Ozone Season Period, the total savings were 138 kWh/day, which translates to translates to 0.22 lbs-NOx/OSD, 0.11 lbs-SOx/OSD, and 207 lbs-CO2/OSD using the 2007 eGRID.

5.2.8.1.3 Hydroelectric

The main source of information for hydroelectric systems came from the Idaho National Laboratory website that has an interactive map regarding hydroelectric sites. The user chooses a specific dam; when the dam is chosen, the name, operator, and the capacity of the dam appears. Locations of twenty-eight dams were found through this process. However, the date of the installation was not available. Further investigation for this information was conducted by contacting the Corps of Engineers and various authorities in charge of each plant including the Guadalupe Blanco River Authority and the Lower Colorado River Authority. Owners of several additional private dams were contacted with limited success. All hydroelectric project information is presented in “Statewide Air Emissions Calculations From Wind and Other Renewables”, August 2007. Since none of the hydroelectric sites were constructed after 2001, no electricity savings were calculated.

5.2.8.1.4 Geothermal

Geothermal projects were also found through various websites. Since this did not result in locating many projects, contractors and manufacturers of geothermal systems were contacted directly to find their projects installed after the year 2001. The Geothermal Heat Pump Consortium's website was used to find contractors of geothermal heat pumps. Six major projects were identified in this website; however, more information is needed in order to conduct a more exhaustive analysis that will allows for the emissions reductions to be calculated due to the use of ground-coupled heat pumps. Companies such as Trane, WaterFurnace, and Mammoth, Inc. also provided a few case studies. Once again, the information was limited, and many of the sites listed were constructed prior to 2001.

The Geothermal Lab and the Geo-Heat Center from the Oregon Institute of Technology provided additional information about geothermal sites, but none of the information obtained contained any specific projects in the Texas area. The resulting information can be found in "Statewide Air Emissions Calculations From Wind and Other Renewables", August 2007.

5.2.8.1.5 Landfill Gas-fired Power Plants

House Bill 3415 went into effect in 2001 and encouraged the development and use of landfill gas for state energy and environmental purposes. This allowed TCEQ to give priority to processing applications for registrations.

The City of Denton's landfill has been given various awards for its innovation to produce biodiesel fuel. This is used to power a three million-gallon biodiesel production facility. This is the first facility of its kind in the world where landfill gas is used to produce biodiesel, according to the Environmental Protection Agency (EPA). This landfill gas supplies all of the energy needs to the production facility including all process heat and power. This biodiesel is then used in part to power the city's truck fleet with B20 which is a blend of 80 % diesel and 20 % biodiesel.

The EPA has a project database for the Landfill Methane Outreach Program (LMOP). The implemented, candidate, and potential projects in Texas are listed in "Statewide Air Emissions Calculations From Wind and Other Renewables", August 2007.

5.2.9 Technical Assistance

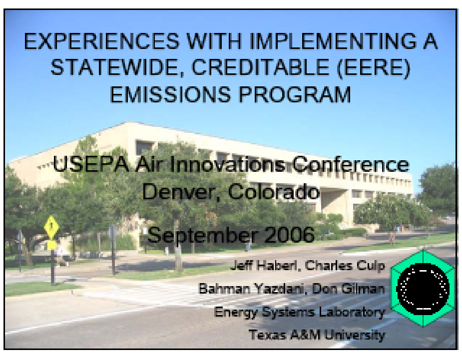
The Laboratory provided technical assistance to the TCEQ, the PUC, SECO and ERCOT, as well as Stakeholders participating in the Energy Code and Renewables programs. In 2005 the Laboratory worked closely with the TCEQ to develop an integrated emissions calculation, that provided the TCEQ with a creditable NOx emissions reduction from energy efficiency and renewable energy (EE/RE) programs reported to the TCEQ in 2005 by the Laboratory, PUC, SECO, and Wind-ERCOT.

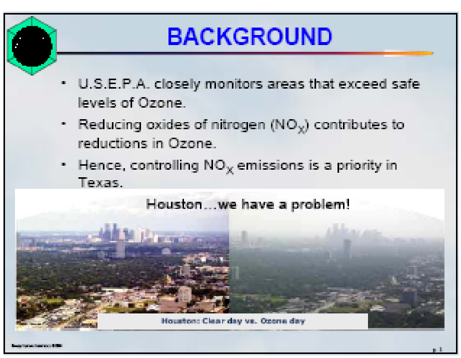
The Laboratory has also enhanced the previously developed emissions calculator by: expanding the capabilities to include all counties in ERCOT; including the collection and assembly of weather from 1999 to the present from 17 NOAA weather stations; and enhancing the underlying computer platform for the calculator.

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.

5.2.9.1 Presentation at the USEPA Air Innovations Conference, Denver, Colorado, September 2006.

In September 2006, the Laboratory was invited by the USEPA to give a presentation on the Emissions Reductions calculations that have been developed for the TCEQ as part of one of their Best Practice sessions at the conference. The following figures present the slides used in this presentation about creditable emissions from EE/RE programs in Texas.





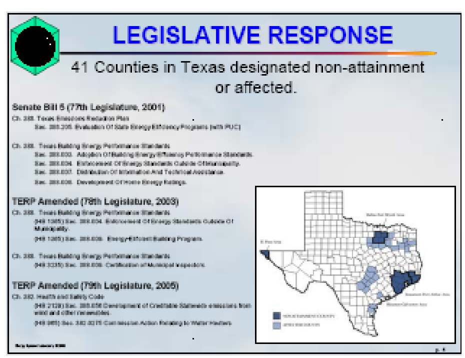
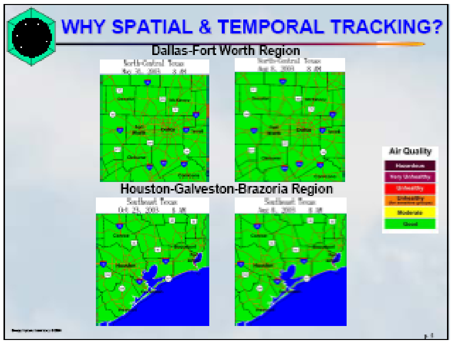
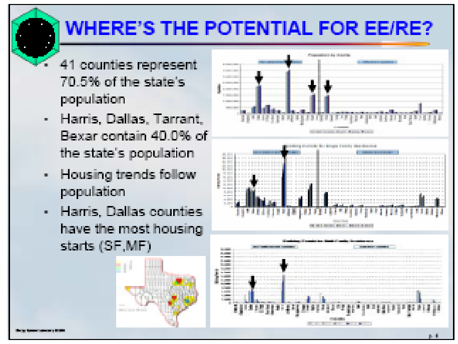
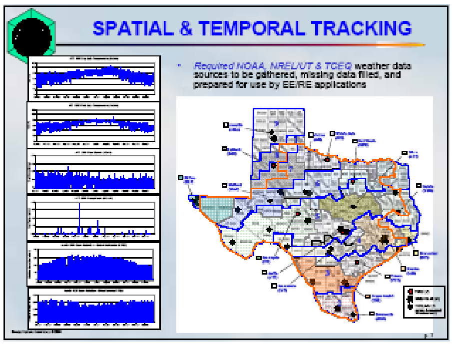
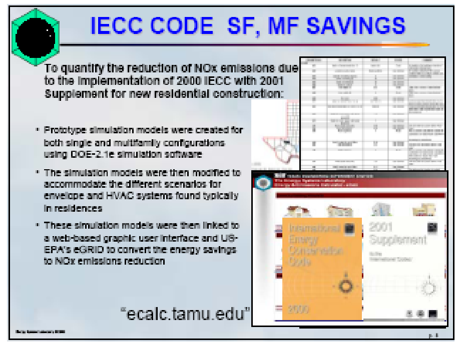


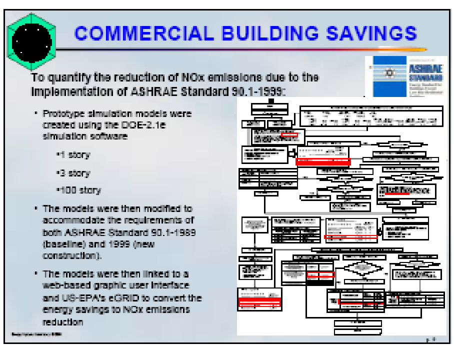
Figure 30: Slides Presented at the USEPA Air Innovations Conference (September, 2006).

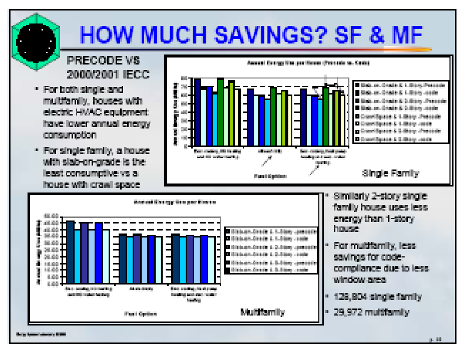


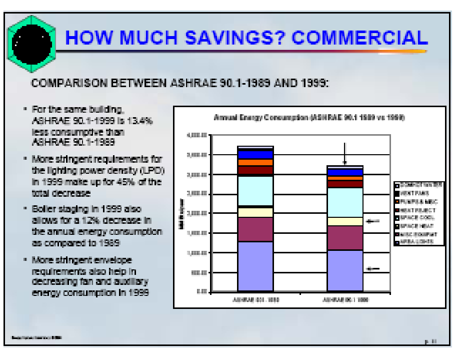












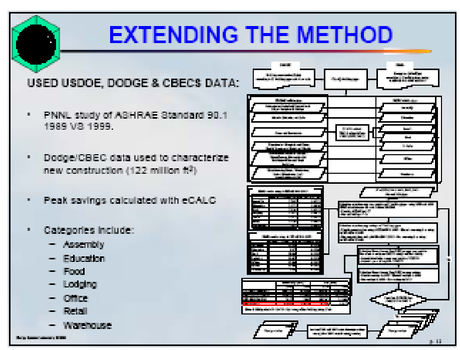
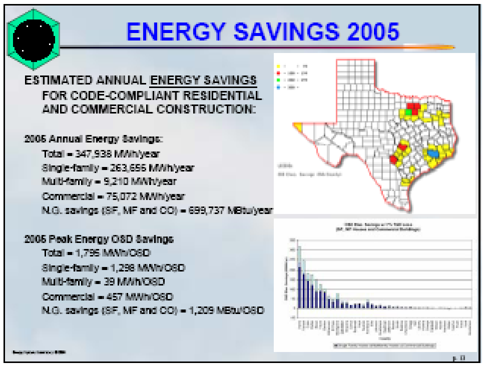
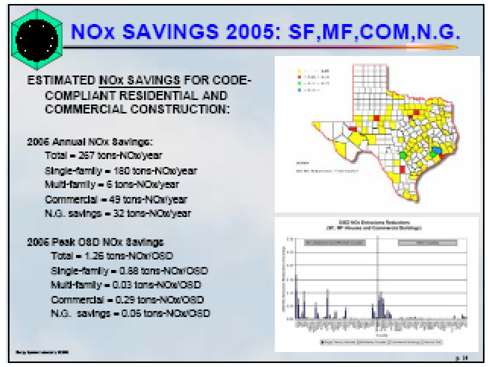
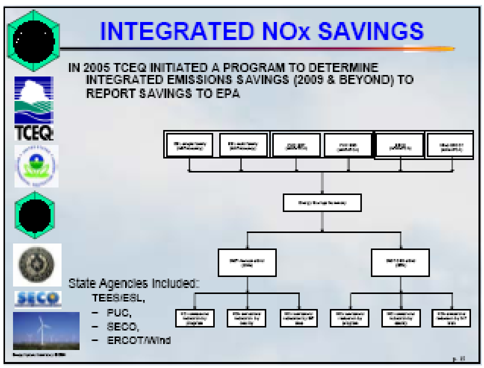
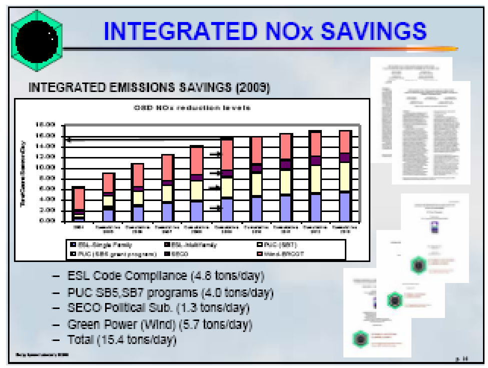


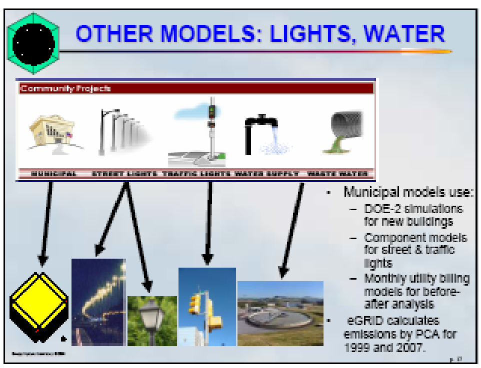
Figure 31: Slides Presented at the USEPA Air Innovations Conference (September, 2006).

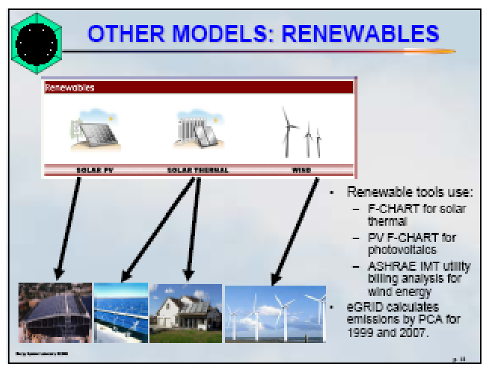


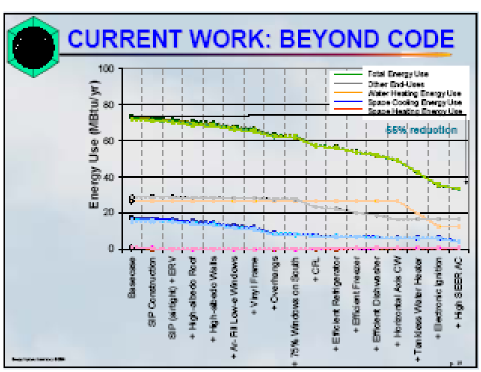












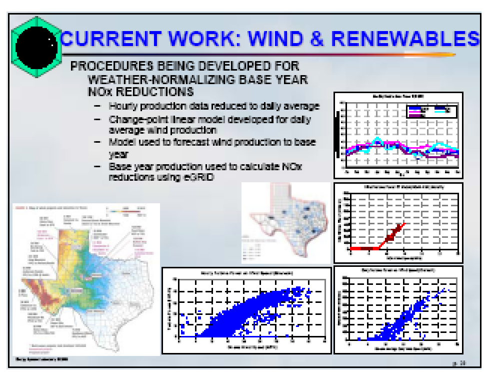


Figure 32: Slides Presented at the USEPA Air Innovations Conference (September, 2006).

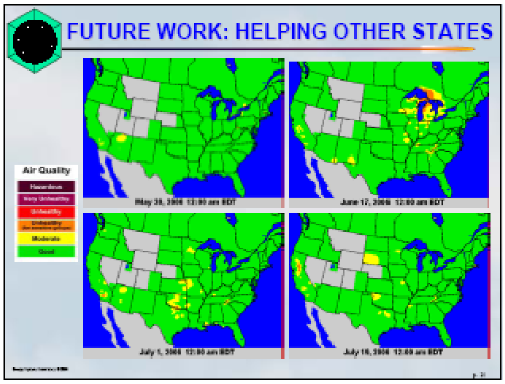
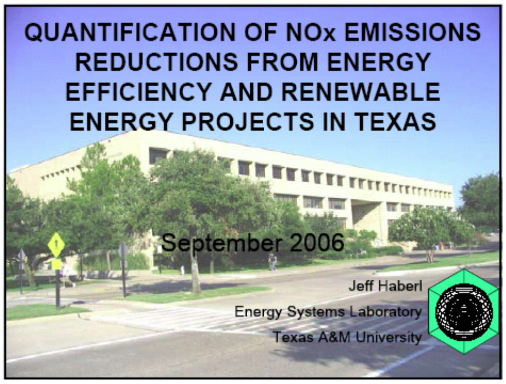
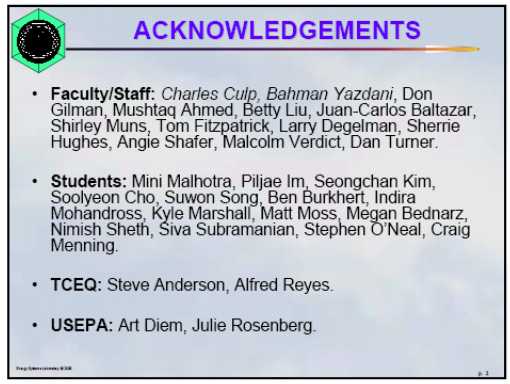


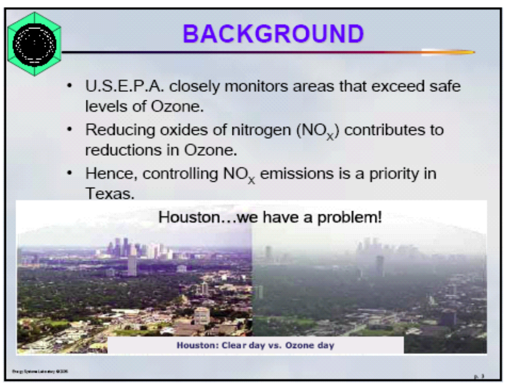
Figure 33: Slides Presented at the USEPA Air Innovations Conference (September, 2006).

5.2.9.2 Presentation at Rice University, September, 2006.

In September 2006, the Laboratory was invited to give a talk to the faculty and graduate students in the Civil Engineering Department at Rice University. This talk covered the development of creditable emissions reductions calculations for EE/RE programs in Texas. The following figures present the slides used in this presentation.







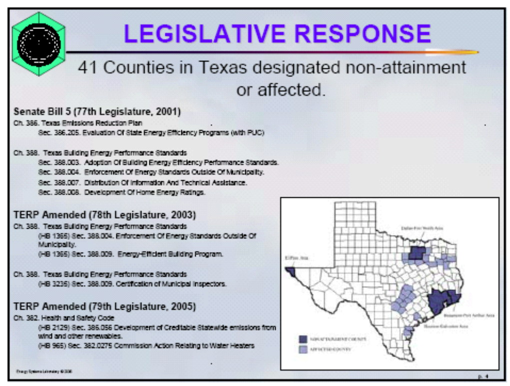
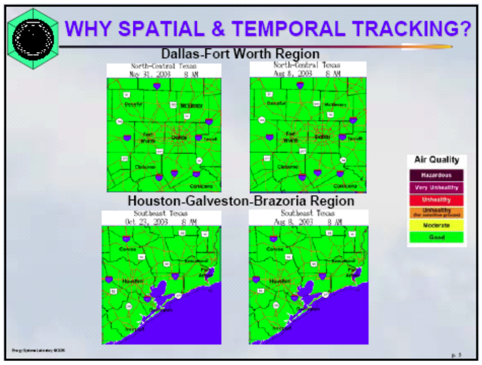
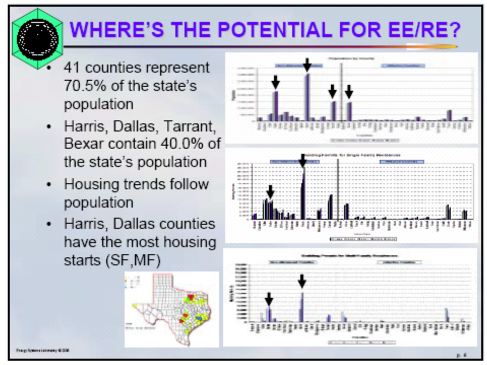
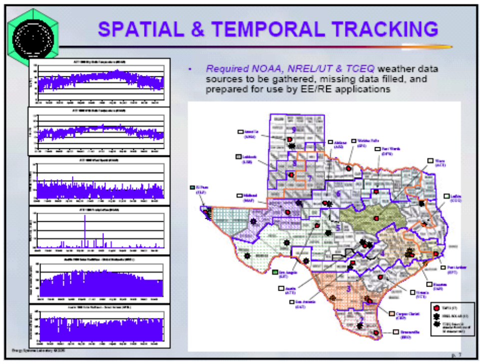
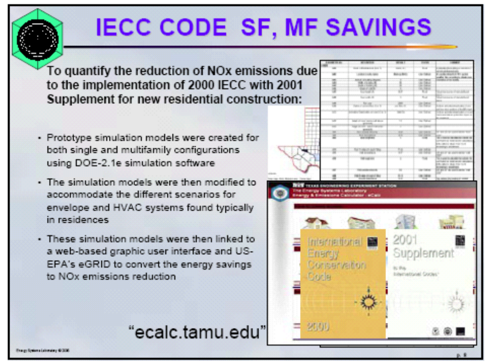


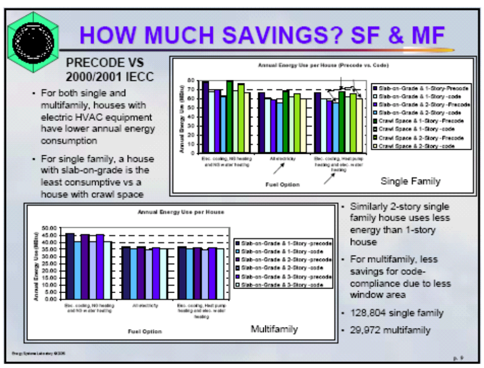
Figure 34: Slides presented at Rice University (September 2006).

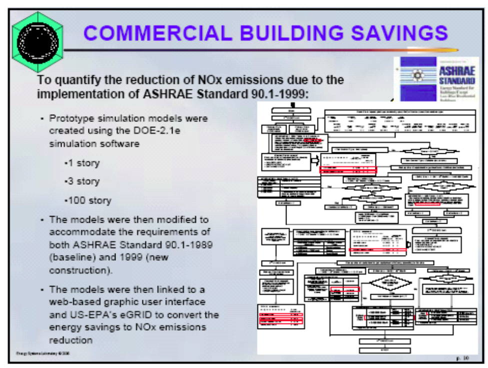


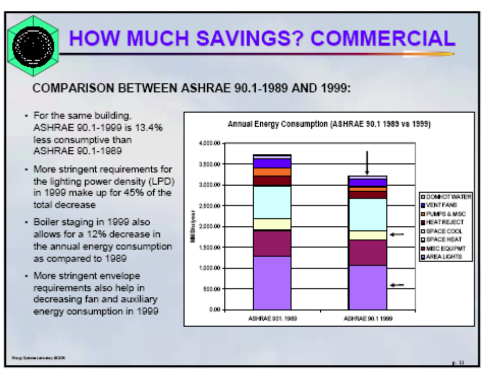












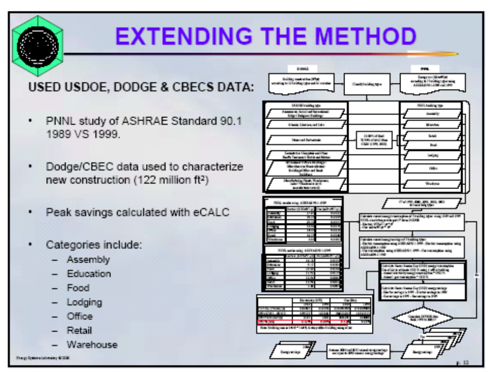
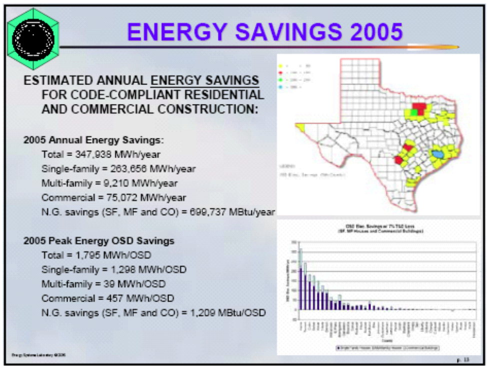
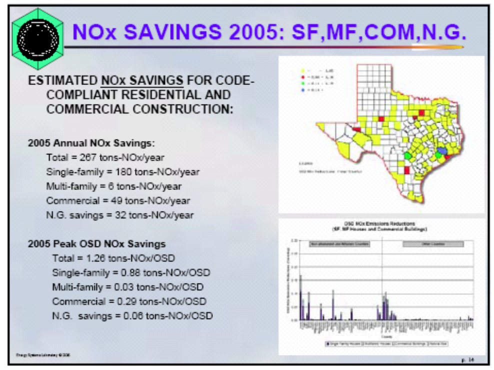
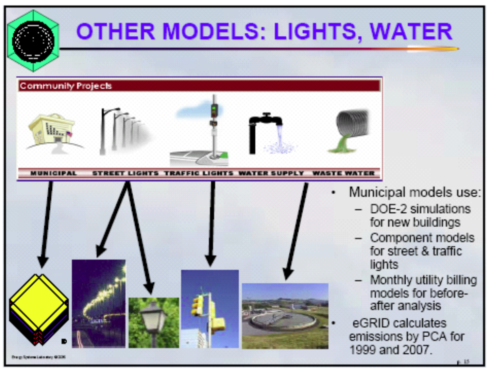
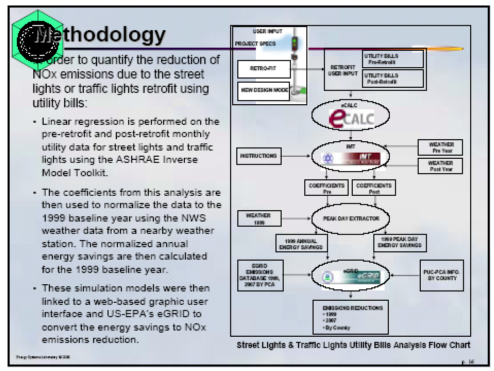


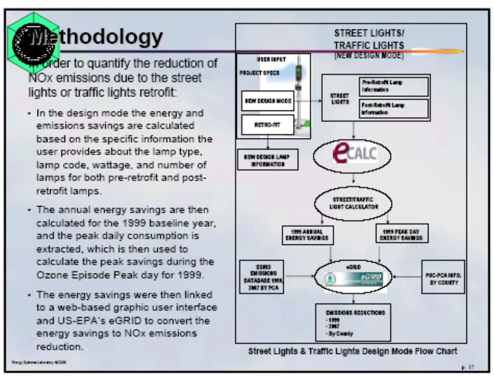
Figure 35: Slides presented at Rice University (September 2006).

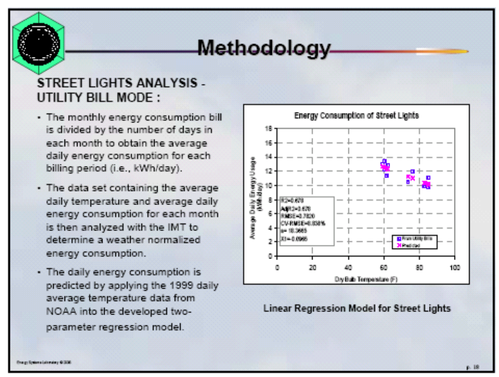


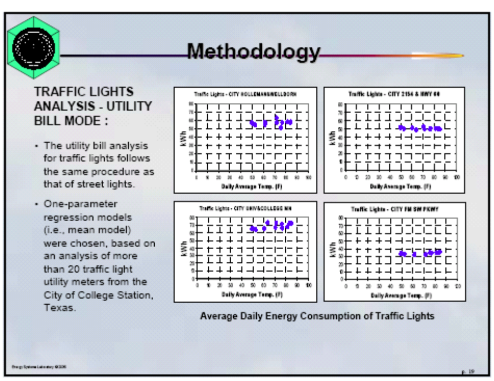












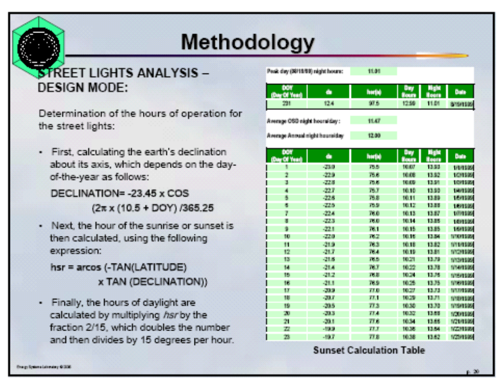
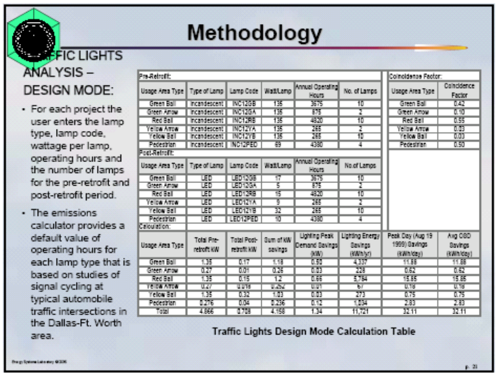
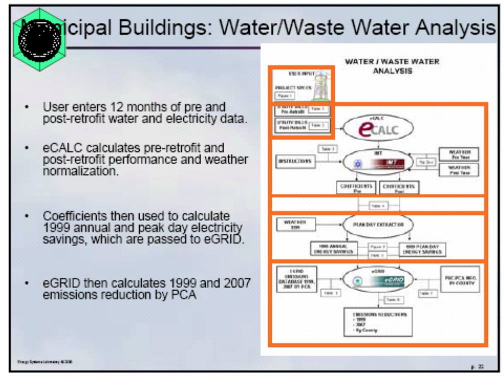
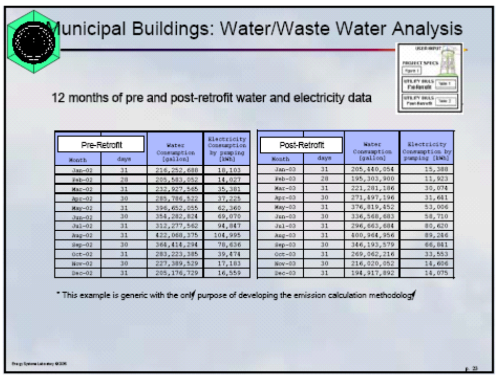
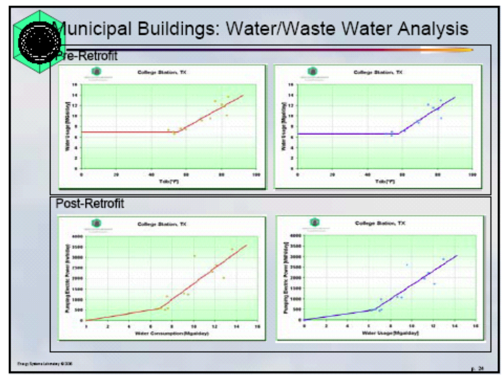


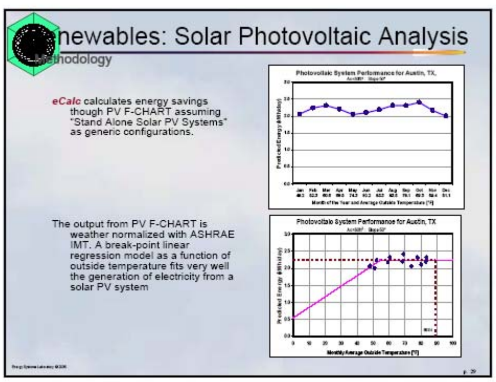
Figure 36: Slides presented at Rice University (September 2006).

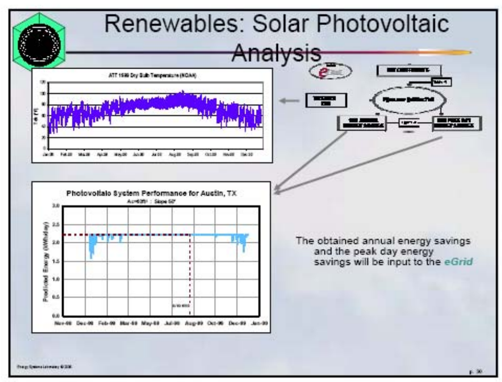


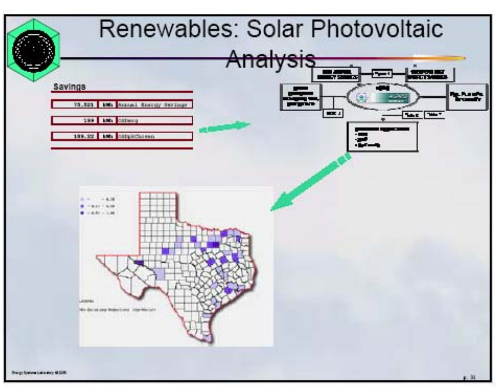












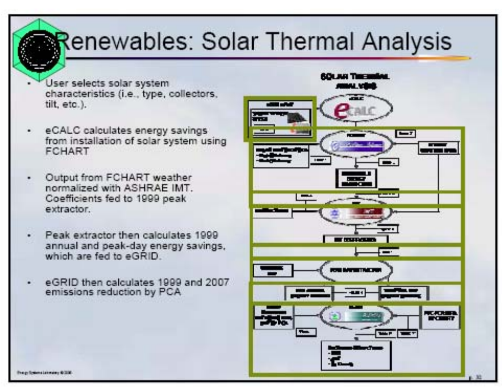
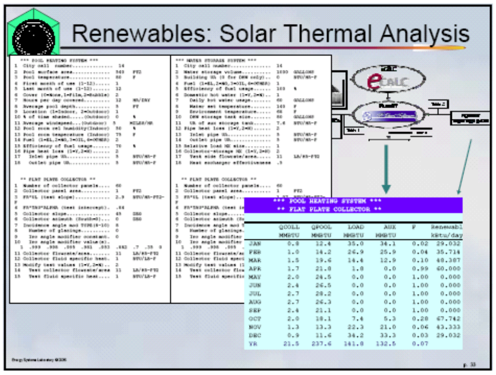
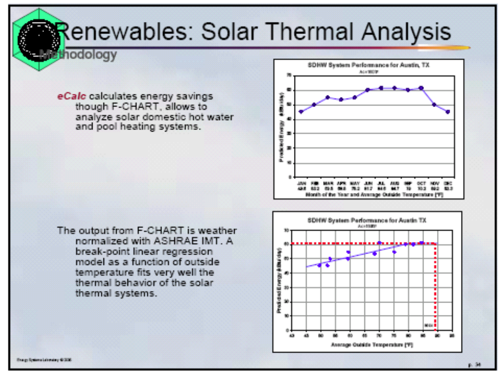
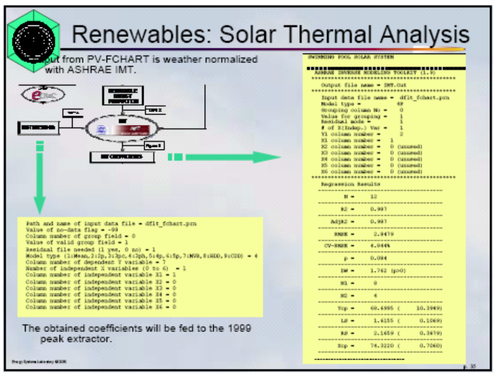
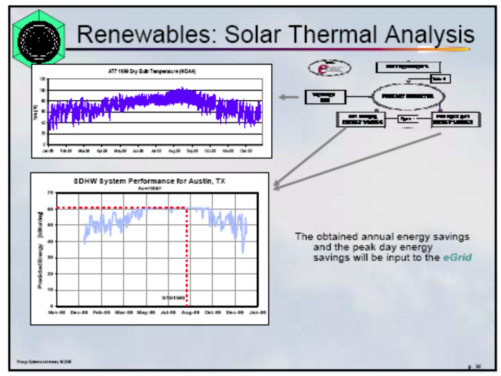


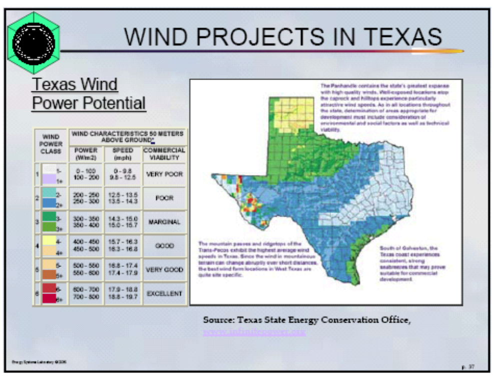
Figure 37: Slides presented at Rice University (September 2006).

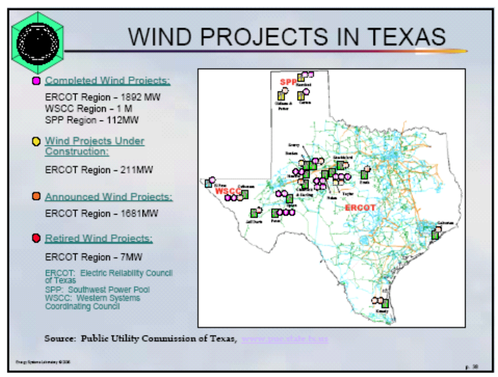


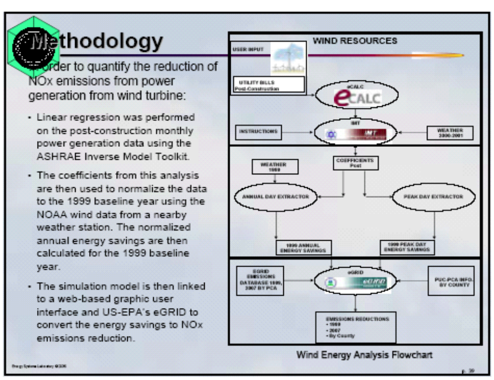












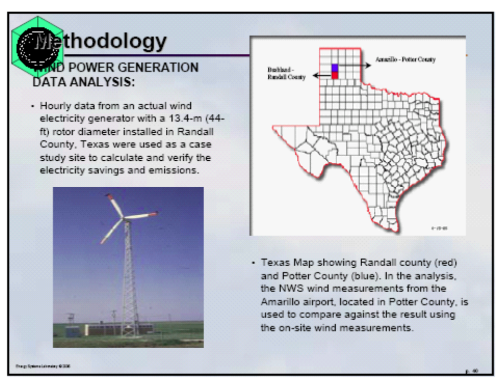


Figure 38: Slides presented at Rice University (September 2006).

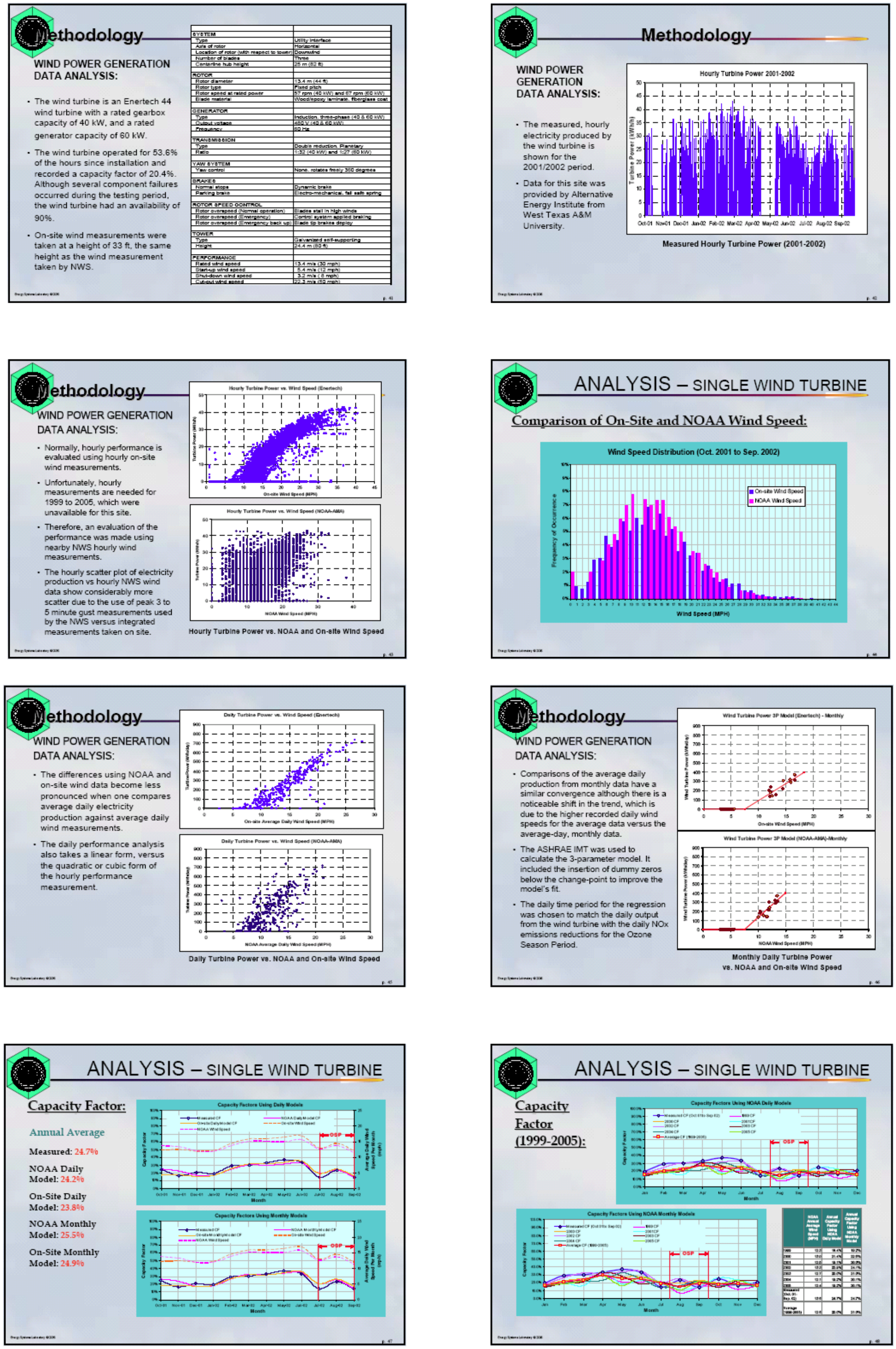
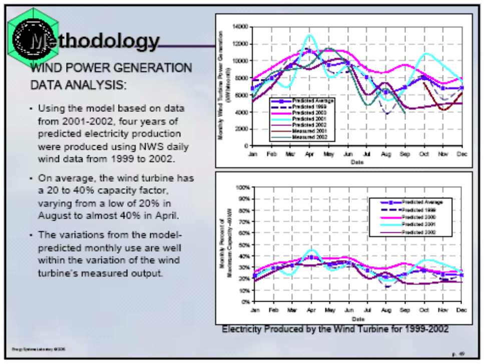
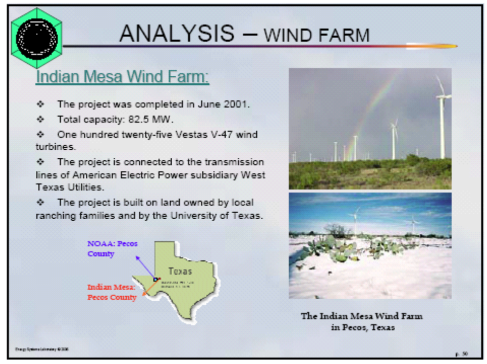
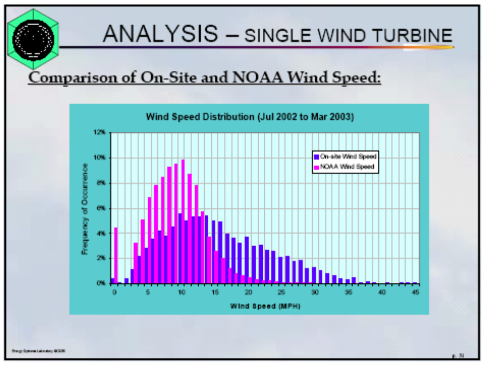
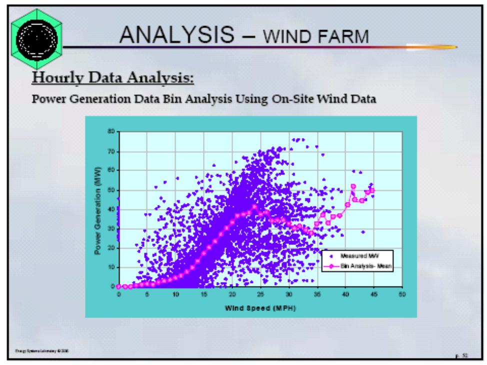


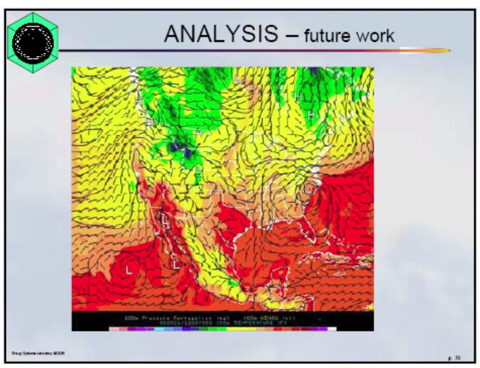
Figure 39: Slides presented at Rice University (September 2006).

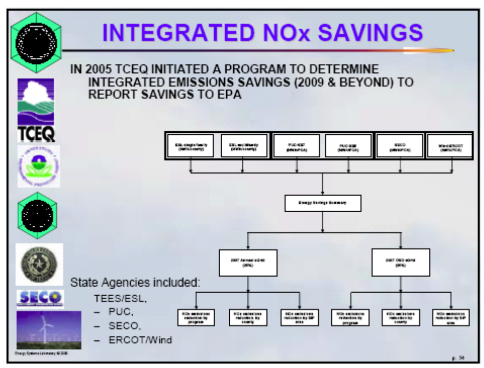


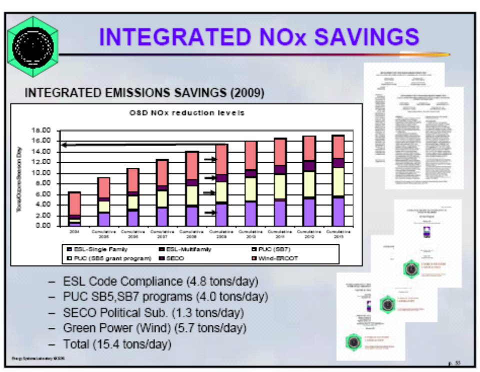












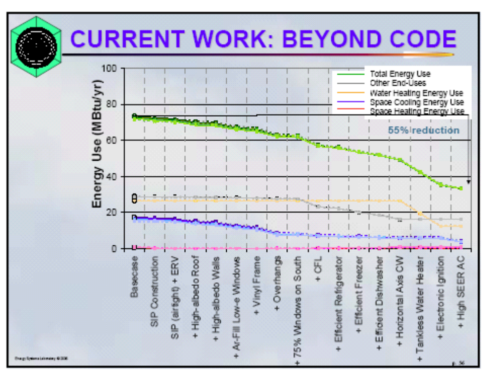


Figure 40: Slides presented at Rice University (September 2006).

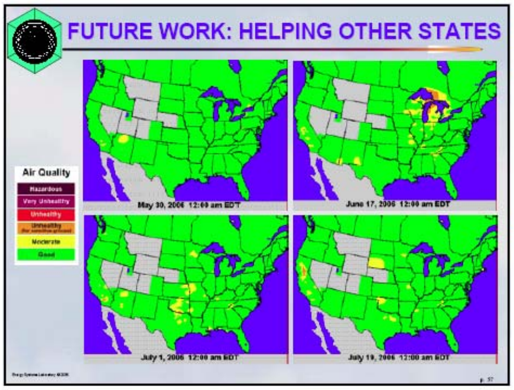


Figure 41: Slides presented at Rice University (September 2006).

5.2.9.3 Presentation at Clean Air Conference, October 11-12, University of Houston.

In October 2006, the Laboratory organized the Clean Air Conference, which was held at the University of Houston. At this conference two presentations were presented on the efforts to develop creditable emissions calculations from energy efficiency and renewable programs. The following figures present the slides used in the first presentation that presented an overview of the methods developed and results obtained to date.

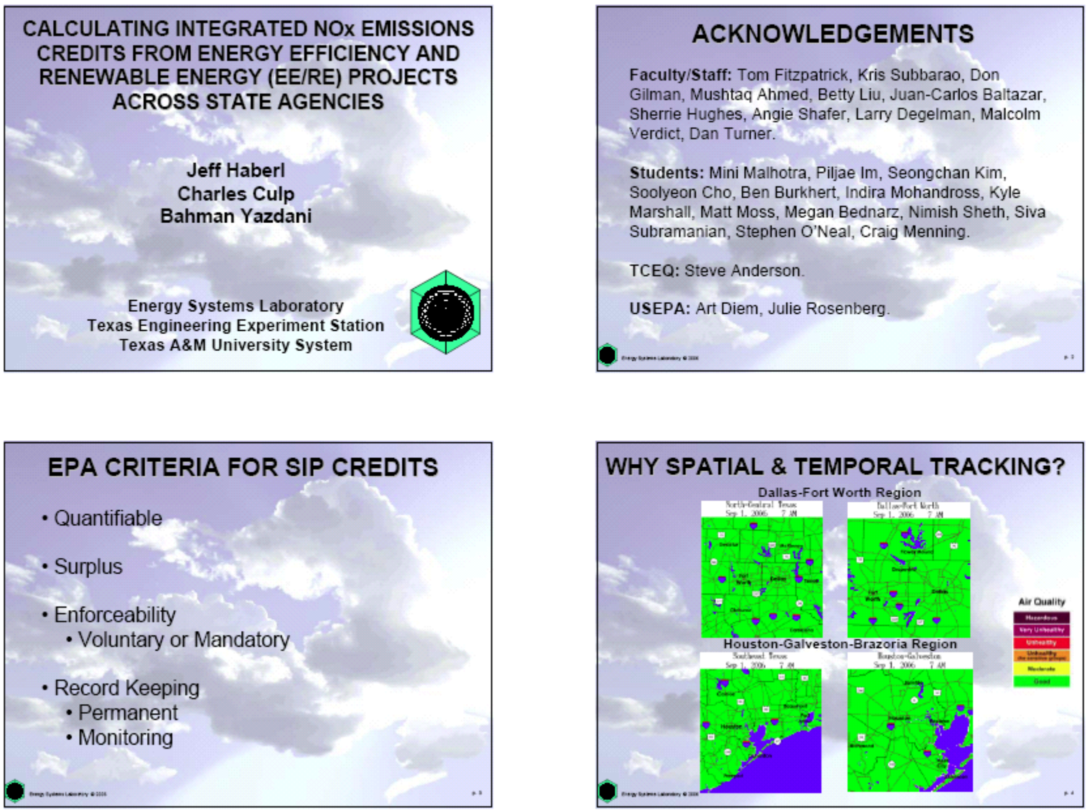
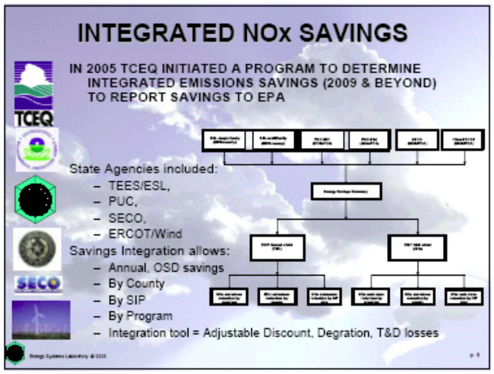
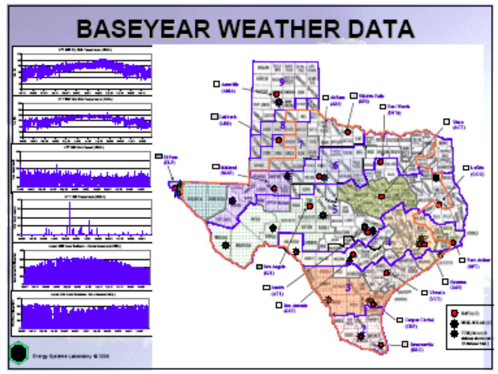
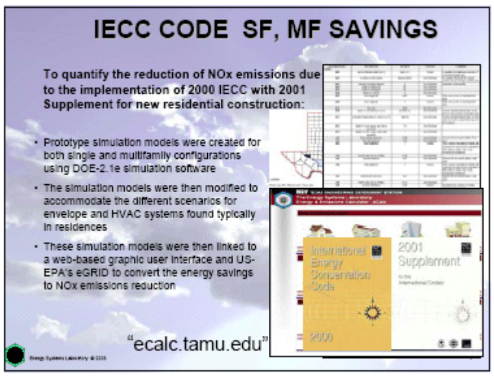
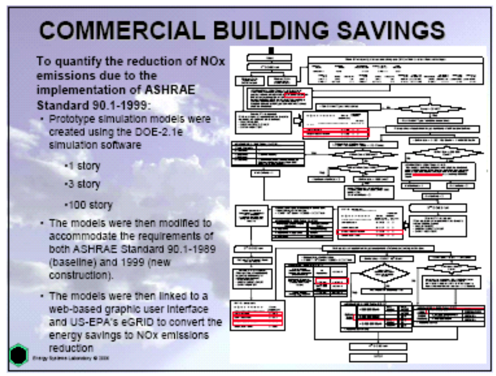


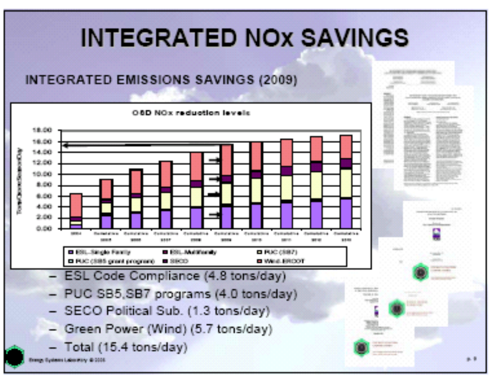
Figure 42: Slides presented at Clean Air Conference, University of Houston (October 2006).

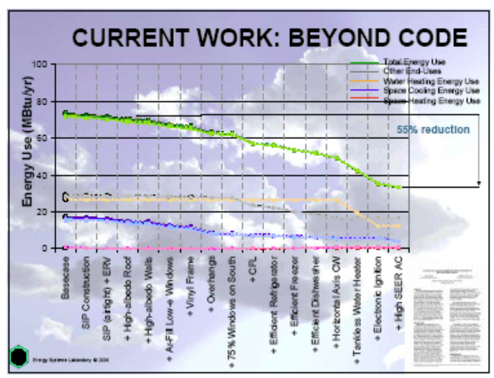


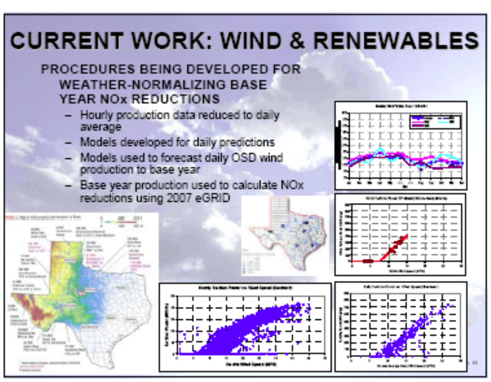












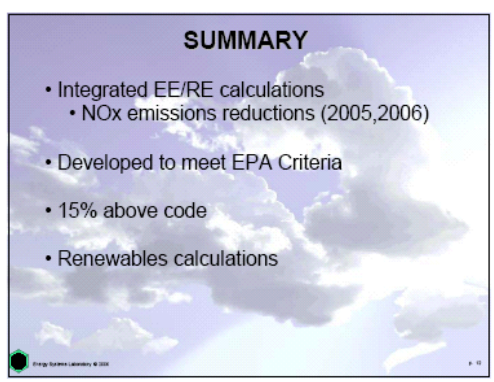


Figure 43: Slides presented at the Clean Air Conference, University of Houston (October 2006).

5.2.9.4 Presentation at Clean Air Conference, October 11-12, University of Houston.

In October 2006, the Laboratory organized the Clean Air Conference, which was held at the University of Houston. At this conference two presentations were presented on the efforts to develop creditable emissions calculations from energy efficiency and renewable programs. The following figures present the slides used in the second presentation that discussed renewable energy projects.

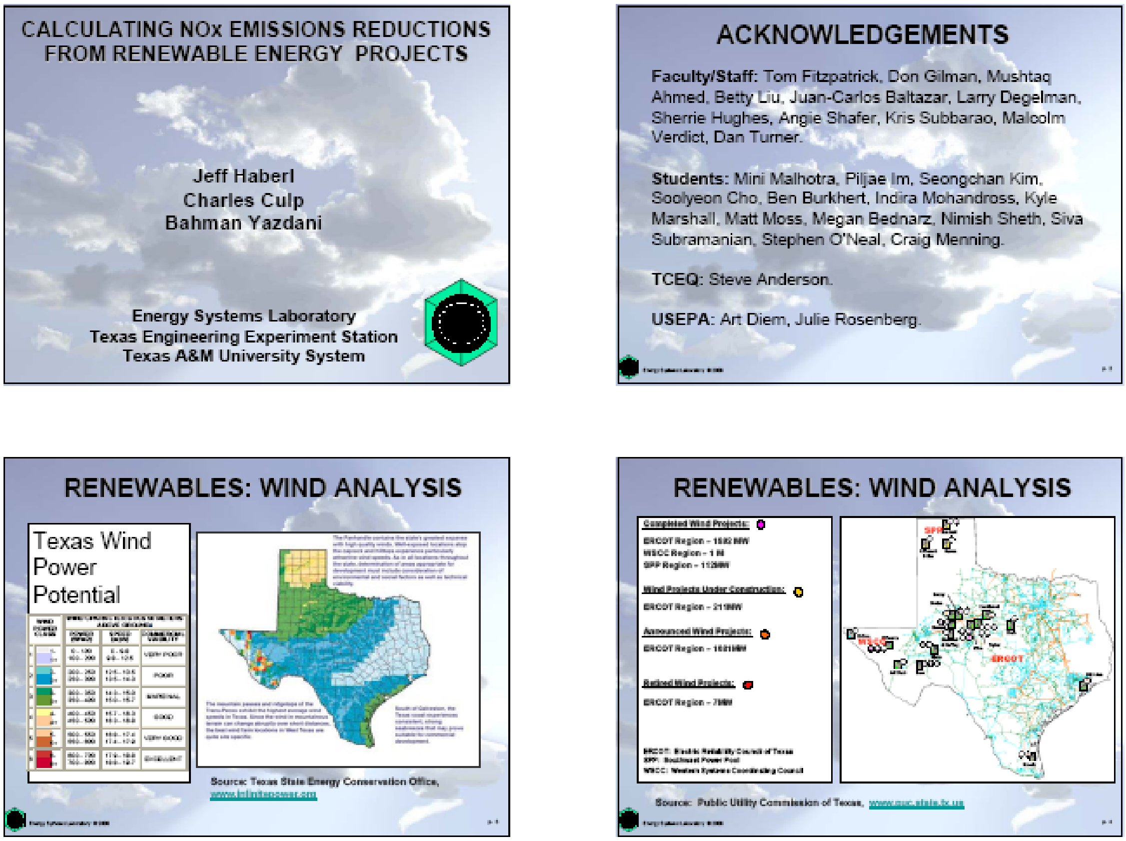
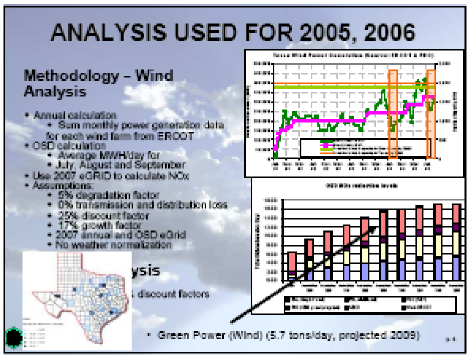
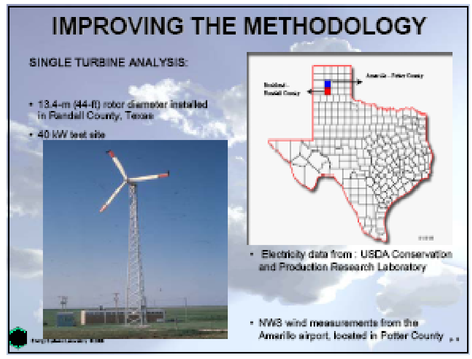
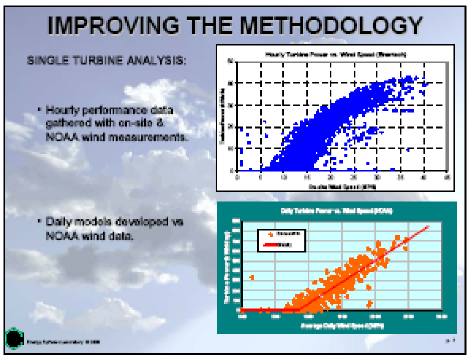
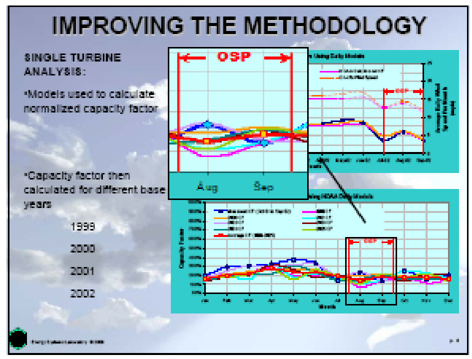


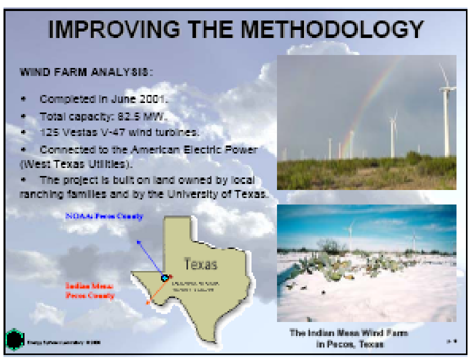
Figure 44: Slides presented at the Clean Air Conference, University of Houston (October 2006).

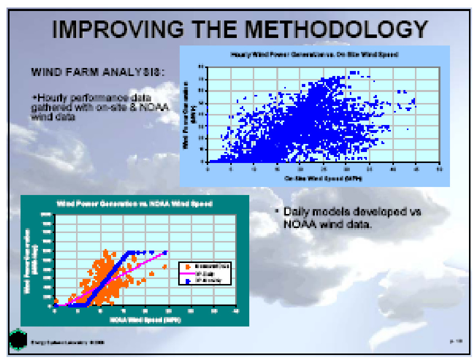


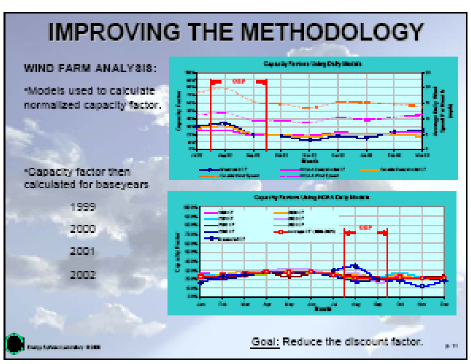












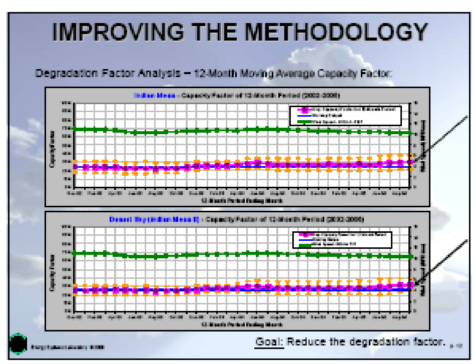
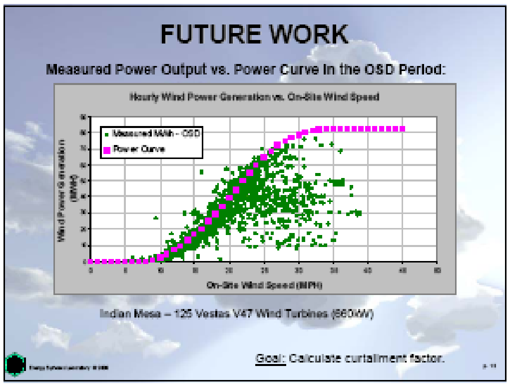
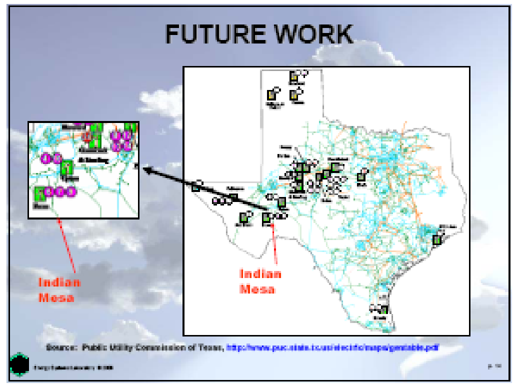
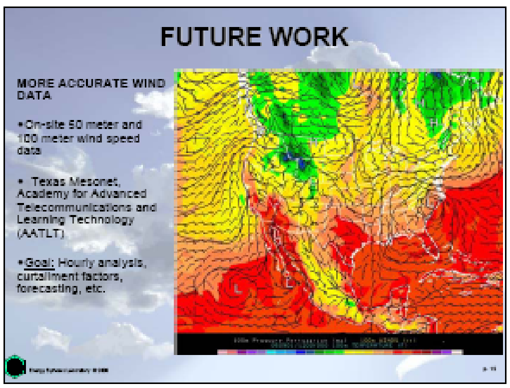


Figure 45: Presentation at the Clean Air Conference, University of Houston (October 2006).







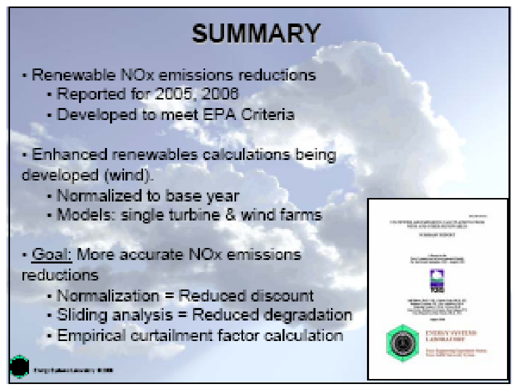
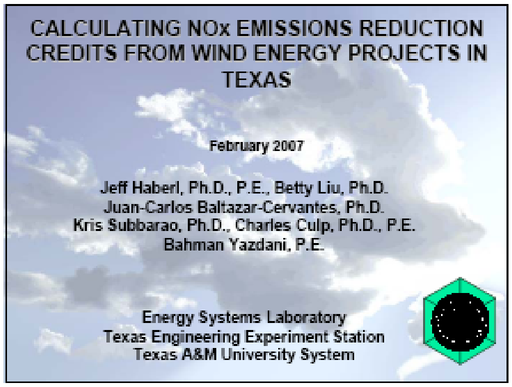
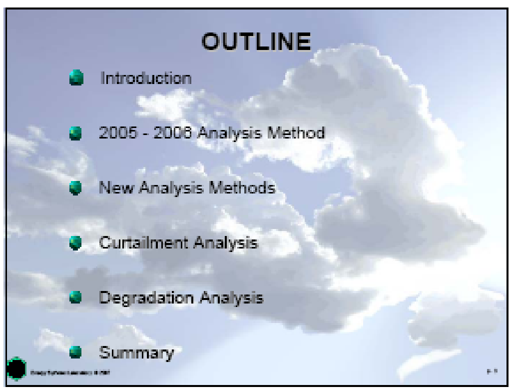


Figure 46: Presentation at the Clean Air Conference, University of Houston (October 2006).

5.2.9.5 Presentation at the American Waste Management Association Meeting, Austin, (February 2007).

In February 2007, the Laboratory was asked to give a talk to the Austin Chapter of the Amercian Waste Managemetn Association. The presentation that was delivered discussed the Laboratory's efforts to develop creditable emissions calculations for electricity generated from wind farms. The following figures present the slides used in the presentation.





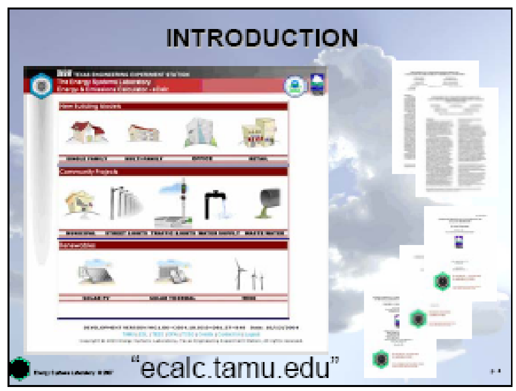
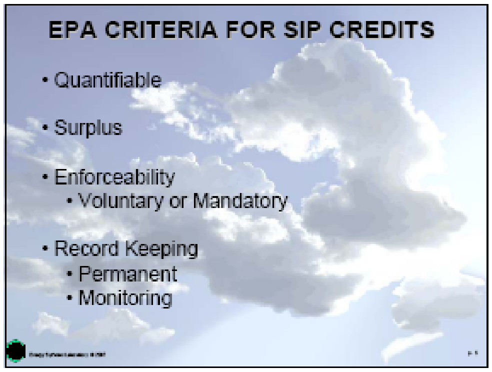
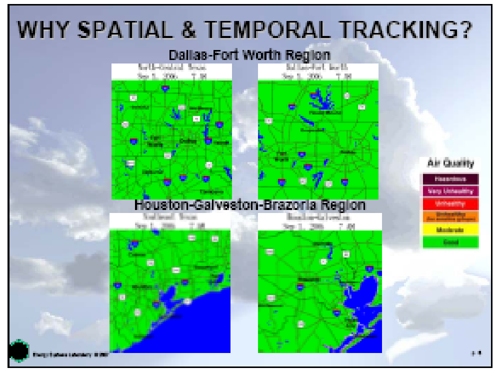
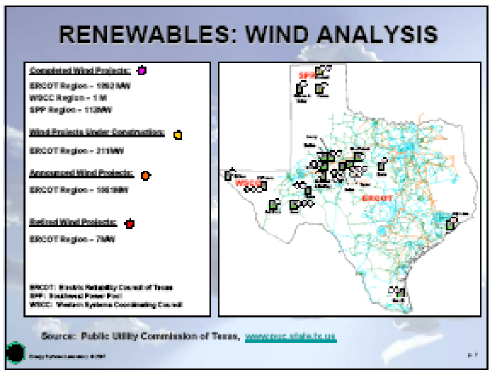
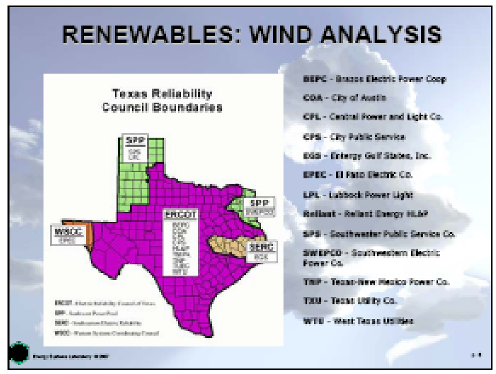


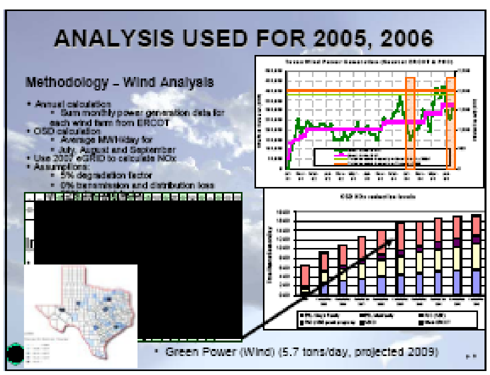
Figure 47: Slides presented at the American Waste Management Association Meeting (February 2007).

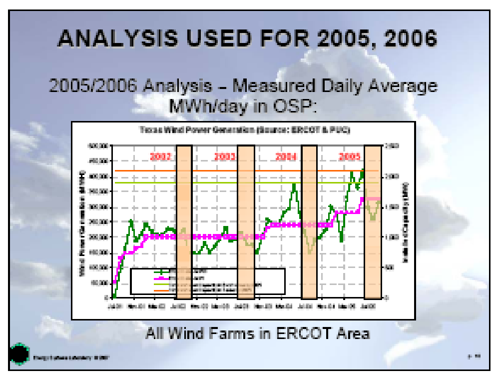


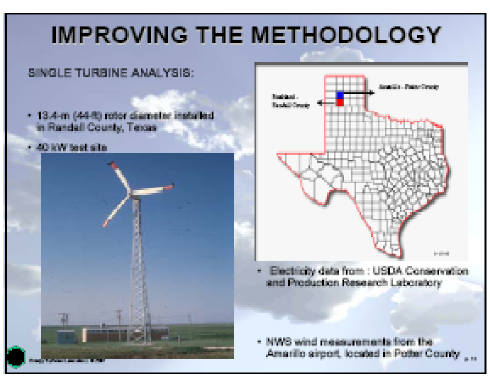












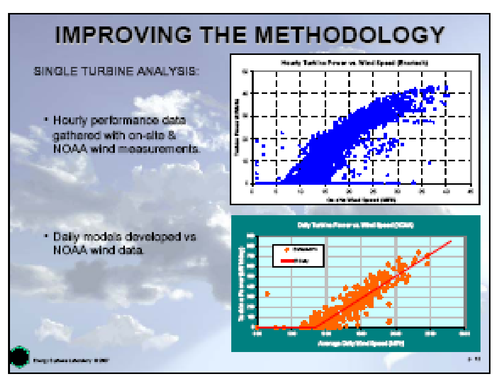
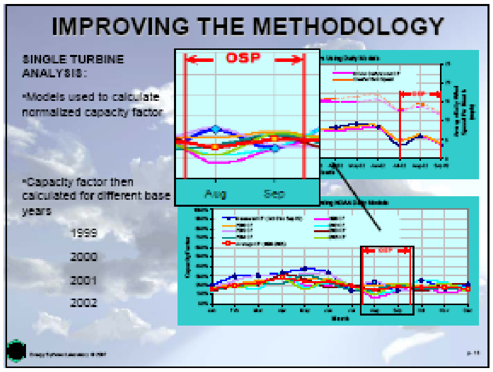
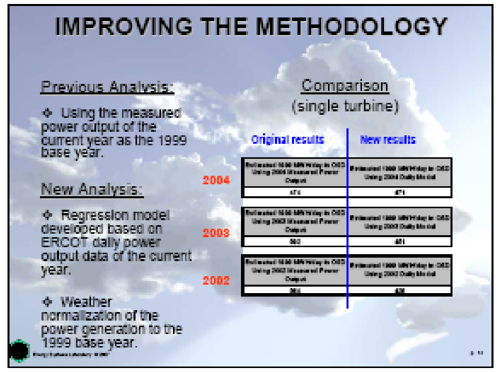
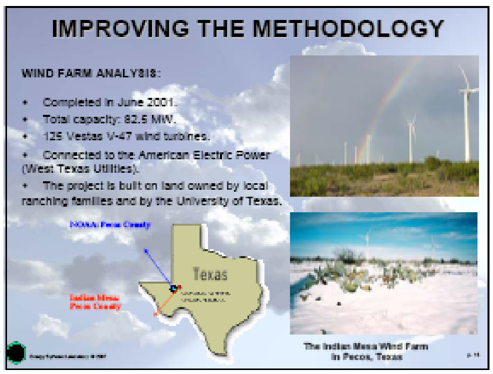
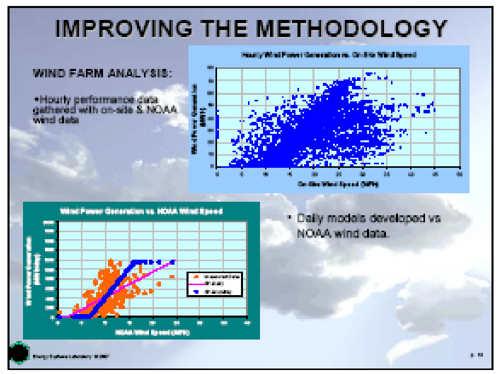


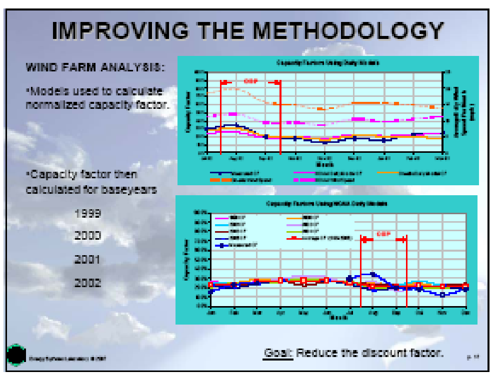
Figure 48: Slides presented at the American Waste Management Association Meeting (February 2007).

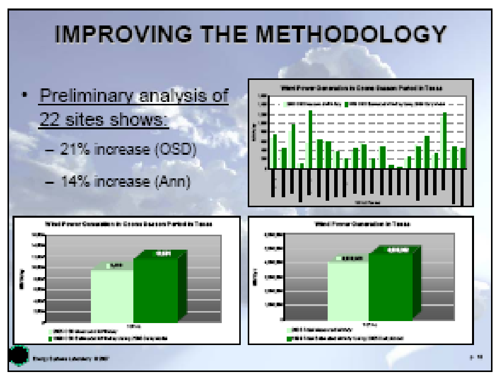


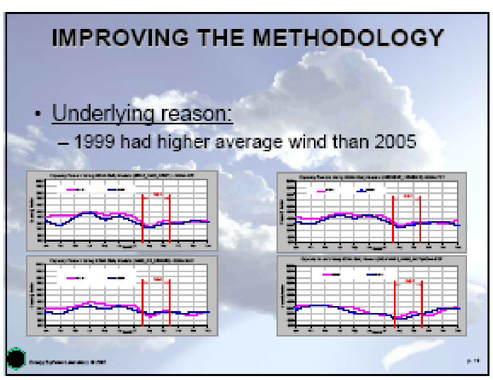












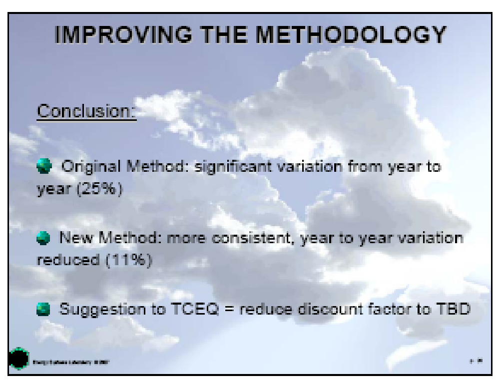
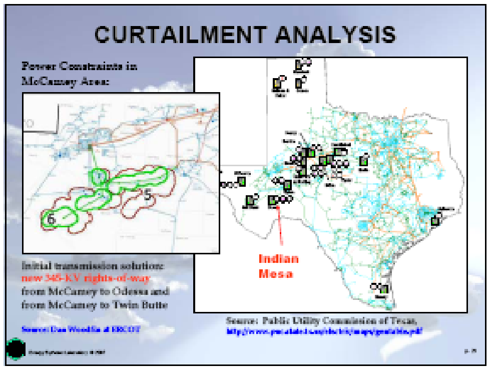
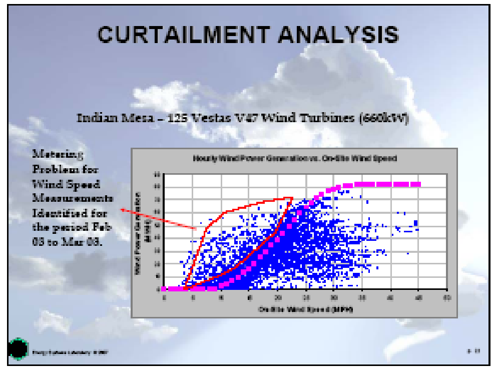
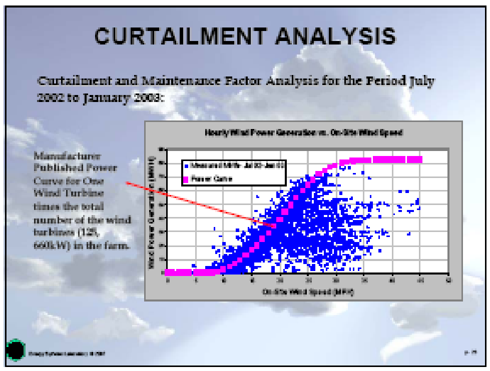
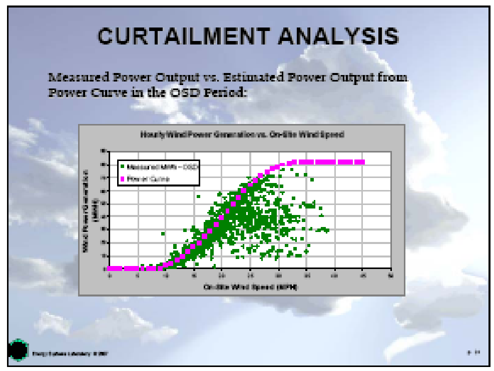


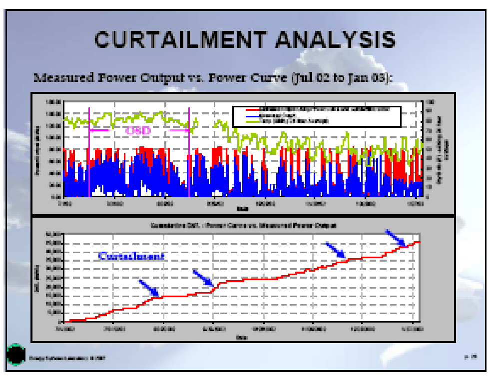
Figure 49: Slides presented at the American Waste Management Association Meeting (February 2007).

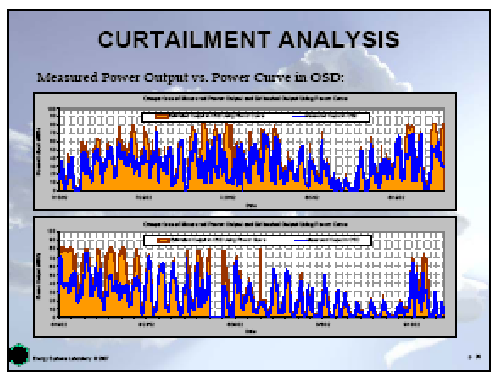


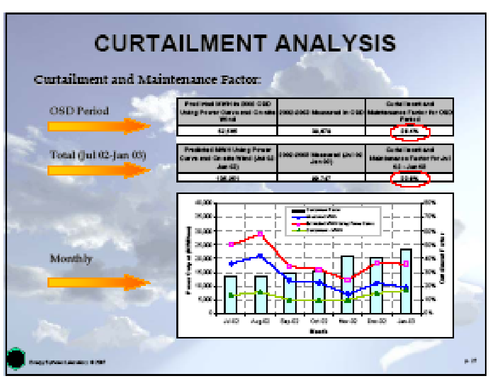












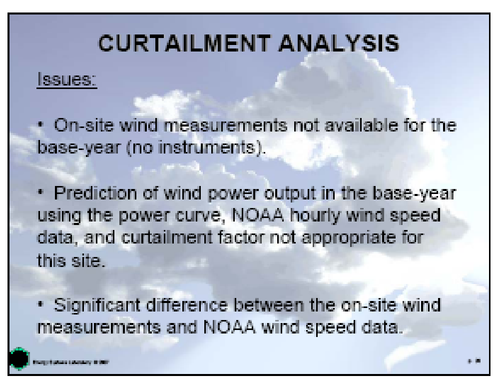
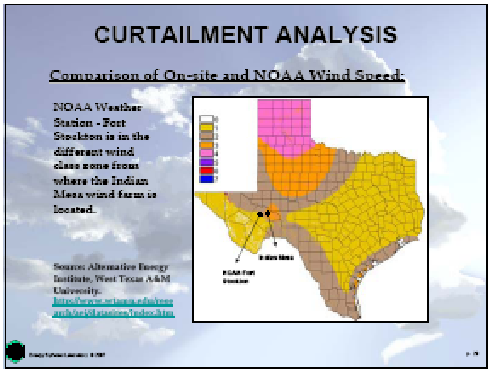
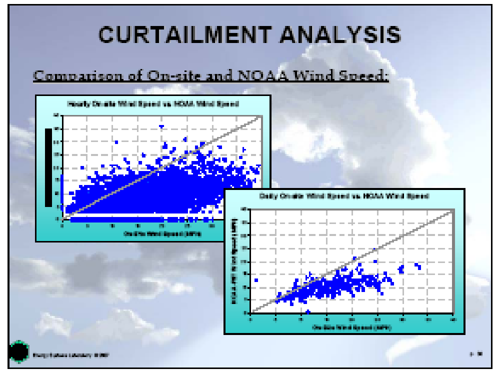
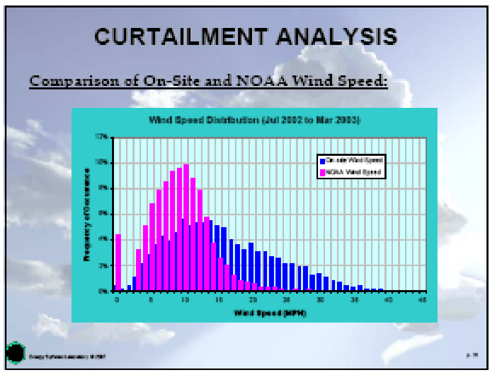
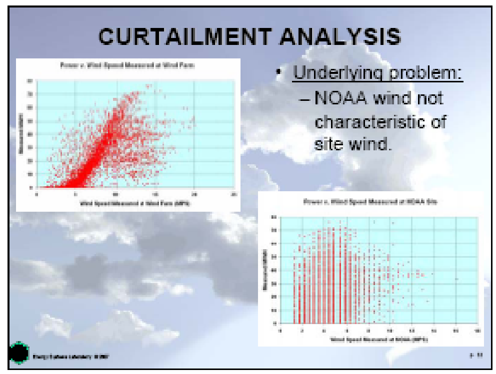


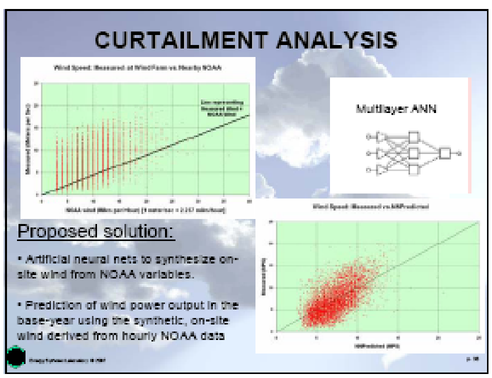
Figure 50: Slides presented at the American Waste Management Association Meeting (February 2007).

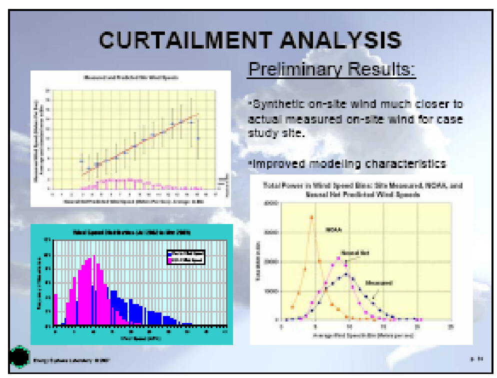


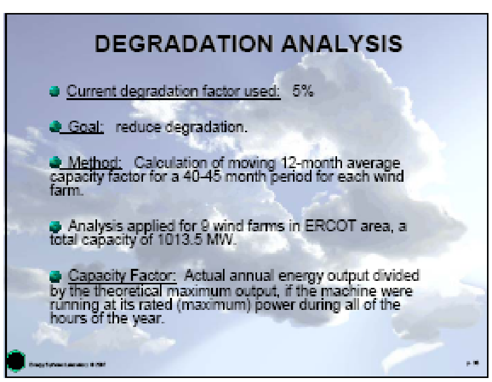












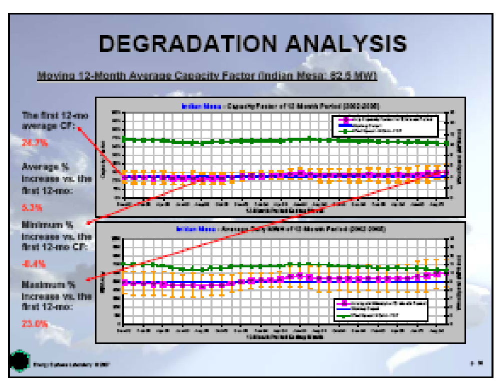
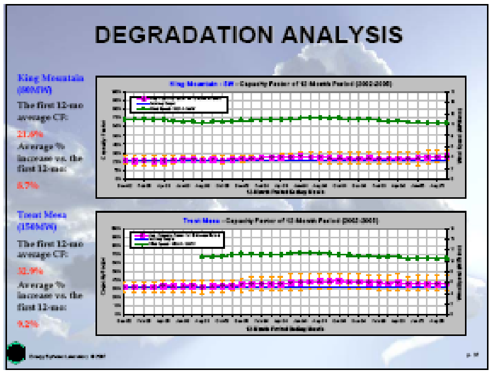
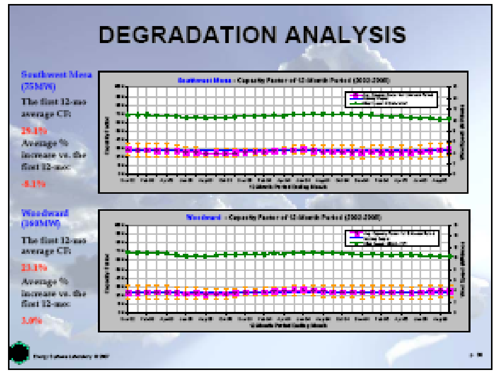
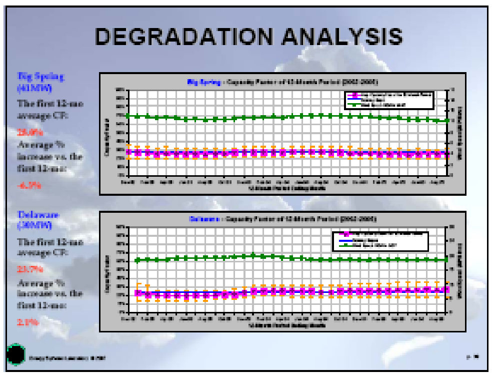
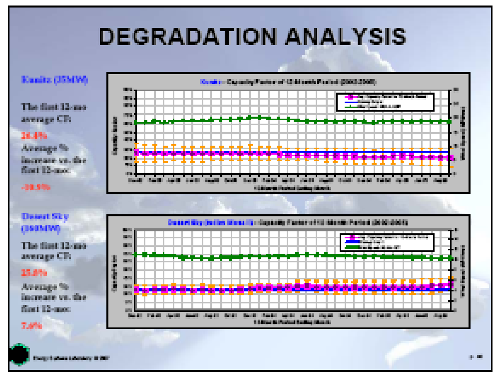


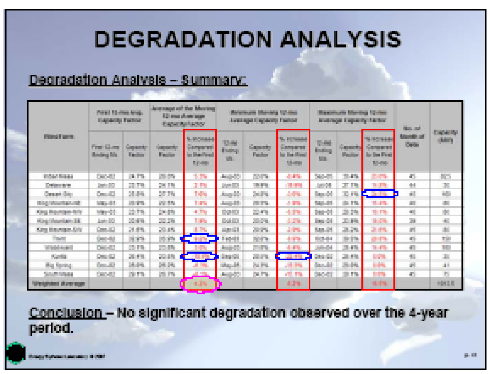
Figure 51: Slides presented at the American Waste Management Association Meeting (February 2007).

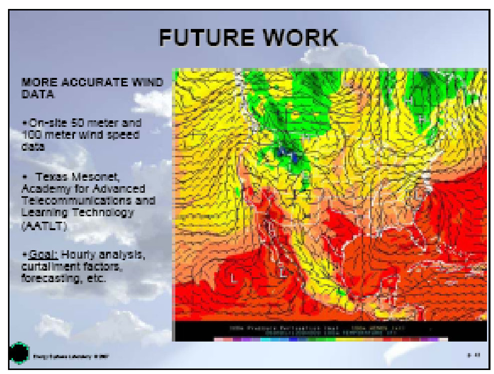


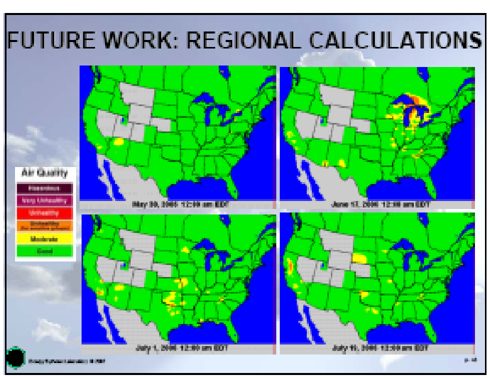












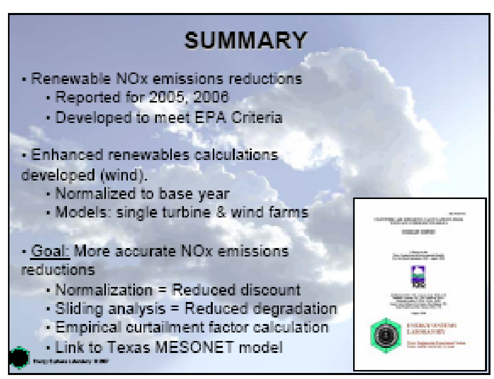
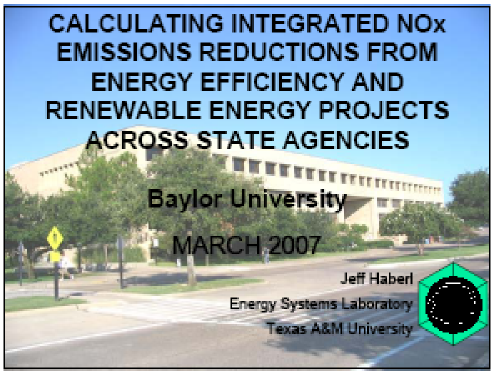
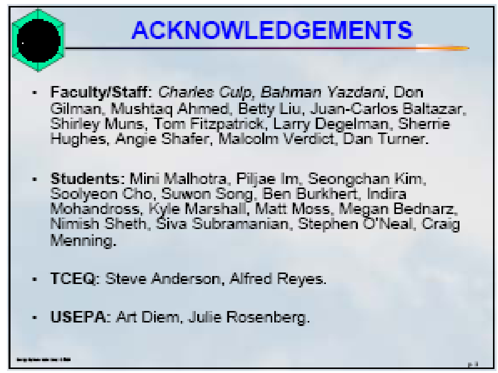


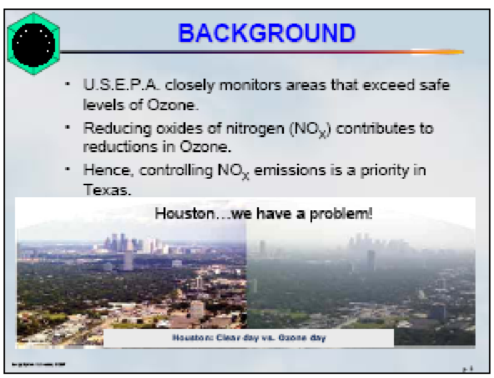
Figure 52: Slides presented at the American Waste Management Association Meeting (February 2007).

5.2.9.6 Presentation at Baylor University, February, 2007

In February 2007, the Laboratory was invited to give a talk to the faculty and graduate students in the Mechanical Engineering Department at Baylor University. This talk covered the development of creditable emissions reductions calculations for EE/RE programs in Texas. The following figures present the slides used in this presentation.







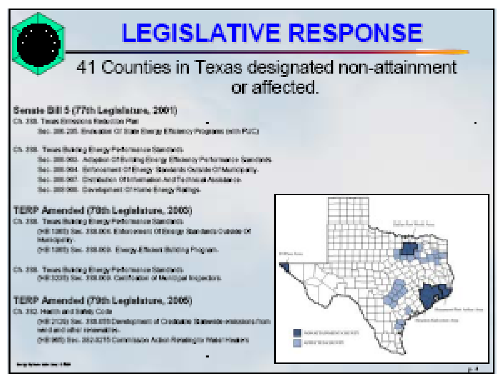
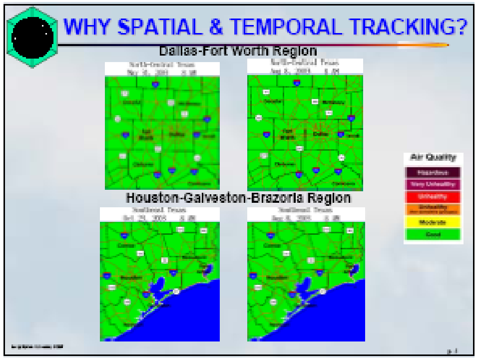
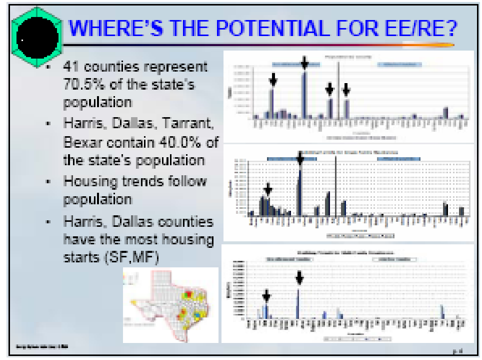
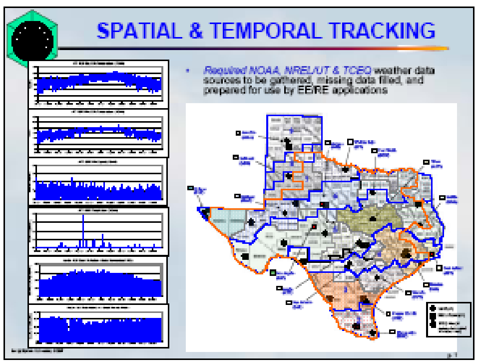
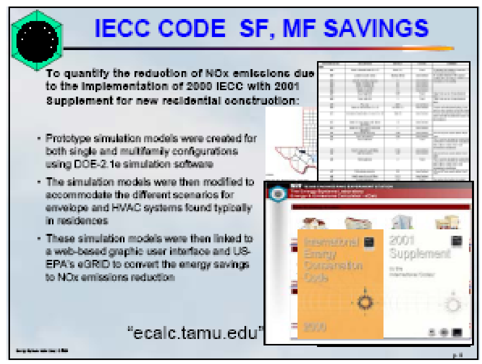


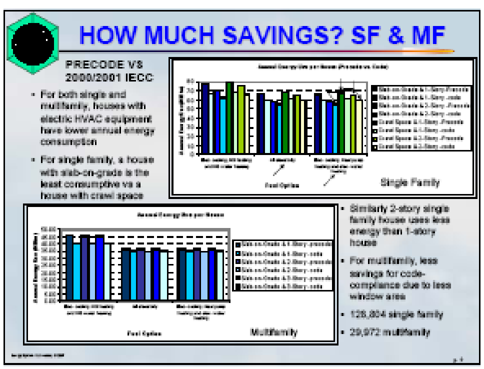
Figure 53: Slides presented at Baylor University (February 2007).

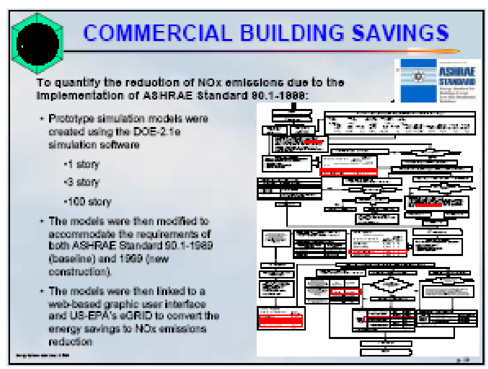


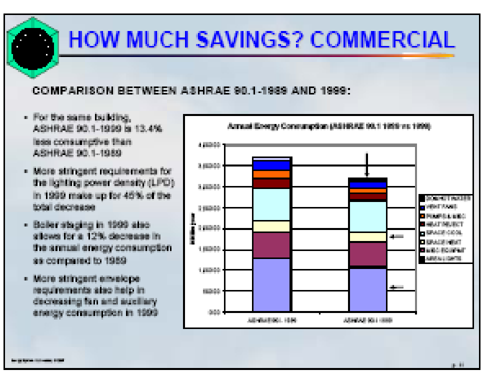












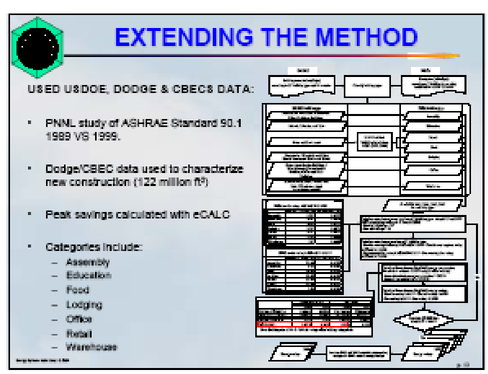


Figure 54: Slides presented at Baylor University (February 2007).

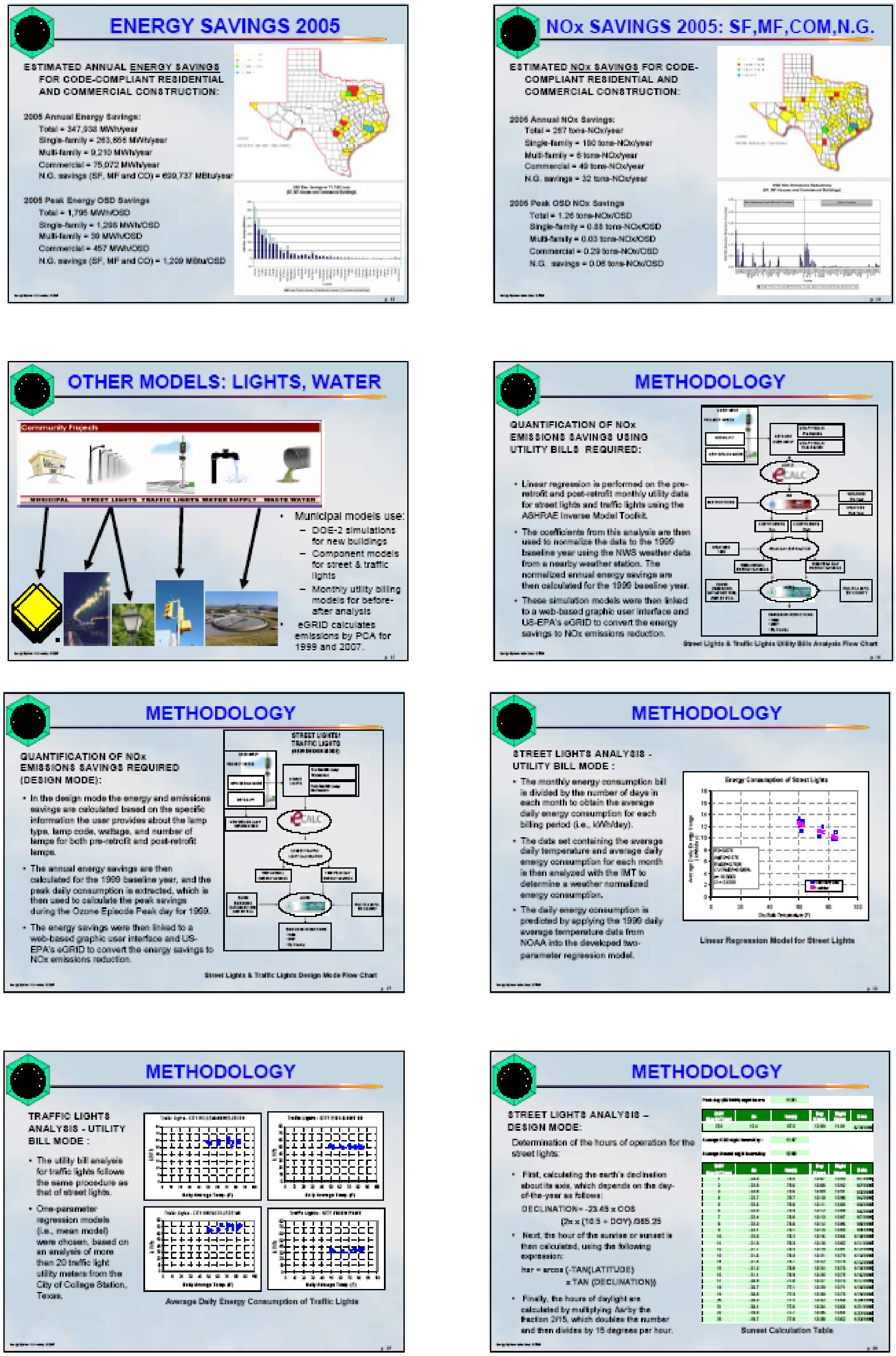
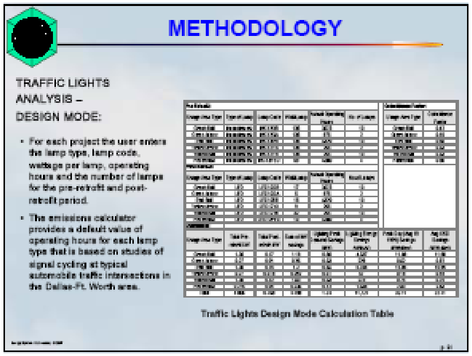
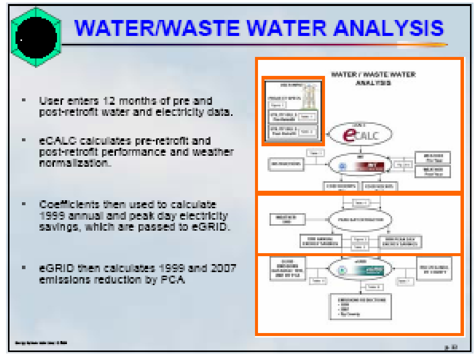
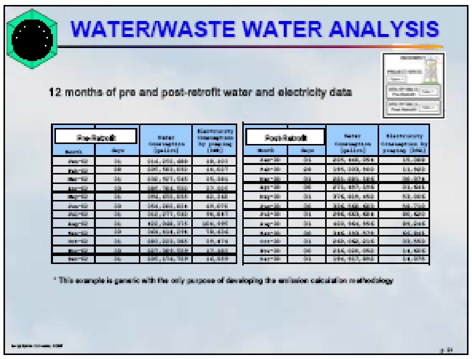
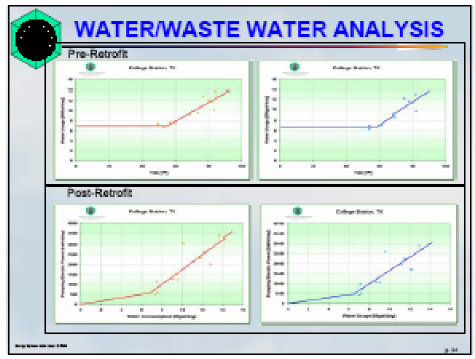


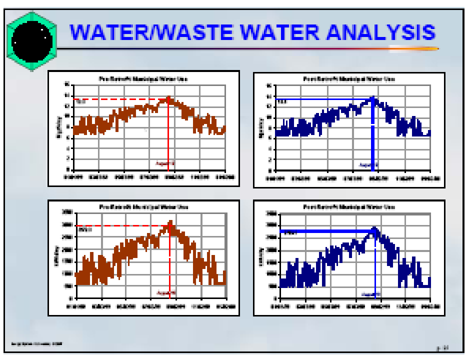
Figure 55: Slides presented at Baylor University (February 2007).

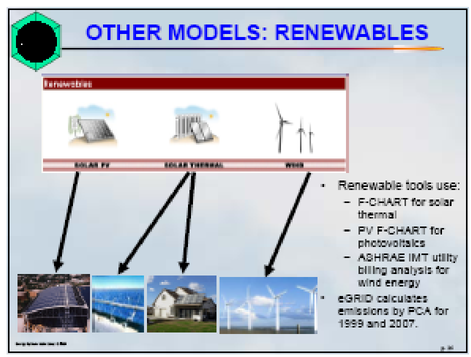


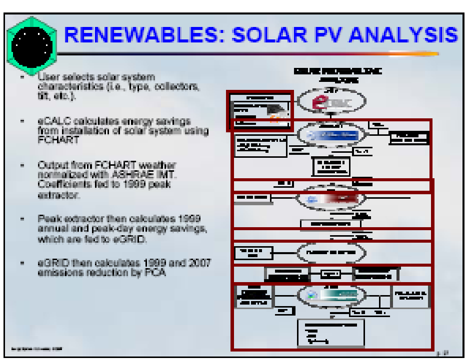












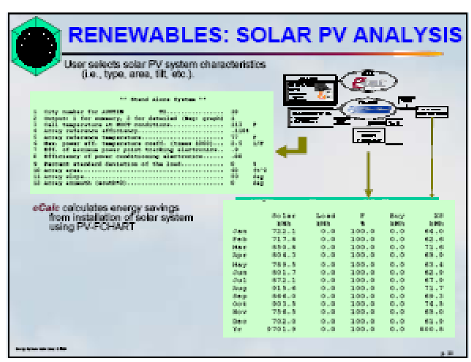


Figure 56: Slides presented at Baylor University (February 2007).

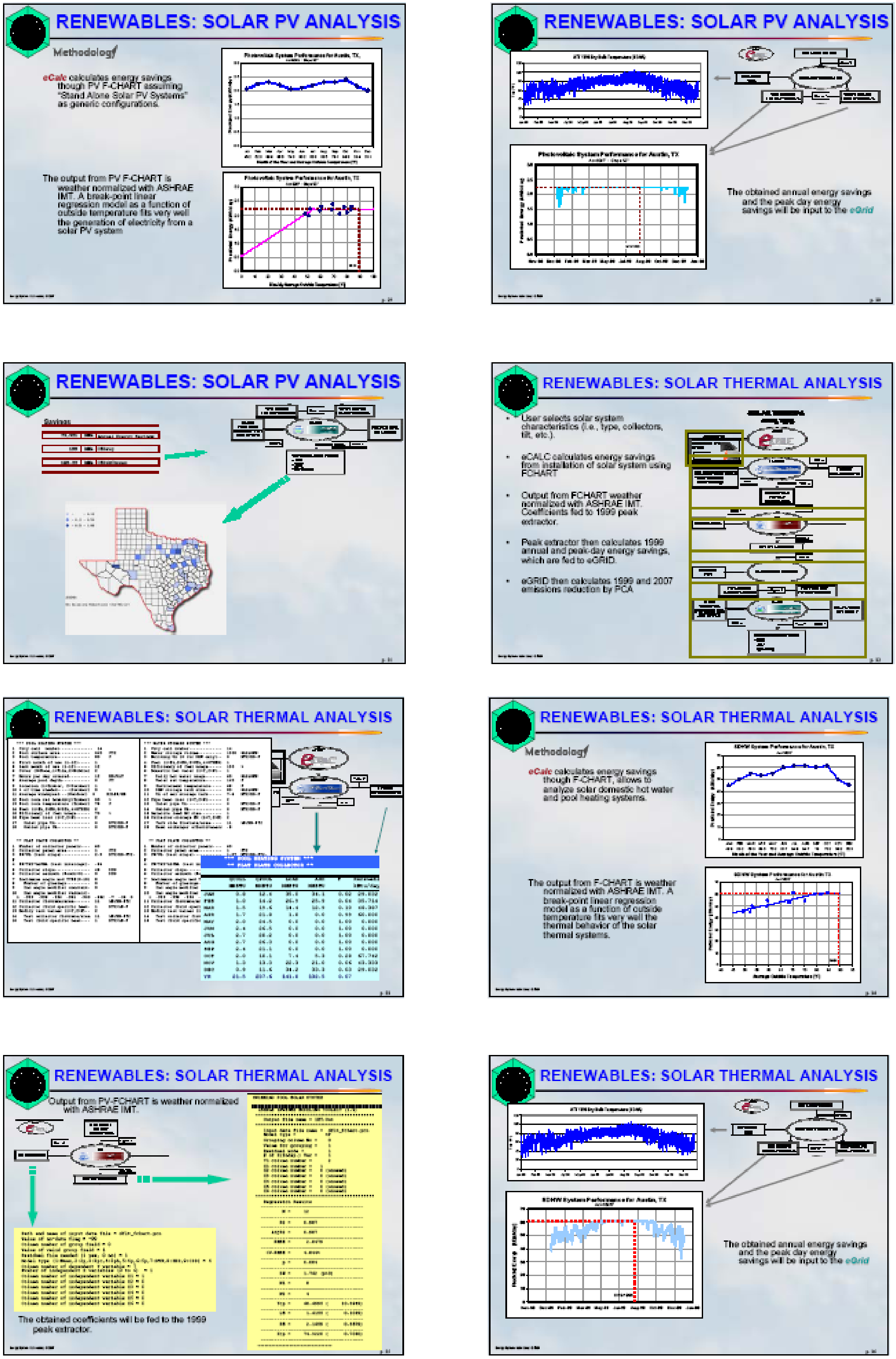
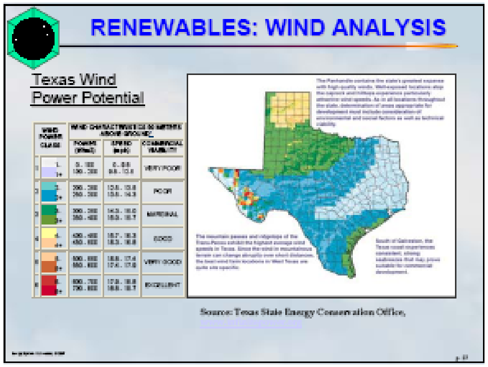
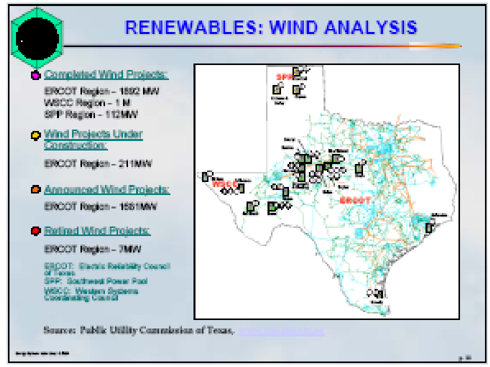
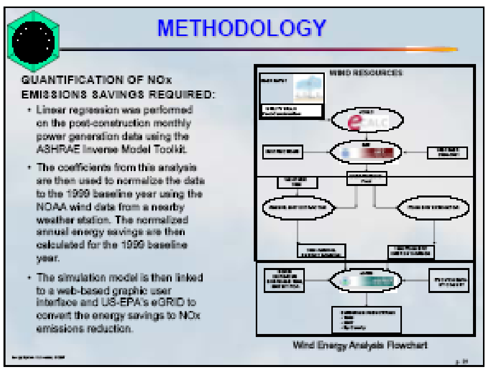
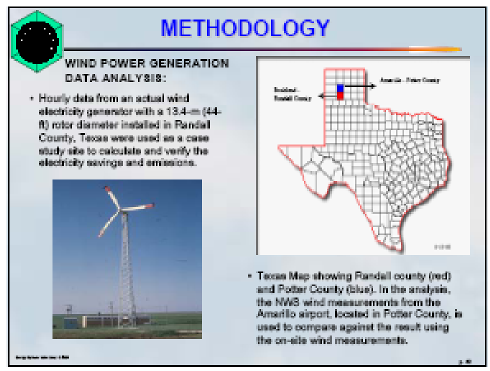


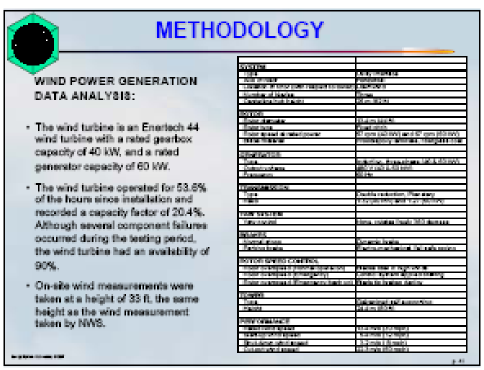
Figure 57: Slides presented at Baylor University (February 2007).

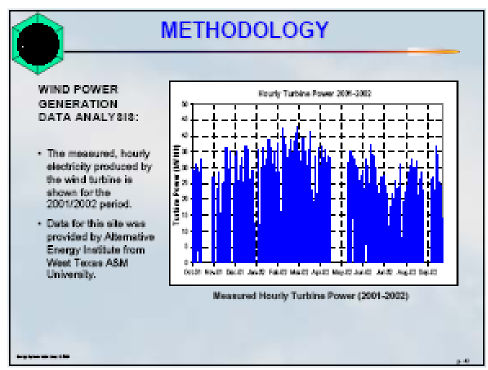


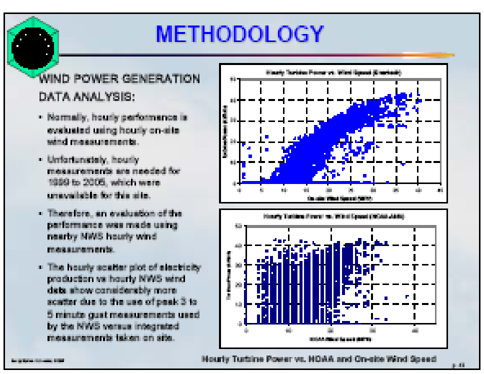












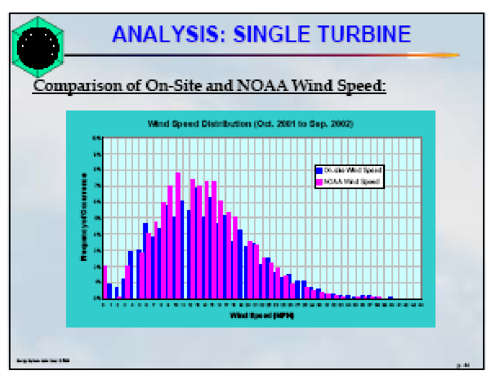


Figure 58: Slides presented at Baylor University (February 2007).

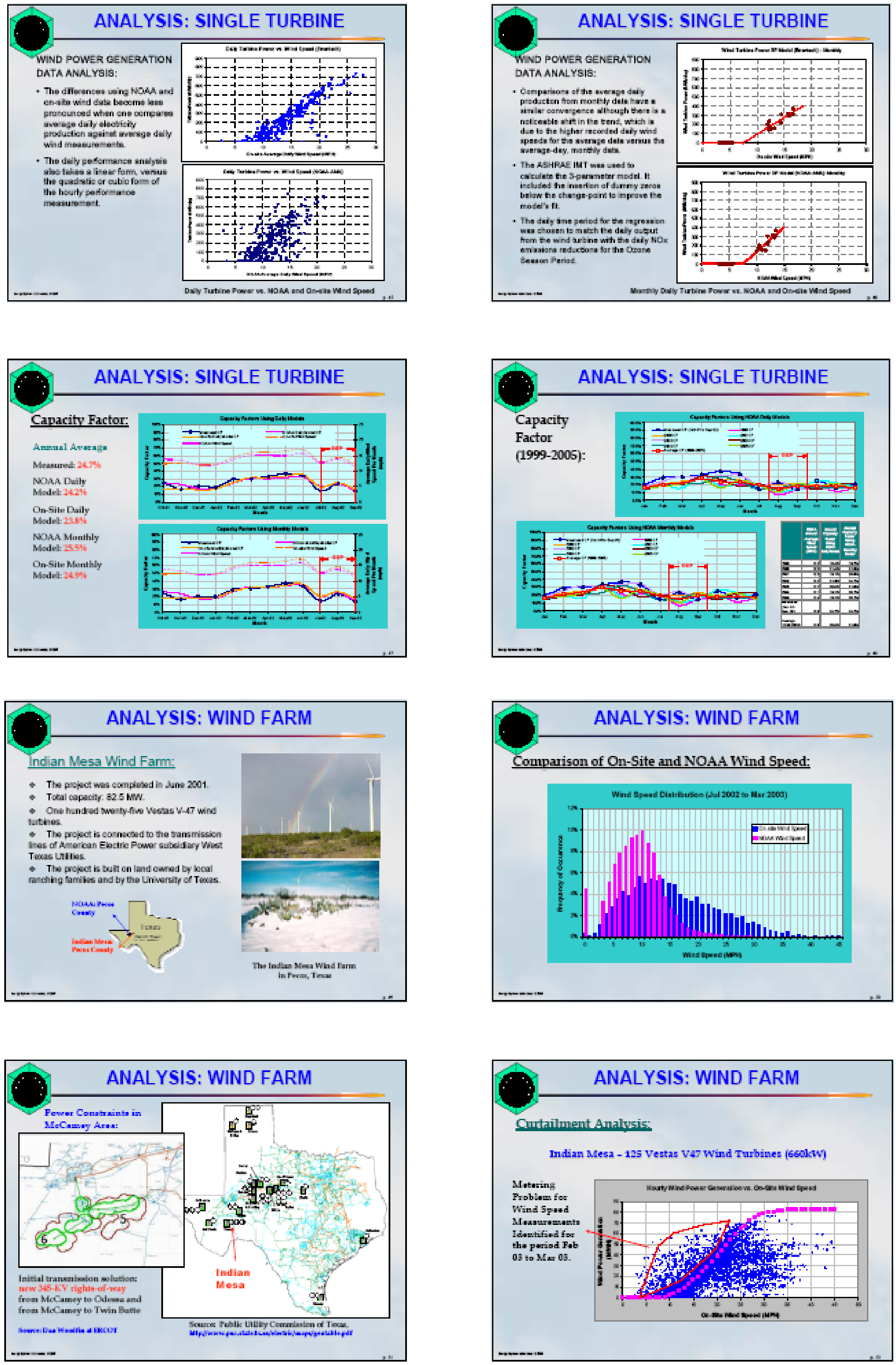
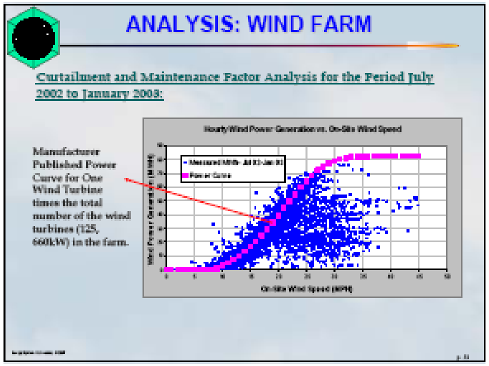
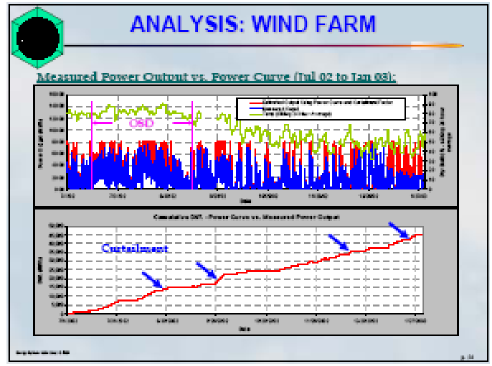
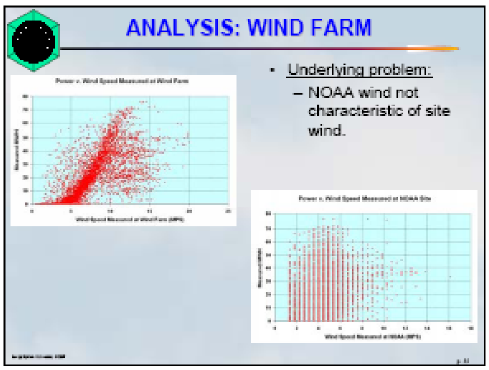
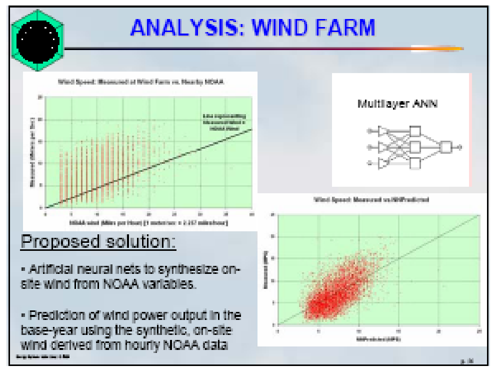


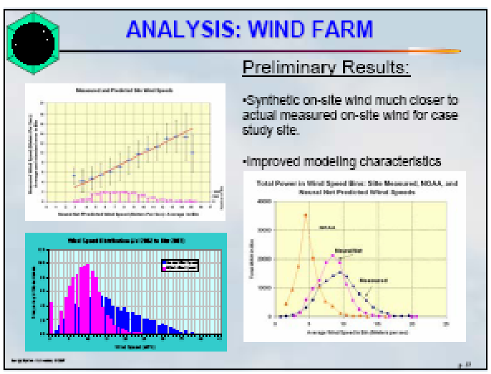
Figure 59: Slides presented at Baylor University (February 2007).

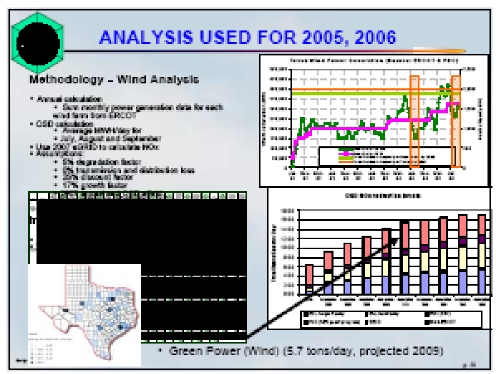


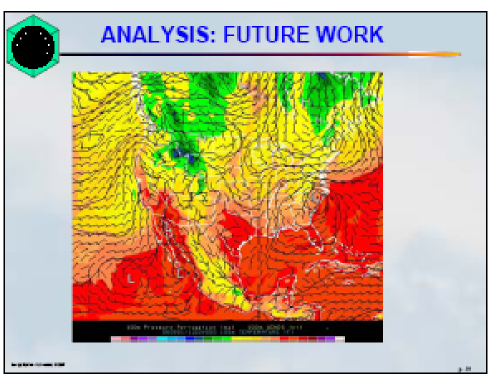












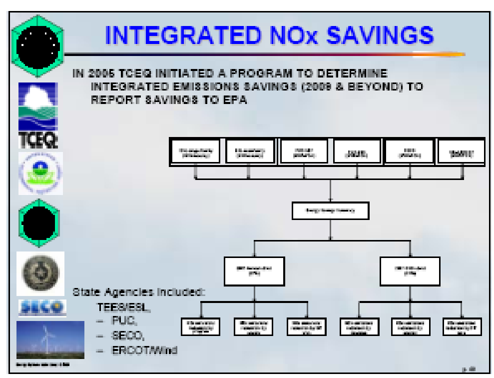
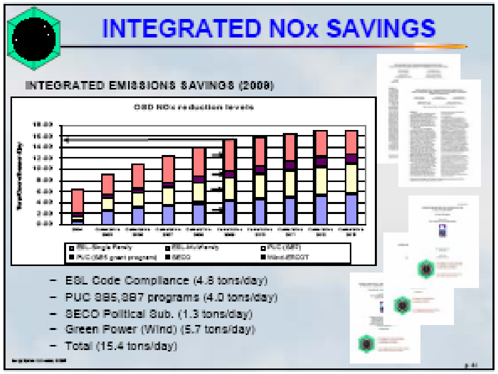
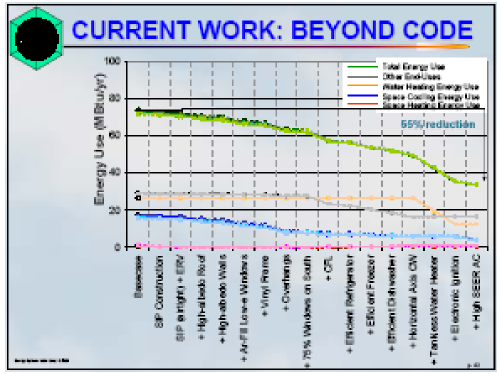


Figure 60: Slides presented at Baylor University (February 2007).





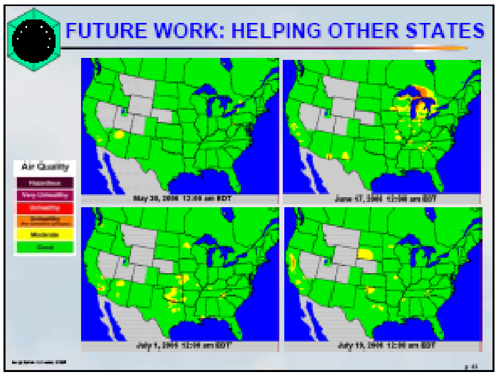


Figure 61: Slides presented at Baylor University (February 2007).

5.2.9.7 Presentation at U.S. Congress for ASHRAE Tech Briefing

In March 2007, the Laboratory was asked to make a presentation to the U.S. Congress regarding the progress that has been made in Texas to quantify emissions credits from energy efficiency and renewable energy projects. This presentation included overview material on ASHRAE's efforts to assist engineers and architects in reducing energy use, as well as information about the Laboratory's effort to quantify emissions credits from energy efficiency and renewable energy projects. The following slides presents the materials presented to U.S.Congressional staff.

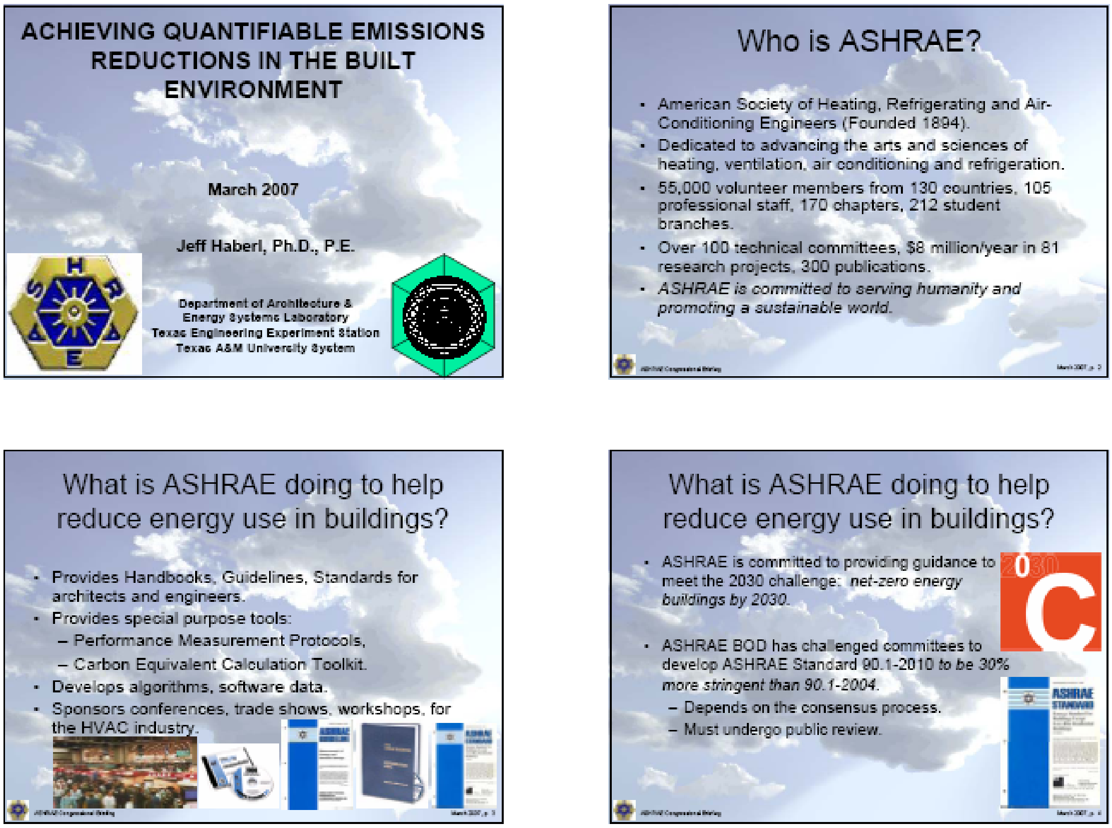
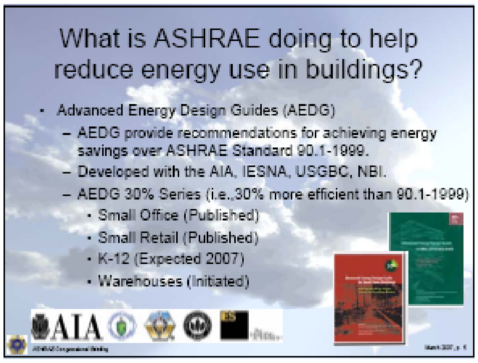
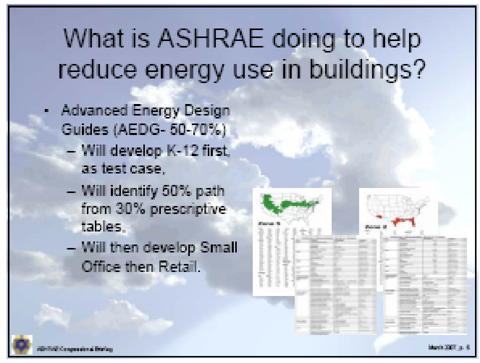
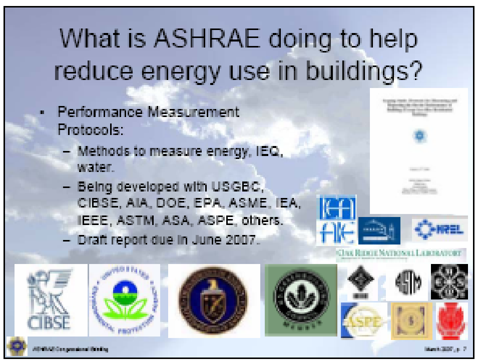
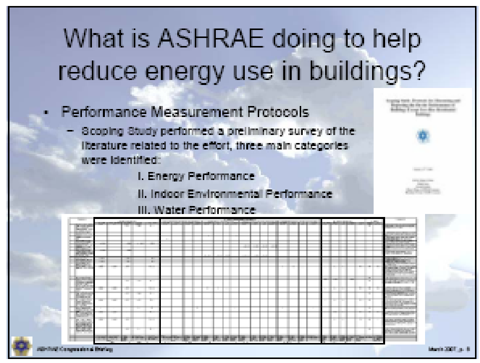


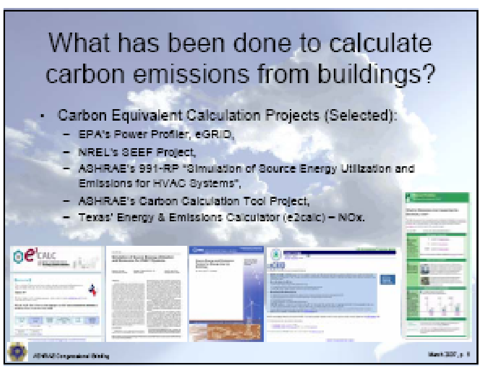
Figure 62: Slides presented to the U.S. Congressional Staff (March 2007).

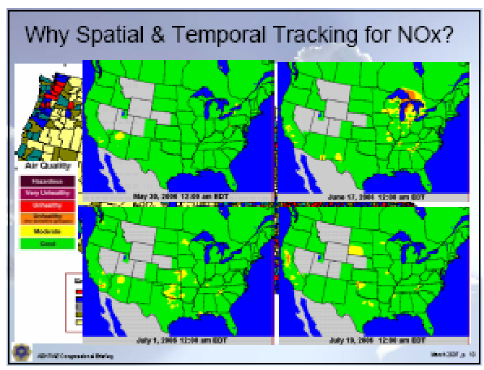












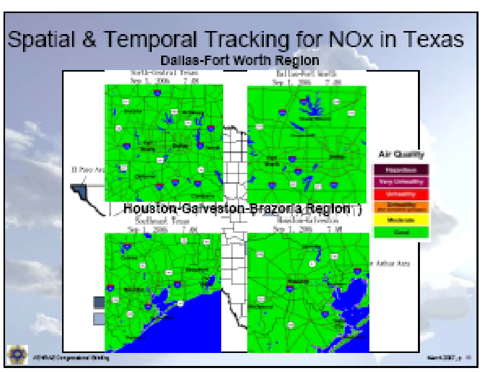
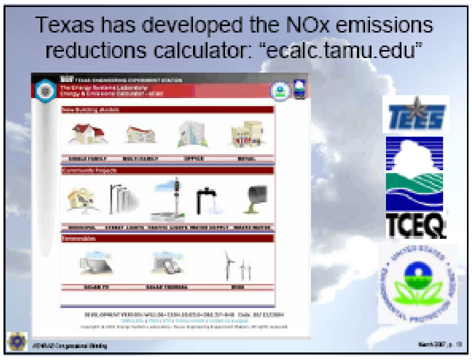
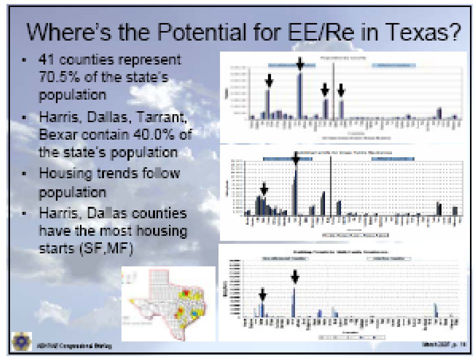
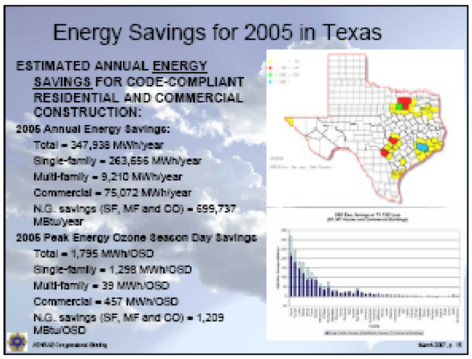
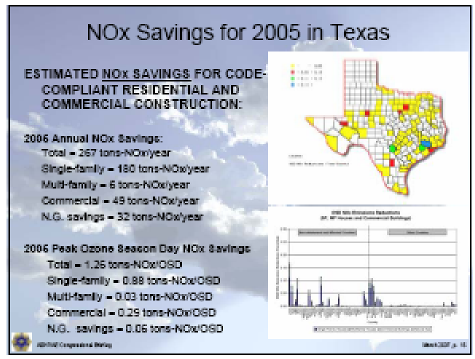


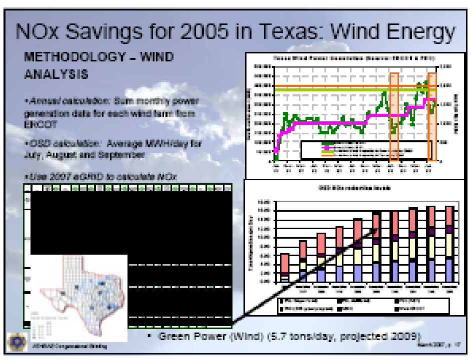
Figure 63: Slides presented to the U.S. Congressional Staff (March 2007).

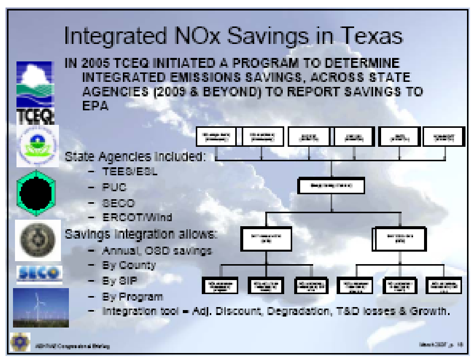


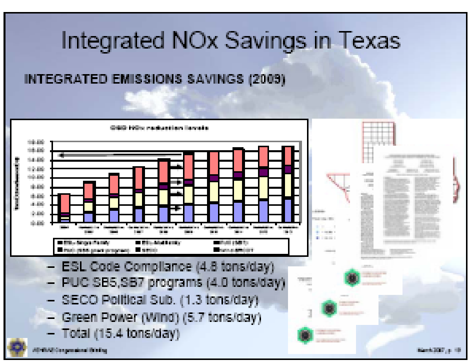












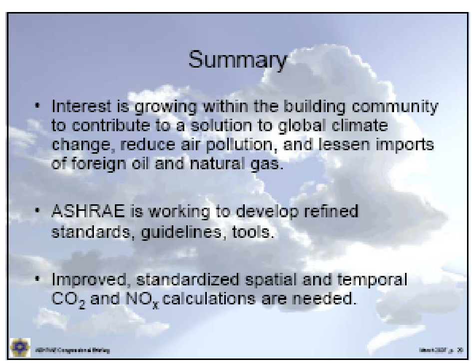
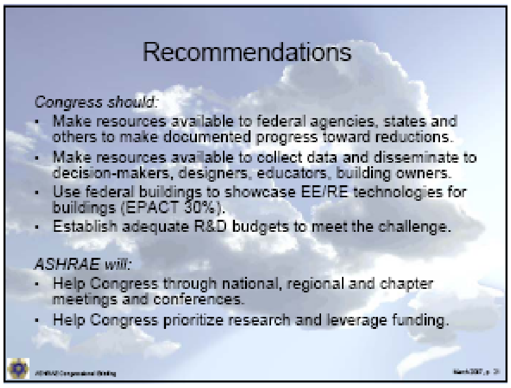


Figure 64: Slides presented to the U.S. Congressional Staff (March 2007).



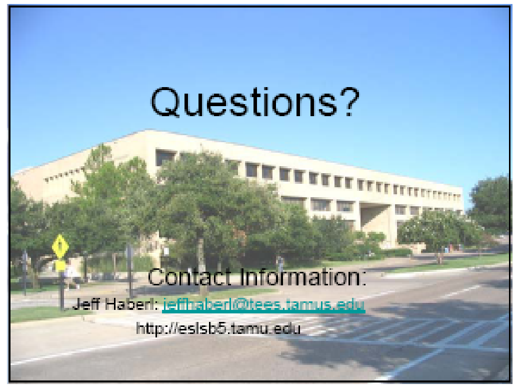


Figure 65: Slides presented to the U.S. Congressional Staff (March 2007).

5.2.9.8 Presentation at ASHRAE Carbon Toolkit Workshop (by phone)

In April 2007, the Laboratory was asked to participate in an ASHRAE Special Project to determine the feasibility of developing a Carbon Emissions Toolkit. This presentation reviewed the development of creditable emissions reductions calculations for EE/RE programs in Texas. The following figures present the slides used in this presentation.

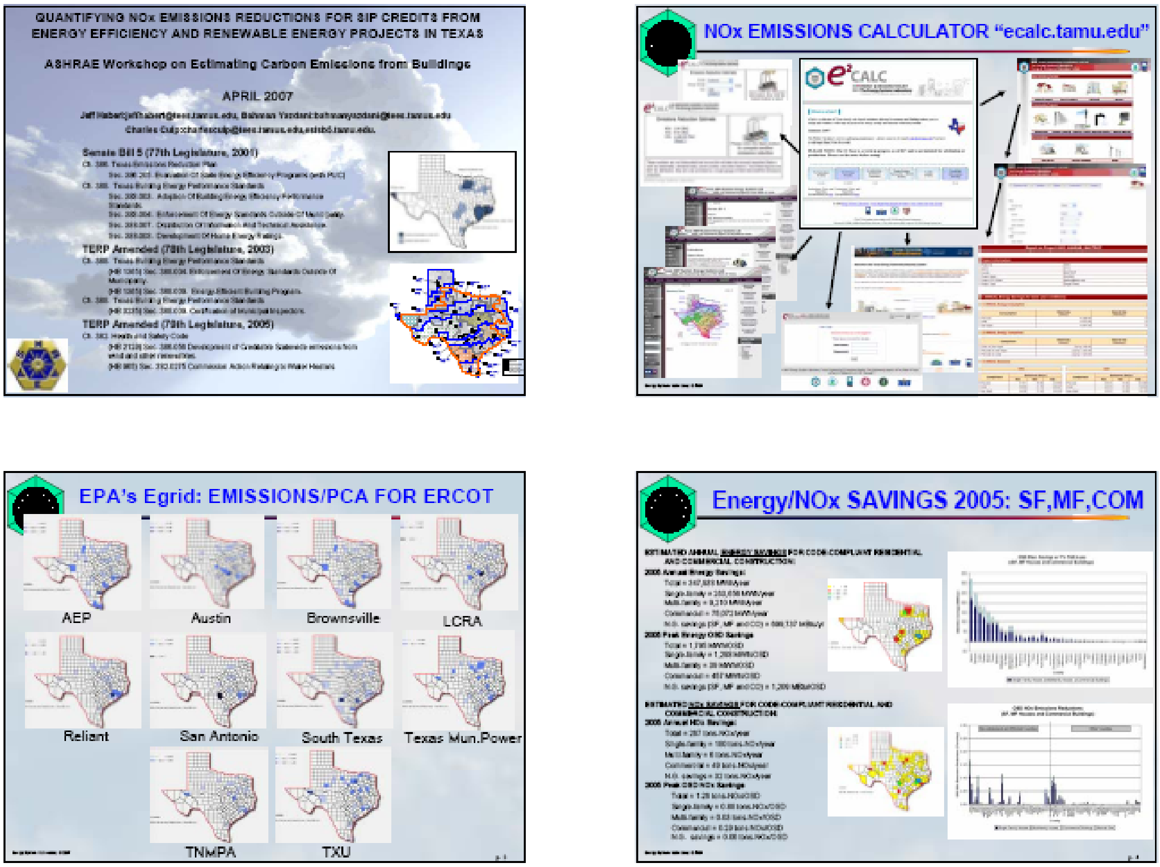


Figure 66: Slides presented at the ASHRAE Carbon Toolkit Workshop (April 2007).

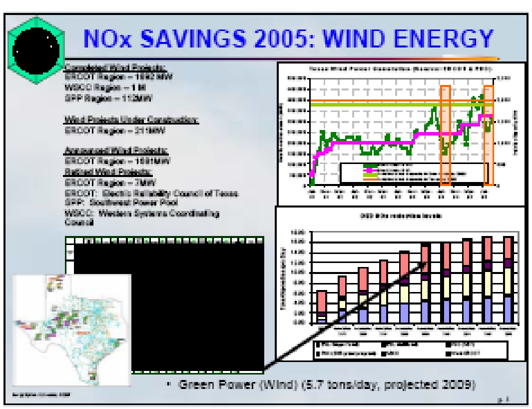


Figure 67: Slides presented at the ASHRAE Carbon Toolkit Workshop (April 2007).

5.2.9.9 Presentation at EPRI Conference, April 2007 (by phone).

In April 2007, the Laboratory was asked to participate in an EPRI Conference Call. This presentation reviewed the development of creditable emissions reductions calculations for EE/RE programs in Texas. The following figures present the slides used in this presentation.

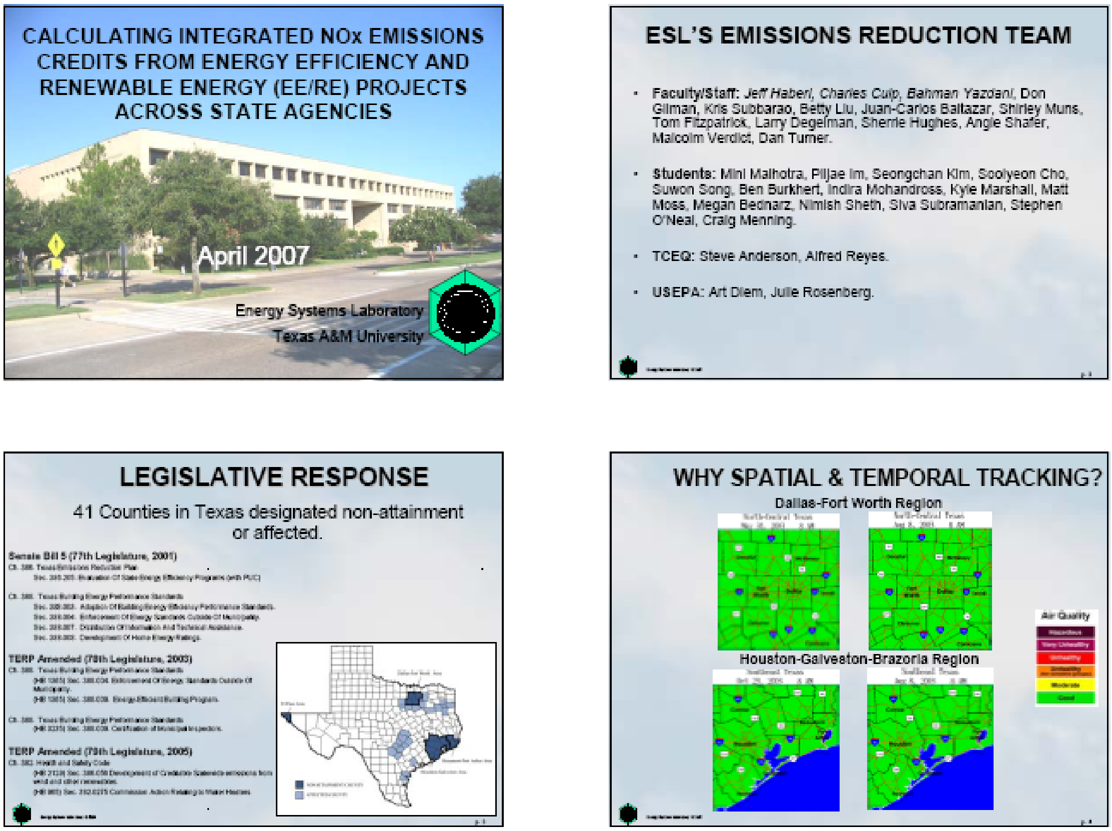


Figure 68: Slides presented at the EPRI Conference Call (April 2007).

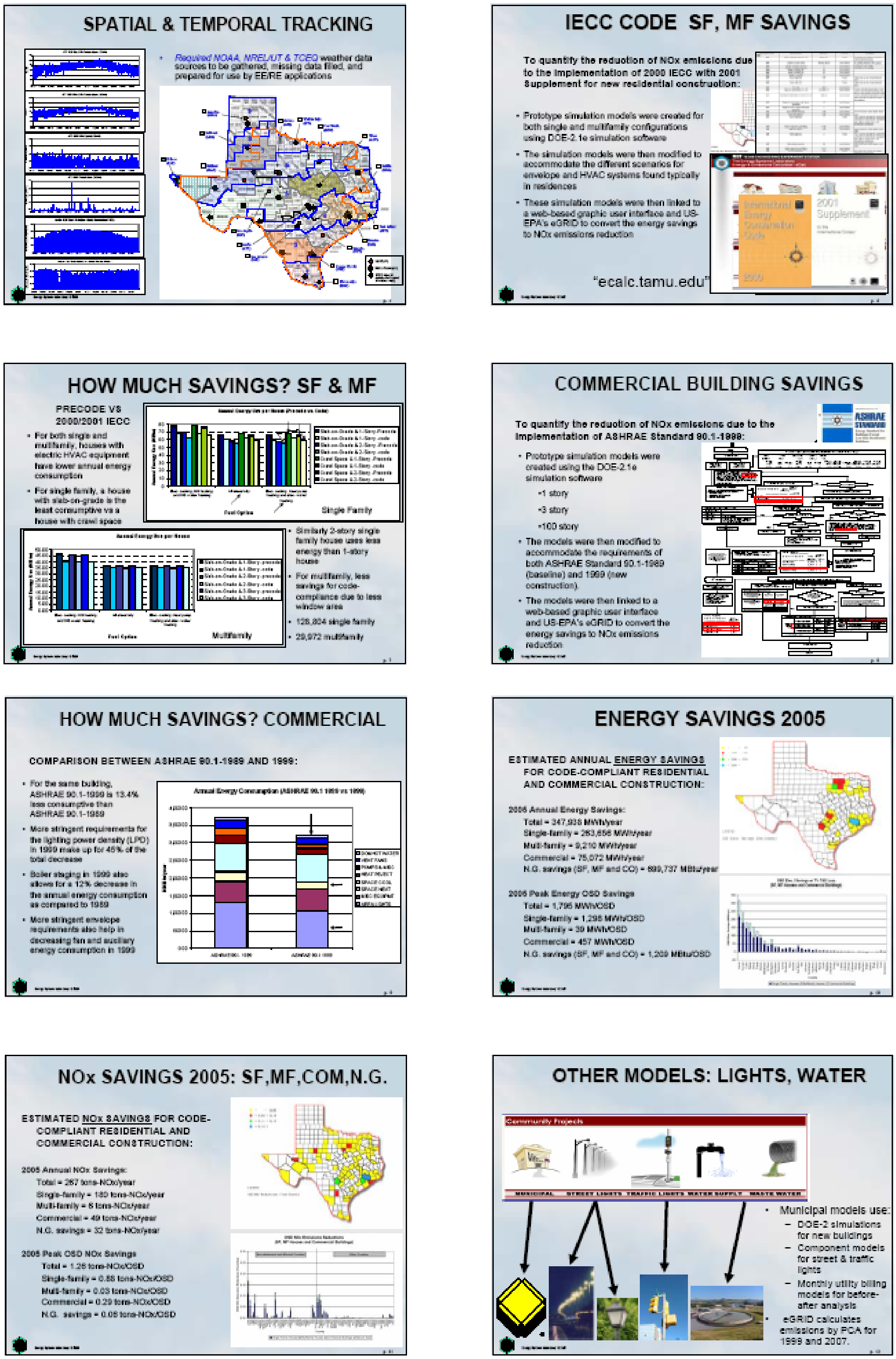
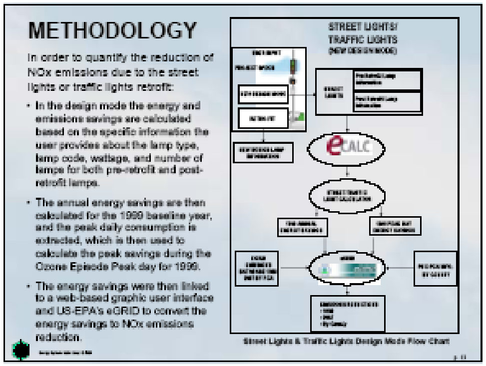
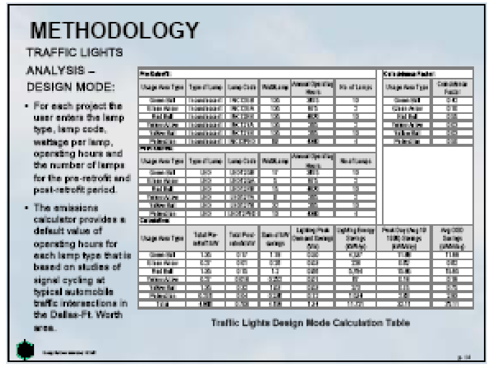
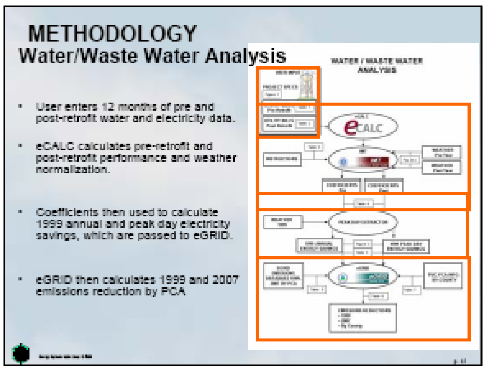
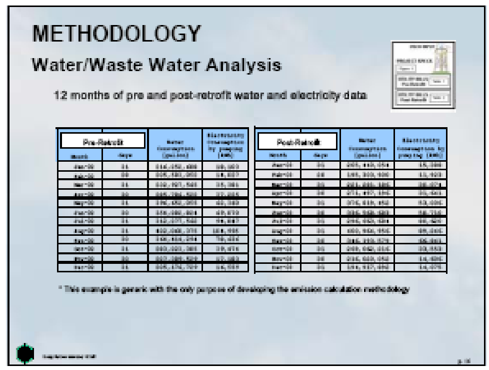


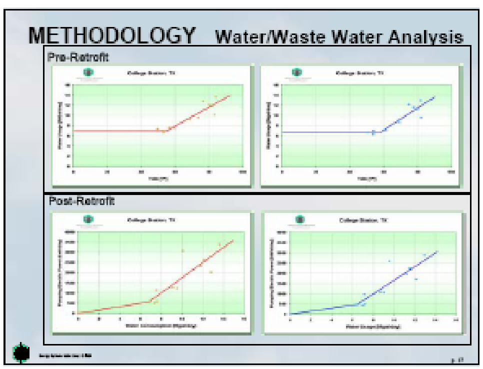
Figure 69: Slides presented at the EPRI Conference Call (April 2007).

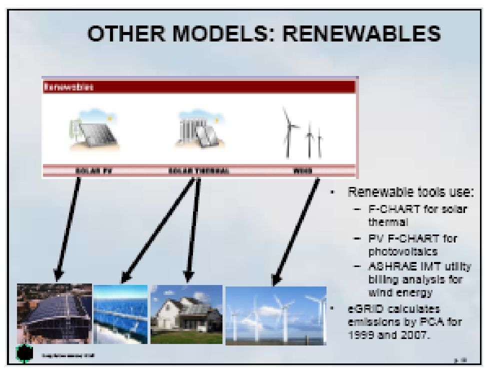


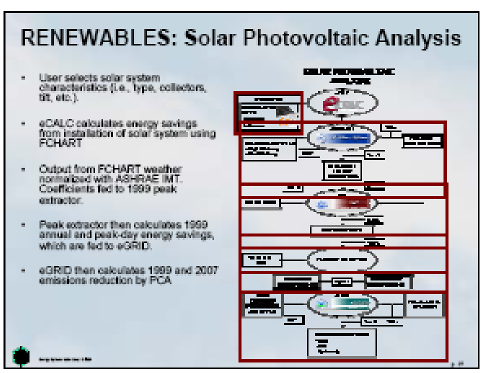












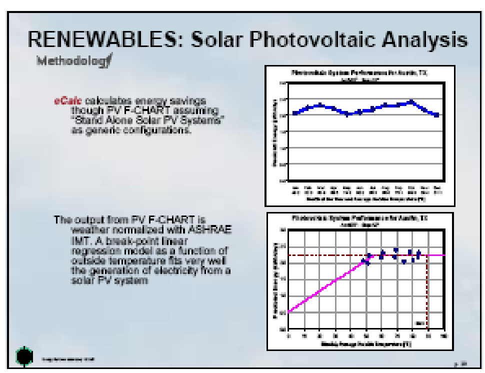
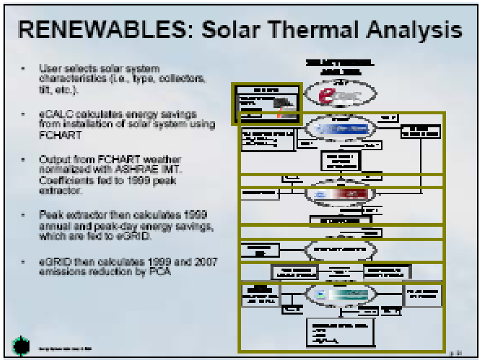
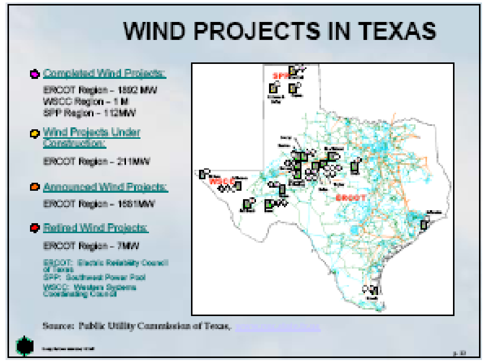
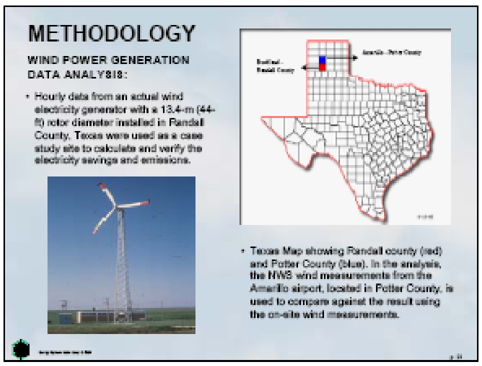
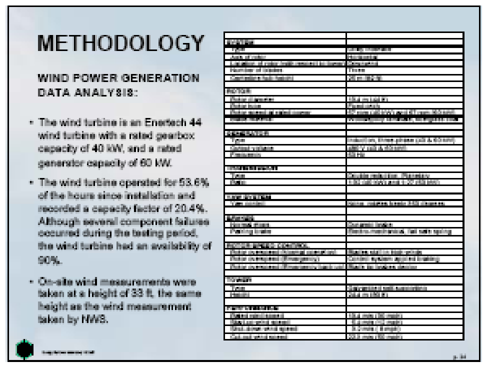


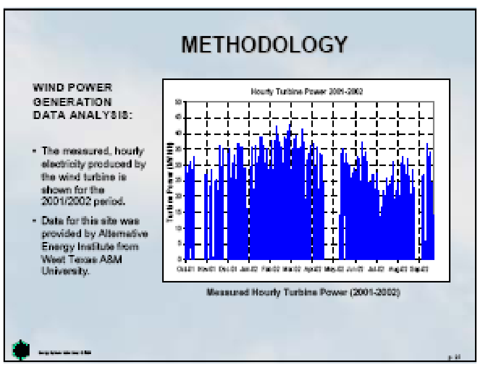
Figure 70: Slides presented at the EPRI Conference Call (April 2007).

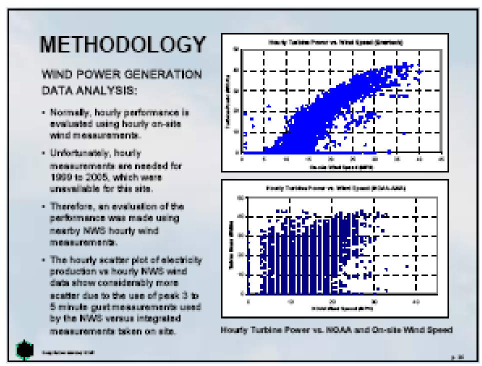


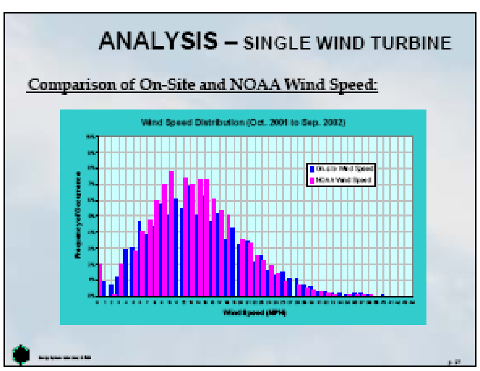












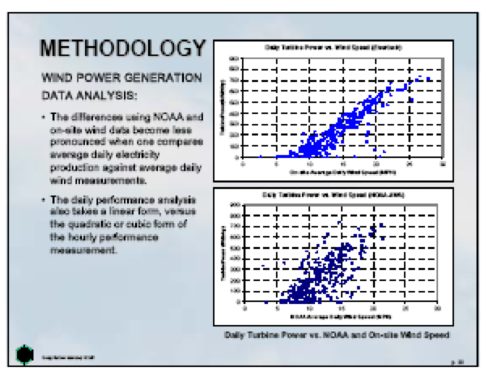
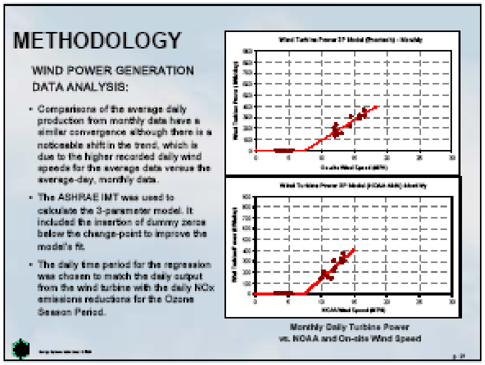
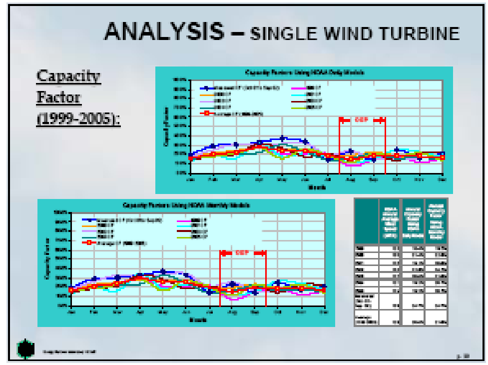
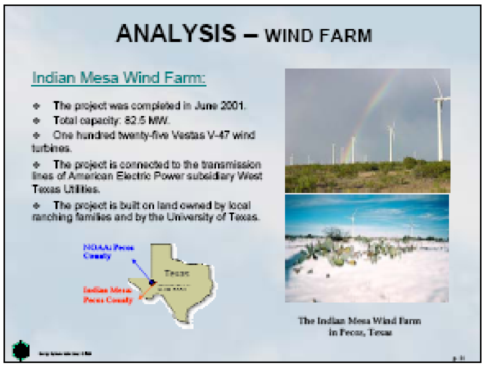
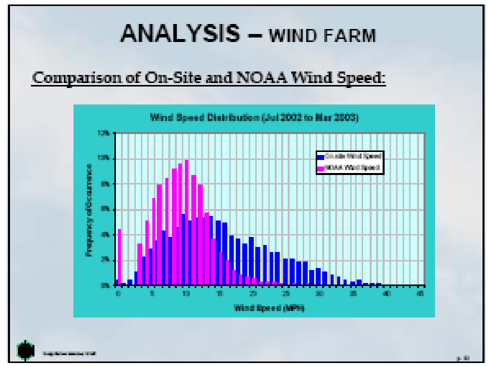


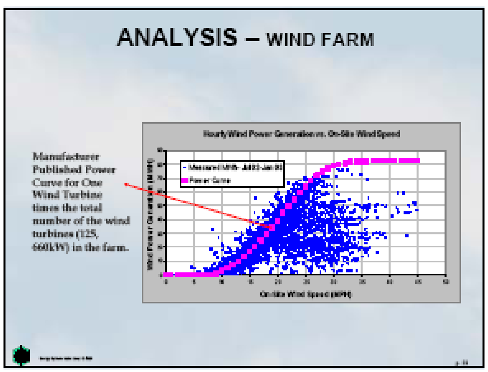
Figure 71: Slides presented at the EPRI Conference Call (April 2007).

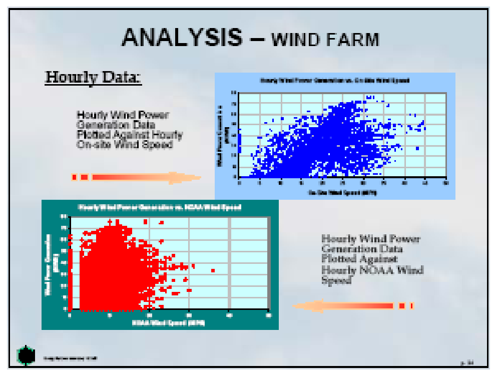


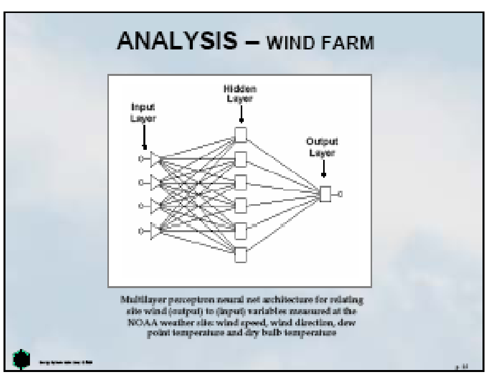












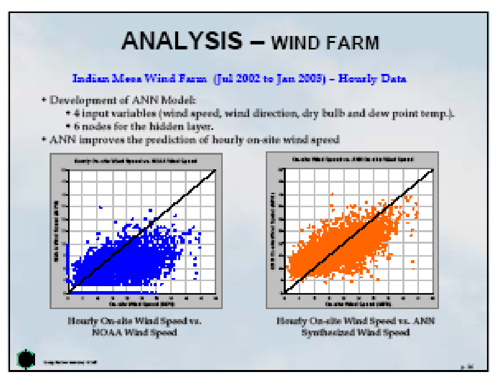
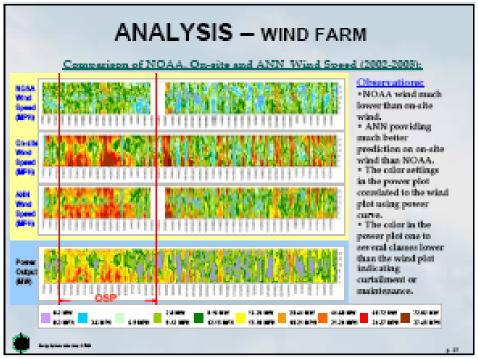
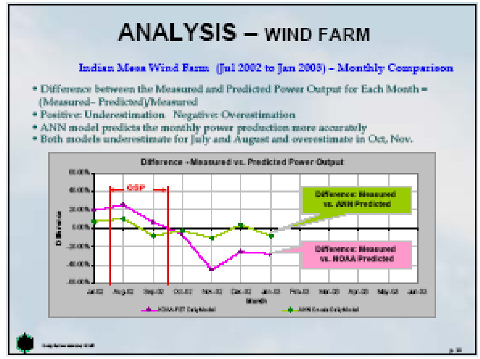
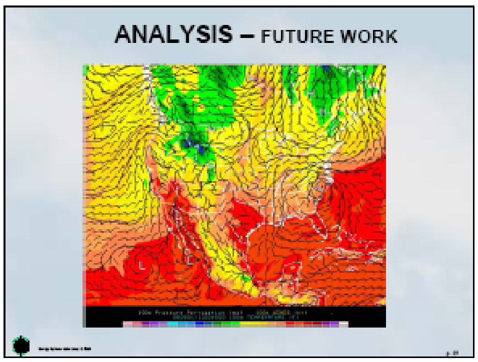
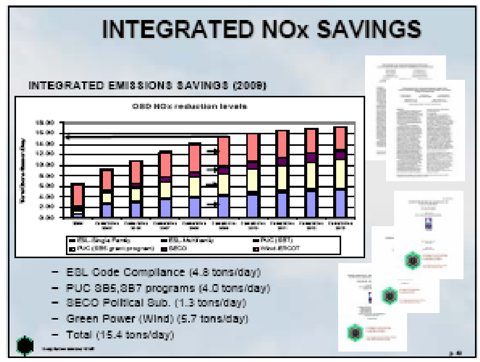


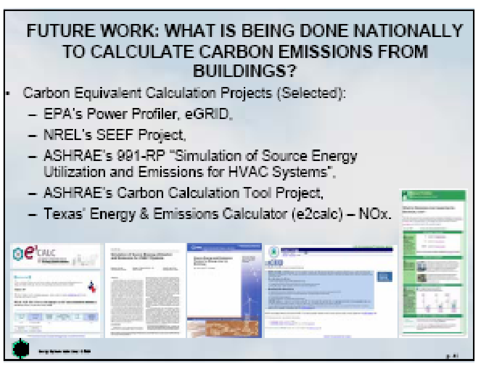
Figure 72: Slides presented at the EPRI Conference Call (April 2007).

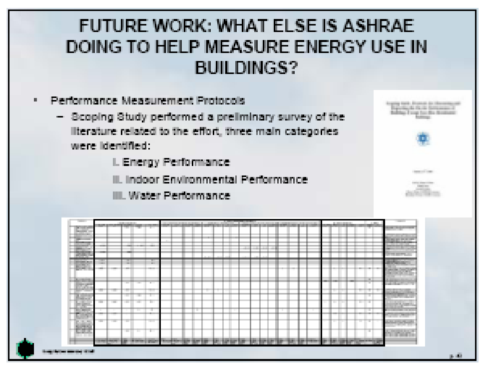


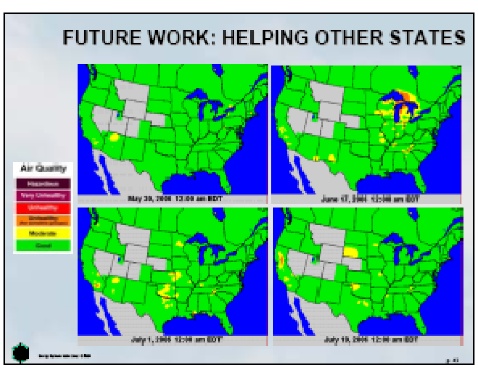












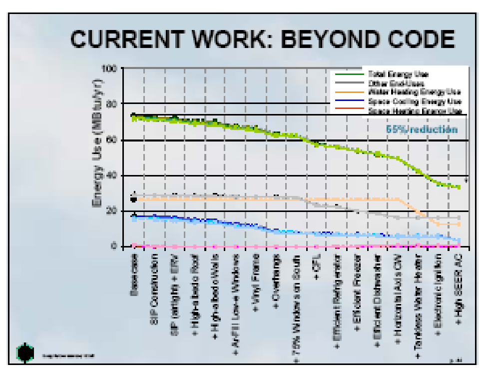
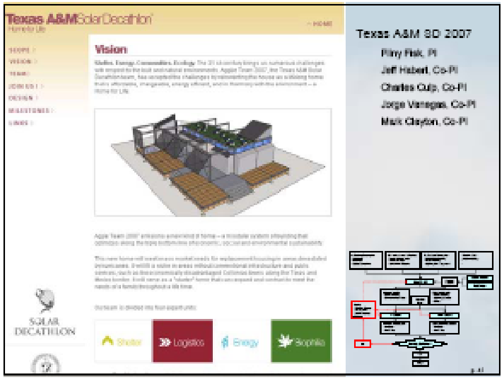


Figure 73: Slides presented at the EPRI Conference Call (April 2007).



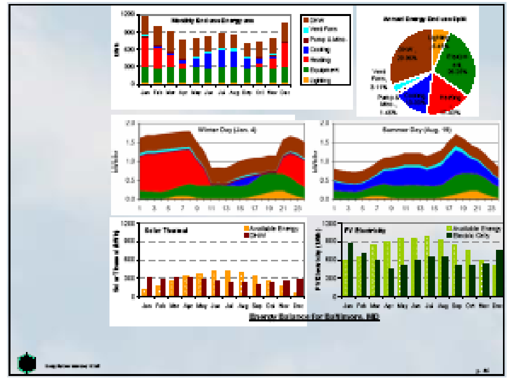


Figure 74: Slides presented at the EPRI Conference Call (April 2007).

5.2.9.10 Held Wind/Renewables Stakeholder's Meetings.

Legislation passed during the regular session of the 79th Legislature directed the Energy Systems Laboratory to work with the TCEQ to develop a methodology for computing emissions reductions attributable to renewable energy and for the Laboratory to quantify the emissions reductions attributable to renewables for inclusion in the State Implementation Plan (SIP) annually. HB 2921 directed the Texas Environmental Research Consortium (TERC) to engage the Texas Engineering Experiment Station for the development of this methodology.

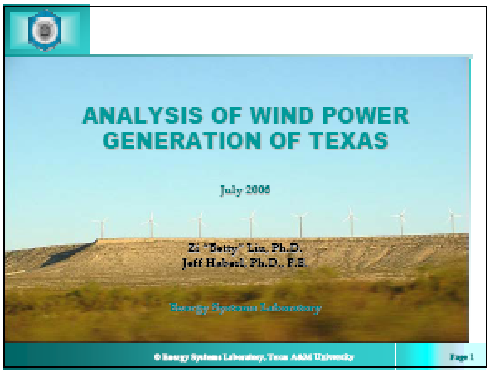
To initiate this effort in 2005, the TERC and Texas A&M held a Stakeholder's meeting at the Texas State Capitol on Tuesday, August 30, 2005. At this meeting the draft scope of work, schedule and deliverables were discussed. Also, at this meeting a group of Stakeholders was established to review and comment on the Laboratory's work. In August 2006 the Laboratory delivered their first Annual report to the TCEQ that documented the work performed during the period from September 2005 to August 2006[16].

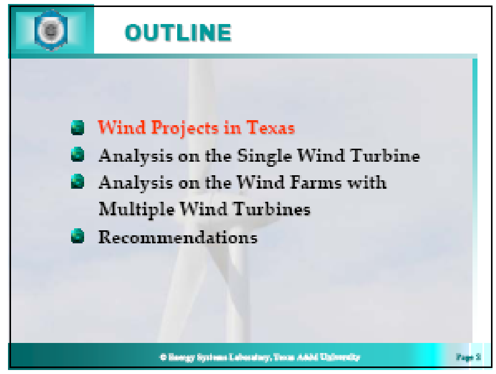
In this section of the report, the materials that were developed and presented to the Stakeholders group are presented.

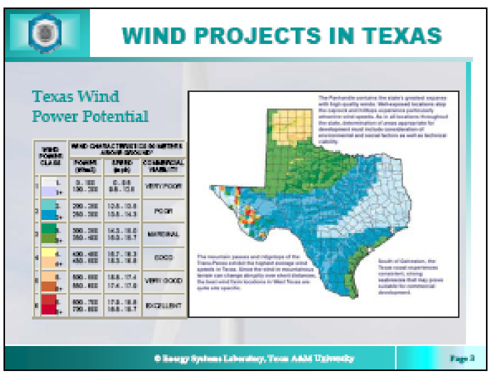
[16] Haberl, J., Culp, C., Yazdani, B., Subbarao, K., Verdict, M., Liu, Z., Baltazar-Cervantes, J-C., Gilman, D., Fitzpatrick, T., Turner, D. 2006. "Statewide Air Emissions Calculations From Wind and Other Renewables", Annual Report to the Texas Commission on Environmental Quality, September 2005 to August 2006, Energy Systems Laboratory Report No. ESL-TR-06-08-01, 111 pages on CDROM & pdf (August).

5.2.9.10.1 July 2006 Stakeholders conference call.

In July 2006 , the Laboratory presented an overview of the analysis developed for single and multiple wind turbines to the Wind Stakeholder's group in a conference call. The following figures present the slides used in this presentation.







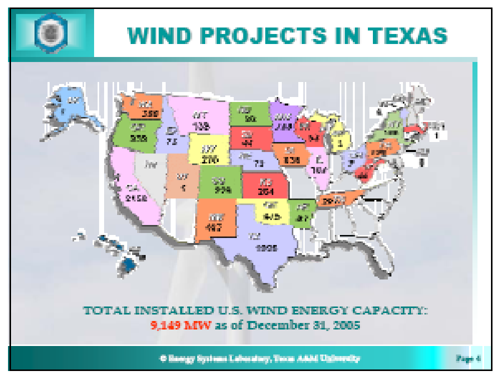
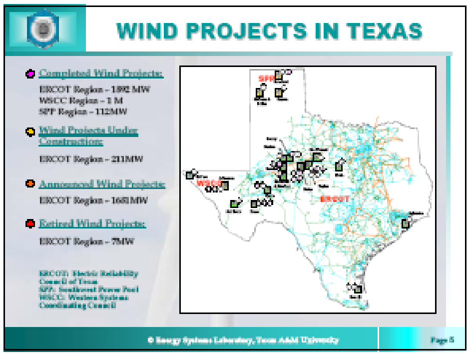
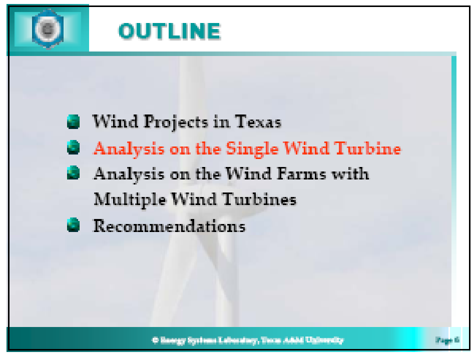
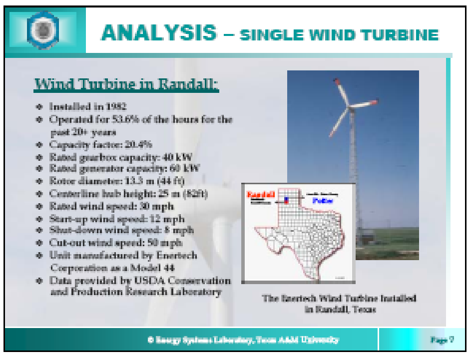
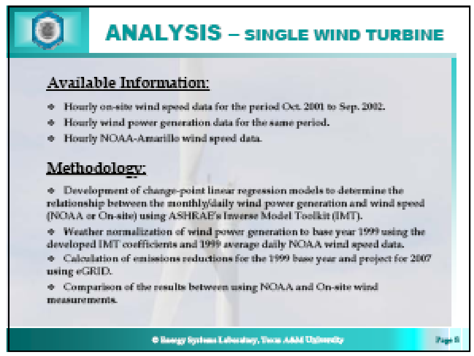


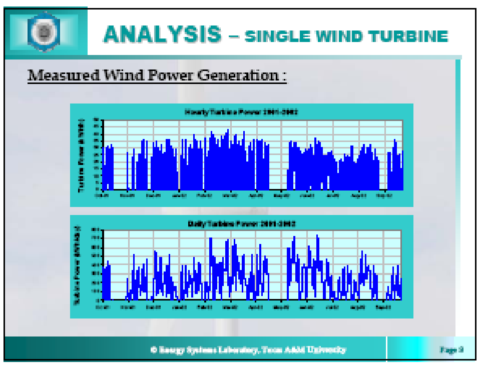
Figure 75: Slides presented at the Wind Energy Stakeholder's conference call (July 2006).

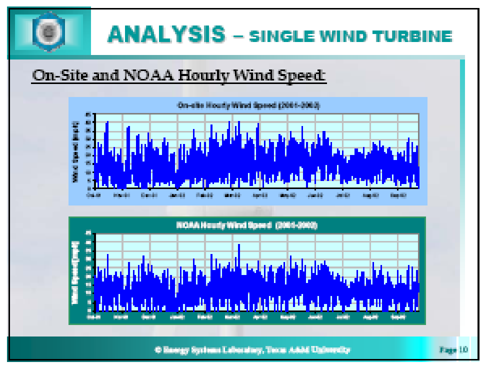


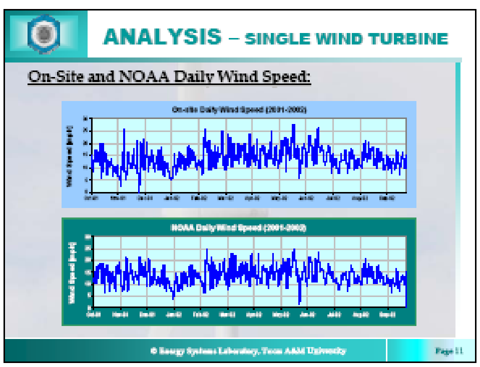












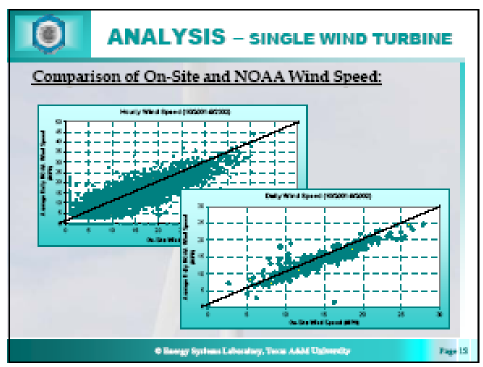
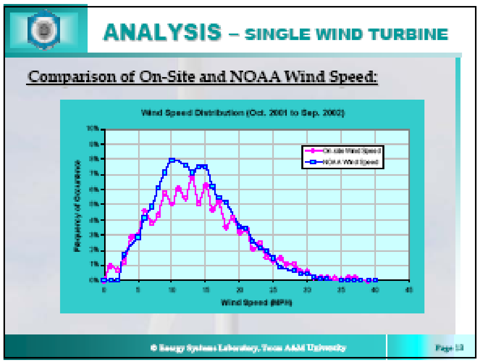
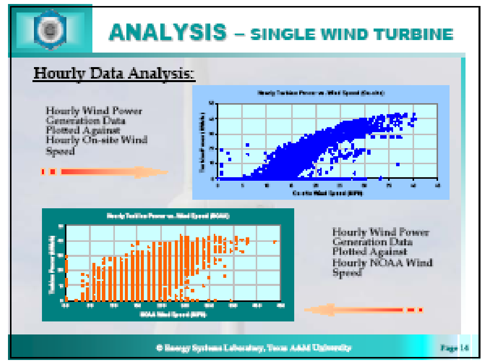
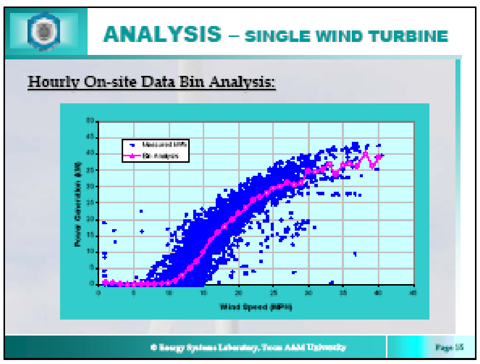
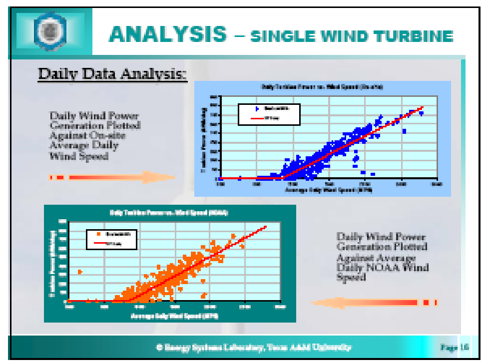


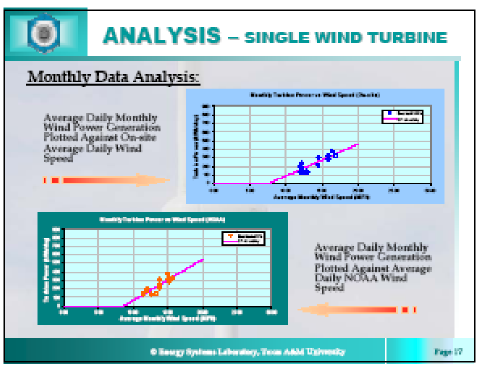
Figure 76: Slides presented at the Wind Energy Stakeholder's conference call (July 2006).

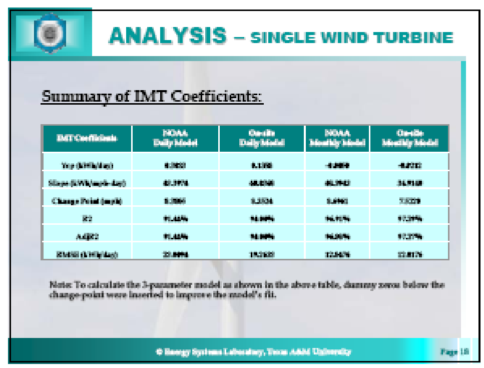


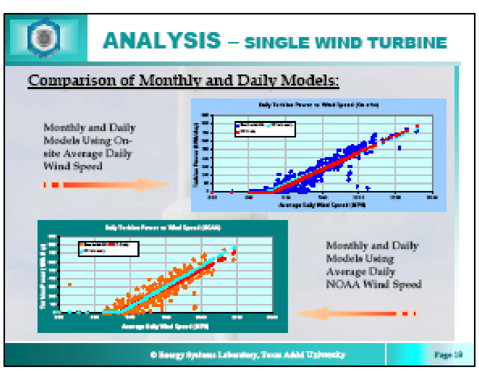












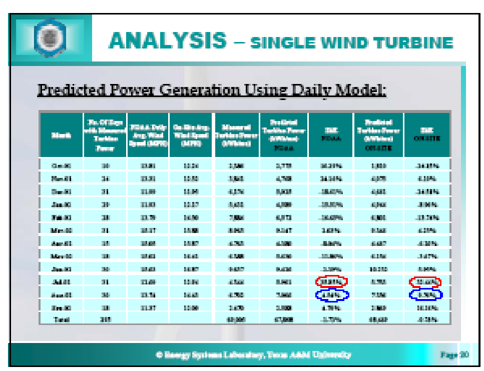
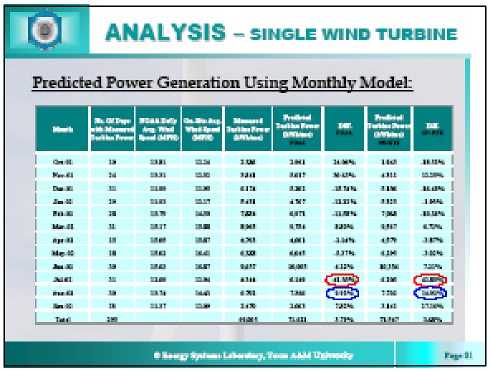
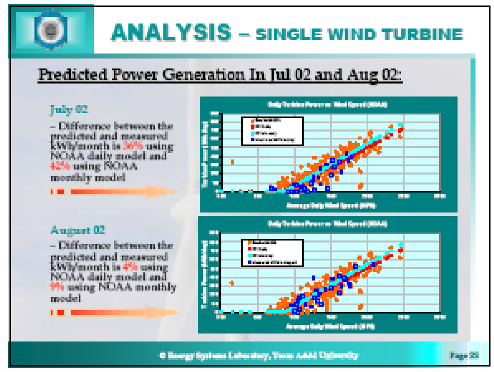
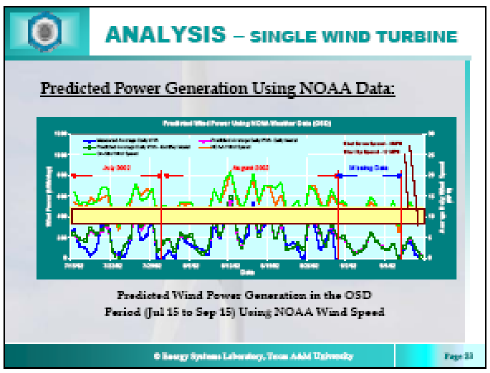
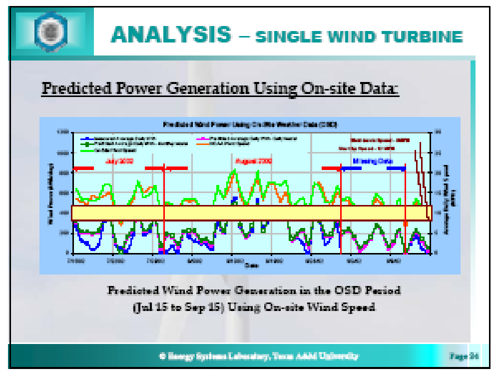


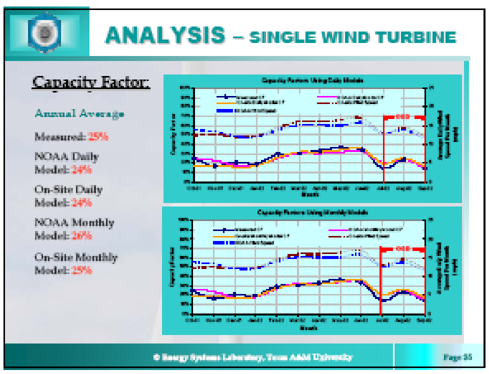
Figure 77: Slides presented at the Wind Energy Stakeholder's conference call (July 2006).

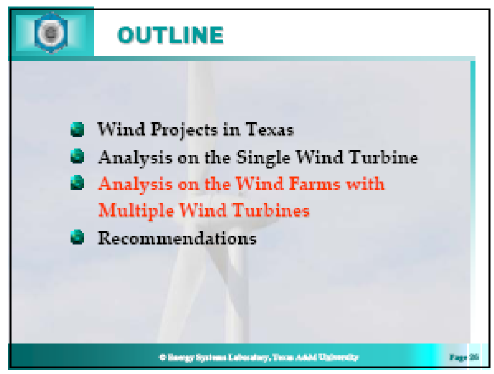


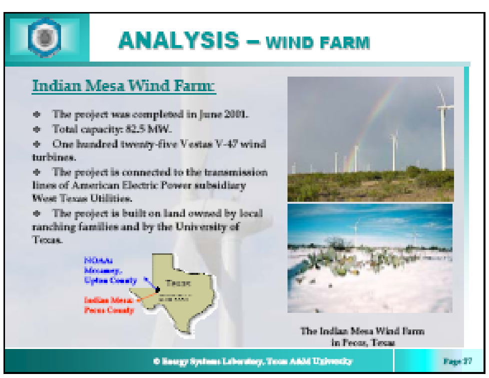












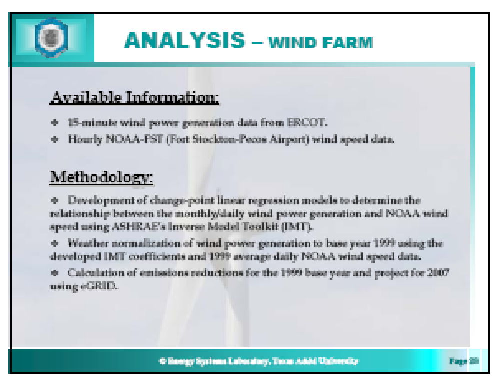


Figure 78: Slides presented at the Wind Energy Stakeholder's conference call (July 2006).

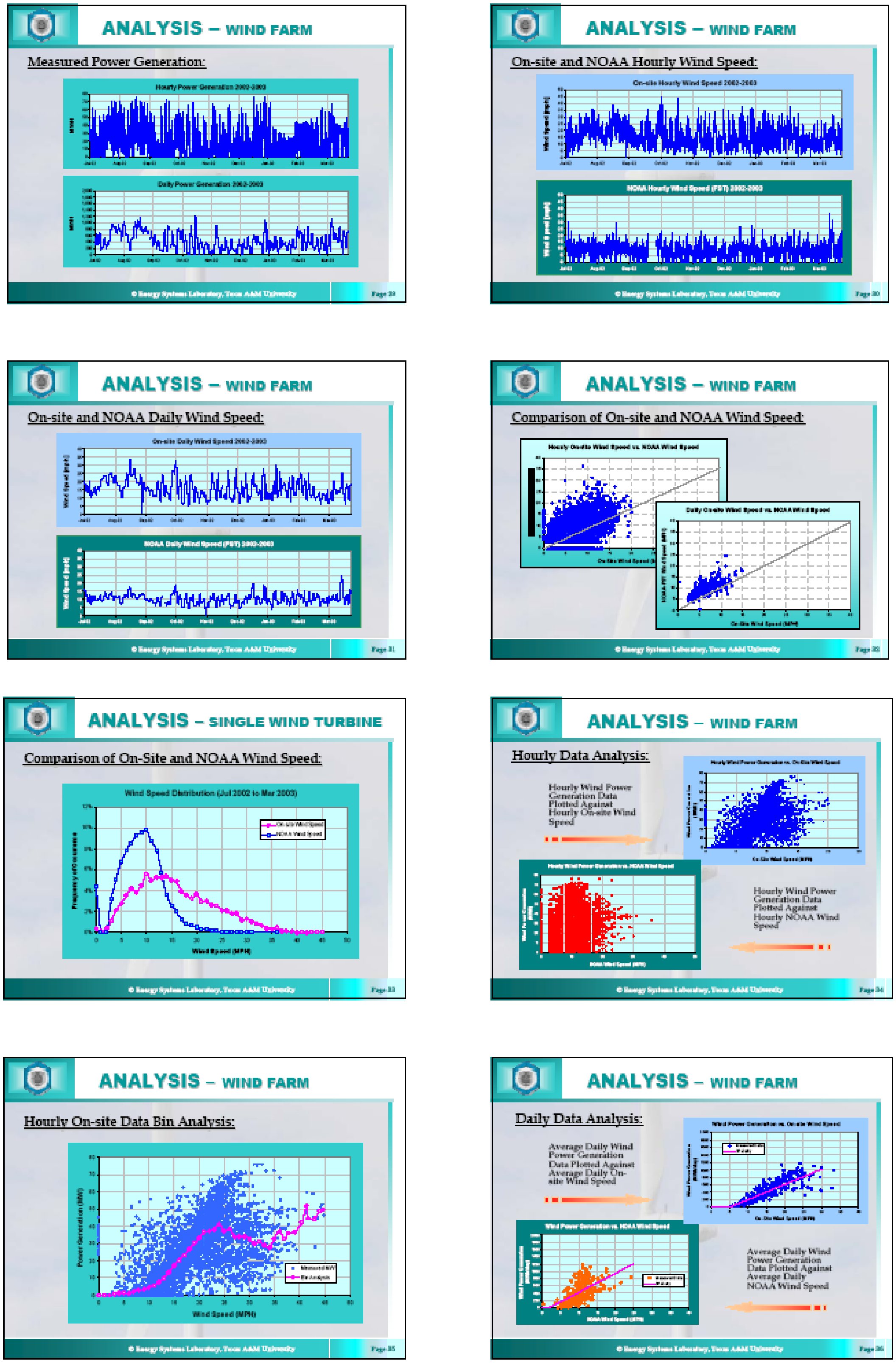
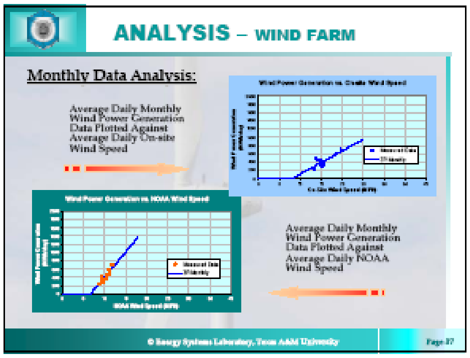
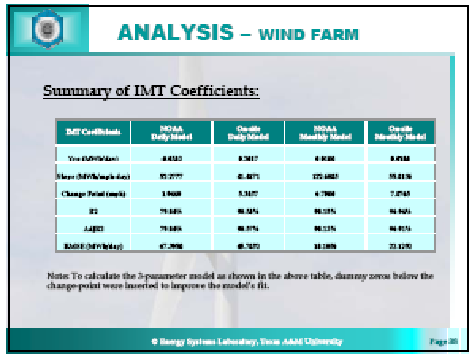
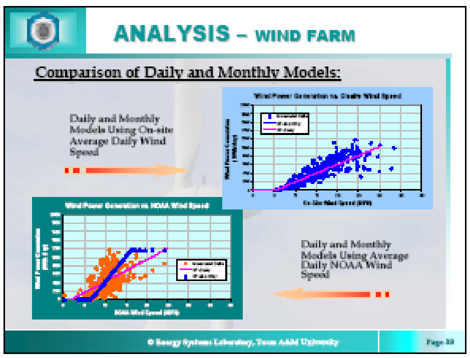
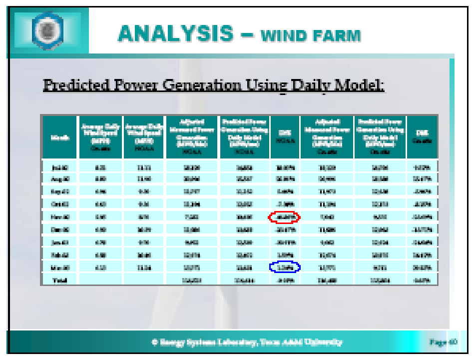


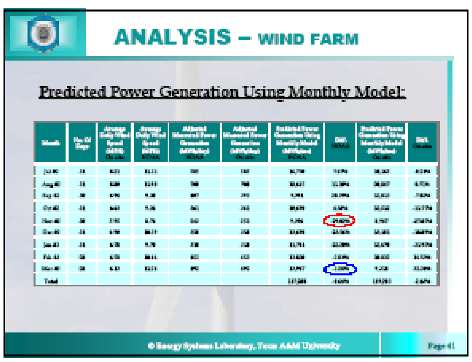
Figure 79: Slides presented at the Wind Energy Stakeholder's conference call (July 2006).

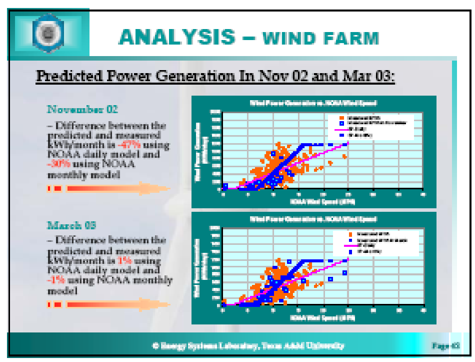


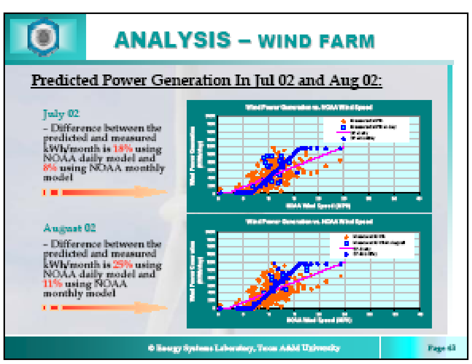












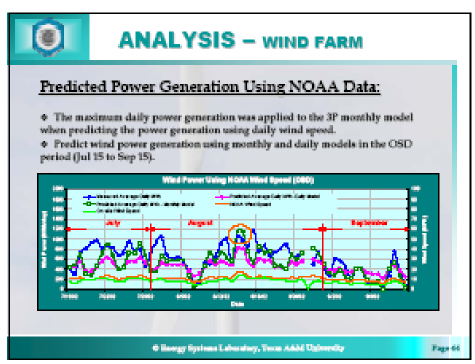
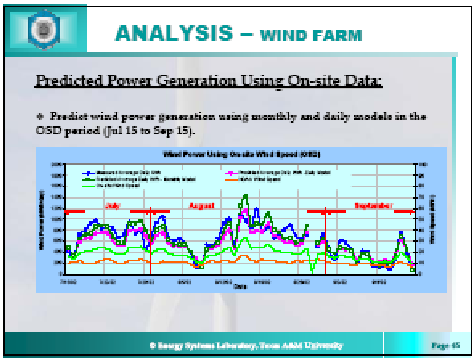
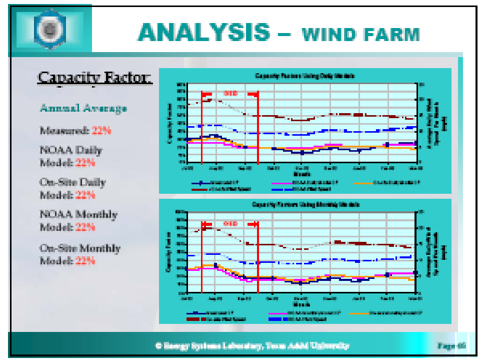
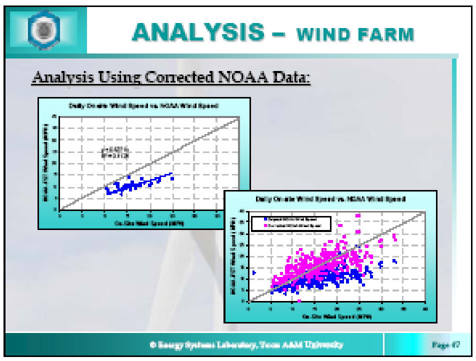
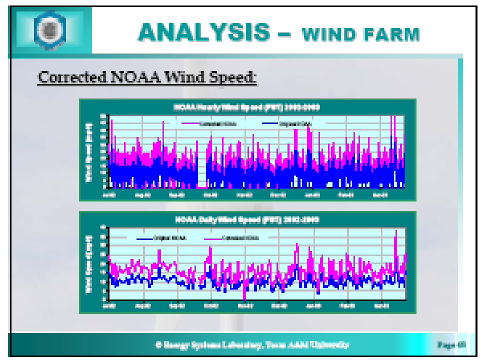


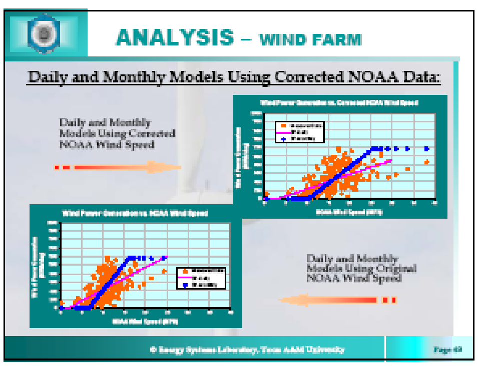
Figure 80: Slides presented at the Wind Energy Stakeholder's conference call (July 2006).

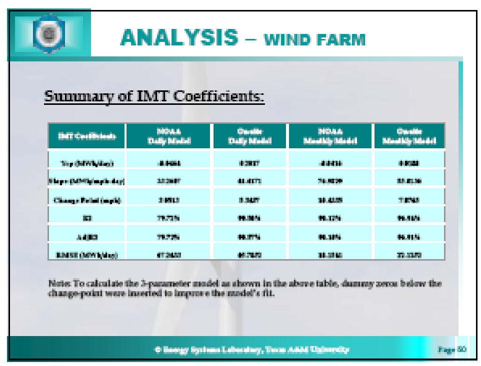












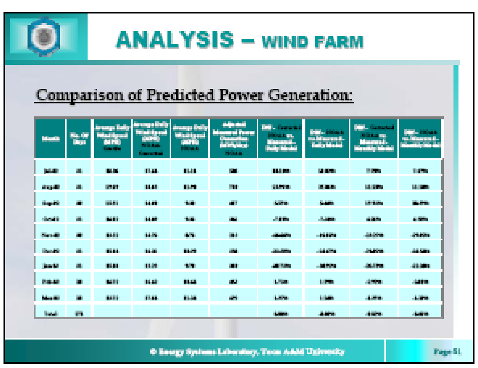


Figure 81: Slides presented at the Wind Energy Stakeholder's conference call (July 2006).

5.2.9.10.2 October 2006 Stakeholders conference call.

In October 2006 , the Laboratory presented an update to the analysis methods, including work performed since July 2006. These results were presented in the format of a conference call to the Stakeholders. The following figures present the slides used in this presentation.

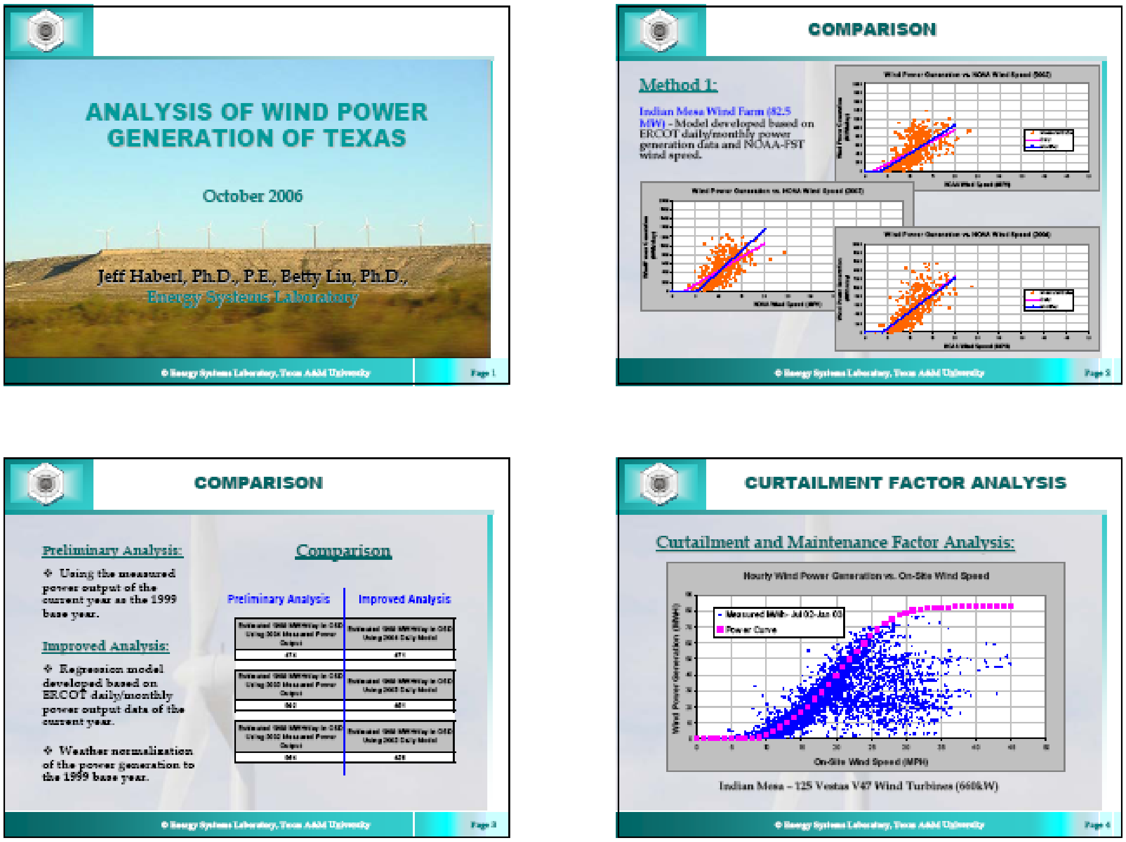
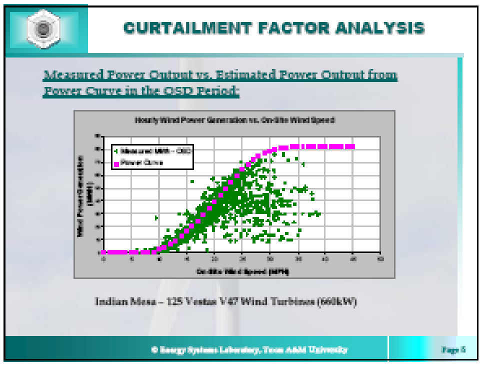
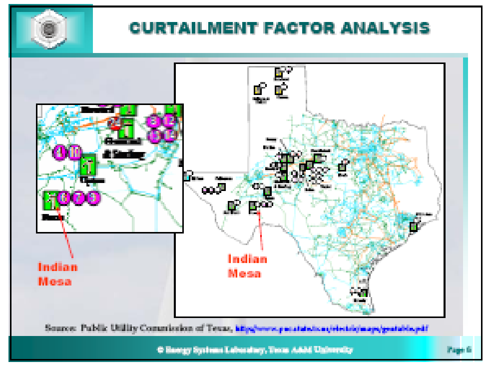
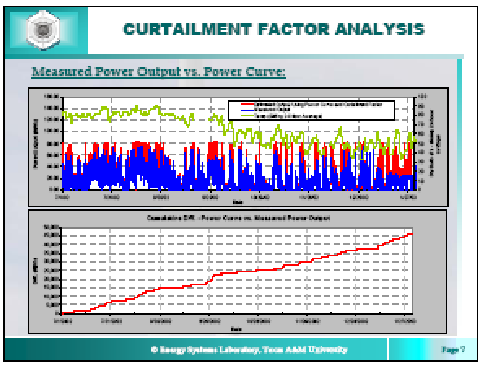
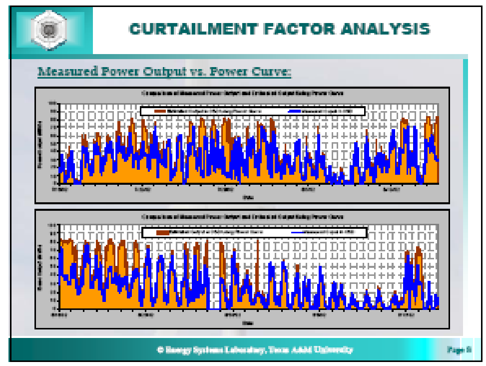


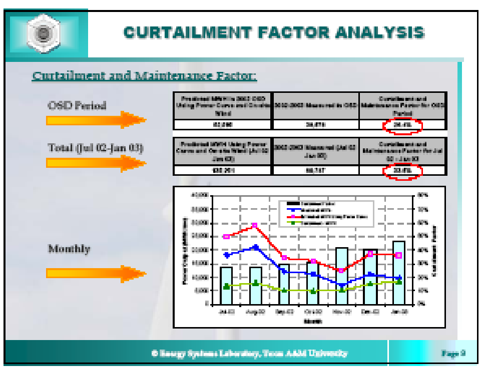
Figure 82: Slides presented at the Wind Energy Stakeholder’s conference call (October 2006).

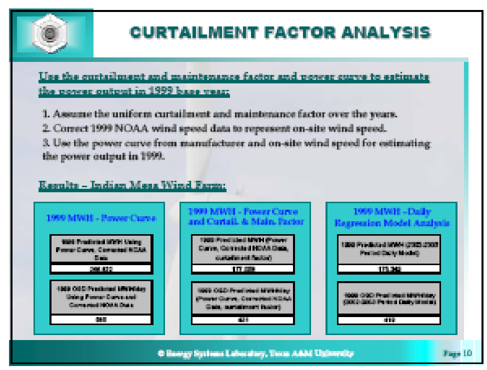


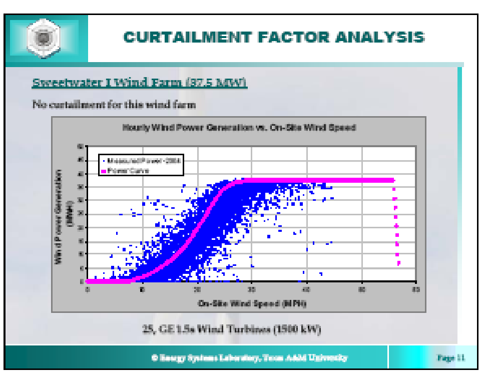












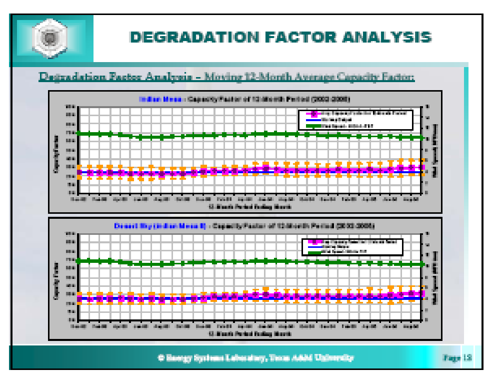
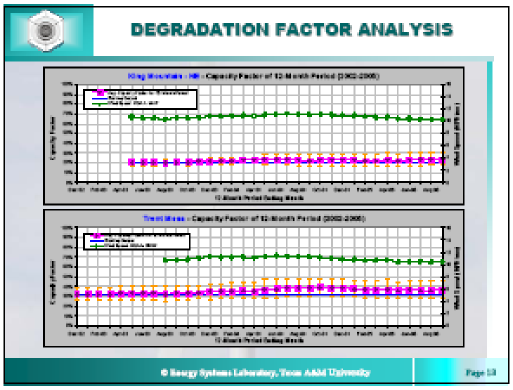
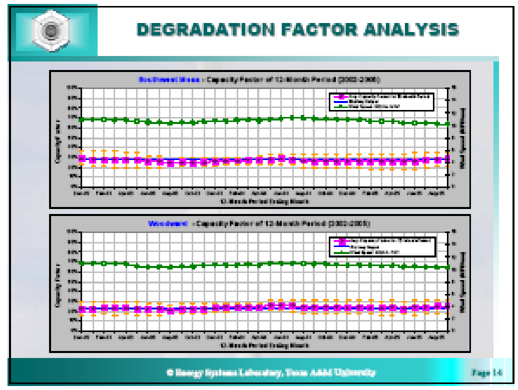


Figure 83: Slides presented at the Wind Energy Stakeholder’s conference call (October 2006).





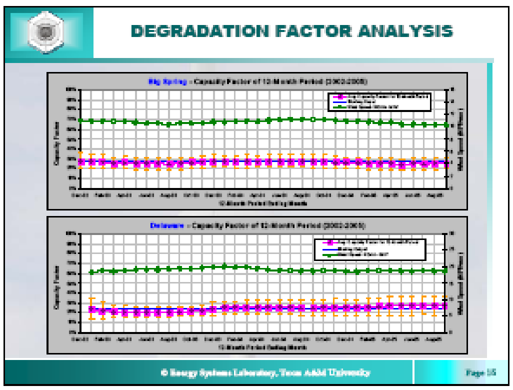
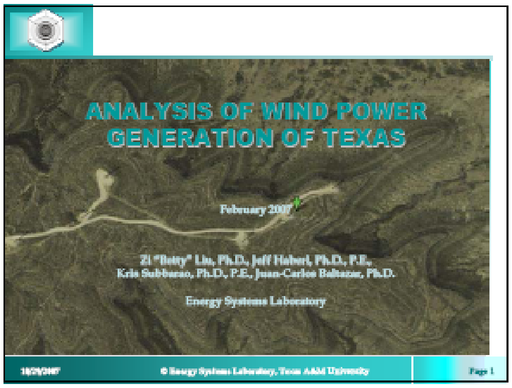
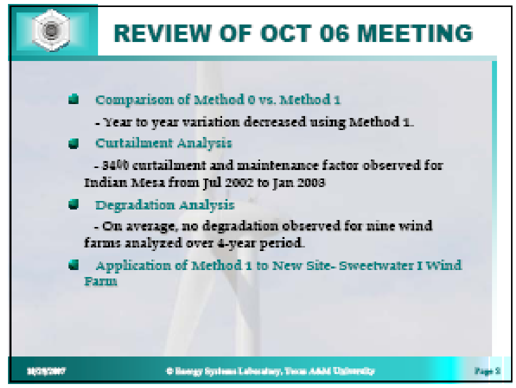


Figure 84: Slides presented at the Wind Energy Stakeholder's conference call (October 2006).

5.2.9.10.3 February 2007 Stakeholders conference call.

In February 2007, the Laboratory presented an update to the analysis methods, including work performed since October 2006. These results were presented in the format of a conference call to the Stakeholders. The following figures present the slides used in this presentation.





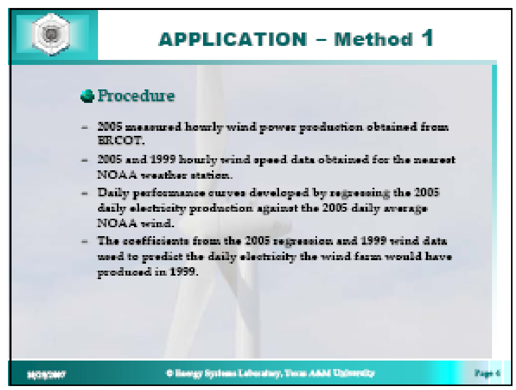


Figure 85: Slides presented at the Wind Energy Stakeholder's conference call (February 2007).

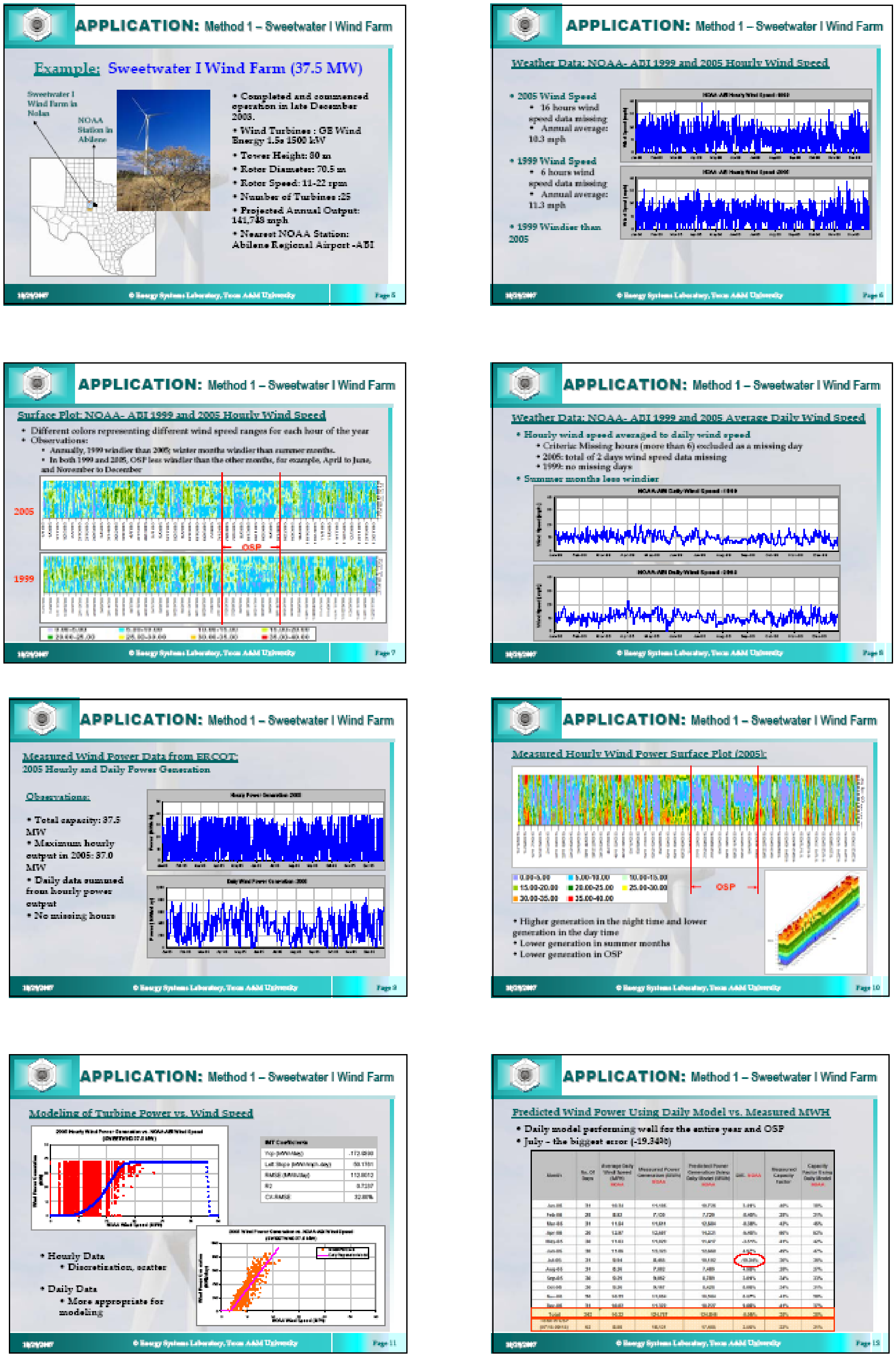
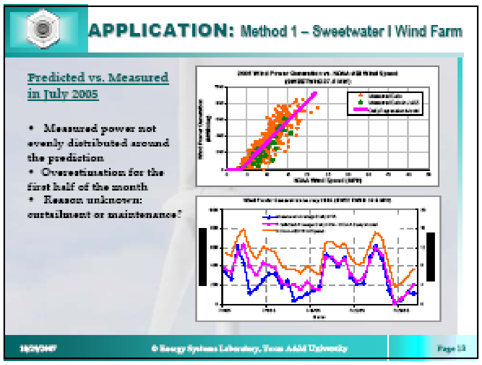
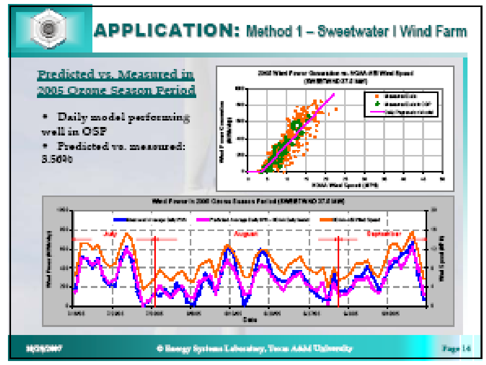
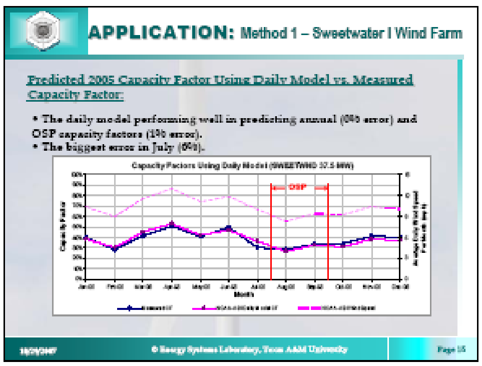
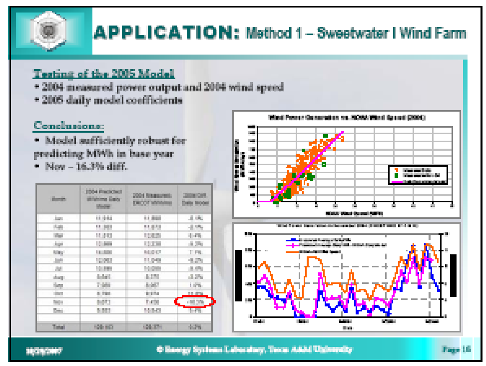


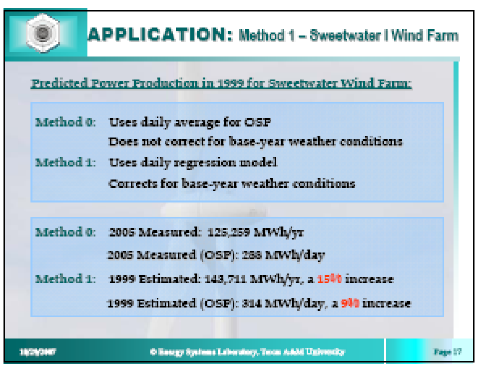
Figure 86: Slides presented at the Wind Energy Stakeholder's conference call (February 2007).

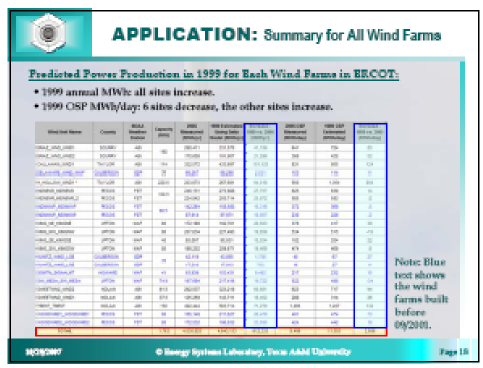


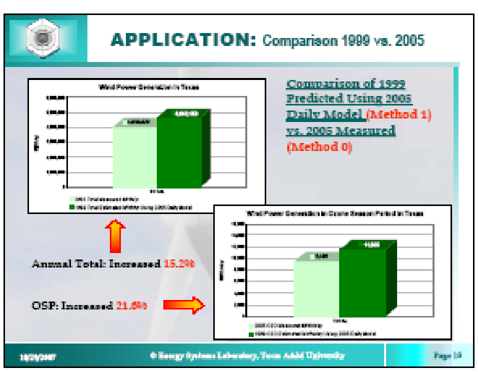












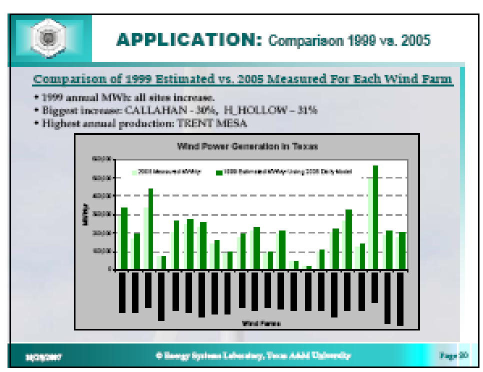
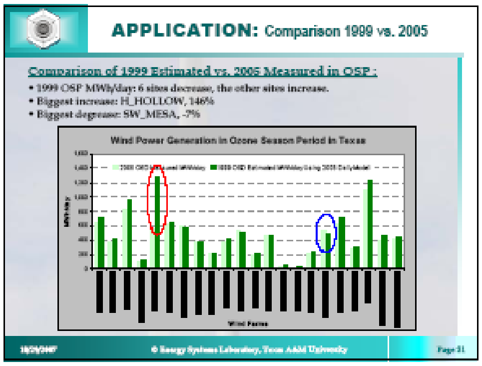
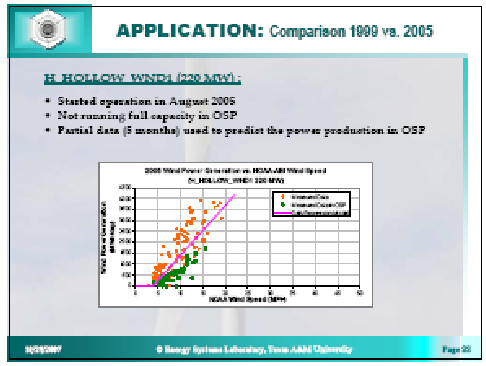
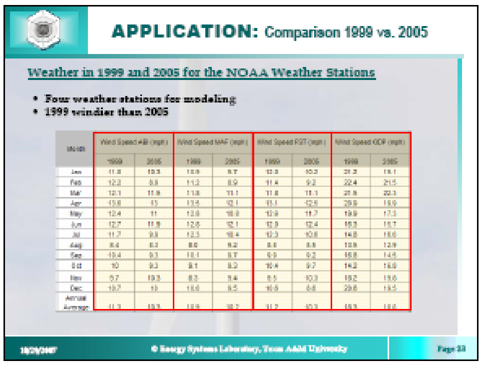
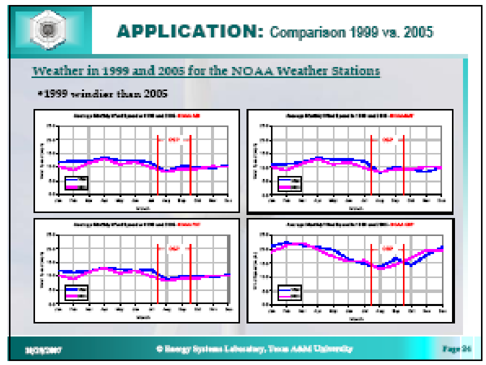


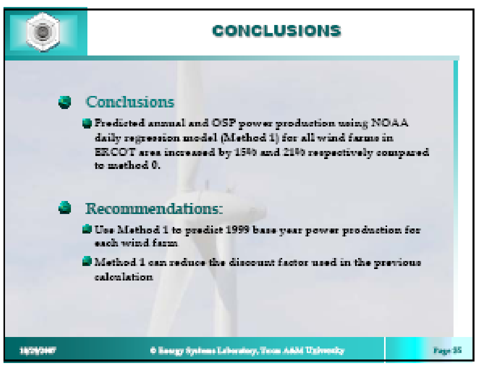
Figure 87: Slides presented at the Wind Energy Stakeholder's conference call (February 2007).

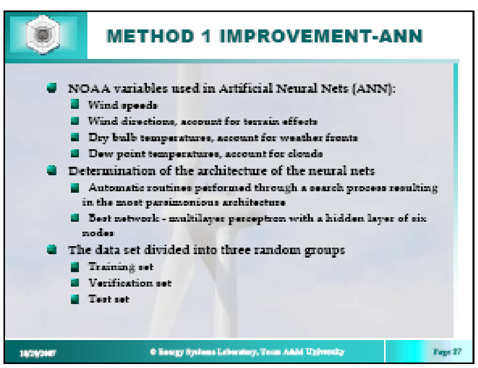












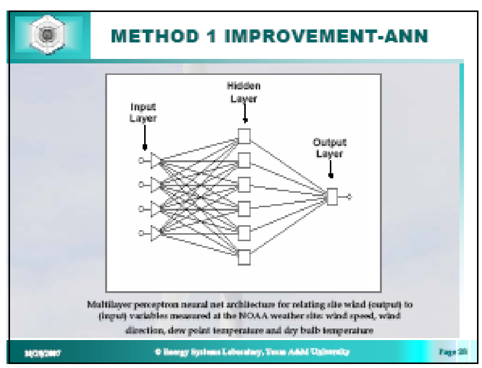


Figure 88: Slides presented at the Wind Energy Stakeholder's conference call (February 2007).

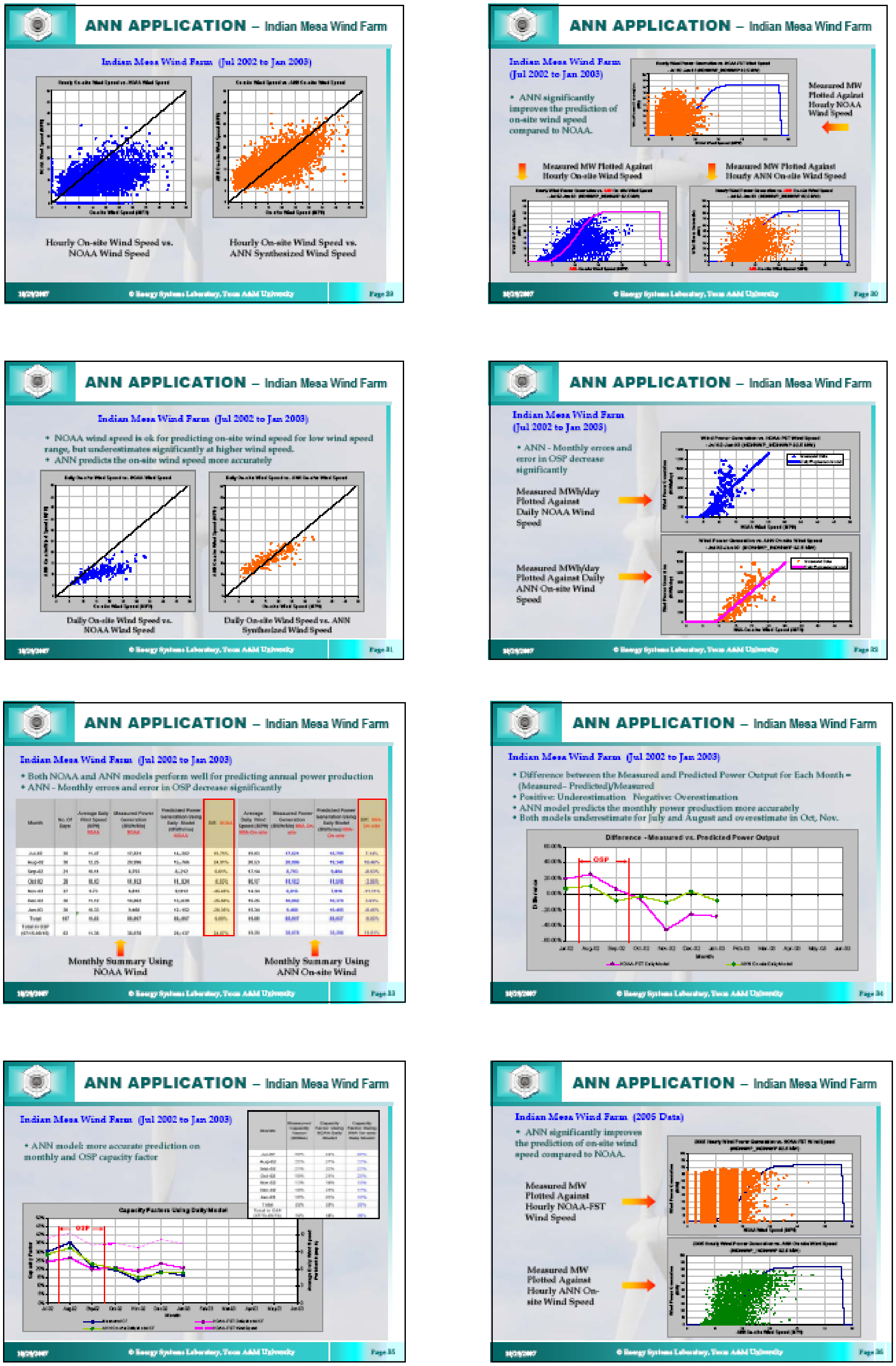
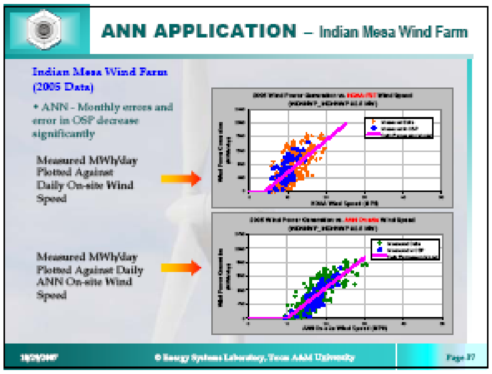
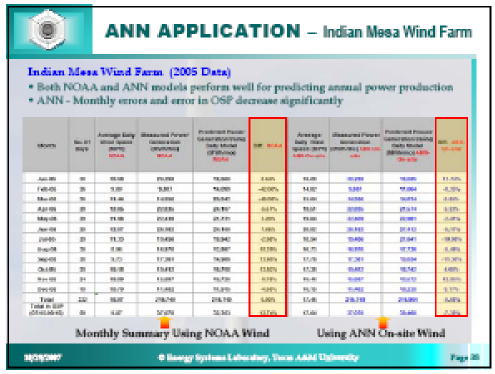
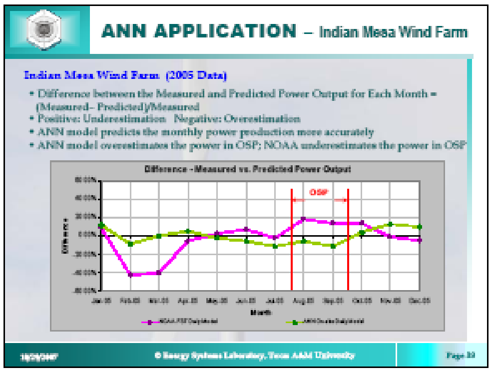
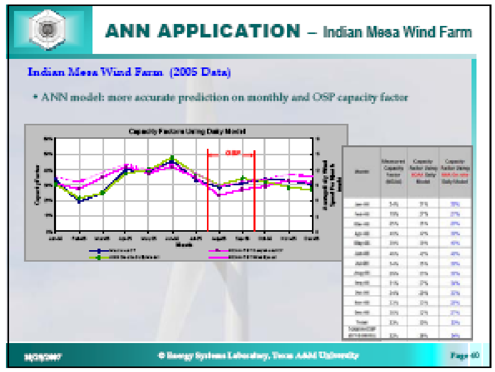


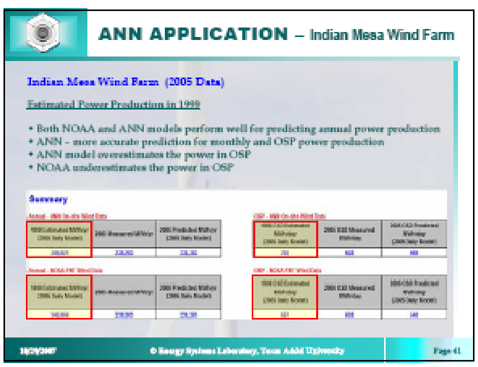
Figure 89: Slides presented at the Wind Energy Stakeholder's conference call (February 2007).

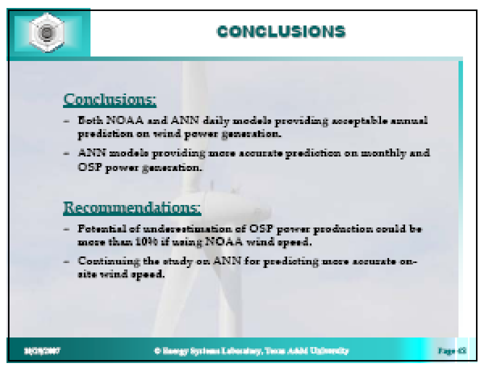












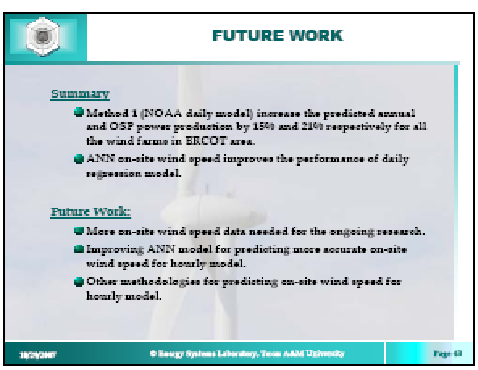
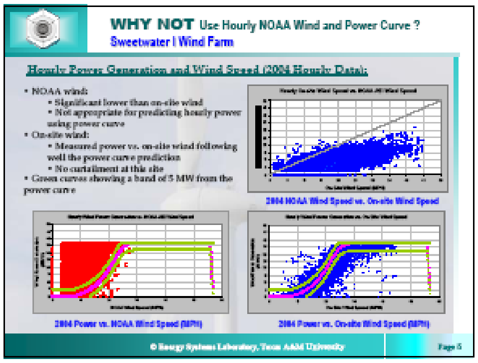


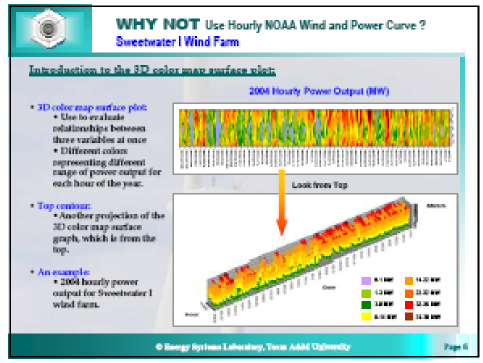
Figure 90: Slides presented at the Wind Energy Stakeholder's conference call (February 2007).

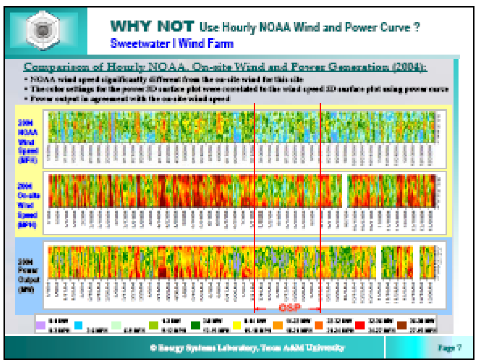
5.2.9.10.4 April 2007 Stakeholders conference call.

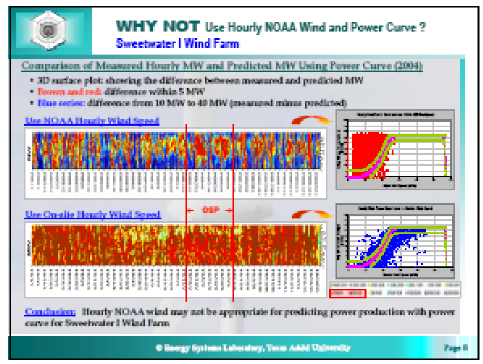
In April 2007 , the Laboratory presented an update to the analysis methods, including work performed since October 2006. These results were presented in the format of a conference call to the Stakeholders. The following figures present the slides used in this presentation.

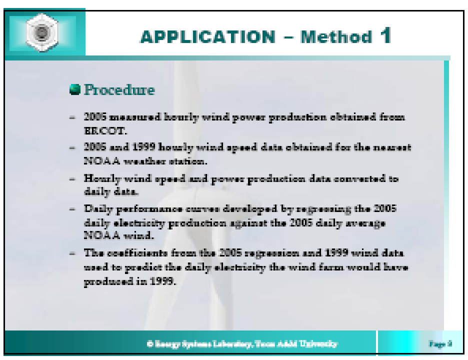
Figure 91: Slides presented at the Wind Energy Stakeholder's conference call (April 2007).

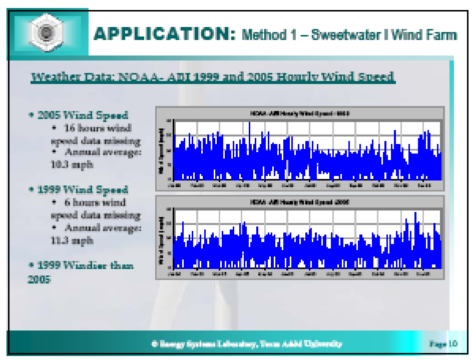


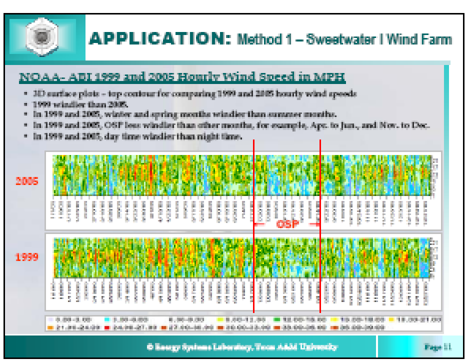












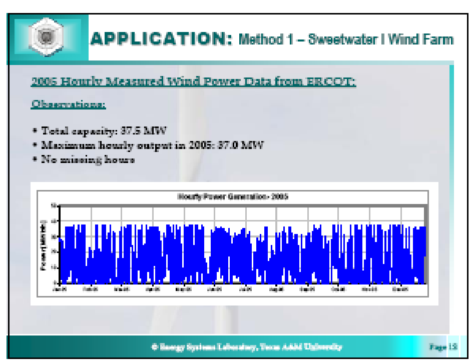
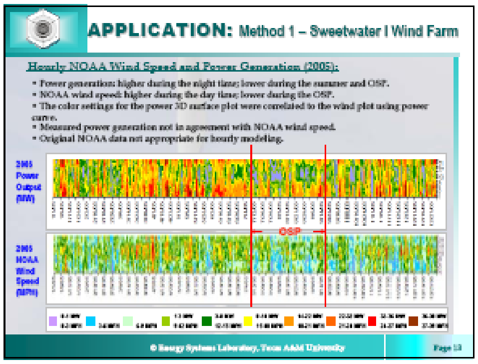
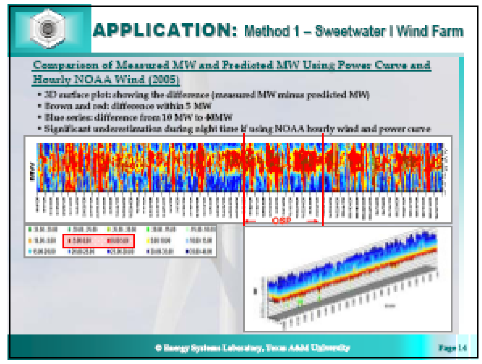
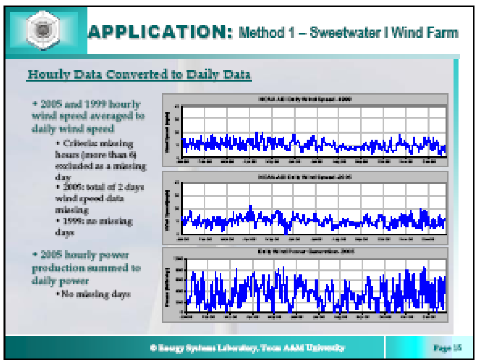
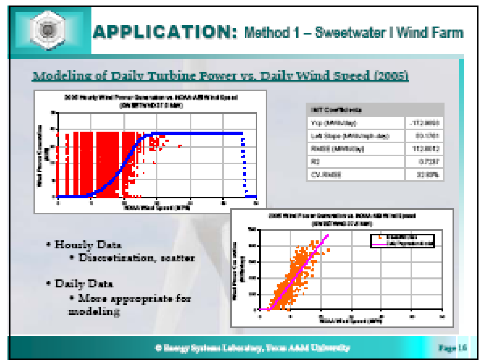


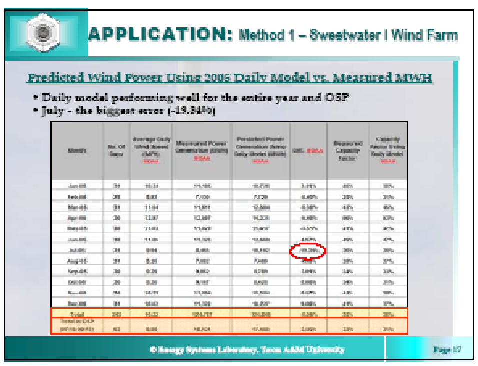
Figure 92: Slides presented at the Wind Energy Stakeholder's conference call (April 2007).

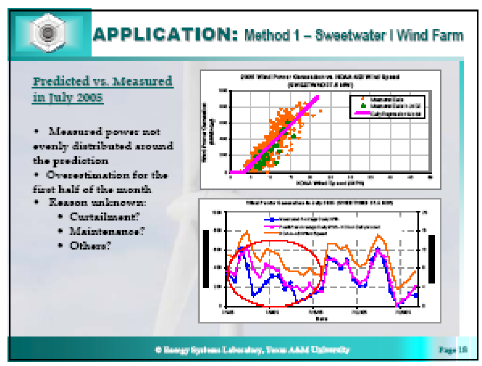


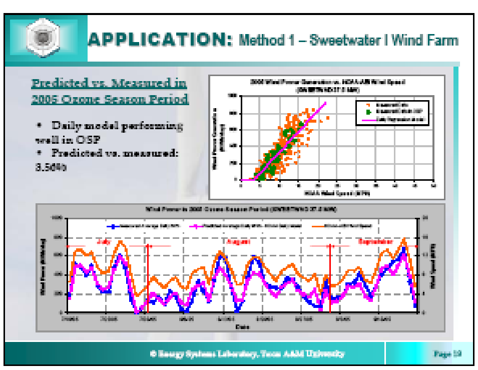












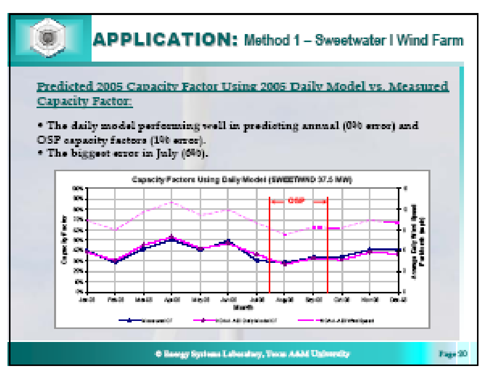
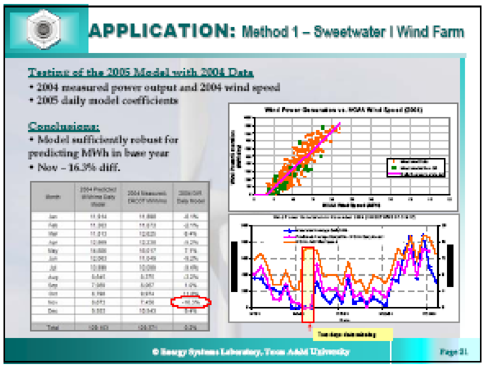
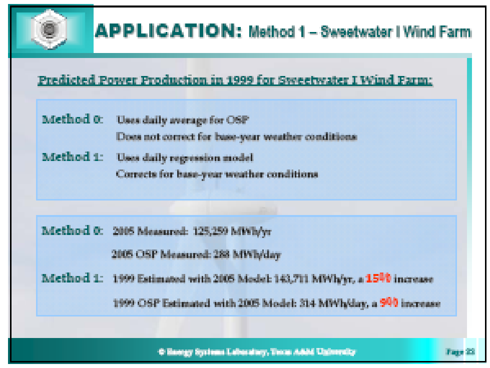
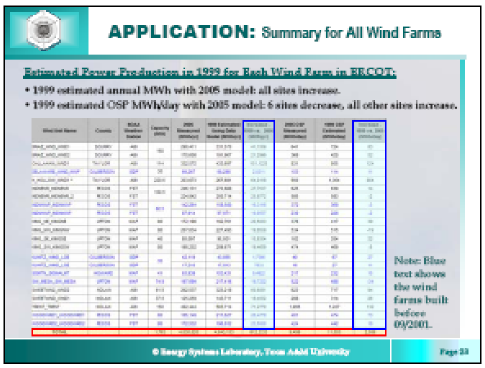
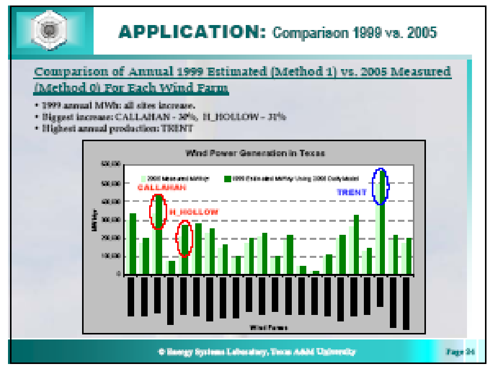


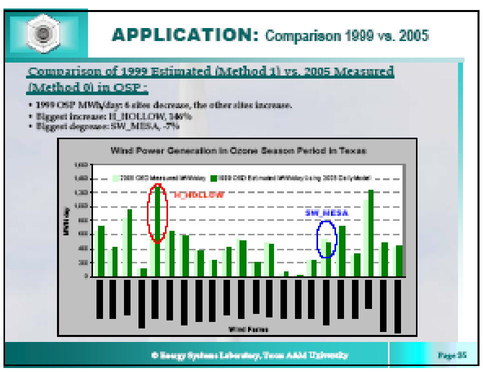
Figure 93: Slides presented at the Wind Energy Stakeholder's conference call (April 2007).

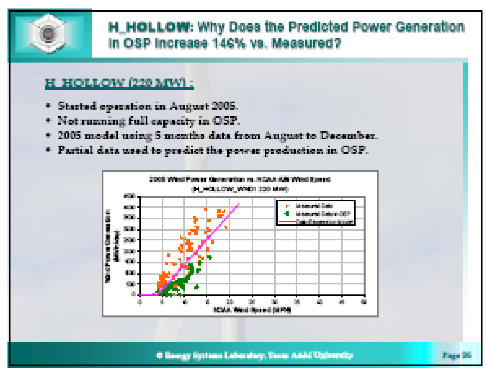


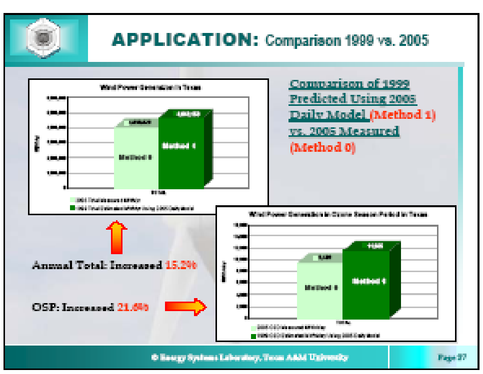












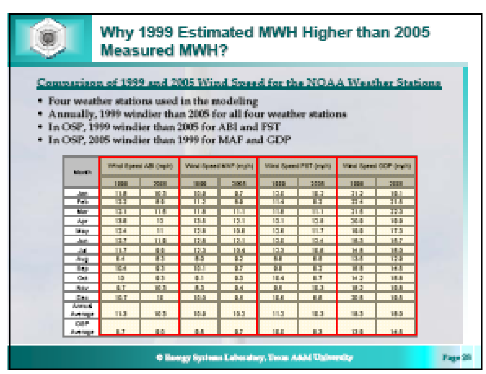
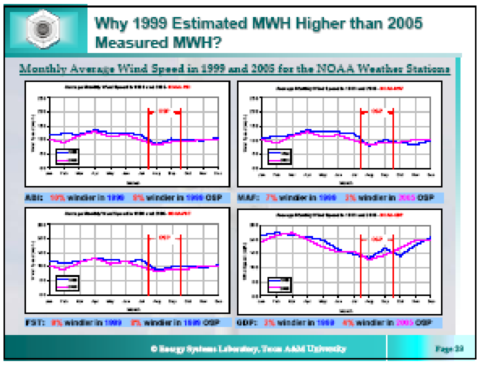
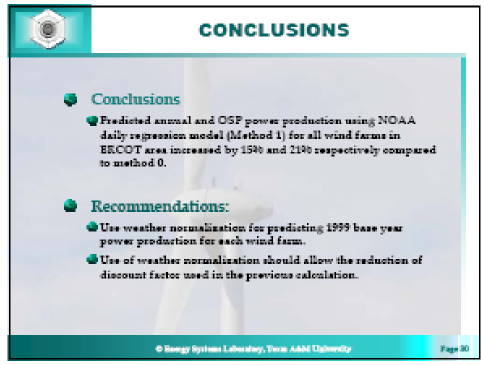
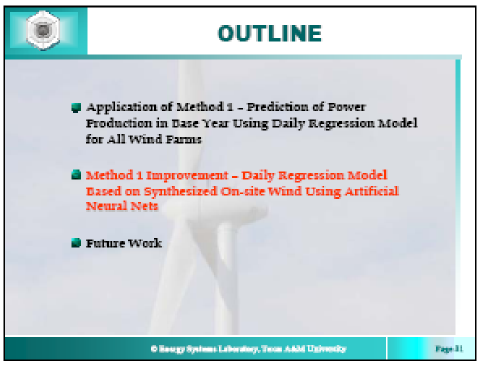
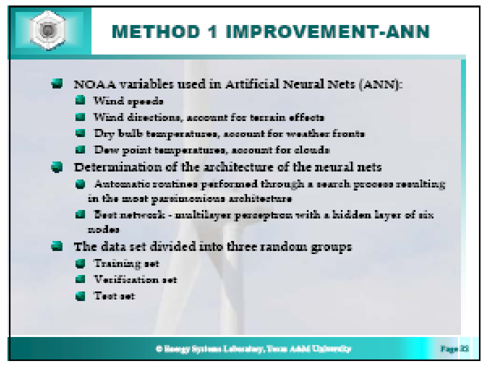


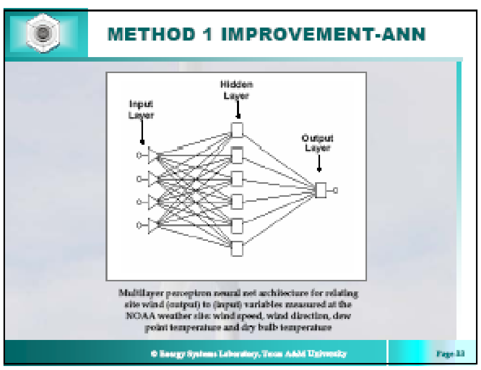
Figure 94: Slides presented at the Wind Energy Stakeholder's conference call (April 2007).

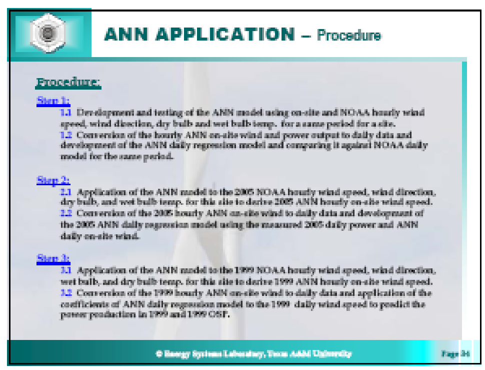


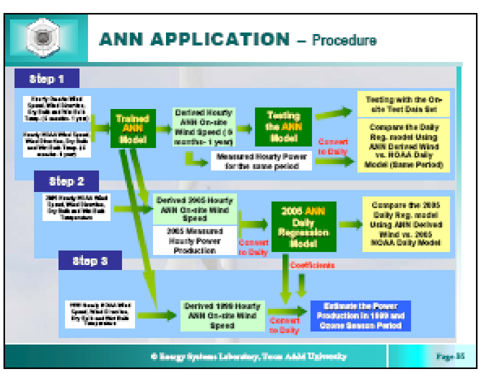












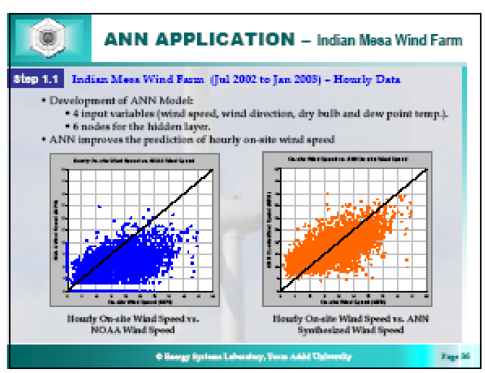
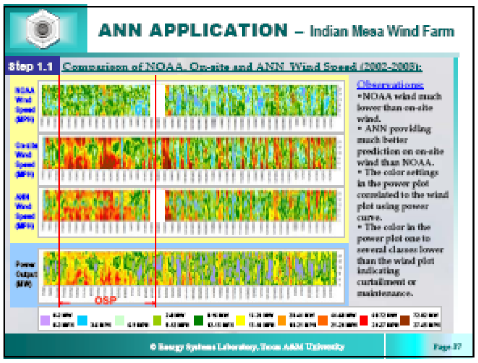
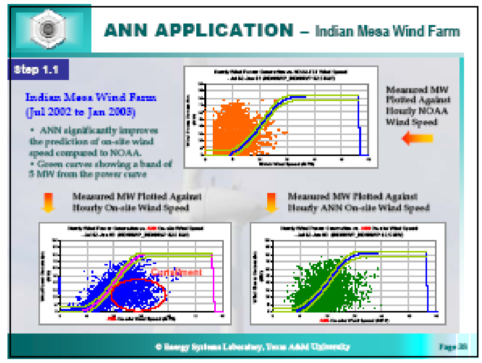
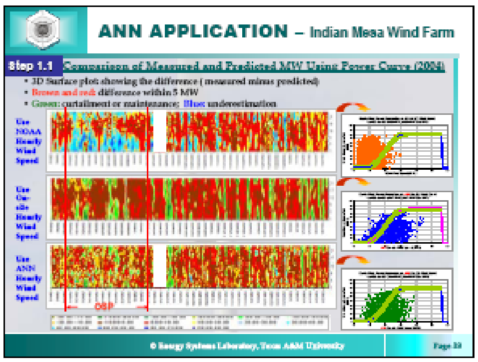
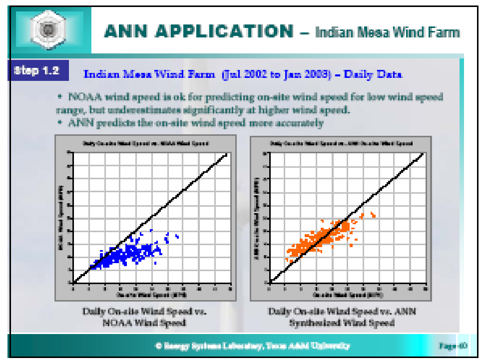


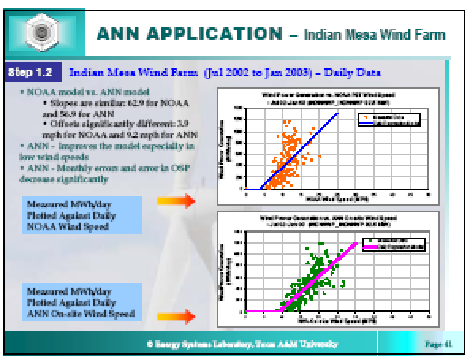
Figure 95: Slides presented at the Wind Energy Stakeholder's conference call (April 2007).

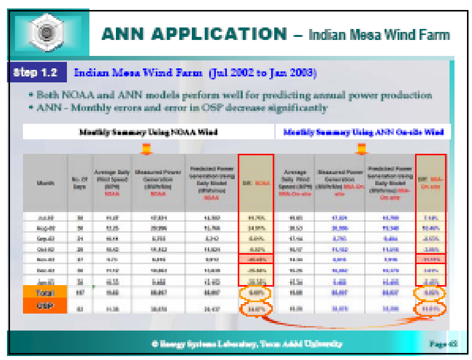


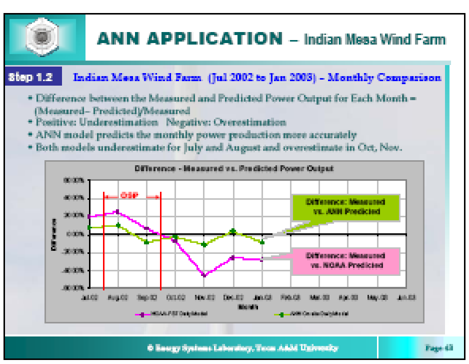












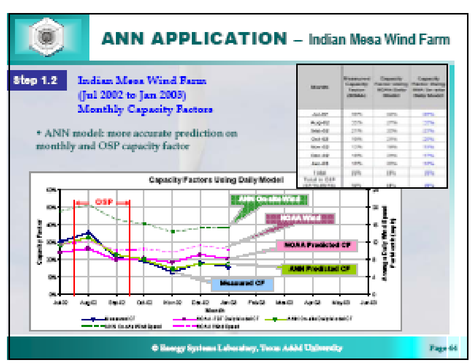
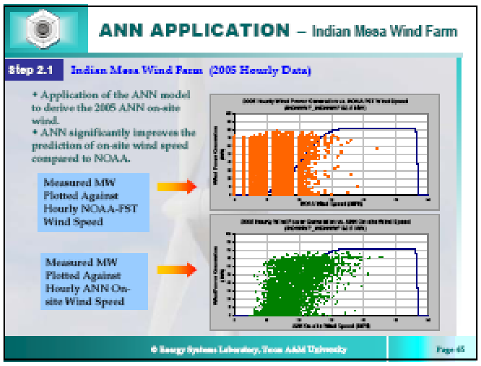
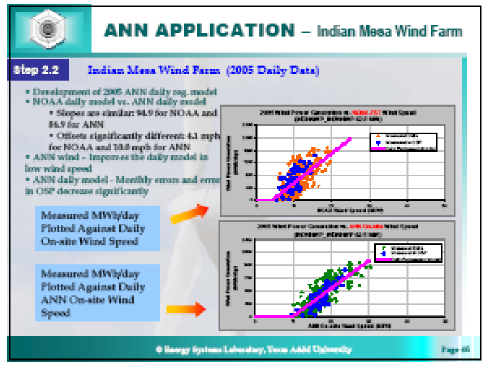
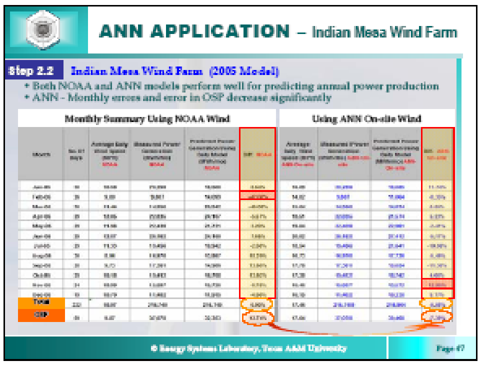
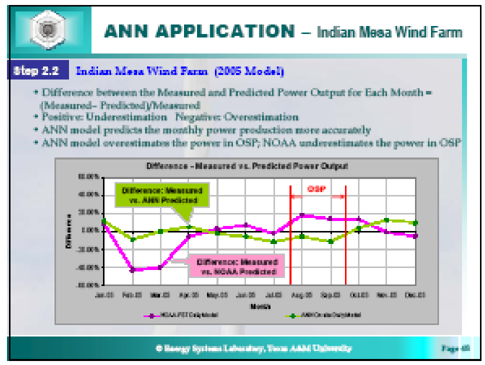


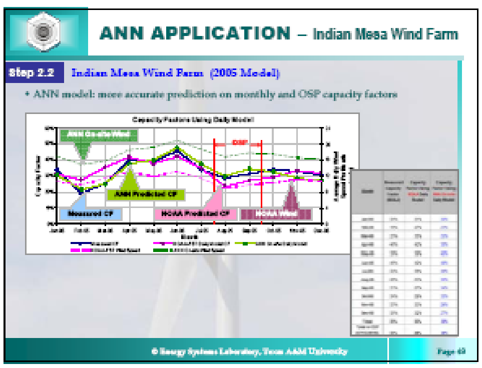
Figure 96: Slides presented at the Wind Energy Stakeholder's conference call (April 2007).

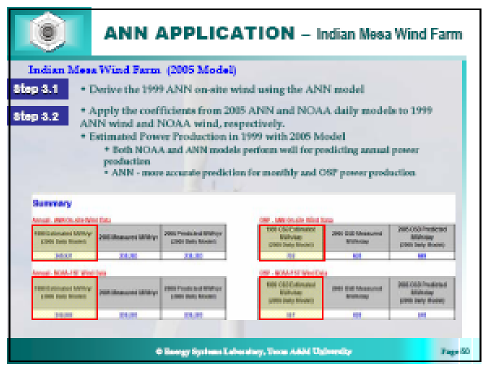


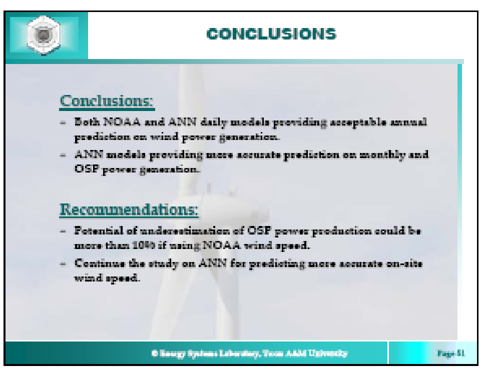












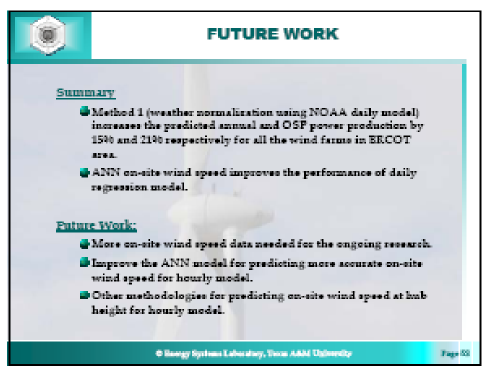


Figure 97: Slides presented at the Wind Energy Stakeholder's conference call (April 2007).

5.2.10 Presented Seven Papers at the 15th Symposium on Improving Building Systems in Hot and Humid Climates, in Orlando, Florida, July 2006.

Seven papers were prepared and presented at the 15th Symposium on Improving Building Systems in Hot and Humid Climates, in Orlando, Florida, July 2006. Copies of these papers have been posted on the Laboratory's Senate Bill 5 web page. Titles and abstracts for each of the papers are as follows.

Malhotra, M., Haberl, J. 2006. "An Analysis of Maximum Residential Energy Efficiency in Hot and Humid Climates", Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).

This paper presents the results of an analysis to determine practical, energy-efficient strategies for reducing residential energy use in hot and humid climates. Strategies considered include: efficient envelope construction, improved fenestration, ventilation heat recovery, shading, efficient lighting and appliances. These strategies were analyzed with a code-compliant, 2000/2001 IECC simulation using the DOE-2 program for Houston, Texas. The results show that the proper selection of measures can accomplish a 55% total annual energy reduction for code-compliant house, which consists of a cooling energy use reduction of 78%, domestic water heating reduction of 72%, and other end-use energy use reduced by 44%.

Cho, S., Haberl, J. 2006. "A Survey of High-performance Office Buildings for Hot and Humid Climates", Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).

This paper presents the results of an investigation of high-performance commercial office buildings to determine the HVAC systems and system components that improve building performance in hot and humid climates, and to examine whether these systems can be simulated with today's simulation programs. The case studies reviewed include high-performance buildings, high-performance components, and measurement tools. Also included is an analysis of whether or not the building systems and components can be modeled using today's simulation programs. This paper outlines the winning characteristics of high-performance buildings in hot and humid climates and the capabilities of simulation tools for modeling high-performance systems

Im, P., Haberl, J. 2006. "A Survey of High-performance Schools for Hot and Humid Climates", Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).

This paper presents the extensive survey of existing high performance schools in the United States and the preliminary results from the case study schools in a Central Texas area. The survey provides some of the high performance school features available these days including high performance building envelop design, high efficiency HVAC systems, renewable energy systems, etc. In addition, the appropriateness of these features particularly for the schools in hot and humid climates is discussed. As a preliminary result for ongoing study, the utility bills from five (5) elementary schools in Central Texas area are analyzed using ASHRAE's Inverse Modeling Toolkit (IMT) to verify the typical energy consumption patterns of the schools.

Ahmed, M., Im, P., Mukhopadyay, J., Malhotra, M., Haberl, J., Culp, C., Yazdani, B. 2006. "Impact of the Implementation of the 2000/2001 IECC on Residential Energy use in Texas: Analysis of Residential Savings", Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).

In September 2001, Texas adopted the 2000 International Residential Code, including the 2001 Supplement as the state energy building code. This building code has substantially improved the energy efficiency of housing in Texas, resulting in reduced annual heating/cooling utility bills for residential customers. This paper outlines the analysis methods for accomplishing this task and reports the savings for 2005 for single-family and multi-family residential construction.

Ahmed, M., Kim, S., Im, P., Chongcharoensuk, C., Haberl, J., Culp, C., Yazdani, B. 2006. "Impact of the Implementation of the 2000/2001 IECC on Commercial Energy use in Texas: Analysis of Commercial Savings", Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).

In September 2001, Texas adopted the 2000 International Residential Code, including the 2001 Supplement as the state energy building code, which references ASHRAE Standard 90.1-1999 in Chapter 7. This building code has substantially improved the energy efficiency of commercial buildings in Texas, resulting in reduced annual heating/cooling utility bills for commercial customers. To accomplish this code-compliant DOE-2 simulations and nationally published analysis were used to calculate the savings per square foot of commercial construction, where were then multiplied by published commercial building statistics for each county, and aggregated to state-wide totals. This paper outlines the analysis methods for accomplishing this task and reports the savings for 2005 for commercial construction.

Mukhopadhyay, J., Haberl, J. 2006. "Comparison of Simulation Methods for Evaluating Improved Fenestration Using the DOE-2.1e Building Energy Simulation Program", Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).

In September 2001, Texas adopted the 2000 International Energy Conservation Code (IECC 2000), including the 2001 Supplement (IECC 2001) as its official energy code for buildings. On examining the previous simulations, which were used to develop the prescriptive tables in the IECC, it was found that older versions of the DOE-2 program had been used that contained the shading coefficient method, and pre-calculated ASHRAE weighting factors. Although these methods were considered accurate for simulating single-pane and double-pane windows, simulations using the multi-layer WINDOW-5 program have been shown to provide more accurate results when simulating low-e windows. Therefore, this study investigates the inaccuracies of calculating energy savings using the shading-coefficient/pre-calculated ASHRAE weighting factor method versus simulations performed with the more accurate WINDOW-5/custom weighting factor method in the DOE-2.1e program. The results show that the difference in the total annual energy savings can be significant (7%), and more importantly, differences in peak energy savings can vary by up to 30 % (for cooling peak loads), which can have a large impact on the evaluation of summertime energy savings. Hence the use of the new, more accurate fenestration model (i.e., WINDOW-5), combined with custom weighting factors, is recommended for calculating prescriptive tables in the IECC and other building energy codes.

Baltazar-Cervantes, J.C., Haberl, J., Culp, C., Yazdani, B. 2006. "Impact of the Implementation of the 2000/2001 on Residential Energy use in Texas: Verification of Residential Energy Savings", Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).

In September 2001, Texas adopted the 2000 International Residential Code, including the 2001 Supplement as the state energy building code. This paper outlines the utility billing analysis methods for verifying the DOE-2 simulations and reports the results of the application of the methodology to a sample of residential houses in the Bryan/College Station, Texas area.

5.2.11 Presented Two Papers at the 2nd SimBuild Conference, Boston, MA, August, 2006.

Two papers were prepared and presented at the 2nd SimBuild Conference, Boston, MA, August, 2006. Copies of these papers have been posted on the Laboratory's Senate Bill 5 web page. Titles and abstracts for each of the papers are as follows.

Mukopadyhay, J., Haberl, J. 2006. "Comparing the Performance of High-performance Glazing in IECC Compliant Building Simulation Model", Proceedings of the 2nd SimBuild Conference, Boston, MA, published on CD ROM (August).

In September 2001, Texas adopted the 2000 International Energy Conservation Code (IECC 2000), including the 2001 Supplement (IECC 2001) as its official energy code for buildings. This paper examines the performance of a number of high-performance glazing options when incorporated in the IECC compliant residential building. Also considered are hypothetical options of dynamic glazing which switch thermal properties depending on environmental conditions. The results show that the use of high-performance marginally lowers the overall energy performance (1 - 4% approximately). However, the use of dynamic glazing yielded the lowest overall energy performance with an increase of 5 - 13% in the energy consumption savings. Moreover, in some cases were lower than the energy consumption results obtained from the windowless house (Approximately 6% increase in energy savings).

Malhotra, M., Haberl, J. 2006. "An Analysis of Building Envelope Upgrades for Residential Energy Efficiency in Hot and Humid Climates", Proceedings of the 2nd SimBuild Conference, Boston, MA, published on CD ROM (August).

This paper presents the results of an analysis of energy performance of individual and combined applications of various energy-efficient envelope upgrades for residences in hot and humid climates. The four building components considered for the upgrade are: (a) building shape: number of floors and aspect-ratio of the house; (b) exterior walls and roof: R-value, reflectance and emissivity; (c) construction types: assembly of materials and air-tightness (with conventional wood-frame, advanced wall framing, structural insulated panels, insulated concrete forms and concrete masonry units); and (d) fenestration: window distribution on the four sides, overhang depth, window U-value and SHGC; respectively. A DOE-2 simulation model of a 2000/2001 IECC code-compliant house in the hot and humid climate of Houston, Texas, was used for the analysis. The results demonstrate the effect of incremental change in the building envelope characteristics on the building energy use, and show that the proper selection of measures for the building envelope can accomplish a 57% cooling energy use reduction and a 16% total annual energy use reduction for a code-compliant house in hot and humid climates.

5.2.12 Presented One Paper at the ACEEE Summer Study on Energy Efficiency, Asilomar, California, August 2006.

One paper was prepared and presented at the ACEEE Summer Study on Energy Efficiency, Asilomar, California, August 2006. Copies of the papers have been posted on the Laboratory's Senate Bill 5 web page. Title and abstract for the paper are follows.

Verdict, M., Haberl, J., Culp, C., Yazdani, B., Fitzpatrick, T., Gilman, D., Ahmed, M., Liu, B., Baltazar, J-C, Muns, S., and Turner, D. 2006. "Quantification of NO_x Emissions Reductions for SIP Credits from Energy Efficiency and Renewable Energy Projects in Texas", 2006 ACEEE Summer Study on Energy Efficiency in Buildings, American Council for an Energy Efficient Economy, Washington, D.C., published on CD ROM (August).

Four areas in Texas have been designated by the United States Environmental Protection Agency (EPA) as non-attainment areas because ozone levels exceed the National Ambient Air Quality Standard (NAAQS) maximum allowable limits. These areas face severe sanctions if attainment is not reached by 2007. Four additional areas in the state are also approaching national ozone limits (i.e., affected areas). In 2001, the Texas State Legislature formulated and passed the Texas Emissions Reduction Plan (TERP), to reduce ozone levels by encouraging the reduction of emissions of NOx by sources that are currently not regulated by the state. An important part of this legislation is the State's energy efficiency and renewable energy programs. This paper provides a detailed discussion of the procedures that have been used to calculate the electricity savings and NOx reductions from residential and commercial construction in non-attainment and affected counties, energy efficiency projects from utility programs, and emissions reductions from green power purchases.

5.2.13 Presented Paper at the 6th International Conference for Enhanced Building Operation, Shenzhen, China, October, 2006.

A paper was prepared and presented at the 6th International Conference for Enhanced Building Operation, Shenzhen, China, October, 2006. A copy of this papers have been posted on the Laboratory's Senate Bill 5 web page. The title and abstract of the paper is follows.

<u>Liu, Z., Haberl, J., Gilman, D., Culp, C., Yazdani, B., 2006. "Development of a Web-based Emissions Reduction Calculator for Storm Water/Infiltration Sanitary Sewage Separation", Proceedings of the 6th International Conference for Enhanced Building Operation", Shenzhen, China, published on CD ROM (October).</u>

This paper presents the procedures developed to calculate the electricity savings and emissions reductions from the infiltration of storm water into sanitary sewage separation using a two-step regression method: one step to correlate the gallons of wastewater treated to the rainfall, and a second step that correlates the gallons of wastewater treated to the electricity consumed during a given period. The procedure integrates ASHRAE's Inverse Model Toolkit (IMT) for the weather-normalization analysis and the EPA's Emissions and Generations Resource Integrated Database (eGRID) for calculating the NOx emissions reductions for the electric utility provider associated with the user.

5.2.14 Measures to Reduce Residential and Commercial Energy use by 15% Above Code-Compliance.

In the 79th Legislature, Regular Session, House Bill 2129 Required the Laboratory to develop at least 3 alternative methods for achieving a 15 percent greater potential energy savings in residential, commercial and industrial construction. As part of this effort an analysis was developed to determine practical, energy-efficient strategies for reducing residential energy use in hot and humid climates. These strategies were analyzed with a DOE-2 simulation model of a 2000/2001 International Energy Conservation Code (IECC) compliant single-family, detached houses and in commercial buildings in Houston, Texas. The following sections present the results for 15% above code residential and commercial.

Measures to Reduce Residential Energy use by 15% Above Code-Compliance.

This section presents an overview of the recommendations for achieving 15% above-code energy performance for single-family residences. The analysis was performed using a simulation model of an International Energy Conservation Code (IECC)-compliant, single family residence in Houston, Texas. To accomplish the 15% annual energy use reductions, twelve measures were considered, which include: tankless water heater, solar domestic hot water system, gas water heater without the standing pilot light, ducts in the conditioned space, improved duct sealing, increased air tightness, window shading and redistribution, improved window performance, improved heating and cooling system efficiency. After the total annual energy use was determined for each measure, they were then grouped to accomplish a 15% total annual energy use reduction.

Introduction

In the U.S. residential sector, up to 50% of the energy use can be reduced using available technologies. Anderson et al. (2004) demonstrated 40-50% whole house energy savings in five locations in different climate zones across the United States. Malhotra and Haberl (2006) demonstrated up to 55% energy use reduction in hot and humid climates[17]. In order to realize energy savings of such order, certain procedure have to be developed for cost-effective implementation of energy-efficient technologies in new construction. This requires setting smaller goals towards improving building energy performance, and developing set of easy-to-follow and implement recommendations for achieving the targeted level of energy savings.

This section presents an overview of the recommendations for achieving 15% above-code energy performance for single-family residences complying with the 2000 International Energy Conservation Code, as modified by the 2001 Supplement[18] (ICC 1999; 2001). The analysis was performed using a DOE-2 simulation model of a 2,325 sq. ft, one story, single family standard residential building in Houston, Texas[19]. To accomplish the 15% annual energy use reductions twelve measures for were considered, which include: tankless water heater, solar domestic hot water system, gas water heater without the standing pilot light, ducts in the conditioned space, improved duct sealing, increased air tightness, window shading and redistribution, improved window performance, improved heating and cooling system efficiency[20]. After the total annual energy use was determined for each measure, they were then grouped to accomplish a 15% total annual energy use reduction.

Base-case Building Description

The base-case building simulation model in this analysis is based on the standard design as defined in Chapter 4 of the 2001 IECC and certain assumptions. The base-case building is a 2,325 sq. ft., square-shape, one story, single-family, detached house oriented N, S, E, W, with floor-to-ceiling height of 8 ft. The

[17] An extensive review of literature about these technologies is included in Malhotra (2005).

[18] In the remainder of this paper, this will be denoted as the 2001 IECC.

[19] The complete analysis by Malhotra et al. (2007) includes recommendations for 15% above-code energy performance for all 41 non-attainment and affected counties in Texas.

[20] Selection of measures for this analysis is, partly, limited to the simulation capabilities of the DOE-2.1e program.

house has an attic with a roof pitched at 23 degrees, which contains the HVAC systems and ductwork. The base-case building envelope and system characteristics were determined from the general characteristics and the climate-specific characteristics as specified in 2001 IECC. Details of the base-case model are summarized in Table 12.

Building Envelope Characteristics

The house was assumed to have light-weight wood frame construction with 2x4 studs spaced at 16" on center, a slab-on-grade floor and an unconditioned, vented attic. The house has fascia brick exterior and asphalt shingle roofing. The window area is equal to 18% of the floor area[21] distributed equally on all four sides with no exterior shading[22]. Two 20 sq. ft. doors of 0.2 Btu/h-sq. ft.-°F U-value[23] were assumed on the north and south walls.

Based on the climate-specific characteristics for the standard design, the base-case was modeled with 0.085 Btu/h-sq. ft.-°F wall assembly U-factor, 0.47 Btu/h-sq. ft.-°F fenestration system U-factor, 0.40 fenestration system solar heat gain coefficient (SHGC), R-30 ceiling insulation and no slab perimeter insulation[24]. The air infiltration rate was 0.47 ACH, which is based on the weather factor specified in ASHRAE Standard 136 (ASHRAE 1993)[25].

The house was simulated as a single-zone building in delayed construction mode to take into account the thermal mass of the construction materials[26]. The fenestration characteristics were simulated by creating custom windows with double pane, low-e glazing and aluminum frames with thermal break, using the WINDOW5 program[27].

HVAC System Characteristics

The base-case HVAC system includes a central air-conditioning system and a heating system. Two options for the heating fuel type were considered: a) natural gas (gas-fired furnace for space heating, and gas water heater for domestic water heating), and b) electricity (heat pump for space heating, and electric water heater for domestic water heating)[28].For an electric/gas house, the base-case HVAC system comprises of a SEER 13 air-conditioner and a gas-fired, forced-air furnace of 0.78 Annual Fuel Utilization Efficiency (AFUE)[29]. For an all-electric house, the base-case HVAC system comprises of a SEER 13 air conditioner with a heat pump of 7.7 Heating Season Performance Factor (HSPF)[29]. For both types of houses, the capacity of the cooling system is 55,800 Btu/hr, which assumes 500 sq. ft. per ton. The capacity of the heating system is 72,540 Btu/hr, which assumes 1.3 x cooling capacity. The heating and cooling set-points were 68°F for winter and 78°F for summer, with a 5°F setback/setup (for winter and summer, respectively) for six hours early in the morning[30].

Air Distribution System Characteristics

The base-case air distribution system, which includes the HVAC unit and the ducts, is located in the unconditioned, vented attic. The attic was assumed to have an air infiltration rate of 15 ACH[31]. The

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21 This amounts to 418.5 sq. ft. window area and 27% window-to-wall area ratio for the base case building size and configuration.
22 These requirements are specified in Section 402.1.1, p.63, and Section 402.1.3.1.1 and 402.1.3.1.3, p.64, of the 2001 IECC.
23 This is specified in Section 402.1.3.4.3, p.64, of the 2001 IECC.
24 These include Table 402.1.1(1) and Table 402.1.1 (2), p.63, Section 402.1.3.1.4, p.64, and Table 502.2.4(6), p.83.
25 This requirement can be found in Section 402.1.3.10, p.65.
26 This is accomplished using DOE-2 Custom Weighting Factors.
27 More information on the Window 5 program can be found at http://windows.lbl.gov/software/window/window.html.
28 In the remainder of this paper, these houses will be referred to as (a) electric/gas house, and (b) all-electric house, respectively.
29 The efficiency of HVAC system is determined by NAECA 2006.
30 As defined by Table 402.1.3.5, p.64, of the 2001 IECC.
31 This infiltration rate was chosen to match measured data by Kim (2006).

insulation for supply and return ducts are R-8 and R-4, respectively[32]. A 10% duct leakage was assumed for the base-case house[33].

DHW System Characteristics

For an electric/gas house, the base-case domestic hot water (DHW) system is a 40-gallon[34], storage type, natural gas water heater with a standing pilot light that consumes 500 Btu/hr[35], with a calculated energy factor (EF) of the system of 0.54[36]. For an all-electric house, the base-case DHW system is a 50-gallon[34], storage type, electric water heater. The energy factor (EF) of the system is 0.86[36]. The daily hot water use was calculated as 70 gallons/day[37], which assumes that the house has four bedrooms. The hot water supply temperature is 120°F[37].

The method to simulate DHW in DOE-2.1e using the energy factor is based on Building America House Performance Analysis Procedures (NREL 2001) that assumes a constant hourly DHW use and eliminates the efficiency dependence on part-loads.

Summary of Energy Efficiency Measures

Table 6 lists individual measures considered for electric/gas and all-electric single-family residences. These include measures for the DHW system, air distribution system, building envelop and fenestration, and HVAC system. One or more of these measures were applied to the base-case house in different combinations for achieving a goal of 15% above-code energy performance. The description of these measures is provided in the following section.

Table 6. Energy Efficiency Measures

NATURAL GAS HEATING/ NATURAL GAS DHW SYSTEM	HEAT PUMP/ELECTRIC DHW SYSTEM
A. Domestic Hot Water System Measures	
1. Tankless Gas Water Heater	1. Tankless Electric Water Heater
2. Solar DHW System	2. Solar DHW System
3. Removal of Pilot Light	
B. Air Distribution System Measures	
4. HVAC Unit and Ducts in Cond. Space	4. HVAC Unit and Ducts in Cond. Space
5. Improved Duct Sealing	5. Improved Duct Sealing
C. Envelope and Fenestration Measures	
6. Increased Air-tightness	6. Increased Air-tightness
7. Window Shading (4' Overhang)	7. Window Shading (4' Overhang)
8. Window Shading & Redistribution	8. Window Shading & Redistribution
9. Improved Window Performance	9. Improved Window Performance
D. HVAC System Measures	
10. AC Eff.: SEER 13 to SEER 15	12. SEER 15 AC/8.5 HSPF Heat Pump
11. Furnace Eff.: 0.78 AFUE to 0.93 AFUE	

Use of a Tankless Water Heater

[32] This requirement can be found in Table 503.3.3.3 (ICC 2001)
[33] This is based on the information found in Parker et al. (1993).
[34] The size of the DHW tank are adopted from HUD-FHA minimum water heater capacities for a four bedroom 2.5 bath single family living unit (Table 4, p.49.9, ASHRAE 2003)
[35] This value is consistent with information provided by DHW manufacturers.
[36] The EF of the DHW system was calculated from the minimum performance requirement using Table 504.2, p.91.
[37] This is specified in Section 402.1.3.7, p.65 of the 2001 IECC.

For an electric/gas house, this measure was simulated by eliminating the standing pilot light, with a resultant change in the DHW Energy Factor (EF) from 0.54 to 0.85[38]. For an all-electric house, this measure was simulated by increasing the DHW energy factor from 0.86 to 0.95[38].

Addition of a Solar DHW System

For this measure, a solar thermal DHW system, comprising of two 32 sq. ft. of flat plate solar collectors, was simulated using the F-Chart program (Klein and Beckman 1983). In this analysis, the collector tilt was assumed to be the same as the latitude for that location, considering a hot water use of 70 gallons/day, year around. Table 7 lists the characteristics of the solar thermal system for Houston. In this analysis, any supplementary hot water heating was provided by the base-case water heating system. Also, additional electricity use was taken into account for operating the pump.

Table 7: Solar DHW System Characteristics

Number of collector panels	2
Collector panel area	32 sq. ft.
Collector slope	30 deg.
Collector azimuth (South=0)	0 deg.
Number of glazing	1
Collector flow rate/area	11 lb/hr-sq. ft.
Water set temperature	120 deg. F
Daily hot water usage	70 gal.

Removal of Standing Pilot Light from Gas Domestic Water Heater

This measure is applicable only for the electric/gas house that has a gas DHW heater with a standing pilot light. This analysis assumed the same DHW Energy Factor as the base-case house, with the removal of calculated hourly energy use equivalent to an average pilot light (i.e. 500 Btu/h[35]).

Ducts in the Conditioned Space

This measure analyzed the energy savings that would occur if the ductwork and HVAC system was moved from the attic location assumed in the base-case house to a location within the thermal envelope of the conditioned space.

Improved Duct Sealing

This measure was simulated by changing the 10% duct leakage of the base-case house to a 5% duct leakage. In this analysis it was assumed that the ducts remained in the attic and that the improved duct sealing was accomplished with foil-backed butyl tape and mastic to seal the duct leaks.

Increased Air-tightness

This measure was simulated by specifying a fixed infiltration rate of 0.35 ACH (compared to 0.47 ACH for the base case), which is the minimum ventilation rate required by ASHRAE Standard 62 (ASHRAE 2001).

[38] The EF for the tankless water heater is based on a survey of manufacturers.

Addition of Window Shading.

This measure was simulated by modeling 4 ft. roof overhangs on all four sides. The gross window area, orientation, and other characteristics were kept the same as the base-case house, which did not have overhangs. The depth of overhangs was determined from the recommendations by Malhotra and Haberl (2006). However, the overhang depth on all sides is not optimized for construction cost.

Window Shading and Redistribution.

For this measure, the house was simulated with the same window area as the base-case house (i.e., an 18% window-to-wall area distributed 25% on each orientation) with the windows distributed 45% on the south, 25% on the north, 15% each on east and west orientations. A 4 ft. roof overhang was also included on all four sides.

Improved Window Performance.
For this measure, the base-case house was simulated with custom windows that were argon-filled, double-pane, low-e glazing with a 0.42 Btu/h-sq. ft.-°F fenestration system U-factor, and a 0.33 SHGC. The frame type remained the same as the base-case house.

Table 8: Simulation Input for an Electric/Gas House

EEM #	Energy Efficiency Measure	DHW System Energy Factor	DHW System Type		DHW Pilot Light	Duct Location (Uncond. Vented Attic/ Cond. Room)	Duct Leakage (%)	Infiltration Rate (ACH/hr)	Exterior Shading (ft.)	Window Distribution (S:N:E:W)	Window U-Factor (Btu/hr-ft2-°F)	Glazing SHGC	AC Eff. (SEER)	Furnace Eff. (AFUE)
	Basecase	0.54	Tanktype	Gas	Yes	Vented Attic	10%	0.462	None	Equal	0.47	0.4	13	0.78
Domestic Hot Water System Measures														
1	Tankless Gas Water Heater	0.85	Tankless	Gas	No	Vented Attic	10%	0.462	None	Equal	0.47	0.4	13	0.78
2	Solar DHW System	0.54 (Aux.)	Tanktype (Aux.)	Solar	Yes (Aux.)	Vented Attic	10%	0.462	None	Equal	0.47	0.4	13	0.78
3	Removal of Pilot Light	0.54	Tanktype	Gas	No	Vented Attic	10%	0.462	None	Equal	0.47	0.4	13	0.78
Air Distribution System Measures														
4	HVAC Unit and Ducts in Cond. Space	0.54	Tanktype	Gas	Yes	Room	None	0.462	None	Equal	0.47	0.4	13	0.78
5	Improved Duct Sealing	0.54	Tanktype	Gas	Yes	Vented Attic	5%	0.462	None	Equal	0.47	0.4	13	0.78
Envelope and Fenestration Measures														
6	Increased Air-tightness	0.54	Tanktype	Gas	Yes	Vented Attic	10%	0.35	None	Equal	0.47	0.4	13	0.78
7	Window Shading (4' Overhang)	0.54	Tanktype	Gas	Yes	Vented Attic	10%	0.462	4' Eaves	Equal	0.47	0.4	13	0.78
8	Window Shading & Redistribution	0.54	Tanktype	Gas	Yes	Vented Attic	10%	0.462	4' Eaves	45:25:15:15	0.47	0.4	13	0.78
9	Improved Window Performance	0.54	Tanktype	Gas	Yes	Vented Attic	10%	0.462	None	Equal	0.42	0.33	13	0.78
HVAC System Measures														
10	AC Eff.: SEER 13 to SEER 15	0.54	Tanktype	Gas	Yes	Vented Attic	10%	0.462	None	Equal	0.47	0.4	15	0.78
11	Furnace Eff.: 0.78 AFUE to 0.93 AFUE	0.54	Tanktype	Gas	Yes	Vented Attic	10%	0.462	None	Equal	0.47	0.4	13	0.93

Table 9: Simulation Input for an All-electric House

EEM #	Energy Efficiency Measure	DHW System Energy Factor	DHW System Type		DHW Pilot Light	Duct Location (Uncond. Vented Attic/ Cond. Room)	Duct Leakage (%)	Infiltration Rate (ACH/hr)	Exterior Shading (ft.)	Window Distribution (S:N:E:W)	Window U-Factor (Btu/hr-ft2-°F)	Glazing SHGC	AC Eff. (SEER)	Heat Pump Eff. (HSPF)
	Basecase	0.86	Tanktype	Elec.	No	Vented Attic	10%	0.462	None	Equal	0.47	0.4	13	7.7
Domestic Hot Water System Measures														
1	Tankless Electric Water Heater	0.95	Tankless	Elec.	No	Vented Attic	10%	0.462	None	Equal	0.47	0.4	13	7.7
2	Solar DHW System	0.86 (Aux.)	Tanktype (Aux.)	Solar	No (Aux.)	Vented Attic	10%	0.462	None	Equal	0.47	0.4	13	7.7
Air Distribution System Measures														
4	HVAC Unit and Ducts in Cond. Space	0.86	Tanktype	Elec.	No	Room	None	0.462	None	Equal	0.47	0.4	13	7.7
5	Improved Duct Sealing	0.86	Tanktype	Elec.	No	Vented Attic	5%	0.462	None	Equal	0.47	0.4	13	7.7
Envelope and Fenestration Measures														
6	Increased Air-tightness	0.86	Tanktype	Elec.	No	Vented Attic	10%	0.35	None	Equal	0.47	0.4	13	7.7
7	Window Shading (4' Overhang)	0.86	Tanktype	Elec.	No	Vented Attic	10%	0.462	4' Eaves	Equal	0.47	0.4	13	7.7
8	Window Shading & Redistribution	0.86	Tanktype	Elec.	No	Vented Attic	10%	0.462	4' Eaves	45:25:15:15	0.47	0.4	13	7.7
9	Improved Window Performance	0.86	Tanktype	Elec.	No	Vented Attic	10%	0.462	None	Equal	0.42	0.33	13	7.7
HVAC System Measures														
12	SEER 15 AC/8.5 HSPF Heat Pump	0.86	Tanktype	Elec.	No	Vented Attic	10%	0.462	None	Equal	0.47	0.4	15	8.5

Improved Air Conditioner Efficiency.

For this analysis, the SEER 13 air conditioner in the electric/gas base-case house was replaced with a similarly sized SEER 15 air conditioner.

Improved Furnace Efficiency.

For this analysis, the gas-fired furnace in the electric/gas base-case house (0.78 AFUE) was replaced with a similarly sized furnace with an AFUE of 0.93.

Improved Efficiency of the Heat Pump.

For an all-electric house, the base-case heat pump with an HSPF of 7.7 was replaced with a similarly-sized heat pump with an HSPF of 8.5.

Simulation Input

The twelve measures described above were simulated by modifying the selected parameters used for the DOE-2 simulation model of the base-case house.
Table 8: and Table 9: list the values for simulating these measures in a house located in Houston (Harris county, Texas), with (a) natural gas heating/natural gas DHW system, and (b) heat pump heating/electric DHW system, respectively. The first row of values in both tables presents information used in the base-case runs. The remaining rows present information used in the simulation of the individual energy efficiency measures. The shaded cell in each row indicates the change in the value used to simulate the measure.

Table 10. Summary of Results for an Electric/Gas House

EEM #	Energy Efficient Measures	Energy Use (MBtu/yr)					Energy Use (Utility Units)			Energy Savings					Increased Marginal Cost ($)	Increased New System Cost ($)	Payback (yrs)
		Cooling	Heating	DHW	Other	Total	kWh/yr	therms/yr	$/yr	MBtu/yr	%	kWh/yr	therms/yr	$/yr			
	Basecase	15.9	9.4	24.8	29.0	78.9	13,115	341	$2,308								
	(% of Total)	20.2%	11.9%	31.4%	36.8%												
DHW System Measures																	
1	Tankless Gas Water Heater	15.9	9.4	17.4	29.0	71.6	13,115	268	$2,235	7.3	9.3%	0	73	$73	$1,000 - $3,500		13.7 - 47.9
2	Solar DHW System	15.9	9.4	12.6	29.0	66.9	13,523	206	$2,235	12.0	15.2%	-408	135	$74		$2,900 - $5,200	39.3 - 70.5
3	Removal of Pilot Light	15.9	9.4	20.4	29.0	74.5	13,115	298	$2,265	4.3	5.5%	0	43	$43	$200 - $600		4.7 - 14.0
Air Distribution System Measures Measures																	
4	HVAC Unit and Ducts in Cond. Space	11.3	7.2	24.8	29.0	72.2	11,785	320	$2,088	6.7	8.5%	1,330	21	$221	$1,000 - $7,000		4.5 - 31.7
5	Improved Duct Sealing	13.5	8.4	24.8	29.0	75.5	12,403	331	$2,191	3.4	4.3%	712	10	$117		$450 - $650	3.9 - 5.6
Envelope and Fenestration Measures																	
6	Increased Air-tightness	15.4	8.3	24.8	28.9	77.2	12,956	330	$2,273	1.7	2.1%	159	11	$35		$350 - $1,500	10.0 - 43.0
7	Window Shading (4' Overhang)	13.0	11.0	24.8	28.6	77.2	12,150	358	$2,181	1.7	2.1%	965	-17	$128		$3,100 - $3,500	24.3 - 27.4
8	Window Shading & Redistribution	12.7	10.2	24.8	28.5	76.0	12,047	349	$2,156	2.8	3.6%	1,068	-8	$152		$3,100 - $3,500	20.4 - 23.0
9	Improved Window Performance	13.9	9.5	24.8	28.7	76.8	12,458	343	$2,212	2.1	2.6%	657	-2	$97	$800 - $1,100		8.3 - 11.4
HVAC System Measures																	
10	AC Eff.: SEER 13 to SEER 15	13.8	9.4	24.8	29.0	76.8	12,495	341	$2,215	2.1	2.7%	620	0	$93	$900 - $2,500		9.7 - 26.9
11	Furnace Eff.: 0.78 AFUE to 0.93 AFUE	15.9	7.8	24.8	29.0	77.4	13,115	326	$2,293	1.5	1.9%	0	15	$15	$600 - $1,500		40.0 - 100.0

Table 11. Summary of Results for an All-electric House

EEM #	Energy Efficient Measures	Energy Use (MBtu/yr)					Energy Use (Utility Units)			Energy Savings					Increased Marginal Cost ($)	Increased New System Cost ($)	Payback (yrs)
		Cooling	Heating	DHW	Other	Total	kWh/yr	therms/yr	$/yr	MBtu/yr	%	kWh/yr	therms/yr	$/yr			
	Basecase	15.9	6.3	12.6	29.0	63.7	18,653	0	$2,798								
	(% of Total)	25.0%	9.9%	19.8%	45.6%												
DHW System Measures																	
1	Tankless Electric Water Heater	15.9	6.3	11.7	29.0	62.7	18,370	0	$2,756	1.0	1.5%	283	0	$42	$700 - $1,400		16.5 - 33.0
2	Solar DHW System	15.9	6.3	5.7	29.0	56.7	16,624	0	$2,494	6.9	10.9%	2,029	0	$304		$2,900 - $5,200	9.5 - 17.1
Air Distribution System Measures Measures																	
4	HVAC Unit and Ducts in Cond. Space	11.3	5.3	12.6	29.0	58.2	17,038	0	$2,556	5.5	8.7%	1,615	0	$242	$1,000 - $7,000		4.1 - 28.9
5	Improved Duct Sealing	13.5	5.6	12.6	29.0	60.6	17,762	0	$2,664	3.0	4.8%	891	0	$134		$450 - $650	3.4 - 4.9
Envelope and Fenestration Measures																	
6	Increased Air-tightness	15.4	5.7	12.6	28.9	62.5	18,321	0	$2,748	1.1	1.8%	332	0	$50		$350 - $1,500	7.0 - 30.1
7	Window Shading (4' Overhang)	13.0	7.2	12.6	28.6	61.3	17,965	0	$2,695	2.3	3.7%	688	0	$103		$3,100 - $3,500	30.0 - 33.9
8	Window Shading & Redistribution	12.7	6.7	12.6	28.5	60.5	17,714	0	$2,657	3.2	5.0%	939	0	$141		$3,100 - $3,500	22.0 - 24.8
9	Improved Window Performance	13.9	6.4	12.6	28.7	61.6	18,042	0	$2,706	2.1	3.3%	611	0	$92	$800 - $1,100		8.7 - 12.0
HVAC System Measures																	
12	SEER 15 AC/8.5 HSPF Heat Pump	13.8	5.8	12.6	29.0	61.1	17,895	0	$2,684	2.6	4.1%	758	0	$114	$1,500 - $2,400		13.2 - 21.1

The simulations used TMY2 hourly weather data for Houston Intercontinental Airport. The cost analysis was based on utility costs of $0.15/kWh for electricity and $1.00/therm for natural gas.

Results

Table 10 and Table 11 summarize the results of simulation and cost analysis for (a) an electric/gas house, and (b) an all-electric house, respectively, and include: the annual energy use[39], calculated energy savings, increased cost of implementation and the calculated payback period for the each measure. These results are graphically represented in Figure 98 to Figure 105.

Figure 98 and Figure 99 show the impact of energy efficiency measures (EEMs) on different energy end-uses; Figure 100 and Figure 101 show the first costs and energy cost savings for different measures; Figure 102 and Figure 103 show the corresponding payback period in years, for (a) an electric/gas house, and (b) an all-electric house, respectively.

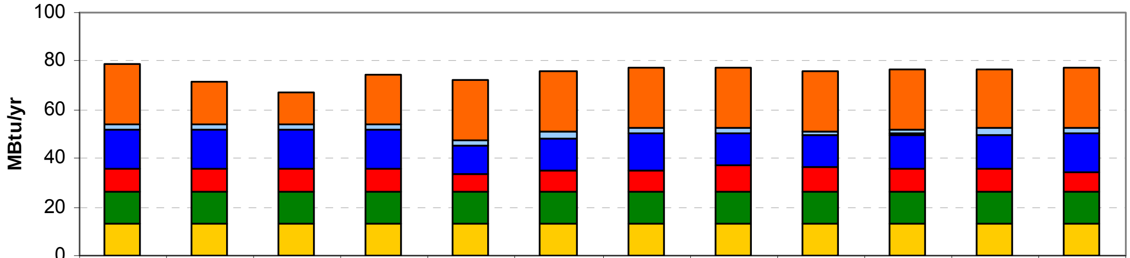
Base Case Energy Use

Table 10 shows that the base case total annual energy consumption was 78.9 MBtu for an electric/gas house. This includes: 20.2% for cooling, 11.9% for heating, 31.4% for domestic water heating and 36.8% for other end-uses (that includes 33.5% for lighting and equipment, and 3.3% for heating and cooling fans, pump and miscellaneous). Table 11 shows that for an all-electric house, the base case total energy consumption was 63.7 MBtu that includes: 25.0% for cooling, 9.9% for heating, 19.8% for domestic water

[39] These values were obtained from BEPS and BEPU reports in the DOE-2 output.

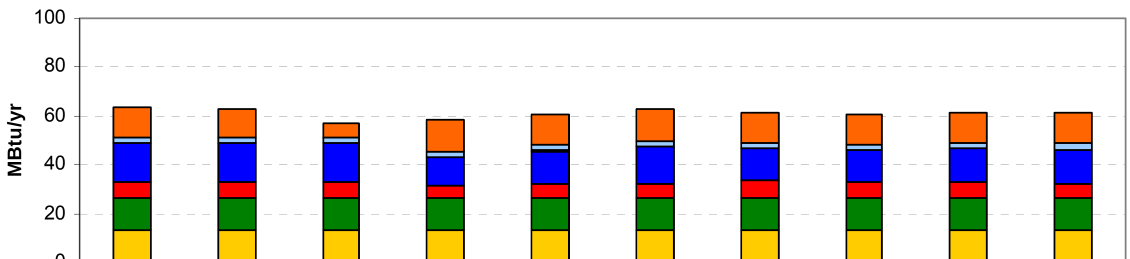
heating and 45.6% for other end-uses (that includes 41.5% for lighting and equipment, and 4.1% for heating and cooling fans, pump and miscellaneous).

This is noted that due to the lower fuel efficiency of gas, space heating and domestic water heating energy use were larger fraction of the total, and cooling energy use was smaller fraction of the total in an electric/gas house compared to an all-electric house. This suggested that measures that reduce space heating and domestic water heating use would have large impact on the total energy use in an electric/gas house, and the measures that reduce the cooling energy use would have higher impact on the total energy use in an all-electric house.



	Basecase	Tankless Gas Water Heater	Solar DHW System	Removal of Pilot Light	HVAC Unit and Ducts in Cond.	Improved Duct Sealing	Increased Air-tightness	Window Shading (4' Overhang)	Window Shading & Redistributi	Improved Window Performance	AC Eff.: SEER 13 to SEER 15	Furnace Eff.: 0.78 AFUE to 0.93
Total	78.9	71.6	66.9	74.5	72.2	75.5	77.2	77.2	76.0	76.8	76.8	77.4
DHW	24.8	17.4	12.6	20.4	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8
Fans	2.4	2.4	2.4	2.4	2.4	2.4	2.3	2	1.9	2.1	2.4	2.4
Misc.	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Cooling	15.9	15.9	15.9	15.9	11.3	13.5	15.4	13	12.7	13.9	13.8	15.9
Heating	9.4	9.4	9.4	9.4	7.2	8.4	8.3	11.0	10.2	9.5	9.4	7.8
Equip.	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
Lighting	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2

Figure 98. Energy Use for Various EEMs for an Electric/Gas House



	Basecase	Tankless Electric Water Heater	Solar DHW System	HVAC Unit and Ducts in Cond. Space	Improved Duct Sealing	Increased Air-tightness	Window Shading (4' Overhang)	Window Shading & Redistribution	Improved Window Performance	SEER 15 AC/8.5 HSPF Heat Pump
Total	63.7	62.7	56.7	58.2	60.6	62.5	61.3	60.5	61.6	61.1
DHW	12.6	11.7	5.7	12.6	12.6	12.6	12.6	12.6	12.6	12.6
Fans	2.4	2.4	2.4	2.4	2.4	2.3	2	1.9	2.1	2.4
Misc.	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Cooling	15.9	15.9	15.9	11.3	13.5	15.4	13	12.7	13.9	13.8
Heating	6.3	6.3	6.3	5.3	5.6	5.7	7.2	6.7	6.4	5.8
Equip.	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
Lighting	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2

Figure 99. Energy Use for Various EEMs for an All-electric House

Energy Savings form Various EEMs

Table 10 and Table 11 show that for both types of houses, the solar DHW system had the largest annual total energy savings of 15.2% in an electric/gas house, and 10.9% in an all-electric house. Tankless water heater resulted in large total energy savings of 9.3%, only in electric/gas house. These savings include 5.5%

savings due to elimination of the standing pilot light and the remainder due to significant increase in the EF from the base case (i.e. from 0.54 to 0.85).

Locating the HVAC unit and ducts in the conditioned space also resulted in large savings of 8.5% in an electric/gas house, and 8.7% in an all-electric house. Improved duct sealing resulted in 4.3% savings in an electric/gas house, and 4.8% in an all-electric house.

Among the envelope measures, increased air-tightness resulted in small total energy savings of 2.1% in an electric/gas house, and 1.8% in an all-electric house. Contrary to the last paragraph in the previous section, fenestration measures were found more effective in an all-electric house than in an electric/gas house. This is because the cooling energy savings from these measures were offset by the heating energy penalty, and the heating energy penalty was more pronounced in the electric/gas house due to lower heating fuel efficiency.

Addition of overhangs was more effective with more windows on the south and least on the east and west. With the window redistribution, the total energy savings were 3.6% in an electric/gas house, and 5.0% in an all-electric house. Improved windows resulted in total energy savings of only 2.6% in an electric/gas house, and 3.3% in an all-electric house.

The equal cooling energy use reduction due to SEER 13 air conditioner was more pronounced in an all-electric house (2.7% in an electric/gas house, and 3.3% in an all-electric house). The savings from 0.93 AFUE furnace was only 1.9% in an electric/gas house and less than 1% in an all-electric house due to 7.7 HSPF heat pump. However, the combined effect of heating and cooling system improvement was comparable (approx. 4 to 4.5%) in both types of houses.

Cost Effectiveness of Various EEMs

This is to be noted that due to the difference in the unit cost of electricity and gas, the energy cost savings for a measure are not always of the same order as the energy savings, and depend on the fuel type associated with the end use affected from that measure. Measures that reduce electricity use for space cooling (in both types of house), heating (in all-electric house) result in large energy cost saving compared to the measures that reduce only gas use.

For example, Figure 100 and Figure 101 show that DHW system measures, which resulted in the large energy savings in an electric/gas house, had small energy cost savings. Even, the solar DHW system that resulted in highest energy use reduction was not very effective in reducing the energy cost. This is because the cost savings from large reduction in gas use was offset by the increased cost of electricity use for operating the pump.

Although, solar DHW system, moving the HVAC unit and ductwork to the conditioned space, and window shading and redistribution had high first cost (ranging from $2,900 to $5,200; $1,000 to $7,000; and $3,100 to $3,500; respectively), they resulted in the largest electricity savings in an all-electric house, and therefore, were the most effective in reducing the energy cost in an all-electric house. For an electric/gas house, moving the HVAC unit and ductwork to the conditioned space, and window shading and redistribution showed significant reduction in cooling electricity use, and therefore, were very effective in reducing the overall energy cost in an electric/gas house, too.

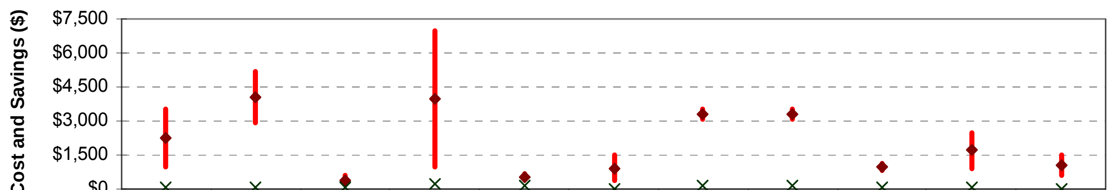
Further, cost-effectiveness of a measure depends on the energy cost savings vs. the cost of implementation. Simple payback for each measure was calculated for both types of houses. Figure 102 and Figure 103 show that most of the common measures had nearly equal payback period for both type of houses, except for the solar DHW system and increased air tightness that showed longer payback period for an electric/gas house. The shortest payback periods were for the improved duct sealing (3 to 6 years) and improved window performance (8 to 12 years). Using a gas water heater without a standing pilot light was a cost-effective measure for an electric/gas house with a payback period of 4.7 to 14 years. On the other hand, solar DHW system with a payback period of 9.5 to 17 years was a cost-effective measure for an all-electric house.

In summary, the most cost-effective measures include: moving HVAC unit and the ductwork to conditioned space which resulted in 8-9% energy savings, 9-11% energy cost savings, and a payback period ranged from 4-32 years for both type of houses. Improved duct sealing resulted in 4-5% energy savings and was the most cost-effective with 3-6 years payback period.

15% Above-Code Energy Savings

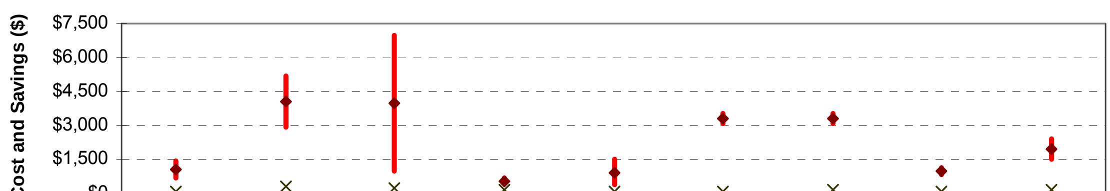
The results from individual measures were used to guide the selection of measures that could result in 15% above-code combined total energy savings. Another set of simulations was performed with the selected measures applied in combination, and the energy cost savings were calculated. Using the estimated first cost for the selected measures, the payback period for the combined application of measures was calculated. These steps were followed for different groups of measures that could result in 15% or more total energy savings above the 2001 IECC compliant base case house with electric/gas systems and all-electric systems.

Figure 104 and Figure 105 present the 15% above-code savings charts[40] for an electric/gas house and an all-electric house, respectively in Houston, Texas. In each figure, the first table summarizes the results obtained from individual measures in terms of annual energy savings and the estimated costs for each measure implemented individually. The second table summarizes the results obtained by implementing three combinations of measures to achieve 15% or more total energy savings, and includes: energy savings, energy cost savings, estimated cost and payback period for each combination. Information regarding the ozone emissions for each of the combinations is also presented in terms of combined annual NOx emission savings and combined ozone season period NOx emission savings.



	Tankless Gas Water Heater	Solar DHW System	Removal of Pilot Light	HVAC Unit and Ducts in Cond. Space	Improved Duct Sealing	Increased Air-tightness	Window Shading (4' Overhang)	Window Shading & Redistributio	Improved Window Performance	AC Eff.: SEER 13 to SEER 15	Furnace Eff.: 0.78 AFUE to 0.93
Minimum Cost	$1,000	$2,900	$200	$1,000	$450	$350	$3,100	$3,100	$800	$900	$600
Maximum Cost	$3,500	$5,200	$600	$7,000	$650	$1,500	$3,500	$3,500	$1,100	$2,500	$1,500
◆ Average Cost	$2,250	$4,050	$400	$4,000	$550	$925	$3,300	$3,300	$950	$1,700	$1,050
× Energy Savings	$73	$74	$43	$221	$117	$35	$128	$152	$97	$93	$15

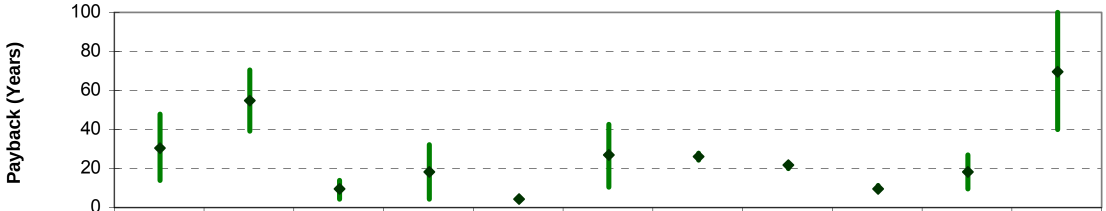
Figure 100. First Costs and Energy Cost Savings for Various EEMs for an Electric/Gas House



	Tankless Electric Water Heater	Solar DHW System	HVAC Unit and Ducts in Cond. Space	Improved Duct Sealing	Increased Air-tightness	Window Shading (4' Overhang)	Window Shading & Redistribution	Improved Window Performance	SEER 15 AC/8.5 HSPF Heat Pump
Minimum Cost	$700	$2,900	$1,000	$450	$350	$3,100	$3,100	$800	$1,500
Maximum Cost	$1,400	$5,200	$7,000	$650	$1,500	$3,500	$3,500	$1,100	$2,400
◆ Average Cost	$1,050	$4,050	$4,000	$550	$925	$3,300	$3,300	$950	$1,950
× Energy Savings	$42	$304	$242	$134	$50	$103	$141	$92	$114

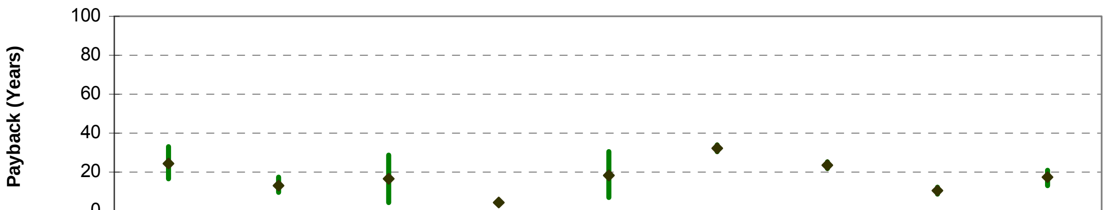
Figure 101. First Costs and Energy Cost Savings for Various EEMs for an All-electric House

40 Based on the code-specified base case house characteristics and the weather data for Houston, Texas, these charts are applicable to Brazoria, Fort Bend, Galveston, Harris, Montgomery and Waller counties. Malhotra et al. (2007) includes similar charts for other non-attainment and affected counties in Texas.



	Tankless Gas Water Heater	Solar DHW System	Removal of Pilot Light	HVAC Unit and Ducts in Cond. Space	Improved Duct Sealing	Increased Air-tightness	Window Shading (4' Overhang)	Window Shading & Redistributio	Improved Window Performance	AC Eff.: SEER 13 to SEER 15	Furnace Eff.: 0.78 AFUE to 0.93
Minimum	13.7	39.3	4.7	4.5	3.9	10.0	24.3	20.4	8.3	9.7	40.0
Maximum	47.9	70.5	14.0	31.7	5.6	43.0	27.4	23.0	11.4	26.9	100.0
◆ Average	31	55	9	18	5	27	26	22	10	18	70

Figure 102. Payback Period for Various EEMs in an Electric/Gas House



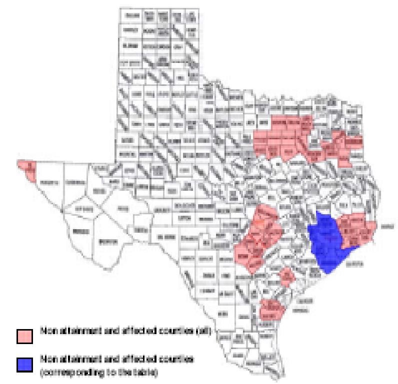
	Tankless Electric Water Heater	Solar DHW System	HVAC Unit and Ducts in Cond. Space	Improved Duct Sealing	Increased Air-tightness	Window Shading (4' Overhang)	Window Shading & Redistribution	Improved Window Performance	SEER 15 AC/8.5 HSPF Heat Pump
Minimum	16.5	9.5	4.1	3.4	7.0	30.0	22.0	8.7	13.2
Maximum	33.0	17.1	28.9	4.9	30.1	33.9	24.8	12.0	21.1
◆ Average	25	13	17	4	19	32	23	10	17

Figure 103. Payback Period for Various EEMs for an All-electric House

Natural Gas Heating (Brazoria, Fort Bend, Galveston, Harris, Montgomery and Waller Counties)

Description of Individual Measures

	Individual Measures	Annual Energy Savings (%)	Annual Energy Savings ($/year)[4]	Estimated Cost ($) Marginal Cost[1]	Estimated Cost ($) New System Cost[2]
A	Domestic Hot Water Measures				
1	Tankless Gas Water Heater (without a Standing Pilot Light)	9.3%	$73	$1,000 - $3,500	
2	Solar Domestic Hot Water System	15.2%	$74		$2,900 - $5,200
3	Removal of Pilot Light from Domestic Hot Water System	5.5%	$43	$200 - $600	
B	Air Distribution System Measures				
4	Relocate HVAC Unit Including Supply and Return Ducts in Conditioned Space	8.5%	$221	$1,000 - $7,000	
5	Improved Duct Sealing (10% to 5% Duct Leakage)	4.3%	$117		$450 - $650
C	Envelope and Fenestration Measures				
6	Reduced Air Infiltration (0.46 to 0.35 Air-changes/hr)	2.1%	$35		$350 - $1,500
7	Window Shading (None to 4 ft. Eaves on All Sides)	2.1%	$128		$3,100 - $3,500
8	Window Shading and Redistribution (Equal Windows on All Four Sides with No Shading to 45% Windows on the South with 4ft. Eaves on All Four Sides)	3.6%	$152		$3,100 - $3,500
9	Improved Windows (U-factor: 0.47 to 0.42 Btu/h-sf-F, SHGC: 0.4 to 0.33)	2.6%	$97	$800 - $1,100	
D	HVAC System Measures				
10	Air Conditioner (SEER 13 to SEER 15)	2.7%	$93	$900 - $2,500	
11	Furnace (0.78 AFUE to 0.93 AFUE)	1.9%	$15	$600 - $1,500	



Description of Combined Measures to Achieve 15% Above Code Savings

	Combination of Measures[3]	Combined Energy Savings (%)	Combined Energy Savings ($/year)	Combined Estimated Cost ($) Marginal Cost[1]	Combined Estimated Cost ($) New System Cost[2]	Combined Annual NO_x Emissions Savings (lbs/year)	Combined Ozone Season Period NO_x Emissions Savings (lbs/day)	Simple Estimated Payback (yrs)
	Combination 1							
1	Tankless Gas Water Heater (without a Standing Pilot Light)	17.8%	$295	$1,000 - $3,500		2.39	0.018	6.8 - 35.7
4	Relocate HVAC Unit Including Supply and Return Ducts in Conditioned Space			$1,000 - $7,000				
	Combination 2							
2	Solar Domestic Hot Water System	21.8%	$269		$2,900 - $5,200	1.50	0.011	15.8 - 31.0
5	Improved Duct Sealing (10% to 5% Duct Leakage)				$450 - $650			
10	Air Conditioner (SEER 13 to SEER 15)			$900 - $2,500				
	Combination 3							
3	Removal of Pilot Light from Domestic Hot Water System	16.8%	$383	$200 - $600		2.99	0.025	11.2 - 29.0
4	Relocate HVAC Unit Including Supply and Return Ducts in Conditioned Space			$1,000 - $7,000				
8	Window Shading and Redistribution (Equal Windows on All Four Sides with No Shading to 45% Windows on the South with 4ft. Eaves on All Four Sides)				$3,100 - $3,500			

Note:
1. Marginal cost = new system cost - original system cost
2. New system cost = new system cost only
3. See individual measures above for specific savings
   * Energy Cost: Electricity cost = $0.15/kWh
     Natural gas cost = $1.00/therm
4. Savings depend on fuel mix used. See detailed writeup

(Building Description)
* Building type: Residential
* Gross area: 2,323 sq-ft.
* Building dimension: 48.2ft x 48.2ft x 8ft (WxLxH)
* Number of floors: 1
* Floor-to-floor height: 8ft
* Window-to-wall ratio: 18%

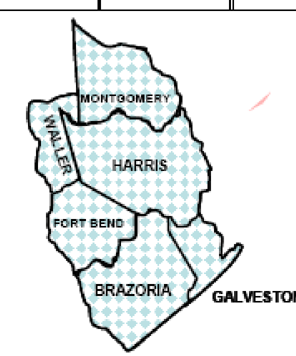


Table 5a: 15% Above Code Savings (Residential – Natural Gas Heating) for Brazoria, Fort Bend, Galveston, Harris, Montgomery and Waller Counties

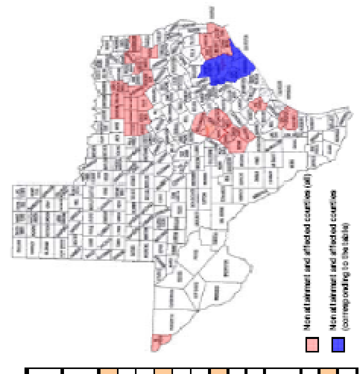
Energy Systems Laboratory - August 2007

Figure 104. Summary of Individual and Combined Measures for a Natural Gas House in Houston

Electric Heating (Brazoria, Fort Bend, Galveston, Harris, Montgomery and Waller Counties)

Description of Individual Measures

	Individual Measures	Annual Energy Savings (%)	Annual Energy Savings ($/year)	Estimated Cost ($)	
				Marginal Cost[1]	New System Cost[2]
A	Domestic Hot Water Measures				
1	Tankless Electric Water Heater	1.5%	$42	$700 - $1,400	
2	Solar Domestic Hot Water System	10.9%	$304		$2,900 - $5,200
B	Air Distribution System Measures				
4	Relocate HVAC Unit including Supply and Return Ducts in Conditioned Space	8.7%	$242	$1,000 - $7,000	
5	Improved Duct Sealing (10% to 5% Duct Leakage)	4.8%	$134		$450 - $650
C	Envelope and Fenestration Measures				
6	Reduced Air Infiltration (0.46 to 0.35 Air-changes/hr)	1.8%	$50		$350 - $1,500
7	Window Shading (None to 4 ft. Eaves on All Sides)	3.7%	$103		$3,100 - $3,500
8	Window Shading and Redistribution (Equal Windows on All Four Sides with No Shading to 45% Windows on the South with 4ft. Eaves on All Four Sides)	5.0%	$141		$3,100 - $3,500
9	Improved Windows (U-factor: 0.47 to 0.42 Btu/h-sf-F, SHGC: 0.4 to 0.33)	3.3%	$92	$800 - $1,100	
D	HVAC System Measures				
12	Air Conditioner with Heat Pump (SEER 13/7.7 HSPF to SEER 15/8.5 HSPF)	4.1%	$114	$1,500 - $2,400	



Description of Combined Measures to Achieve 15% Above Code Savings

	Combination of Measures[3]	Combined Energy Savings (%)	Combined Energy Savings ($/year)	Combined Estimated Cost ($)		Combined Annual NO_x Emissions Savings (lbs/year)	Combined Ozone Season Period NO_x Emissions Savings (lbs/day)	Simple Estimated Payback (yrs)
				Marginal Cost[1]	New System Cost[2]			
	Combination 1							
2	Solar Domestic Hot Water System	15.7%	$438		$2,900 - $5,200	1.01	0.020	7.6 - 13.4
5	Improved Duct Sealing (10% to 5% Duct Leakage)				$450 - $650			
	Combination 2							
1	Tankless Electric Water Heater	15.4%	$431	$700 - $1,400		3.26	0.029	9.3 - 27.6
4	Relocate HVAC Unit including Supply and Return Ducts in Conditioned Space			$1,000 - $7,000				
9	Improved Windows (U-factor: 0.47 to 0.42 Btu/h-sf-F, SHGC: 0.4 to 0.33)			$800 - $1,100				
12	Air Conditioner with Heat Pump (SEER 13/7.7 HSPF to SEER 15/8.5 HSPF)			$1,500 - $2,400				
	Combination 3							
1	Tankless Electric Water Heater	15.1%	$422	$700 - $1,400		3.19	0.026	14.5 - 22.4
5	Improved Duct Sealing (10% to 5% Duct Leakage)				$450 - $650			
6	Reduced Air Infiltration (0.46 to 0.35 Air-changes/hr)				$350 - $1,500			
8	Window Shading and Redistribution (Equal Windows on All Four Sides with No Shading to 45% Windows on the South with 4ft. Eaves on All Four Sides)				$3,100 - $3,500			
12	Air Conditioner with Heat Pump (SEER 13/7.7 HSPF to SEER 15/8.5 HSPF)			$1,500 - $2,400				

Note:
1. Marginal cost = new system cost - original system cost
2. New system cost = new system cost only
3. See individual measures above for specific savings
   * Energy Cost: Electricity cost = $0.15/kWh
     Natural gas cost = $1.00/therm
4. Savings depend on fuel mix used. See detailed writeup

(Building Description)
* Building type: Residential
* Gross area: 2,323 sq-ft.
* Building dimension: 48.2ft x 48.2ft x 8ft (WxLxH)
* Number of floors: 1
* Floor-to-floor height: 8ft
* Window-to-wall ratio: 18%

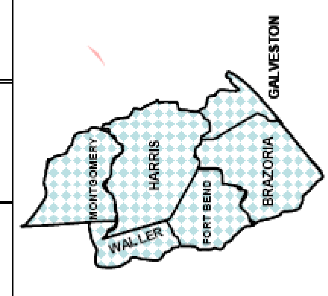


Table 5b: 15% Above Code Savings (Residential – Electric Heating) for Brazoria, Fort Bend, Galveston, Harris, Montgomery and Waller Counties

Energy Systems Laboratory - August 2007

Figure 105. Summary of Individual and Combined Measures for an All-electric House in Houston

Summary

This section presented an overview of the recommendations for achieving 15% above-code energy performance for single-family residences. The analysis was performed for a 2,325 sq. ft., one story, single family residence in Houston, Texas, with 18% window to floor area. To accomplish the 15% annual energy cost reductions, twelve measures were considered, including: tankless water heaters, solar water heaters, removal of the standing pilot light from the water heater, use of ducts in the conditioned space, duct sealing, decreased air infiltration, window shading and redistribution, improved window performance, improved air conditioner efficiency, and improved furnace efficiency.

This analysis identified the energy saving potential of individual measures which can guide the selection of measures to achieve 15% above-code annual energy savings in residential buildings.
The analysis demonstrates that for an electric/gas house, solar DHW system and tankless water heater resulted in 15.2% and 9.3% energy savings, followed by 8.5% savings from moving HVAC unit and ductwork in the conditioned space. Similarly, for an all-electric house, solar DHW system resulted in 10.9% energy savings, followed by 8.7% savings from moving HVAC unit and ductwork in the conditioned space These potential measures can be implemented individually or in combination with other measures for building envelope and/or HVAC system measures to accomplish 15% total energy use savings. It is to be noted that the energy cost savings and cost-effectiveness for individual measures were not of the same order as the energy use savings, since these depend on the fuel type used for the energy end use saved, and the first cost vs. energy cost savings, respectively.

Further, the high energy savings from DHW system measures demonstrate relatively low NAECA standards for domestic water heating equipment compared to the high efficiency products available in the market. However, the current NAECA standards for HVAC equipment performance seem to be in sync with the improved HVAC equipment efficiencies. Although, improvements in lighting and appliances are feasible, they are not recognized by the residential building codes and therefore, were not considered in this analysis.

Table 12: Base-case Summary

CHARACTERISTIC	BASECASE ASSUMPTIONS		COMMENTS	SOURCES
Building				
Building type	Single family, detached house			
Gross area	2,325 sq. ft. (48.22 ft. x 48.22 ft.)			NAHB (2003)
Number of floors	1			NAHB (2003)
Floor to floor height (ft.)	8			NAHB (2003)
Orientation	South facing			
Construction				
Construction	Light-weight wood frame with 2x4 studs spaced at 16” on center			NAHB (2003)
Floor	Slab-on-grade floor			NAHB (2003)
Roof configuration	Unconditioned, vented attic			NAHB (2003)
Roof absorptance	0.75		Assuming asphalt shingle roofing	
Ceiling insulation (hr-sq.ft.-°F/Btu)	R-30		Based on HDD65 and 27% window-to-wall area ratio	2001 IECC, Table 502.2.4(6), (p.83)
Wall absorptance	0.75		Assuming brick facia exterior	
Wall insulation (hr-sq.ft.-°F/Btu)	R-13		Based on HDD65	2001 IECC, Table 402.1.1(1), (p.63)
Slab Perimeter Insulation	None		Based on HDD65 and 27% window-to-wall area ratio	2001 IECC, Table 502.2.4(6), (p.83)
Ground reflectance	0.24		Assuming grass	DOE2.1e User Manual (LBL 1993)
U-Factor of glazing (Btu/hr-sq.ft.°F)	0.47		Based on HDD65	2001 IECC, Table 402.1.1(2), (p.63)
Solar Heat Gain Coefficient (SHGC)	0.4		0.4 for HDD < 3500, and 0.68 for HDD ≥ 3500	2001 IECC, Section 402.1.3.1.4, (p.64)
Window area	18% of conditioned floor area		This amounts to 418.5 sq. ft. window area and 27% window-to-wall area ratio for the assumed base case building configuration	2001 IECC, Section 402.1.1, (p.63)
Exterior shading	None			2001 IECC, Section 402.1.3.1.3, (p.64)
Space Conditions				
Space temperature setpoint	68°F Heating, 78°F Cooling, 5°F set-back/ set-up for winter and summer, respectively, for 6 hours per day			2001 IECC, Table 402.1.3.5, (p.64)
Internal heat gains	0.88 W (modeled as 0.44 W for lighting and 0.44 W for equipment)		This assumes heat gains from lighting, equipment and occupants.	2001 IECC, Section 402.1.3.6, (p.65)
Number of occupants	None		Assuming internal gains include heat gain from occupants	2001 IECC, Section 402.1.3.6, (p.65)
Mechanical Systems	Electric/Gas	All-electric		
HVAC system type	Electric cooling (air conditioner) and natural gas heating (gas fired furmace)	Electric cooling and heating (air conditioner with heat pump)		
HVAC system efficiency	SEER 13 AC, 0.78 AFUE furnace	SEER 13 AC, 7.7 HSPF heat pump		NAECA (2006)
Cooling capacity (Btu/hr)	55,800		500 sq. ft./ton	
Heating capacity (Btu/hr)	72,540		1.3 x cooling capacity	
DHW system type	40-gallon tanktype gas water heater with a standing pilot light	50-gallon tanktype electric water heater (without a pilot light)		Tank size from ASHRAE HVAC Systems and Equipment Handbook
DHW heater energy factor	0.54	0.86	(a) 0.62-0.0019V, (b) 0.93-0.00132V, Where V=storage volume (gal.)	2001 IECC, Table 504.2, (p.91)
Duct location	Unconditioned, vented attic			NAHB (2003)
Duct leakage (%)	10%			Parker et al. (1993)
Duct insulation (hr-sq.ft.-°F/Btu)	R-8 (supply) and R-4 (return)			2001 IECC

5.2.14.1 Measures to Reduce Commercial Energy use by 15% Above Code-Compliance.

This section presents an overview of the recommendations for achieving 15% above code energy performance for commercial office buildings complying with ASHRAE Standard 90.1-1999. To accomplish the 15% annual energy consumption reductions, ten measures were considered. After energy savings were determined for each measure, they were then grouped in several groups to accomplish a minimum of 15% total annual energy consumption reduction.[41]

Introduction

Efforts to improve energy efficiency in new commercial buildings for hot and humid climates have been reported in several studies. Torcellini et al. (2004) reported an energy cost savings from 44% to 67% for six high-performance buildings when compared to ASHRAE 90.1-2001 specifications. Sylvester et al. (2002) reported a potential of reducing up to 46% in annual energy use for Robert E. Johnson building in Austin, Texas. Another study performed by Parker et al. (1997) presented the energy performance of the new Florida Solar Energy Center building. The optimized building with the implementation of several high performance systems showed an energy reduction of 62% and a cooling capacity decrease of 52% when compared to the energy use of the conventional building characteristics of Florida.

This section presents an overview of the recommendations for achieving 15% above code energy performance for commercial office buildings complying with ASHRAE Standard 90.1-1999. The analysis was performed for a 6-story office building (89,304 ft^2) in Houston, Texas.[42] To accomplish the 15% annual energy consumption reductions, ten measures were considered, including: improved glazing U-value, decreasing lighting power density, window shading, reducing static pressure, improving chiller coefficient of performance (COP), improving boiler efficiency, cold deck reset, variable speed drives (VSDs) on chilled and hot water pumps, and occupancy sensors for lighting control[43]. After energy savings were determined for each measure, they were then grouped in several groups to accomplish a minimum of 15% total annual energy consumption reduction. Finally a cost analysis was performed and a simple payback calculated.

Base-case Building Description

The base-case building simulation model in this analysis is based on specifications in ASHRAE 90.1 1999. The simulation used the DOE-2 program and the TMY2 hourly weather data for Houston. Electricity costs were $0.119/kWh, demand charges were $5.00/kW, and costs for natural gas were $8.00/MCF. Details of the base-case model are summarized in Table 18. Additional details regarding the analysis can be found in the accompanying report (Cho et al. 2007).

Building Envelope, Lighting and Fenestration Characteristics

The analysis was performed for a 6-story office building (89,304 ft^2), with a 50% window-to-wall ratio that follows the prescriptive tables in ASHRAE 90.1-1999. Four perimeter zones and a central core zone were modeled for each floor.

Based on climate specific characteristics, the base-case was modeled with a wall insulation of R-13 value and a roof insulation of R-15. The U-value of the windows in the base-case building was set at 1.22 Btu/hr

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[41] The analysis in this paper uses the total annual energy consumption of a simulated commercial building to determine the 15% above-code recommendations. The analysis also reports end-use energy use, including: heating, cooling, domestic hot water use, fans, heat rejection, equipment and lighting loads, and miscellaneous loads as defined by the BEPS and BEPU reports from the DOE-2 program. Since the 15% above code savings use annual energy cost savings, these same measures will report greater savings when compared against total heating and cooling loads, which has been used in other above-code programs.

[42] The complete analysis by Cho et al. (2007) includes recommendations for 15% above-code energy performance for all 41 non-attainment and affected counties in Texas.

[43] Selection of measures for this analysis is partly limited to the simulation capabilities of the DOE-2.1e program.

ºF ft². [44] As per ASHRAE 90.1 1999, the SHGC of the base-case building set at 0.44 for the north orientation and 0.17 for the other orientations.[45] Window overhangs or shading was not used. The base-case building was modeled with a lighting power density (LPD) of 1.3 W/ft², which is the maximum value for office applications, allowed by ASHRAE 90.1-1999.[46] The electric lighting profile was set to the recommended profile from ASHRAE's Diversity Factor Toolkit (RP-1093), as shown in Figure 106 (Abushakra et al. 2001).

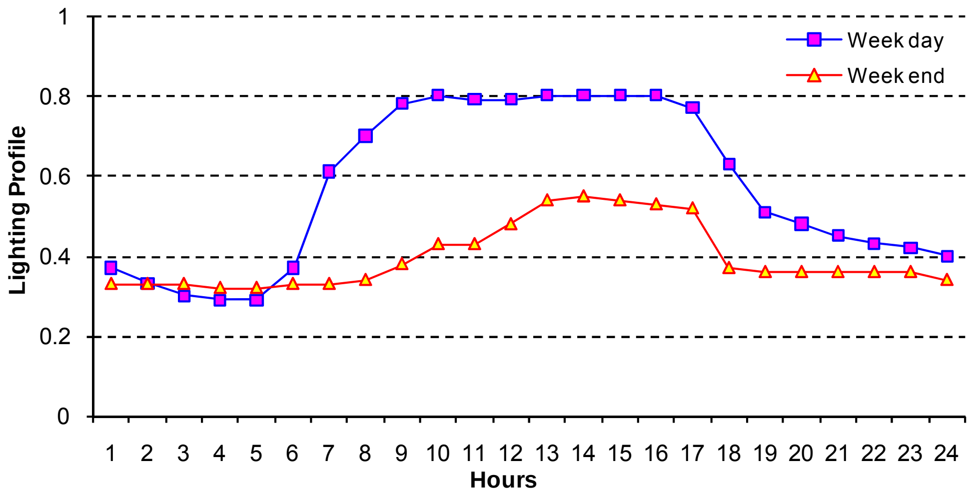

Figure 106: Base-case Lighting Profile for a large commercial building (Abushakra et al. 2001).

HVAC System Characteristics

The base-case building model used a variable air volume (VAV) system with terminal reheat that was set to have a total supply air static pressure of 2.5 inches of water (gauge), and has a constant supply air temperature of 55 ºF.

1. Plant Characteristics

The base-case building has one 160 ton (1.926 MBtu/hr) screw chiller[47] with a COP of 4.9, and a constant speed chilled water pump. Two options for the heating fuel type were considered: a) natural gas (natural gas hot water boiler for space heating, and natural gas water heater for service water heating), and b) electricity (electric resistance hot water boiler for space heating, and electric water heater for service water heating).[48] For the electric/gas building, heating is provided by two 731 kBtu/hr hot water gas boilers[49] with an efficiency of 75%. For the all-electric building, heating was provided by an electric resistance boiler with an efficiency of 100%.

Summary of Energy Efficiency Measures

A total of 10 measures were considered to achieve a 15% annual energy consumption reduction when compared to code for the electric/gas and the all-electric buildings. These measures included: improved glazing U-value, decreasing lighting power density, window shading, reducing static pressure, improving chiller COP, improving boiler efficiency, cold deck reset, VSDs on chilled and hot water pumps, and occupancy sensors for lighting control. After costs were determined for each measure, they were then

[44] ASHRAE Standard 90.1-1999, Table B-5(Climate zone for Houston), p.95.
[45] ASHRAE Standard 90.1-1999, Table B-5(Climate zone for Houston), p.95.
[46] ASHRAE Standard 90.1-1999, Table 9.3.1.1, p.51.
[47] As required by ASHRAE 90.1-1999, Table 6.2.1C, p.29, for chiller sizes between 100 tons and 300 tons.
[48] In the remainder of this paper, these buildings will be referred to as (a) electric/gas building, and (b) all-electric building, respectively.
[49] As required by ASHRAE 90.1-1999, Table 6.2.1F, p.31.

grouped in several groups to accomplish a minimum of 15% total annual energy consumption reduction. A list of all measures is provided in Table 13. A brief description is provided in the following sections. Additional details are provided in the ESL report by Cho et al. (2007).

Decreasing Glazing U-value (from 1.22 to 0.45).

To improve the glazing performance, the U-value was reduced to 0.45 Btu/hr ft^2 °F[50] from 1.22 Btu/hr ft^2 °F (ASHRAE 2004). The selection of this U-value was chosen to minimize winter-time heat loss using available commercial glazing products. The SHGC of the base-case building remained at 0.44 for the north orientation and 0.17 for the other orientations[51].

Table 13: Energy Efficiency Measures.

	NATURAL GAS HEATING/NATURAL GAS DHW SYSTEM	ELECTRIC RESISTANCE HEATING / ELECTRIC DHW SYSTEM
A	**Envelope and Fenestration Measures**	
1	Improved Window Performance (U-factor = 0.45 Btu/hr-sqft C)	Improved Window Performance (U-factor = 0.45 Btu/hr-sqft C)
2	Improved lighting load (1W/sqft)	Improved lighting load (1W/sqft)
3	Occupancy sensors for lights	Occupancy sensors for lights (Using occupancy schedules)
4	Shading (ft) (From 0 ft to 2.5 ft)	Shading (ft) (From 0 ft to 2.5 ft)
B	**HVAC System Measures**	
5	Cold deck reset (Constant to variable)	Cold deck reset (From 55F to 60:55F; 55:85F)
6	Supply fan total pressure (From 2.5 inW.G. to 1.5 inW.G.)	Supply fan total pressure (From 2.5 inW.G. to 1.5 inW.G.)
C	**Plant Equipment Measures**	
7	Chiller COP (from 4.9 to 6.1)	Chiller COP (from 4.9 to 6.1)
8	Boiler efficiency (75% to 90%)	NA
9	VSD on chiller water loop	VSD on chiller water loop
10	VSD on hot water loop	VSD on hot water loop

2) Energy-Efficient Lighting (Decreasing Lighting Power Density from 1.3 W/ft^2 to 1.0 W/ ft^2)

The impact of energy-efficient lighting was determined by reducing the Lighting Power Density (LPD) from 1.3 W/ ft^2 to 1.0 W/ ft^2.[52] There are a number of lighting systems available to meet the LPD requirements described above. Some of these include changing the fixture type, fixture size, type of lens or louver, and mounting height. However, the cost analysis was simplified by only considering changing the lamp type and ballast type.

3) Window Shading (No Overhangs vs. 2.5 ft Width of Overhangs)

The impact of the addition of window shades was considered by adding window shades to all orientations (except north), using a projection factor of 0.5, as recommended by the ASHRAE Advanced Energy Design Guide for Small Office Buildings (ASHRAE 2004). Since the windows used in the base-case simulation was set to a height of 5 feet, this resulted in shade that projected 2.5 feet, which was attached at the top of the window.

[50] From Table for Climate Zone 2 from Advanced Energy Design Guide for Small Office Buildings. Although this guide was developed for small office buildings (i.e. up to 20,000 ft^2), its use in this study was deemed appropriate.
[51] As required by ASHRAE 90.1-1999, Table 5.3, p.24. (Derived from Table B-5, p.95.)
[52] Recommended level in ASHRAE 90.1-2004 for general office space.

4) Supply Fan Total Pressure (2.5 in W.G. to 1.5 in W.G.)

To improve the HVAC system's performance, the total supply fan static pressure was reduced to 1.5 inches of water (gauge) from the 2.5 inches of water (gauge) which was set for the base-case simulation.[53]

5) Chiller COP (COP 4.9 to COP 6.1)

To improve the performance of the building's chiller the COP was raised to 6.1[54] from 4.9, which was set for the base-case building.

6) Boiler Efficiency (75% to 95%)

The building's heating system efficiency was improved by increasing the natural gas boiler efficiency to 95% (condensing boiler) from 75% (conventional boiler), which was set for the base-case simulation.[55] For the all-electric system, the boiler efficiency was set at 100% for the base-case and hence no changes were made to the boiler efficiency in the all-electric case.

7) Cold Deck Reset (Constant to Variable)

To further improve the performance of the cooling system the cold deck schedule was changed from a constant 55 ºF to a schedule as shown in the graph in Figure 107. This saves cooling energy by maintaining the cold deck air temperature at 60 ºF when outdoor temperature is 55 ºF or lower and maintains the cold deck temperature at 55 ºF when outdoor temperature is 85 ºF or higher.[56] The cold deck temperature decreases linearly from 60 ºF to 55 ºF as the outdoor temperature increases from 55 ºF to 85 ºF.

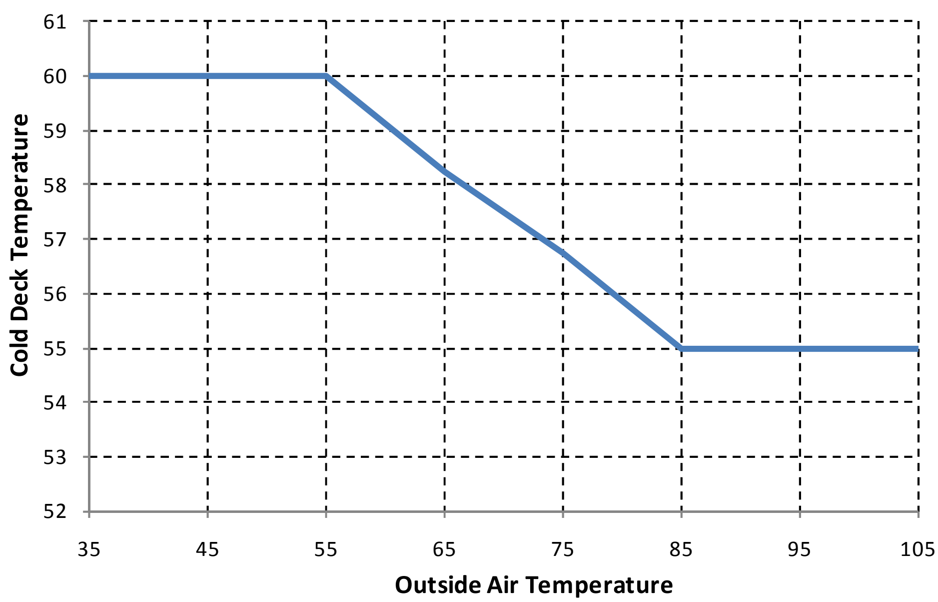

Figure 107: Cold Deck Temperature Schedule.

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[53] The 1.5 inches of water (gauge) was a recommendation by the Laboratory's Continuous Commissioning ® (CC®) group (registered trademarks of the Texas A&M University System). This can be accomplished by: a larger sized ductwork, using low static filters and other such measures which reduce frictional losses in ducts. This pressure difference can also be achieved by slowing down the speed of the fans with no added first costs, assuming the indoor air quality conditions are met.

[54] To find currently available high COP screw chillers, a literature review was performed. The EE/RE website of DOE has a guide 'How to buy an energy-efficient water-cooled electric chiller'(www1.eere.energy.gov/femp/pdfs/wc_chillers.pdf, p.1).

[55] The 95% efficiency was based on communications with Mr. Jeff Leep at Rheem Corporation.

[56] This cold deck schedule was implemented based on settings revealed by a survey of the buildings at the Texas A&M campus that had received Continuous Commissioning ® (CC®).

8) <u>VSD on Chilled Water Pump</u>

To improve the performance of the cooling system, variable speed drives were included for the chilled water pumps.

9) <u>VSD on Hot Water Pump</u>

To improve the performance of the heating system, variable speed drives were included for the hot water pumps.

10) <u>Installation of Occupancy Sensors for Lighting</u>

Finally, to improve the performance of the lighting systems occupancy sensors that control the general lighting were included in the simulation. In order to simulate the impact, the electric lighting profiles were modified using the occupancy schedules published in ASHRAE 90.1-1989 (Table 13-3, p.104). These modified lighting schedules were then used to represent the implementation of occupancy sensors (Figure 108).

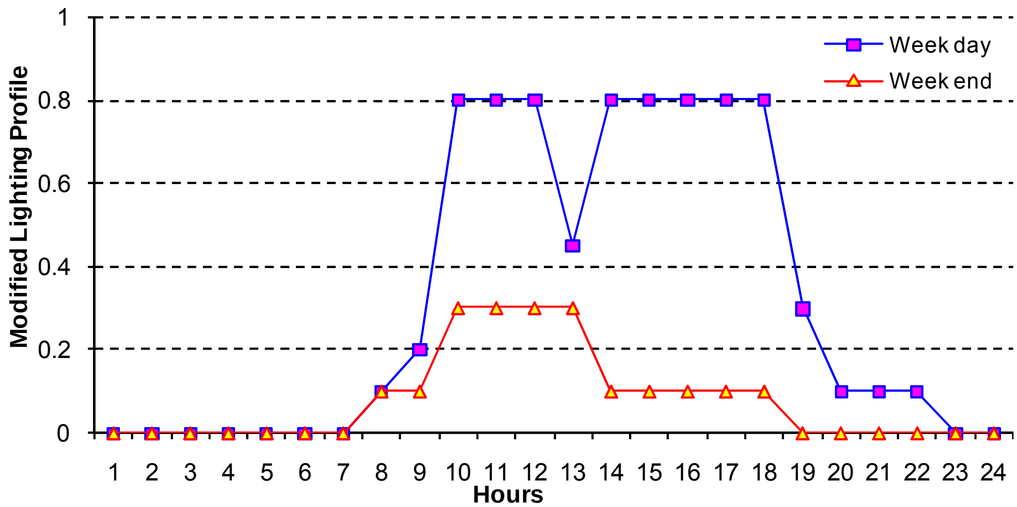


Figure 108: Modified Lighting Profile (ASHRAE Standard 90.1-1989).

Table 14: Specifications for an Electric/Gas Building.

EEM #	Energy Efficiency Measures	Glazing U-factor (Btu/hr-sqft-F)	Lighting Load (W/sqft)	Occupancy Sensors for Lights	Shading (ft)	Cold Deck Reset (F)	Supply Fan Total Pressure (in W.G.)	Chiller COP	Boiler Efficiency (%)	VSD on Chilled Water Loop	VSD on Hot Water Loop
	BaseCase	1.22	1.3	None	None	55	2.5	4.9	Efficiency	Constant Speed	Lighting Schedule
Envelope and fenestration measures											
1	Glazing U-factor (Btu/hr-sqft-F)	**0.45**	1.3	None	None	55	2.5	4.9	75	Constant Speed	Constant Speed
2	Lighting Load (W/sqft)	1.22	**1**	None	None	55	2.5	4.9	75	Constant Speed	Constant Speed
3	Occupancy Sensors for Lights	1.22	1.3	**Lit. Sch. = Occ. Sch.**	None	55	2.5	4.9	75	Constant Speed	Constant Speed
4	Shading (ft)	1.22	1.3	None	**2.5**	55	2.5	4.9	75	Constant Speed	Constant Speed
HVAC System Measures											
5	Cold Deck Reset (F)	1.22	1.3	None	None	**(60:55,55:85)**	2.5	4.9	75	Constant Speed	Constant Speed
6	Supply Fan Total Pressure (in W.G.)	1.22	1.3	None	None	55	**1.5**	4.9	75	Constant Speed	Constant Speed
Plant Equipment Measures											
7	Chiller COP	1.22	1.3	None	None	55	2.5	**6.1**	75	Constant Speed	Constant Speed
8	Boiler Efficiency (%)	1.22	1.3	None	None	55	2.5	4.9	**95**	Constant Speed	Constant Speed
9	VSD on Chilled Water Loop	1.22	1.3	None	None	55	2.5	4.9	75	**Variable Speed**	Constant Speed
10	VSD on Hot Water Loop	1.22	1.3	None	None	55	2.5	4.9	75	Constant Speed	**Variable Speed**

Table 15: Specifications for an All-Electric building.

EEM #	Energy Efficiency Measures	Glazing U-factor (Btu/hr-sqft-F)	Lighting Load (W/sqft)	Occupancy Sensors for Lights	Shading (ft)	Cold Deck Reset (F)	Supply Fan Total Pressure (in W.G.)	Chiller COP	Boiler Efficiency (%)	VSD on Chilled Water Loop	VSD on Hot Water Loop
	BaseCase	1.22	1.3	None	None	55	2.5	4.9	100	Constant Speed	Lighting Schedule
Envelope and fenestration measures											
1	Glazing U-factor (Btu/hr-sqft-F)	**0.45**	1.3	None	None	55	2.5	4.9	100	Constant Speed	Constant Speed
2	Lighting Load (W/sqft)	1.22	**1**	None	None	55	2.5	4.9	100	Constant Speed	Constant Speed
3	Occupancy Sensors for Lights	1.22	1.3	**Lit. Sch. = Occ. Sch.**	None	55	2.5	4.9	100	Constant Speed	Constant Speed
4	Shading (ft)	1.22	1.3	None	**2.5**	55	2.5	4.9	100	Constant Speed	Constant Speed
HVAC System Measures											
5	Cold Deck Reset (F)	1.22	1.3	None	None	**(60:55,55:85)**	2.5	4.9	100	Constant Speed	Constant Speed
6	Supply Fan Total Pressure (in W.G.)	1.22	1.3	None	None	55	**1.5**	4.9	100	Constant Speed	Constant Speed
Plant Equipment Measures											
7	Chiller COP	1.22	1.3	None	None	55	2.5	**6.1**	100	Constant Speed	Constant Speed
8	Boiler Efficiency (%)	1.22	1.3	None	None	55	2.5	4.9	100	Constant Speed	Constant Speed
9	VSD on Chilled Water Loop	1.22	1.3	None	None	55	2.5	4.9	100	**Variable Speed**	Constant Speed
10	VSD on Hot Water Loop	1.22	1.3	None	None	55	2.5	4.9	100	Constant Speed	**Variable Speed**

SIMULATION INPUT

Table 14 and Table 15 list the inputs for simulating the energy efficiency measures in a representative office building located in Houston, Texas for an electric/gas building and an all-electric building. Both systems had an electric chiller with a VAV air-handling unit. In the first row of each of the tables the values used for base-case are presented. The subsequent rows present information used in each of the individual energy efficiency measures. The shaded boxes in each row indicate changes in input values of the measures being simulated.

Results

Table 16 and Table 17 summarize the annual energy use, energy costs,[57] savings (both energy and dollars), implementation costs, and the calculated simple payback periods for the energy efficiency measures simulated for both the electric/gas building, and the all-electric building, for a building in Houston, Texas. In order to calculate the 15% above-code annual energy cost savings, the simulated electric and/or natural gas use was converted into total annual energy costs.[58]

Figure 109 to Figure 115 graphically present the results of the simulations and cost analysis. Figure 109 and Figure 110 present the impact of energy efficiency measures on different energy uses; Figure 111 and Figure 112 present the first cost and the energy cost savings for different measures; Figure 113 and Figure 114 show the corresponding payback period in years; Figure 115 and **Error! Reference source not found.** present the 15% above code savings charts[59] for an electric/gas building and an all-electric building,[60] respectively.

Table 16: Summary of Annual Energy use, Energy Costs, Savings, Implementation Costs, and Payback Periods for Houston, Texas (Electric/Gas).

[57] The energy use shown was obtained from DOE-2's BEPS and BEPU report.
[58] This is required when simulating a code-compliant building that follows ASHRAE Standard 90.1-1999. For this analysis, costs of $.119/kWh, $5/kW and $.80/therm were used.
[59] Based on the code-specified base-case building characteristics and the weather data for Houston, Texas, these charts are applicable to Brazoria, Fort Bend, Galveston, Harris and Montgomery counties. Cho et al. (2007) includes similar charts for other non-attainment and affected counties.
[60] The energy use shown was obtained from DOE-2's BEPS report.

EEM #	Energy Efficiency Measures	Energy Use (MBtu/yr)					Energy Use (Utility Units)			Energy Savings					Increased First Year Cost ($)	Payback
		Cooling	Heating	DHW	Other	Total	kWh/yr	therms/yr	$/yr	MBtu/yr	%	kWh/yr	therms/yr	$/yr		(yrs)
Envelope and Fenestration Measures																
	Basecase	1,126	590	43	3,899	5,658	1,472,338	6,325	$196,566							
1	Glazing U Factor (1.22 to 0.45 Btu/hr-sf-F)	1,125	68	43	3,815	5,051	1,447,640	1,106	$188,935	606	10.7%	24,698	5,219	$7,631	$95,130 - $174,150	12.5 - 22.8
2	Lighting Load (1.3 to 1.0 w/sq-ft)	1,064	702	43	3,460	5,268	1,325,451	7,447	$178,289	389	6.9%	146,887	-1,122	$18,277	$0 - $0	0.0 - 0.0
3	Occupancy Sensors Installation	976	879	43	3,024	4,922	1,172,190	9,211	$163,534	736	13.0%	300,148	-2,886	$33,032	$26,500 - $28,000	0.8 - 0.8
4	Shading (none to 2.5 ft overhangs)	1,058	590	43	3,859	5,549	1,440,495	6,331	$192,343	108	1.9%	31,843	-6	$4,223	$67,900 $110,000	16.1 - 26.0
HVAC System Measures																
	Basecase	1,126	590	43	3,899	5,658	1,472,338	6,325	$196,566							
5	Cold Deck Reset	1,053	384	43	3,905	5,385	1,452,735	4,269	$192,679	273	4.8%	19,603	2,056	$3,887	$0 - $800	0.0 - 0.2
6	Supply Fan Total Pressure (2.5 to 1.5 in-H2O)	1,109	591	43	3,841	5,583	1,450,195	6,333	$193,608	75	1.3%	22,143	-8	$2,958	$0 - $200	0.0 - 0.1
Plant Equipment Measures																
	Basecase	1,126	590	43	3,899	5,658	1,472,338	6,325	$196,566							
7	Chiller COP (4.9 to 6.1)	905	590	43	3,899	5,436	1,407,487	6,325	$187,848	221	3.9%	64,851	0	$8,718	$16,000 - $18,000	1.8 - 2.1
8	Boiler Efficiency	1,126	466	43	3,899	5,533	1,472,338	5,084	$195,573	124	2.2%	-64,851	1,241	$993	$25,000 - $35,000	25.2 - 35.3
9	VSD on Chilled Water Pump (from Constant to VSD)	1,061	590	43	3,828	5,521	1,432,301	6,325	$191,681	137	2.4%	40,037	0	$4,885	$3,700 - $4,700	0.8 - 1.0
10	VSD on Hot Water Pump (from Constant to VSD)	1,126	444	43	3,868	5,481	1,463,265	4,871	$194,260	176	3.1%	9,073	1,454	$2,306	$4,000 - $5,000	1.7 - 2.2

Table 17: Summary of Annual Energy use, Energy Costs, Savings, Implementation Costs, and Payback Periods for Houston, Texas (All-Electric).

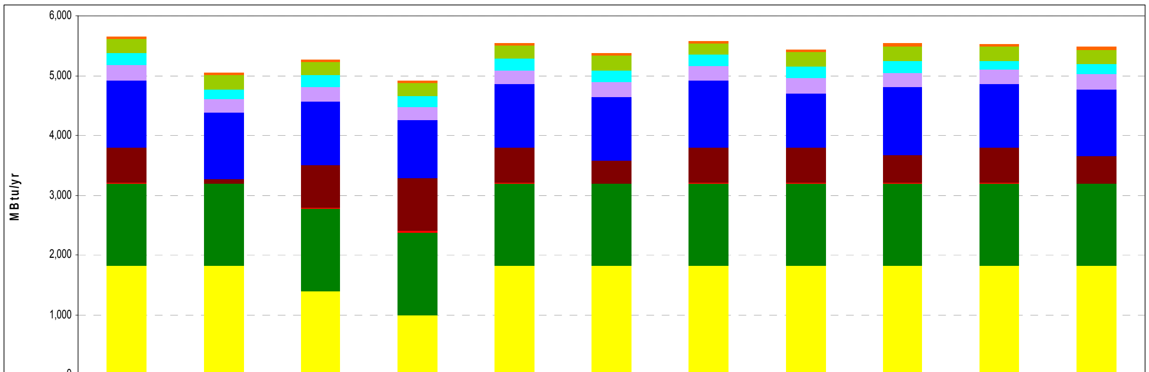
EEM #	Energy Efficiency Measures	Energy Use (MBtu/yr)					Energy Use (Utility Units)			Energy Savings					Increased First Year Cost ($)	Payback
		Cooling	Heating	DHW	Other	Total	kWh/yr	therms /yr	$/yr	MBtu/yr	%	kWh/yr	therms /yr	$/yr		(yrs)
Envelope and Fenestration Measures																
	Basecase	1,126	513	36	3,879	5,554	1,627,216	0	$214,554							
1	Glazing U Factor (1.22 to 0.45 Btu/hr-sf-F)	1,125	87	36	3,812	5,061	1,482,815	0	$192,644	493	8.9%	144,401	0	$21,910	$95,130 - $174,150	4.3 - 7.9
2	Lighting Load (1.3 to 1.0 w/sq-ft)	1,064	594	36	3,436	5,130	1,503,067	0	$199,237	424	7.6%	124,149	0	$15,317	$0 - $0	0.0 - 0.0
3	Occupancy Sensors Installation	976	727	36	2,995	4,735	1,387,338	0	$187,476	819	14.7%	239,878	0	$27,078	$26,500 $0 $28,000	1.0 - 1.0
4	Shading (none to 2.5 ft overhangs)	1,058	511	36	3,838	5,443	1,594,868	0	$210,233	110	2.0%	32,348	0	$4,321	$67,900 $110,000	15.7 - 25.5
HVAC System Measures																
	Basecase	1,126	513	36	3,879	5,554	1,627,216	0	$214,554							
5	Cold Deck Reset	1,053	0	36	4,252	5,341	1,564,931	0	$205,898	213	3.8%	62,285	0	$8,656	$0 - $800	0.0 - 0.1
6	Supply Fan Total Pressure (2.5 to 1.5 in-H2O)	1,109	0	36	4,334	5,479	1,605,230	0	$211,638	75	1.4%	21,986	0	$2,916	$0 - $200	0.0 - 0.1
Plant Equipment Measures																
	Basecase	1,126	513	36	3,879	5,554	1,627,216	0	$214,554							
7	Chiller COP (4.9 to 6.1)	905	0	36	4,392	5,332	1,562,366	0	$206,072	221	4.0%	64,850	0	$8,482	$16,000 - $18,000	1.8 - 2.1
8	Boiler Efficiency (Not Aplicable)	1,126	0	36	4,372	5,533	1,627,216	0	$214,554	0	0.0%	0	0	$0	NA - NA	0.0 - 0.0
9	VSD on Chilled Water Pump (from Constant to VSD)	1,061	0	36	4,320	5,417	1,587,179	0	$209,582	137	2.5%	40,037	0	$4,972	$3,700 - $4,700	0.7 - 0.9
10	VSD on Hot Water Pump (from Constant to VSD)	1,126	0	36	4,283	5,445	1,595,389	0	$210,594	109	2.0%	31,827	0	$3,960	$4,000 - $5,000	1.7 - 2.2

Base-case energy use

The total annual energy consumption for the base-case building in Houston, Texas, was 5,658 MBtu for the electric/gas building, and 5,554 MBtu for the all-electric building.

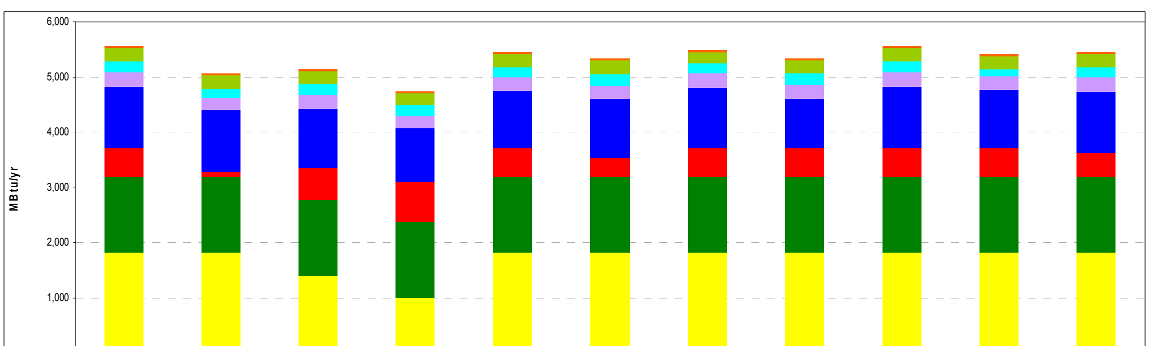
Energy Use and Cost Savings from Individual Measures

For both building types, the implementation of occupancy sensors for lighting and improved glazing U-factors had the greatest individual impact on the total annual energy consumption of the building. The implementation of occupancy sensors in the electric/gas building yields an annual energy consumption savings of 736 MBtu (13%). This same measure in the all-electric building yields a saving of 819 MBtu (14.7%). Surprisingly, the implementation of shading strategies and reduction of the supply fan static pressure resulted in comparatively small annual savings. For the electric/gas building, the implementation of shading strategies yields an annual energy saving of 108 MBtu (1.9%). This same measure in the all-electric building yields a saving of 110 MBtu (2%).



	New Baseline (L&E Schedule from RP-1093)	Glazing U-factor (Btu/hr-sqft-F)	Lighting Load (W/sqft)	Occupancy Sensors for Lights	Shading (ft)	Cold Deck Reset (F)	Supply Fan Total Pressure (in W.G.)	Chiller COP	Boiler Efficiency (%)	VSD on Chilled Water Loop	VSD on Hot Water Loop
Total	5,658	5,051	5,268	4,922	5,549	5,385	5,583	5,436	5,533	5,521	5,481
DHW	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7
Fans	239	238	221	211	225	257	187	239	239	239	239
Misc.	201	157	200	189	191	195	199	201	201	130	178
HtRj.	250	229	245	219	234	251	246	250	250	250	250
Cooling	1,126	1,125	1,064	976	1,058	1,053	1,109	905	1,126	1,061	1,126
Heating-NG	589.9	67.9	702.1	878.5	590.4	384.2	590.6	589.9	465.8	589.9	444.4
Heating-Elec.	20.5	3.2	23.8	28.9	20.4	13.6	20.6	20.5	20.5	20.5	13.4
Equip.	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377
Lighting	1,811	1,811	1,393	999	1,811	1,811	1,811	1,811	1,811	1,811	1,811

Figure 109: Energy Use for Individual Energy Efficiency measures (Electric/Gas) for Houston, Texas.

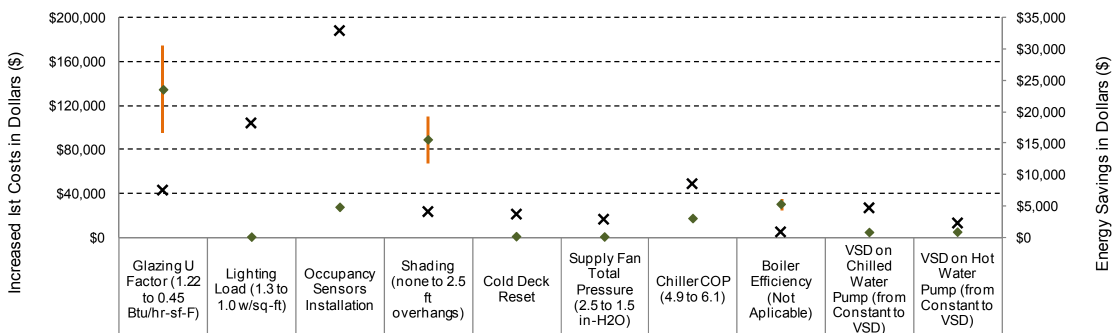


	Baseline	Glazing U-factor (Btu/hr-sqft-F)	Lighting Load (W/sqft)	Occupancy Sensors for Lights	Shading (ft)	Cold Deck Reset (F)	Supply Fan Total Pressure (in W.G.)	Chiller COP	Boiler Efficiency (%)	VSD on Chilled Water Loop	VSD on Hot Water Loop
Total	5,554	5,061	5,130	4,735	5,443	5,341	5,479	5,332	5,554	5,417	5,445
DHW	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1	36.1
Fans	239	238	221	211	225	257	187	239	239	239	239
Misc.	201	157	200	189	191	195	199	201	201	130	178
HtRj.	250	229	245	219	234	251	246	250	250	250	250
Cooling	1,126	1,125	1,064	976	1,058	1,053	1,109	905	1,126	1,061	1,126
Heating-NG											
Heating-Elec.	513.1	87.2	593.9	727.1	511.2	360.5	513.6	513.1	513.1	513.1	428.3
Equip.	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377	1,377
Lighting	1,811	1,811	1,393	999	1,811	1,811	1,811	1,811	1,811	1,811	1,811

Figure 110: Energy Use for Individual Energy Efficiency measures (All-Electric) for Houston, Texas

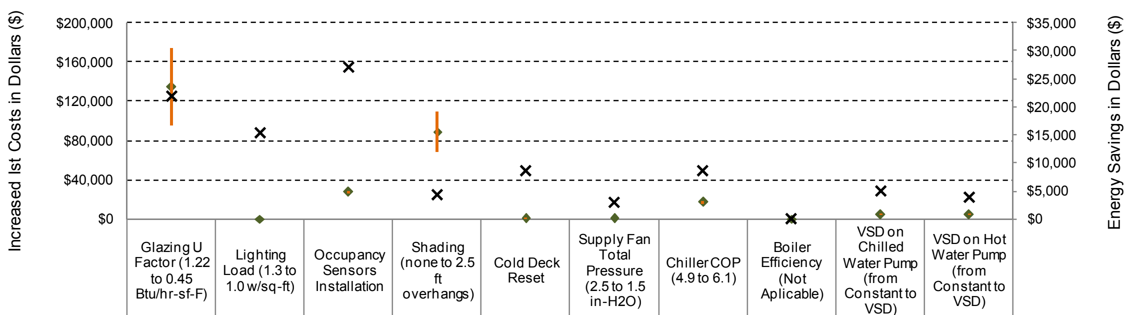
First Costs, Energy savings and Payback Periods for the Selected Energy Efficiency Measures

Figure 111 and show the increased costs and annual energy cost savings from the energy efficiency measures for lowered energy consumption for the different measures adopted. For example, in an electric/gas building with an improved glazing U-factor, the estimated first costs increased by $134,640 and saved $7,631, which represents a payback period of 12 years. In contrast, installing occupancy sensors cost $27,250, which saved $33,031, for a simple payback of less than one year. For both system types, four measures had very favorable paybacks of less than four years. These include: occupancy sensors, improved chiller COP, and VSDs on the hot and chilled water pumps. Figure 113 and Figure 114 present the payback period in years for each of the measures implemented. Shading strategies did not perform well for both building types. The average first costs of installing shading strategies were $88,000 for both the building types. However, the energy savings obtained from implementing these strategies was $4,233 for the electric/gas building and $4,321 for the all-electric building. The resulting average payback periods were 21years for both the building types.



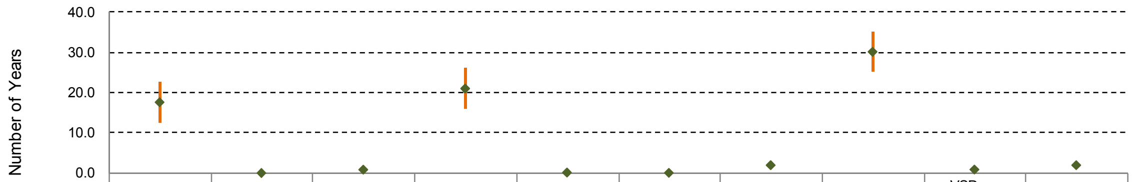
	Glazing U Factor (1.22 to 0.45 Btu/hr-sf-F)	Lighting Load (1.3 to 1.0 w/sq-ft)	Occupancy Sensors Installation	Shading (none to 2.5 ft overhangs)	Cold Deck Reset	Supply Fan Total Pressure (2.5 to 1.5 in-H2O)	Chiller COP (4.9 to 6.1)	Boiler Efficiency (Not Aplicable)	VSD on Chilled Water Pump (from Constant to VSD)	VSD on Hot Water Pump (from Constant to VSD)
Min 1st costs	$95,130	$0	$26,500	$67,900	$0	$0	$16,000	$25,000	$3,700	$4,000
Max 1st costs	$174,150	$0	$28,000	$110,000	$800	$200	$18,000	$35,000	$4,700	$5,000
◆Av. 1st costs	$134,640	$0	$27,250	$88,950	$400	$100	$17,000	$30,000	$4,200	$4,500
×Energy Savings	$7,631	$18,277	$33,032	$4,223	$3,887	$2,958	$8,718	$993	$4,885	$2,306

Figure 111: Increased First Costs and Energy Savings for the Selected Measures (Electric/Gas).



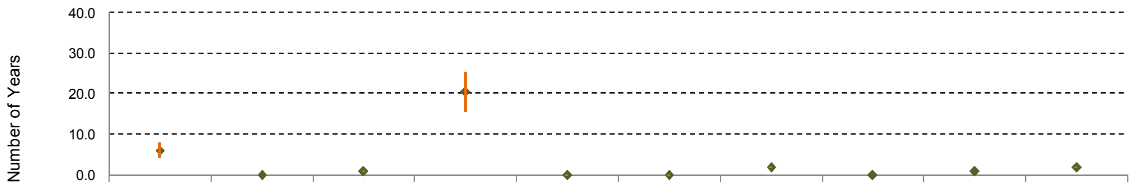
	Glazing U Factor (1.22 to 0.45 Btu/hr-sf-F)	Lighting Load (1.3 to 1.0 w/sq-ft)	Occupancy Sensors Installation	Shading (none to 2.5 ft overhangs)	Cold Deck Reset	Supply Fan Total Pressure (2.5 to 1.5 in-H2O)	Chiller COP (4.9 to 6.1)	Boiler Efficiency (Not Aplicable)	VSD on Chilled Water Pump (from Constant to VSD)	VSD on Hot Water Pump (from Constant to VSD)
Min 1st costs	$95,130	$0	$26,500	$67,900	$0	$0	$16,000	$0	$3,700	$4,000
Max 1st costs	$174,150	$0	$28,000	$110,000	$800	$200	$18,000	$0	$4,700	$5,000
◆Av. 1st costs	$134,640	$0	$27,250	$88,950	$400	$100	$17,000	$0	$4,200	$4,500
×Energy Savings	$21,910	$15,317	$27,078	$4,321	$8,656	$2,916	$8,482	$0	$4,972	$3,960

Figure 112: Increased First Costs and Energy Savings for the Selected Measures (All-Electric).



	Glazing U Factor (1.22 to 0.45 Btu/hr-sf-F)	Lighting Load (1.3 to 1.0 w/sq-ft)	Occupancy Sensors Installation	Shading (none to 2.5 ft overhangs)	Cold Deck Reset	Supply Fan Total Pressure (2.5 to 1.5 in-H2O)	Chiller COP (4.9 to 6.1)	Boiler Efficiency	VSD on Chilled Water Pump (from Constant to VSD)	VSD on Hot Water Pump (from Constant to VSD)
Min Years	12.5	0.0	0.8	16.1	0.0	0.0	1.8	25.2	0.8	1.7
Max Years	22.8	0.0	0.8	26.0	0.2	0.1	2.1	35.3	1.0	2.2
◆ Av. Years	18	0	1	21	0	0	2	30	1	2

Figure 113: Payback Periods for the Selected Measures (Electric/Gas).



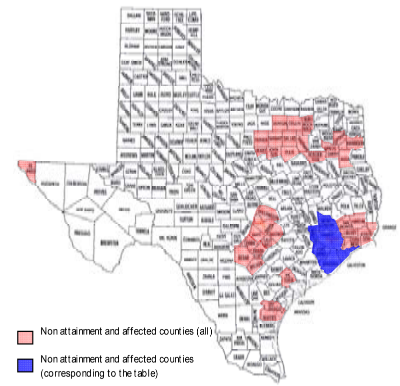
	Glazing U Factor (1.22 to 0.45 Btu/hr-sf-F)	Lighting Load (1.3 to 1.0 w/sq-ft)	Occupancy Sensors Installation	Shading (none to 2.5 ft overhangs)	Cold Deck Reset	Supply Fan Total Pressure (2.5 to 1.5 in-H2O)	Chiller COP (4.9 to 6.1)	Boiler Efficiency (Not Aplicable)	VSD on Chilled Water Pump (from Constant to VSD)	VSD on Hot Water Pump (from Constant to VSD)
Min Years	4.3	0.0	1.0	15.7	0.0	0.0	1.8	0.0	0.7	1.7
Max Years	7.9	0.0	1.0	25.5	0.1	0.1	2.1	0.0	0.9	2.2
◆ Av Years	6	0	1	21	0	0	2	0	1	2

Figure 7b: Payback Periods for the Selected Measures (All-Electric).

Natural Gas Heating (Brazoria, Fort Bend, Galveston, Harris, Montgomery and Waller Counties)

Description of Individual Measures

	Individual Measures	Annual Energy Savings (%)	Annual Energy Savings ($/year)	Annual Demand Savings (%)	Annual Demand Savings ($/year)	Combined Savings (Energy+Demand) ($/year)	Estimated Cost ($) Marginal Cost[1]	Estimated Cost ($) New System Cost[2]
A	Envelope and Fenestration Measures							
1	Glazing U Factor (1.22 to 0.45 Btu/hr-sf-F)	10.7%	$7,114	3.2%	$517	$7,631	$95,130 - $174,150	
2	Lighting Load (1.3 to 1.0 w/sq-ft)	6.9%	$16,582	10.4%	$1,695	$18,277	$0 - $0	
3	Occupancy Sensors Installation	13.0%	$33,409	-2.3%	-$377	$33,032		$26,500 - $28,000
4	Shading (none to 2.5 ft overhangs)	1.9%	$3,785	2.7%	$438	$4,223		$67,900 - $110,000
B	HVAC System Measures							
5	Cold Deck Reset	4.8%	$3,978	-0.6%	-$91	$3,887	$0 - $800	
6	Supply Fan Total Pressure (2.5 to 1.5 in-H2O)	1.3%	$2,629	2.0%	$329	$2,958	$0 - $200	
C	Plant Equipment Measures							
7	Chiller COP (4.9 to 6.1)	3.9%	$7,717	6.1%	$1,000	$8,718	$16,000 - $18,000	
8	Boiler Efficiency (75% to 95%)	2.2%	$993	0.0%	$0	$993	$25,000 - $35,000	
9	VSD on Chilled Water Pump (from Constant to VSD)	2.4%	$4,764	0.7%	$121	$4,885	$3,700 - $4,700	
10	VSD on Hot Water Pump (from Constant to VSD)	3.1%	$2,243	0.4%	$63	$2,306	$4,000 - $5,000	



Description of Combined Measures to Achieve 15% Above Code Savings

	Combination of Measures[3]	Combined Energy Savings (%)	Combined Energy Savings ($/year)	Combined Demand Savings (%)	Combined Demand Savings ($/year)	Combined Savings (Energy+Demand) ($/year)	Combined Estimated Cost ($) Marginal Cost[1]	Combined Estimated Cost ($) New System Cost[2]	Combined Annual NOx Emissions Savings (lbs/year)	Combined Ozone Season Period NOx Emissions Savings (lbs/day)	Simple Estimated Payback (yrs)
	Combination 1										
1	Glazing U Factor (1.22 to 0.45 Btu/hr-sf-F)	20.1%	$26,160	13.6%	$2,214	$28,374	$95,130 - $174,150		258	0.95	3.6 - 6.7
2	Lighting Load (1.3 to 1.0 w/sq-ft)						$0 - $0				
	Combination 2										
3	Occupancy Sensors Installation	19.6%	$38,856	-3.4%	-$558	$38,299		$26,500 - $28,000	371	1.37	0.7 - 0.7
5	Cold Deck Reset						$0 - $800				
	Combination 3										
1	Glazing U Factor (1.22 to 0.45 Btu/hr-sf-F)	16.8%	$18,719	9.5%	$1,554	$20,273	$95,130 - $174,150		187	0.71	7.5 12.4
7	Chiller COP (4.9 to 6.1)						$16,000 - $18,000				
8	Boiler Efficiency (75% to 95%)						$25,000 - $35,000				
9	VSD on Chilled Water Pump (from Constant to VSD)						$3,700 - $4,700				

Note:
1. Marginal cost = new system cost - original system cost
2. New system cost = new system cost only
3. See individual measures above for specific savings
   * Energy Cost: Electricity cost = $0.119/kWh
   Demand cost = $5.00/kW
   (Yearly demand cost = Sum of monthly demand cost for 12 months
   Natural gas cost = $0.80/therm

(Building Description)
Building type: Office
Gross area: 89,340 sq-ft
Building dimension: 122ft x 122ft x 78ft (WxLxH)
Number of floors: 6
Floor-to-floor height: 13ft
Window-to-wall ratio: 50%

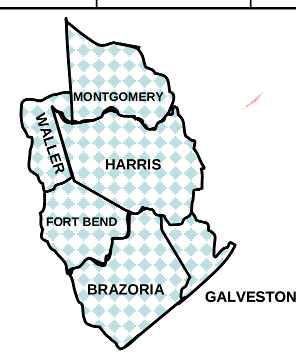


Table 5a: 15% Above Code Savings (Commercial – Natural Gas Heating) for Brazoria, Fort Bend, Galveston, Harris, Montgomery and Waller Counties

Energy Systems Laboratory - August 2007

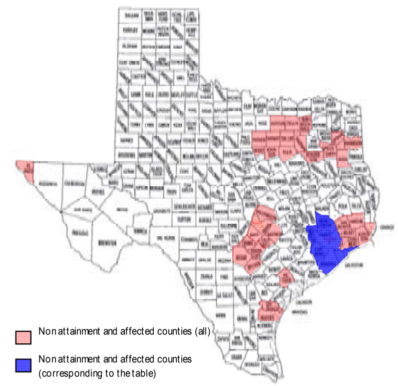
1

Figure 114: 15% Above-Code Savings (Commercial – Electric/Gas) for Brazoria, Fort Bend, Galveston, Harris, Montgomery and Waller Counties.

Electric Heating (Brazoria, Fort Bend, Galveston, Harris, Montgomery and Waller Counties)

Description of Individual Measures

	Individual Measures	Annual Energy Savings (%)	Annual Energy Savings ($/year)	Annual Demand Savings (%)	Annual Demand Savings ($/year)	Combined Savings (Energy+Demand) ($/year)	Estimated Cost ($) Marginal Cost[1]	Estimated Cost ($) New System Cost[2]
A	Envelope and Fenestration Measures							
1	Glazing U Factor (1.22 to 0.45 Btu/hr-sf-F)	8.9%	$17,184	22.6%	$4,726	$21,910	$95,130 - $174,150	
2	Lighting Load (1.3 to 1.0 w/sq-ft)	7.6%	$14,774	2.6%	$543	$15,317	$0 - $0	
3	Occupancy Sensors Installation	14.7%	$28,545	-7.0%	-$1,468	$27,078		$26,500 - $28,000
4	Shading (none to 2.5 ft overhangs)	2.0%	$3,849	2.3%	$471	$4,321		$67,900 - $110,000
B	HVAC System Measures							
5	Cold Deck Reset	3.8%	$7,412	5.9%	$1,244	$8,656	$0 - $800	
6	Supply Fan Total Pressure (2.5 to 1.5 in-H2O)	1.4%	$2,616	1.4%	$299	$2,916	$0 - $200	
C	Plant Equipment Measures							
7	Chiller COP (4.9 to 6.1)	4.0%	$7,717	3.7%	$765	$8,482	$16,000 - $18,000	
8	Boiler Efficiency (Not Aplicable)	n/a	n/a	n/a	n/a	n/a	n/a - n/a	
9	VSD on Chilled Water Pump (from Constant to VSD)	2.5%	$4,764	1.0%	$208	$4,972	$3,700 - $4,700	
10	VSD on Hot Water Pump (from Constant to VSD)	2.0%	$3,787	0.8%	$172	$3,960	$4,000 - $5,000	



Description of Combined Measures to Achieve 15% Above Code Savings

	Combination of Measures[3]	Combined Energy Savings (%)	Combined Energy Savings ($/year)	Combined Demand Savings (%)	Combined Demand Savings ($/year)	Combined Savings (Energy+Demand) ($/year)	Combined Estimated Cost ($) Marginal Cost[1]	Combined Estimated Cost ($) New System Cost[2]	Combined Annual NOx Emissions Savings (lbs/year)	Combined Ozone Season Period NOx Emissions Savings (lbs/day)	Simple Estimated Payback (yrs)
	Combination 1										
1	Glazing U Factor (1.22 to 0.45 Btu/hr-sf-F)	18.5%	$35,763	29.8%	$6,237	$42,000	$95,130 - $174,150		341	1.08	2.7 - 4.9
2	Lighting Load (1.3 to 1.0 w/sq-ft)						$0 - $0				
	Combination 2										
3	Occupancy Sensors Installation	19.8%	$38,343	0.0%	$5	$38,348		$26,500 - $28,000	366	1.36	0.7 - 0.8
5	Cold Deck Reset						$0 - $800				
	Combination 3										
1	Glazing U Factor (1.22 to 0.45 Btu/hr-sf-F)	15.5%	$30,066	27.7%	$5,793	$35,859	$95,130 - $174,150		287	0.90	4.0 - 6.7
7	Chiller COP (4.9 to 6.1)						$16,000 - $18,000				
9	VSD on Chilled Water Pump (from Constant to VSD)						$3,700 - $4,700				
10	VSD on Hot Water Pump (from Constant to VSD)						$4,000 - $5,000				

Note:
1. Marginal cost = new system cost - original system cost
2. New system cost = new system cost only
3. See individual measures above for specific savings
   * Energy Cost: Electricity cost = $0.119/kWh
   Demand cost = $5.00/kW
   (Yearly demand cost = Sum of monthly demand cost for 12 months
   Natural gas cost = $0.80/therm

(Building Description)
- Building type: Office
- Gross area: 89,340 sq-ft
- Building dimension: 122ft x 122ft x 78ft (WxLxH)
- Number of floors: 6
- Floor-to-floor height: 13ft
- Window-to-wall ratio: 50%

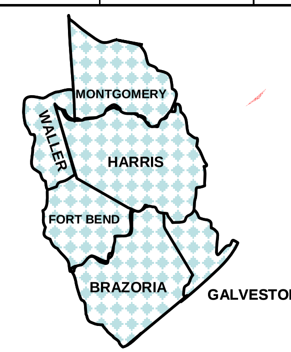


Table 5b: 15% Above Code Savings (Commercial – Electric Heating) for Brazoria, Fort Bend, Galveston, Harris, Montgomery and Waller Counties

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Figure 115: 15% Above-Code Savings (Commercial – All-Electric) for Brazoria, Fort Bend, Galveston, Harris, Montgomery and Waller Counties.

Figures Containing 15% above Code Savings Charts

Figure 114and Figure 115 present the 15% above-code saving charts for an electric/gas building, and an all-electric building. These charts represent the final summary presentation of the detailed information previously shown. In these figures the results are presented for Houston, Texas, which are also applicable for Brazoria, Fort Bend, Galveston, Harris, Montgomery and Waller counties. Similar results for other non-attainment[61] counties in Texas can be found on the Laboratory's Senate Bill 5 website (eslsb5.tamu.edu).

In these figures, the upper table summarizes the results for individual measures in terms of annual energy savings (% and dollars/year), annual demand savings (% and dollars/year), combined savings (energy and demand in dollars/year) and the estimated costs for each measure.[62] The second table in each figure summarizes the results obtained by implementing combinations of measures. Results are presented in terms of combined energy savings (% and dollars/year), combined demand savings (% and dollars/year), combined savings (energy + demand in dollars/year), combined implementation costs (marginal and new system costs) and simple payback periods (years). NOx emissions reductions for each of the combinations are also presented in terms of annual NOx emission savings (lbs/year) and savings during the ozone season period (lbs/day).[63] The maps of all the non-attainment and near non-attainment counties and specific counties for each page are included in the upper and lower figures.

For the case of an electric/gas building, combining the measures of a glazing U-value of 0.45 Btu/hr-ft^2-°F and lighting load of 1 W/ft^2 in combination 1yields a combined energy saving of 20%. Combining the measures of installing occupancy sensors and cold deck reset in combination 2 yields a combined energy saving of 19.6%. Combination 3 consisting of implementing a low glazing U-value of 0.45 Btu/hr-ft^2-°F, a chiller COP of 6.1, a boiler efficiency of 95% and a VSD on the chilled water pump yields a combined energy saving of 16.8%.

For the case of an all-electric building, combining the measures of a glazing U-value of 0.45 Btu/hr-ft^2-°F and lighting load of 1 W/ft^2 in combination 1 yields a combined energy saving of 18.5%. Combining the measures of installing occupancy sensors and cold deck reset in combination 2 yields a combined energy saving of 19.8%. Combination 3 consisting of implementing a low glazing U-value of 0.45 Btu/hr-ft^2-°F, a chiller COP of 6.1 and VSDs on the chilled water pump and hot water pump yields a combined energy saving of 15.5%.

SUMMARY

This section presented an overview of the recommendations for achieving 15% above-code energy performance for commercial office buildings complying with ASHRAE Standard 90.1-1999. In the section an analysis was performed for an 89,304 ft^2, 6-story office building in Houston, Texas, with 50% window-to-wall ratio. To accomplish the 15% annual energy consumption reductions, ten measures were considered, including: improved glazing U-value, decreasing lighting power density, window shading, reducing static pressure, improving chiller COP, improving boiler efficiency, cold deck reset, VSDs on chilled and hot water pumps, and occupancy sensors for lighting control. After savings were determined for each measure, they were then grouped into several groups to accomplish a 15% total annual energy consumption reduction. The 15% above code energy performance accounted for the energy use of the building. If only the HVAC and lighting energy consumption were considered, the range of savings from implementing these measures would increase up to 20-30%.

[61] The Clean Air Act and Amendments of 1990 define a "nonattainment area" as a locality where air pollution levels persistently exceed National Ambient Air Quality Standards, or that contributes to ambient air quality in a nearby area that fails to meet standards(http://www.scorecard.org/env-releases/def/cap_naa.html).
[62] The costs for measures are presented as marginal costs and new systems costs, where marginal costs represent the incremental costs to implement the measure by modifying an existing system. New system costs represent costs for newly installed measures.
[63] The Ozone Season Period (OSP) represents average daily savings during the hottest period of the year from mid-July to mid-September as defined by the U.S.E.P.A.

For Houston, reducing lighting loads and implementing occupancy sensors were the most effective individual measures for both electric/gas and all-electric buildings. The strategy which combined lowering the glazing U factor and lighting loads proved to be most effective for the electric/gas building with savings of up to 20%. For the all-electric building the combination of implementing occupancy sensors and cold deck reset proved to be most effective with savings up to 20%. It is to be noted that the energy cost savings and cost-effectiveness for individual and combined measures were not of the same order as the energy use savings, since these depend on the fuel type used, demand savings, and the first cost vs. energy cost savings.

Table 18: Base-case Summary.

CHARACTERISTIC	BASECASE ASSUMPTIONS	SOURCES
Building		
Building type	Office	
Gross area (sq-ft)	89,304	Prototypical office building size and number of floors (Huang & Franconi, 1999, p.31)
Dimension (ft x ft)	122 x 122	
Number of floors	6	
Floor to floor height (ft)	13	ASHRAE 90.1-1989-13.7.1 (p.105)
Construction		
Roof absorptance	0.7	ASHRAE 90.1-1999-11.4.2(b) (p.58)
Roof insulation R-value (hr-sq.ft-F/Btu)	15	ASHRAE 90.1-1999, Table B-5 (11.4.2(a)), (p.95)
Wall absorptance	0.7	ASHRAE 90.1-1989-13.7.3.3 (p.106)
Wall insulation R-value (hr-sq.ft-F/Btu)	13	ASHRAE 90.1-1999, Table B-5 (11.4.2(a)), (p.95)
Ground reflectance	0.2	ASHRAE 90.1-1989-13.7.3.3 (p.106)
U-Factor of glazing (Btu/hr-sq.ft-F)	1.22	ASHRAE 90.1-1999, Table B-5 (11.4.2(c)), (p.95)
Solar Heat Gain Coefficient (SHGC)	0.17	ASHRAE 90.1-1999, Table B-5 (11.4.2(c)), (p.95)
Window-to-wall ratio (%)	50	Average WWR of new construction (Huang & Franconi, 1999, p.31[1])
Space		
Area per person (ft^2/person) for office	275 (325 occupants)	ASHRAE 90.1-1989, Table 13-2, (p.103)
Occupancy schedule	8am-10pm (Monday - Saturday)	ASHRAE 90.1-1989, Table 13-3, (p.104)
Space temperature setpoint	70F Heating / 75F Cooling	ASHRAE 90.1-1989-13.7.6.2 (p.110)
Lighting load (W/ft2) for Office	1.3	ASHRAE 90.1-1999, Table 9.3.1.1, (p.51)
Lighting schedule	24 hours (Monday - Saturday)	Abushakra et al., 2001, (ASHRAE RP-1093, p.61)
Equipment load (W/ft2) for office	0.75	ASHRAE 90.1-1989, Table 13-4, (p.106)
Equipment schedule	24 hours (Monday - Saturday)	Abushakra et al., 2001, (ASHRAE RP-1093, p.62)
HVAC Systems		
HVAC system type	VAV with terminal reheat	ASHRAE 90.1-1999, Table 11.4.3A, (p.59, System2)
Number of HVAC units	5	Serving 5 thermal zones
Supply motor efficiency (%)	90	Kavanaugh, 2003 (p.38)
Supply fan efficiency (%)	61	ASHRAE 90.1-1989, Table 13-6, (p.108, System #5)
Supply fan total pressure (in W.G)	2.5	Info. by ESL CC engineers
Plant Equipment		
Chiller type	Screw	ASHRAE 90.1-1999, Table 6.2.1C, (p.29)
Chiller COP	4.9	ASHRAE 90.1-1999, Table 6.2.1C, (p.29)
Boiler type	Hot water boiler	ASHRAE 90.1-1999, Table 11.4.3A, (p.59, System2)
Boiler fuel type	Natural gas	ASHRAE 90.1-1999, Table 11.4.3A, (p.59, System2)
Boiler thermal efficiency (%)	75	ASHRAE 90.1-1999, Table 6.2.1F, (p.31)
DHW fuel type	Natural gas	ASHRAE 90.1-1999, Table 7.2.2, (p.47)
DHW heater thermal efficiency (%)	80	ASHRAE 90.1-1999, Table 7.2.2, (p.47)

5.2.15 Review of Local Amendments

5.2.15.1 June 2006 Stakeholder's Meeting

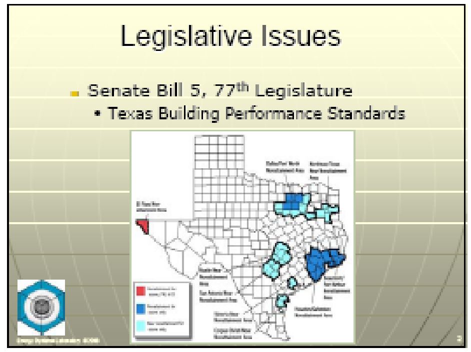
In 2005 the Laboratory received several requests for a review of Local Amendments from the North Central Texas COG, the City of Plano and several other COGs. These requests focused on whether or not these jurisdictions should migrate to the 2006 IECC. In response to these requests the Laboratory performed an extensive analysis of the 2006 IECC for the entire state. The results of this analysis was presented in a series of workshops held in June and November 2006. These workshops were attended by code officials, builders, architects and interested others who were part of the SB5 Stakeholders group.

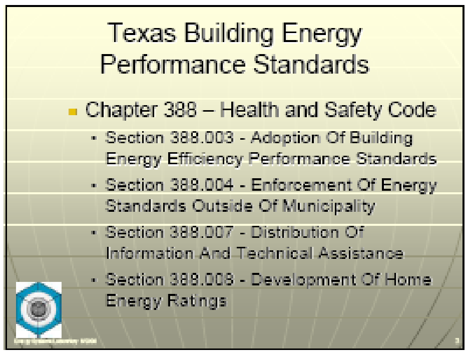
In the June 2006 workshop, the preliminary results were presented. At this meeting first the Laboratory's Legislative duties were reviewed, then an analysis was presented that pointed out the specific differences between the 2000/2001 IECC and the 2006 IECC. These differences include changes in the climate zones, differences in the window-to-wall area ratios and envelope requirements.

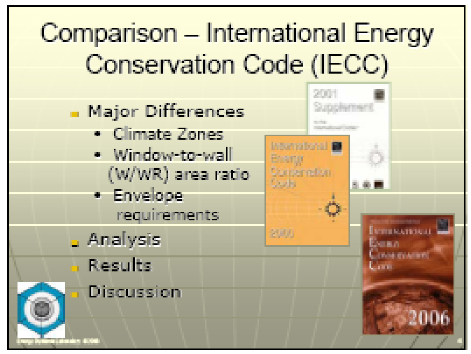
In the 2006 IECC the previous eight weather zones were reduced to three weather zones for the entire state. Although this was intended to reduce the number of climate tables in the IECC, which would simplify the code it had the unintended effect of imposing similar window and wall thermal properties across areas of the state that varied by 2000+ HDD. Previously, climate regions were limited to differences of about 500 HDD.

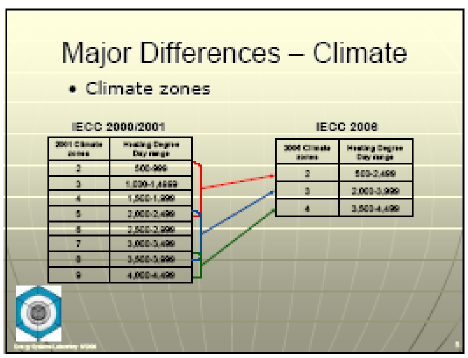
In the 2006 IECC the increasing insulation requirements with increasing window-to-wall areas were eliminated. This was intended to simplify the code by allowing for one set of thermal values to apply for a climate region regardless of the window areas. To analyze this effect, code compliant simulations were performed for varying window-to-wall ratios for different areas of the state using the 2000/2001 performance-based requirements and the new 2006 requirements, both with SEER 13. Unfortunately, this change in the code was determined to be less stringent that the 2000/2001 IECC for selected window-to-wall ratios in selected areas of the state. In some areas of the state, it was even determined that single-family residences built to 2006 IECC were not as stringent as the 2000/2001 IECC even if no windows were installed (i.e., an improbably building).

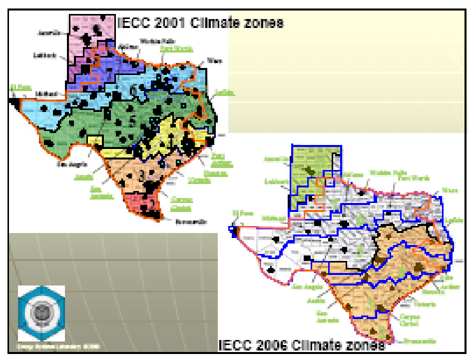
Several different recommendations were presented to the stakeholders, including: 1) remaining with the IECC for residential construction, and 2) only modifying specific tables in the 2006 IECC (Table 402.1.1), and keeping the weather zones as published for the 2006 IECC to allow for one set of weather classification across residential and commercial construction. Based on recommendations from the Stakeholders, it was recommended that the Laboratory perform the simulations to develop a new Table 402.1.1 for the 2006 IECC that reinserts the window-to-wall ratio tables for the new weather zones.

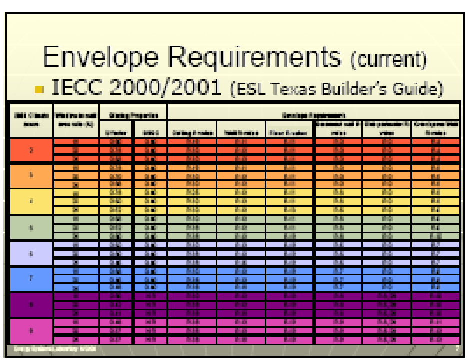












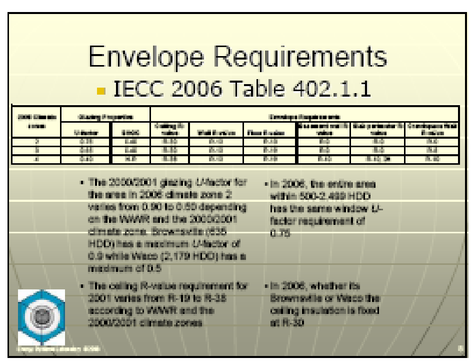
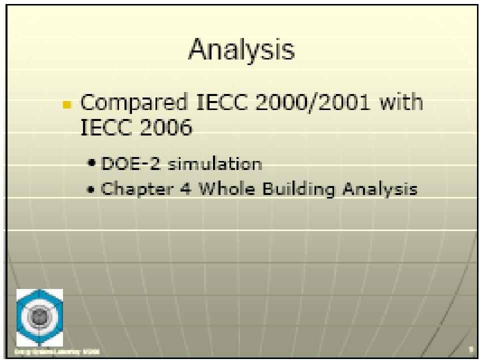
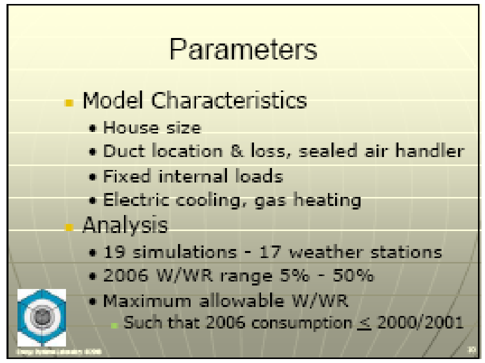
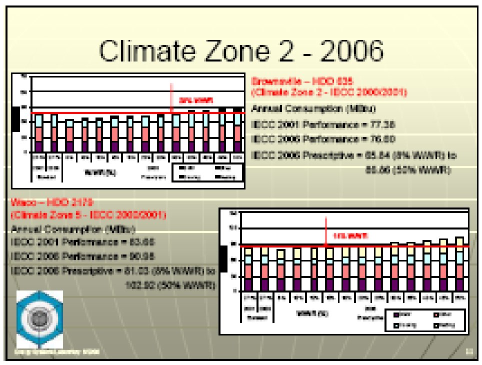
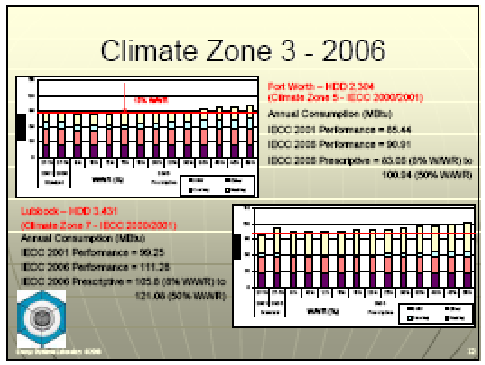


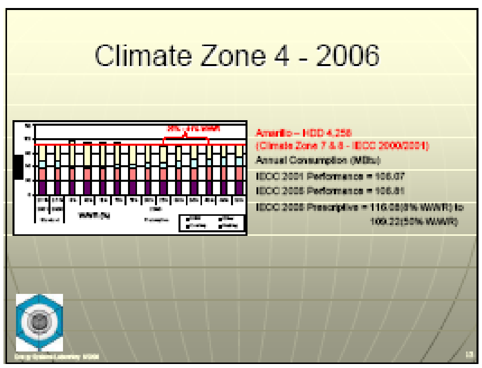
Figure 116: Slides presented at the June 2006 Stakeholders workshop.

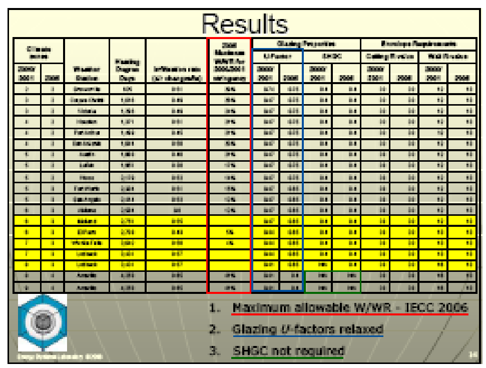


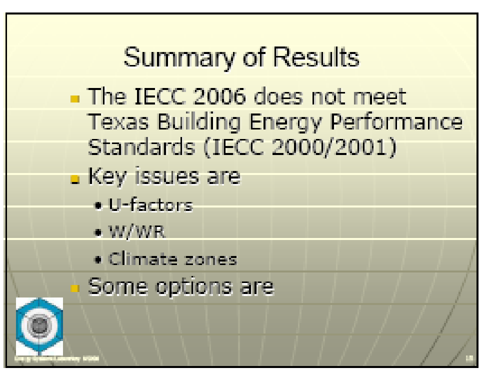












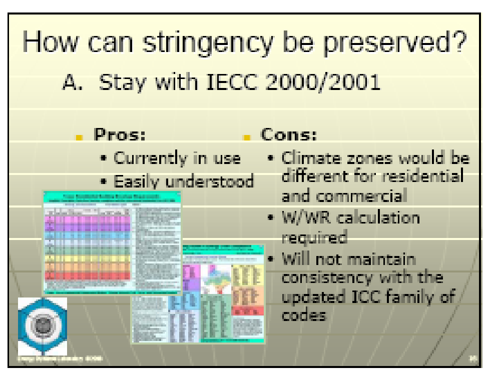
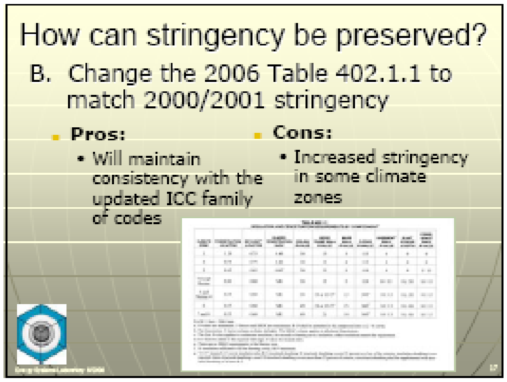
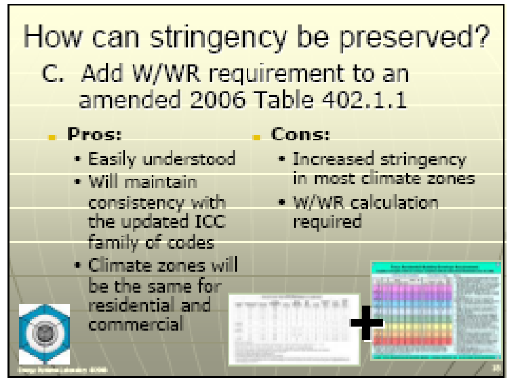
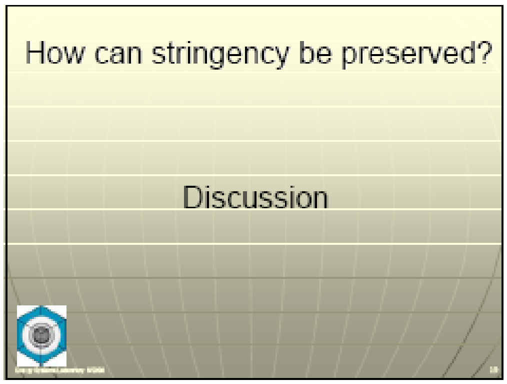


Figure 117: Slides presented at the June 2006 Stakeholders workshop.







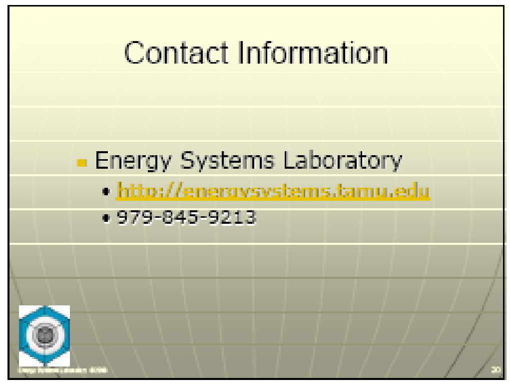


Figure 118: Slides presented at the June 2006 Stakeholders workshop.

5.2.15.2 September 2006 Stakeholder's Meeting.

In the September 2006 workshop, the results of the requested simulations were presented. This included the reconfiguration of the weather zones to allow for the use of zones 2, 3 and 4 in the 2006 IECC to be further subdivided into zones that more accurately reflected the 2001 IECC, yet retained the 2, 3 and 4 notation. Hence the use of the 2.1, 2.2, 3.1, 3.2, 3.3, 3.4 and 4 designation.

The presentation of the new prescriptive table was also presented that utilized the new weather zones. These proposed changes were discussed with the stakeholders, who provided feedback and new requests for additional work to be performed and reported in the next workshop.

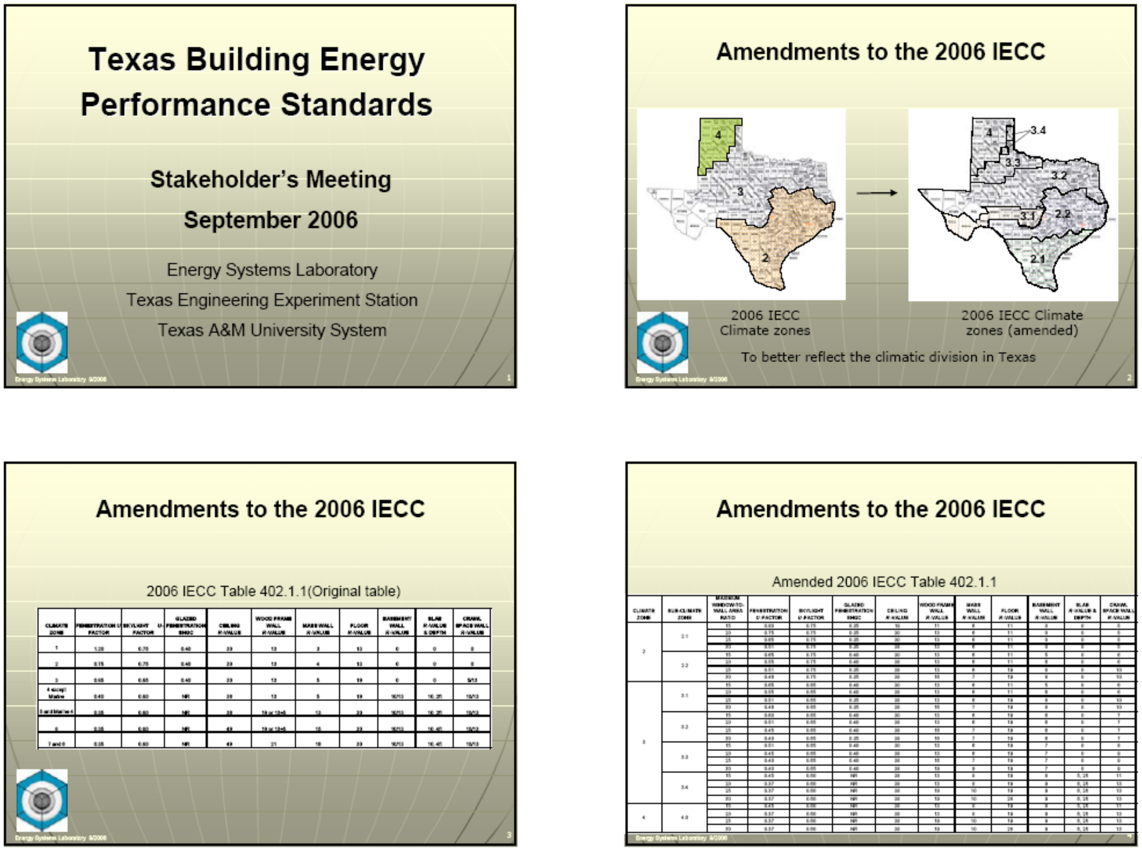


Figure 119: Slides presented at the September 2006 Stakeholders workshop.

5.2.15.3 November 2006 Stakeholder's Meeting.

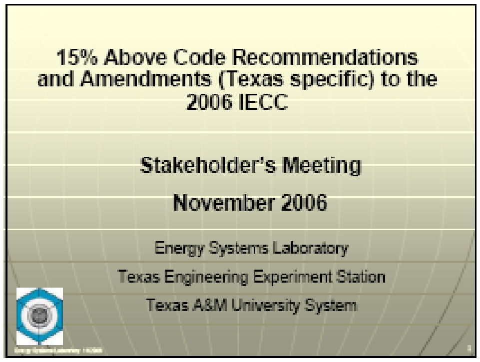
In the November 2006 workshop, the results of the requested simulations from the September 2006 workshop were presented as well as preliminary results of the Laboratory's efforts to develop the 15% above code recommendations required by the Legislation.

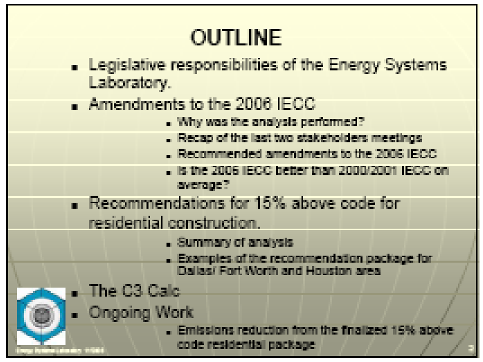
The workshop again began with a review of the Legislative responsibilities for the Laboratory, and a review of the preliminary information presented in the June 2006 workshop. This was then followed by a presentation of the methodology that was being used to evaluate measures for the 15% above-code residential construction, which included handouts of the presentation tables for several of the climate zones.

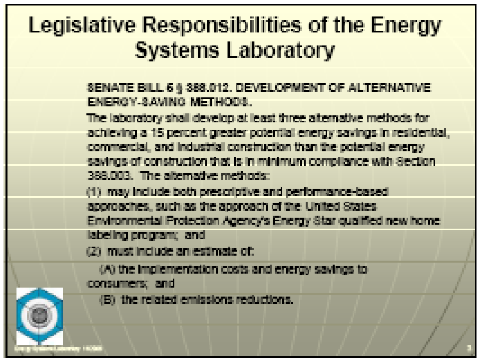
At the meeting a working group was formed from the Stakeholder's group to assist the Laboratory with the final assembly of the measures, which included a review of the costing information used in the analysis. The final results of this effort were completed in August of 2007, and can be found on the Laboratory's Senate Bill 5 web site. These measures evaluated eleven individual options, including: tankless gas water heaters, solar domestic water heaters, removal of the pilot light from the gas-fired water heater, relocating ducts to the conditioned space, improved duct sealing, reduced air infiltration, window shading, window redistribution, and improved windows. These individual measures were then grouped into combinations that yielded 15% or more annual energy savings over a code compliant building.

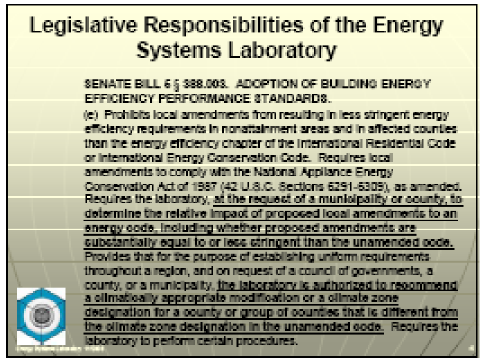
Following the presentation of the 15% above-code residential construction recommendations, there was a discussion of the Laboratory's Code Compliance Calculator, which was requested by the NCTCOG and several other municipalities. This was then followed by a recap of the September 13th meeting with the working group to discuss how to realign the weather zones for the state, and new prescriptive tables.

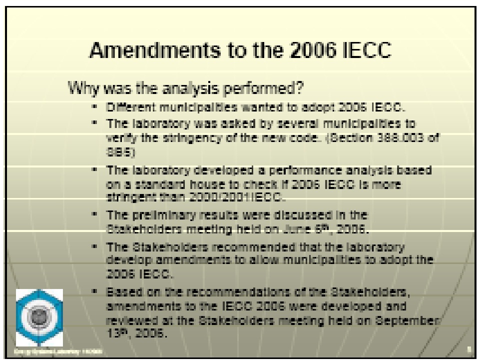
In addition, at the September 2006 stakeholders meeting the Laboratory was asked to determine if the new revised tables would be more/less stringent that the 2001 IECC. This analysis was performed and the results presented, which showed . The laboratory analyzed Dallas/Fort Worth (DFW) area (9 counties) and Houston area (8 counties) which constitutes more than 56% of all the new residential construction. The analysis was based on a standard house with a conditioned square footage and window area from published characteristics from NAHB and F.W. Dodge. Results show that for DFW area, 2006 IECC is less stringent by 4.4% and for Houston area, 2006 IECC is more stringent by 1.7% when compared with 2000/2001 IECC. Hence, the 2006, on average, would be less stringent for both areas combined.

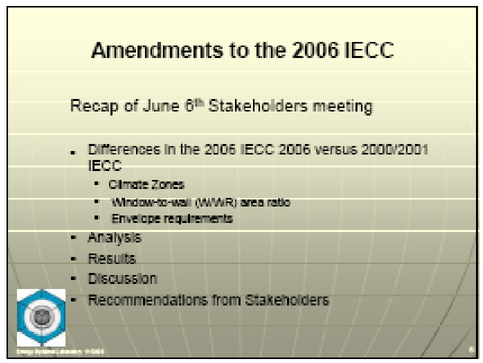


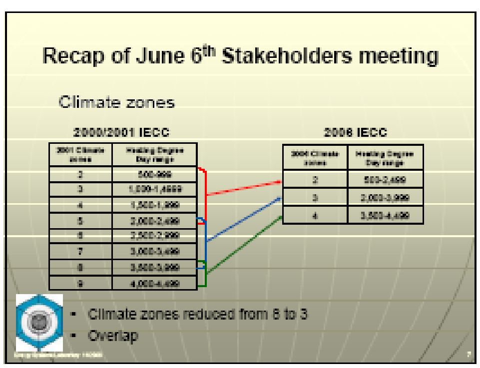












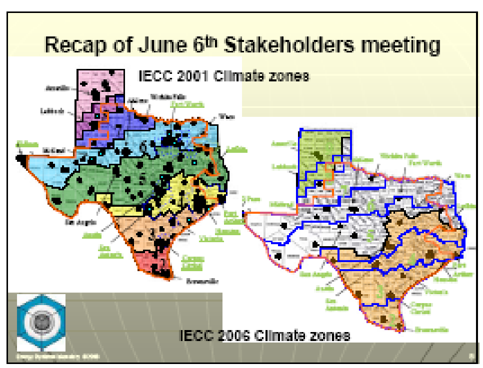
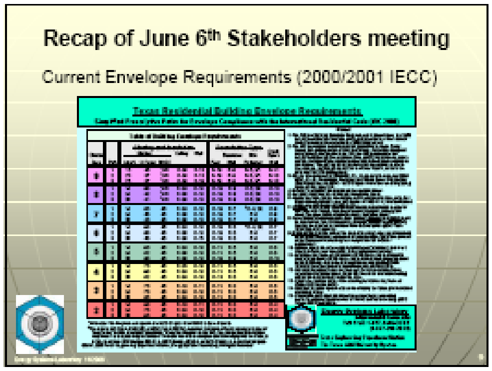
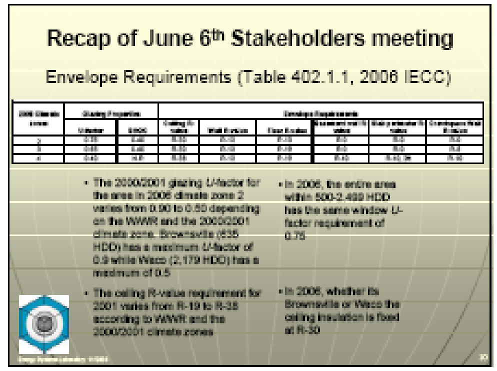
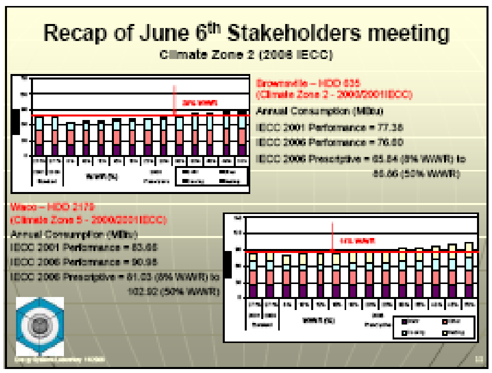
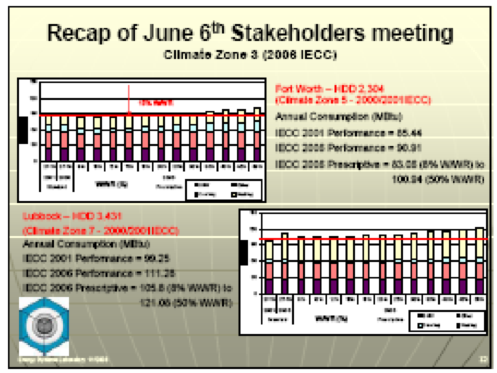


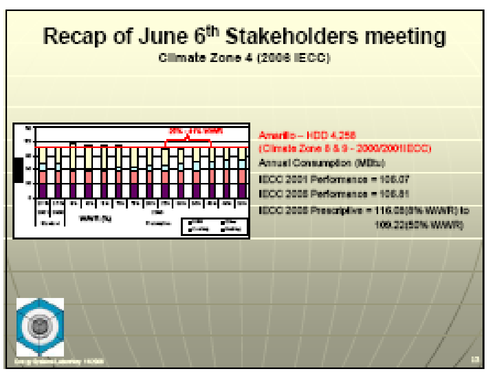
Figure 120: Slides presented at the November 2006 Stakeholders workshop.

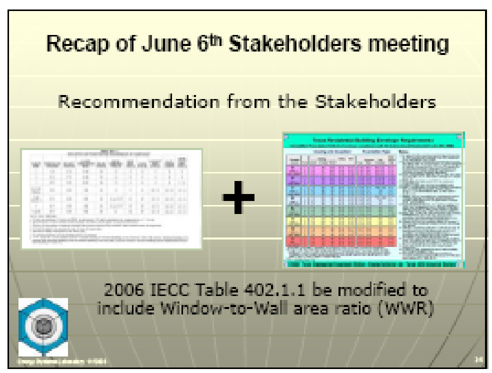


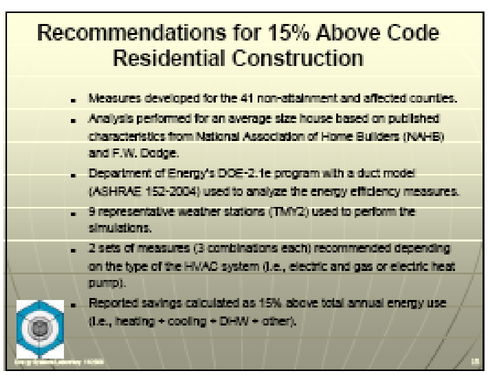












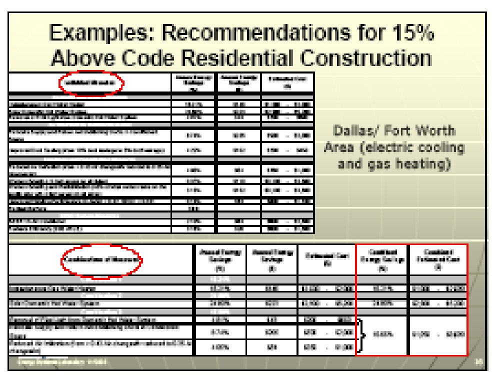
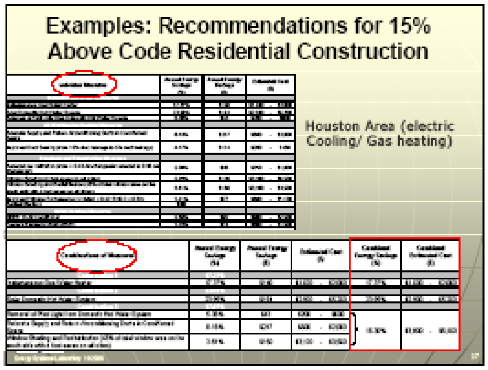
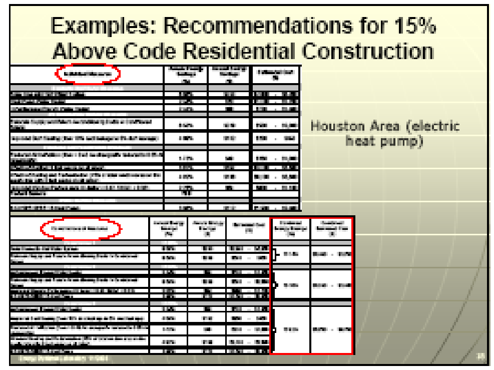
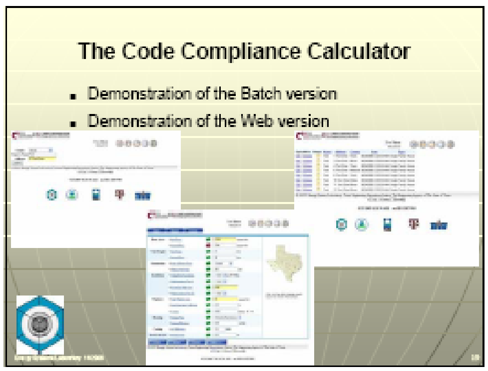
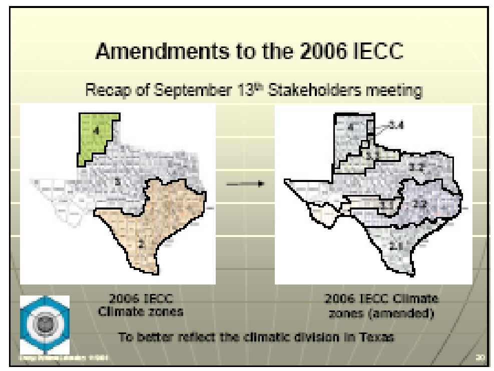


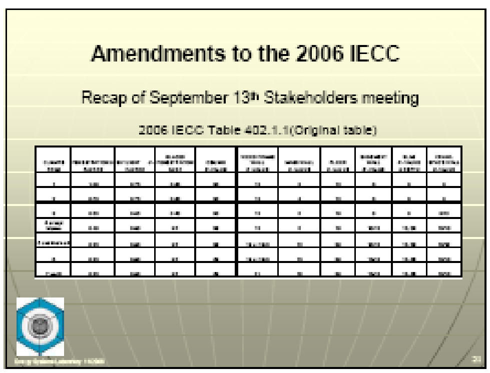
Figure 121: Slides presented at the November 2006 Stakeholders workshop.

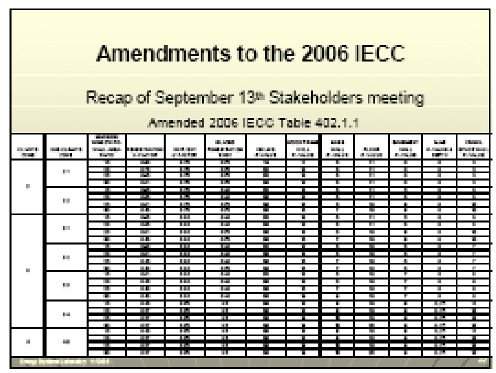


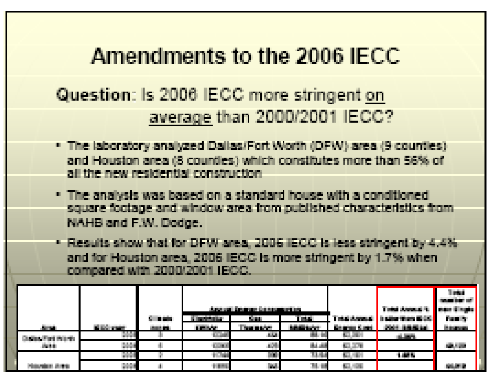












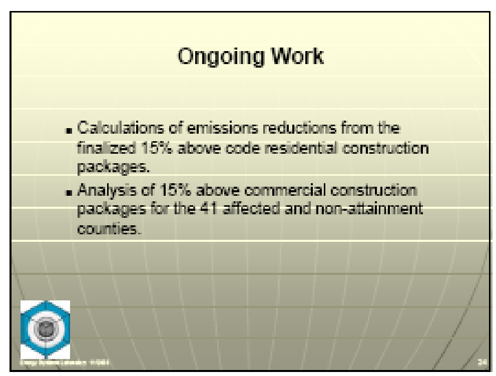


Figure 122: Slides presented at the November 2006 Stakeholders workshop.

6 CALCULATED NOx REDUCTION POTENTIAL FROM IMPLEMENTATION OF THE IECC / IRC

6.1 Calculated 2006 Electricity and Natural Gas Savings Due to the Implementation of the IECC / IRC to New Residential Construction (Single-family and Multi-family), and Commercial Buildings Using Code-traceable, Fuel-Neutral Simulation.

A complete reporting of the savings from the implementation of the IECC / IRC requires tracking and analyzing savings to new construction and construction activity to existing buildings that undergoes a building permit. Adoption of the IECC / IRC is expected to impact the following types of buildings:

- single-family residential
- multi-family residential
- commercial buildings
- industrial buildings
- renewables

Adoption of the IECC / IRC is also expected to impact construction activity in existing buildings that undergoes a building permit. Such activity would impact the following types of buildings:

- single-family residential
- multi-family residential
- commercial buildings
- industrial buildings
- renewables

The following sections report calculations of the energy savings associated only with new construction activity in new residences (i.e., single-family and multi-family), and commercial construction. Calculation of energy savings adoption of the IECC / IRC in industrial building and renewables is currently under development at the Laboratory, and will be reported in future reports.

6.1.1 2006 Results for New Single-family Residential Construction.

In this section of the report, calculations are provided regarding the potential electricity reductions and associated emissions reductions from the implementation of the IECC / IRC to new single-family residences in the 41 non-attainment and affected counties[64]. To calculate the NOx emissions reductions from the implementation of the IECC / IRC, a number of procedures were followed. First, new construction activity by county had to be determined; then energy savings attributable to the IECC / IRC had to be modeled using the code-traceable, DOE-2 simulation that the Laboratory has developed for the TERP; these estimates were then applied to the NAHB Builder's survey data to determine the appropriate number of housing types; then estimates of the NOx reduction potential from the electricity reductions in each county were calculated using the US EPA's 2007 eGRID database[65].

In Table 19 and

Table 20, the 1999 and IECC / IRC code-compliant building characteristics are shown for each county. The 1999 building characteristics reflect those published by the NAHB, ARI and GAMA for Texas. The

[64] The three new counties, Henderson, Hood and Hunt were added in the 2003 Legislative session are included in this.
[65] This preliminary analysis does not include actual power transfers on the grid, and assumes transmission and distribution losses of 7%. Counties were assigned to utility service districts as indicated.

IECC / IRC code-compliant characteristics are the minimum building code characteristics required by the IECC / IRC for each county for single-family residences (i.e., Type A.1)[66]. In Table 19 and

Table 20, the rows are sorted first by the US EPA's non-attainment, affected designation, and other ERCOT Counties, then alphabetically. Next, in the third column, the NAHB survey classification is listed. The fourth column in Table 19 and

Table 20 lists the window area for the average house as defined by the NAHB survey[67]. The fifth, sixth, seventh, eighth, and ninth columns show the NAHB's average glazing U-value, Solar Heat Gain Coefficient (SHGC), roof insulation and wall insulation, respectively. In columns nine through thirteen of Table 19 and

Table 20, the corresponding values from the IECC / IRC code-compliant house are listed for each county (i.e., percent area, glazing U-value, SHGC, roof and wall insulation R-value). For each county, the identical window percent area was used for the 1999 and code-compliant calculation (i.e., window-to-wall area).

The IECC / IRC SHGC is 0.4 for all non-attainment and affected counties since they all fall below the 3,500 HDD_{65}, as required by the IECC / IRC. All the 1999 houses were assumed to have an air-conditioner efficiency[68] equal to a SEER 11, a furnace efficiency (AFUE) of 0.80, and a domestic water heater efficiency of 76%. All the IECC/IRC code-compliant houses were assumed to have an air-conditioner efficiency equal to a SEER 13[69]. The values shown in Table 19 and

Table 20, represent the only changes that were made to the simulation to obtain the savings calculations. All other variables in the simulation remained the same for the 1999 and IECC / IRC code-compliant simulation. In cases where the 1999 values were more efficient than the IECC / IRC code-compliant simulation, the 1999 values were used in both simulations, since this indicates that the prevailing practice is already above code. For example, in Brazoria County, according to the NAHB, the roof insulation is R-27.08, which is already above the code-required insulation of R-19. Therefore, R-27.08 was used in both simulations.

In the code-traceable simulation results are shown for each county. In a similar fashion as Table 19 and

Table 20, Table 21 and Table 22 is first divided into US EPA affected and then non-attainment classifications, followed by an alphabetical listing of counties. In the third column, the IECC / IRC climate zone is listed followed by the number of projected new housing units[70] in the fourth column. In the fifth column, the total simulated energy use is listed if all new construction had been built to pre-code specifications, and, in the sixth column, the total county-wide energy use for code-compliant construction is shown.

The values in the fifth and sixth columns come from the associated tables in the 2006 Volume III Appendix. , which remain the same as the 2005 listing, 24 simulations were run for each county, which

[66] As modified by the 2001 Supplement.
[67] This value represents the NAHB's reported number of window units times an average window size of 3 x 5 feet, which was determined by surveying local building suppliers. Additional information about the procedures used to determine these values can be found in the MS Thesis by Im (2003).
[68] The choice of a SEER 11 efficiency for the air conditioner was based on ARI sales numbers for Texas which show an average SEER 11 for houses built in 1999.
[69] Based on the regulation effective ….
[70] The number of projected new housing units uses the published values for the new housing units in 2004. A vacancy rate of 0% was assumed for 2005 calculations, based on information suggested by the Real Estate Center at Texas A&M University.

were then distributed according to the NAHB's survey data to account for 1 story, 2 story, slab-on-grade, crawlspace, and three different system types. In the seventh and eighth columns, the total pre-code and code-compliant peak OSD energy use is reported for the Ozone Season Day across all counties[71]. In a similar fashion as the annual pre-code and code-compliant energy use, these values are from the associated tables for each county in the Volume III Appendix to this report for the 1999 peak OSD results.

In the ninth and tenth columns, the total annual electricity and peak OSD savings are shown for each county, respectively. A 7% transmission and distribution loss is used in the 2006 report, which represents a fixed 1.07 multiplier for the electricity use. In the eleventh and twelfth columns, the total annual pre-code and code-compliant natural gas use is shown for those residences that had natural gas-fired furnaces and domestic water heaters. Similarly, in columns thirteen and fourteen, the simulated total peak OSD natural gas use on the peak Ozone Season Day (OSD) is shown for each county. Finally, in columns fifteen and sixteen, the total annual and peak OSD natural gas savings are shown for each county.

Table 23 and Table 24 the 2006 PCA assignments for each county are shown. These assignments are also expanded from the 2005 report because all ERCOT counties are shown in the 2006 report. In Table 25, the annual electricity savings are assigned to PCA provider(s) according to Table 23 and Table 24. The total electricity savings for each PCA, as shown in then entered into the bottom row of Table 26 and Table 28, which is the 2007 US EPA eGRID database for Texas. eGRID then proportions each MWh of electricity savings according to the 1999 measured data from the power plants assigned to that PCA. For each county in which there is a power plant the lbs-NOx/MWh are calculated and displayed as NOx reductions (lbs) in the column adjacent to the PCA column. Adding across the rows then totals the NOx reductions in each county from multiple PCAs that have power plants in that county. Counties that do not show NOx reductions represent counties that do not have power plants in eGRID's database. In Table **27** the PCA assignments for peak reductions are shown for each county; and in the peak OSD NOx reductions are shown calculated with eGRID.

[71] In the 2005 report, the peak Ozone Season Day (OSD) was used to report peak savings. This is different than the peak day for 2004, which was August 19, 1999. This change was made at the request of the TCEQ. In the 2002 and 2003 reports, these dates represent the TMY2 non-coincident dates that were chosen by the DOE-2 simulation program as the peak date for the houses simulated in a specific county. Hence, the 2002 and 2003 dates did not correspond to the same calendar date.

Table 19: 1999 and IECC / IRC Code-compliant Building Characteristics used in the DOE-2 Simulation for Single-family Residential (1).

	County	Climate Zone	Division	1999 Average					2000 IECC				
			(East or West)	Area %	Glazing U-value (Btu/ hr-ft2-F)	SHGC	Roof Insulation (hr-ft2-F/Btu)	Wall Insulation (hr-ft2-F/Btu)	Area %	Glazing U-value (Btu/ hr-ft2-F)	SHGC	Roof Insulation (hr-ft2-F/Btu)	Wall Insulation (hr-ft2-F/Btu)
	BRAZORIA	3	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	19.00	11.00
	CHAMBERS	4	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	26.00	13.00
	COLLIN	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	DALLAS	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	DENTON	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	EL PASO	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	FORT BEND	4	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	26.00	13.00
Non-attainment	GALVESTON	3	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	19.00	11.00
	HARDIN	4	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	26.00	13.00
	HARRIS	4	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	26.00	13.00
	JEFFERSON	4	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	26.00	13.00
	LIBERTY	4	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	26.00	13.00
	MONTGOMERY	4	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	26.00	13.00
	ORANGE	4	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	26.00	13.00
	TARRANT	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	WALLER	4	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	26.00	13.00
	BASTROP	4	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.52	0.40	30.00	13.00
	BEXAR	4	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.52	0.40	30.00	13.00
	CALDWELL	4	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.52	0.40	30.00	13.00
	COMAL	4	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.52	0.40	30.00	13.00
	ELLIS	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	GREGG	6	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.60	0.40	30.00	13.00
	GUADALUPE	4	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.52	0.40	30.00	13.00
	HARRISON	6	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.60	0.40	30.00	13.00
	HAYS	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	HENDERSON	5	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.65	0.40	30.00	13.00
	HOOD	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	HUNT	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
Affected	JOHNSON	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	KAUFMAN	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	NUECES	3	East Texas	13.8	1.11	0.71	27.08	14.18	13.8	0.75	0.40	19.00	11.00
	PARKER	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	ROCKWALL	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	RUSK	5	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.65	0.40	30.00	13.00
	SAN PATRICIO	3	East Texas	13.8	1.11	0.71	27.08	14.18	13.8	0.75	0.40	19.00	11.00
	SMITH	5	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.65	0.40	30.00	13.00
	TRAVIS	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	UPSHUR	6	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.60	0.40	30.00	13.00
	VICTORIA	3	East Texas	13.8	1.11	0.71	27.08	14.18	13.8	0.75	0.40	19.00	11.00
	WILLIAMSON	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	WILSON	4	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.52	0.40	30.00	13.00
	ANDERSON	5	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.65	0.40	30.00	13.00
	ANDREWS	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	ANGELINA	5	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.65	0.40	30.00	13.00
	ARANSAS	3	East Texas	13.8	1.11	0.71	27.08	14.18	13.8	0.75	0.40	19.00	11.00
	ARCHER	7	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.45	0.40	38.00	19.00
	ATASCOSA	3	West Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.60	0.40	30.00	13.00
	AUSTIN	4	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	26.00	13.00
	BANDERA	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	BAYLOR	7	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.45	0.40	38.00	19.00
	BEE	3	East Texas	13.8	1.11	0.71	27.08	14.18	13.8	0.75	0.40	19.00	11.00
	BELL	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	BLANCO	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	BORDEN	7	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.45	0.40	38.00	19.00
	BOSQUE	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	BRAZOS	4	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	26.00	13.00
	BREWSTER	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	BRISCOE	8	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.41	0.40	38.00	19.00
	BROOKS	2	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.90	0.40	19.00	11.00
	BROWN	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	BURLESON	4	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	26.00	13.00
	BURNET	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	CALHOUN	3	East Texas	13.8	1.11	0.71	27.08	14.18	13.8	0.75	0.40	19.00	11.00
	CALLAHAN	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	CAMERON	2	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.90	0.40	19.00	11.00
	CHEROKEE	5	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.65	0.40	30.00	13.00
	CHILDRESS	7	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.45	0.40	38.00	19.00
	CLAY	7	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.45	0.40	38.00	19.00
ERCOT	COKE	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	COLEMAN	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	COLORADO	4	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	26.00	13.00
	COMANCHE	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	CONCHO	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	COOKE	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	CORYELL	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	COTTLE	7	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.45	0.40	38.00	19.00
	CRANE	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	CROCKETT	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	CROSBY	7	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.45	0.40	38.00	19.00
	CULBERSON	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	DAWSON	7	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.45	0.40	38.00	19.00
	DE WITT	3	East Texas	13.8	1.11	0.71	27.08	14.18	13.8	0.75	0.40	19.00	11.00
	DELTA	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	DICKENS	7	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.45	0.40	38.00	19.00
	DIMMIT	3	West Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.60	0.40	30.00	13.00
	DUVAL	3	East Texas	13.8	1.11	0.71	27.08	14.18	13.8	0.75	0.40	19.00	11.00
	EASTLAND	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	ECTOR	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	EDWARDS	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	ERATH	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	FALLS	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	FANNIN	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	FAYETTE	4	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	26.00	13.00
	FISHER	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	FOARD	7	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.45	0.40	38.00	19.00
	FRANKLIN	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	FREESTONE	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00

Table 20: 1999 and IECC / IRC Code-compliant Building Characteristics used in the DOE-2 Simulation for Single-family Residential (2).

	County	Climate Zone	Division (East or West)	1999 Average Area %	1999 Average Glazing U-value (Btu/ hr-ft2-F)	1999 Average SHGC	1999 Average Roof Insulation (hr-ft2-F/Btu)	1999 Average Wall Insulation (hr-ft2-F/Btu)	2000 IECC Area %	2000 IECC Glazing U-value (Btu/ hr-ft2-F)	2000 IECC SHGC	2000 IECC Roof Insulation (hr-ft2-F/Btu)	2000 IECC Wall Insulation (hr-ft2-F/Btu)
	FRIO	3	West Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.60	0.40	30.00	13.00
	GILLESPIE	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	GLASSCOCK	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	GOLIAD	3	East Texas	13.8	1.11	0.71	27.08	14.18	13.8	0.75	0.40	19.00	11.00
	GONZALES	4	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.52	0.40	30.00	13.00
	GRAYSON	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	GRIMES	4	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	26.00	13.00
	HALL	8	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.41	0.40	38.00	19.00
	HAMILTON	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	HARDEMAN	7	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.45	0.40	38.00	19.00
	HASKELL	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	HIDALGO	2	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.90	0.40	19.00	11.00
	HILL	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	HOPKINS	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	HOUSTON	5	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.65	0.40	30.00	13.00
	HOWARD	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	HUDSPETH	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	IRION	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	JACK	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	JACKSON	3	East Texas	13.8	1.11	0.71	27.08	14.18	13.8	0.75	0.40	19.00	11.00
	JEFF DAVIS	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	JIM HOGG	2	West Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.60	0.40	30.00	13.00
	JIM WELLS	3	East Texas	13.8	1.11	0.71	27.08	14.18	13.8	0.75	0.40	19.00	11.00
	JONES	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	KARNES	3	West Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.60	0.40	30.00	13.00
	KENDALL	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	KENEDY	2	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.90	0.40	19.00	11.00
	KENT	7	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.45	0.40	38.00	19.00
	KERR	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	KIMBLE	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	KING	7	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.45	0.40	38.00	19.00
	KINNEY	4	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.52	0.40	30.00	13.00
	KLEBERG	2	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.90	0.40	19.00	11.00
	KNOX	7	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.45	0.40	38.00	19.00
	LA SALLE	3	West Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.60	0.40	30.00	13.00
	LAMAR	6	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.60	0.40	30.00	13.00
	LAMPASAS	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	LAVACA	4	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	26.00	13.00
	LEE	4	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.52	0.40	30.00	13.00
	LEON	5	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.65	0.40	30.00	13.00
	LIMESTONE	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	LIVE OAK	3	East Texas	13.8	1.11	0.71	27.08	14.18	13.8	0.75	0.40	19.00	11.00
	LLANO	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	LOVING	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	MADISON	4	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	26.00	13.00
	MARTIN	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	MASON	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	MATAGORDA	3	East Texas	13.8	1.11	0.71	27.08	14.18	13.8	0.75	0.40	19.00	11.00
	MAVERICK	3	West Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.60	0.40	30.00	13.00
	MCCULLOCH	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	MCLENNAN	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	MCMULLEN	3	West Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.60	0.40	30.00	13.00
ERCOT	MEDINA	4	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.52	0.40	30.00	13.00
	MENARD	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	MIDLAND	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	MILAM	4	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.52	0.40	30.00	13.00
	MILLS	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	MITCHELL	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	MONTAGUE	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	MOTLEY	7	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.45	0.40	38.00	19.00
	NACOGDOCHES	5	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.65	0.40	30.00	13.00
	NAVARRO	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	NOLAN	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	PALO PINTO	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	PECOS	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	PRESIDIO	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	RAINS	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	REAGAN	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	REAL	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	RED RIVER	6	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.60	0.40	30.00	13.00
	REEVES	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	REFUGIO	3	East Texas	13.8	1.11	0.71	27.08	14.18	13.8	0.75	0.40	19.00	11.00
	ROBERTSON	4	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	26.00	13.00
	RUNNELS	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	SAN SABA	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	SCHLEICHER	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	SCURRY	7	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.45	0.40	38.00	19.00
	SHACKELFORD	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	SOMERVELL	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	STARR	2	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.90	0.40	19.00	11.00
	STEPHENS	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	STERLING	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	STONEWALL	7	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.45	0.40	38.00	19.00
	SUTTON	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	TAYLOR	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	TERRELL	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	THROCKMORTON	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	TITUS	6	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.60	0.40	30.00	13.00
	TOM GREEN	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	UPTON	5	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.50	0.40	38.00	13.00
	UVALDE	4	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.52	0.40	30.00	13.00
	VAL VERDE	4	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.52	0.40	30.00	13.00
	VAN ZANDT	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	WARD	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	WASHINGTON	4	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.75	0.40	26.00	13.00
	WEBB	3	West Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.60	0.40	30.00	13.00
	WHARTON	3	East Texas	13.8	1.11	0.71	27.08	14.18	13.8	0.75	0.40	19.00	11.00
	WICHITA	7	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.45	0.40	38.00	19.00
	WILBARGER	7	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.45	0.40	38.00	19.00
	WILLACY	2	East Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.90	0.40	19.00	11.00
	WINKLER	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	WISE	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	YOUNG	6	West Texas	20.6	0.87	0.66	26.75	14.18	20.6	0.46	0.40	38.00	16.00
	ZAPATA	2	West Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.60	0.40	30.00	13.00
	ZAVALA	3	West Texas	13.8	1.11	0.71	27.08	13.99	13.8	0.60	0.40	30.00	13.00

Table 21: 2006 Annual and Peak-day Electricity Savings from Implementation of the IECC / IRC for Single-family Residences (1).

2006 Summary															
	County	Climate Zone	No. of Projected Units (2006)	Precode Total Annual Elec. Use (MWh/yr)	Code-compliant Total Annual Elec. Use (MWh/yr)	Precode OSD Elec. Use (MWh/day)	Code-compliant OSD Elec. Use (MWh/day)	Total Annual Elec. Savings (MWh/yr) w/ 7% of T&D Loss	Total OSD Elec. Savings (MWh/day) w/ 7% of T&D Loss	Precode Total NG Use (Therm/yr)	Code-compliant Total NG Use (Therm/yr)	Precode OSD NG Use (Therm/day)	Code-compliant OSD NG Use (Therm/day)	Total Annual NG Savings (Therm/yr)	Total OSD NG Savings (Therm/day)
Affected County	BASTROP	4	269	4,250	3,560	18.95	14.81	739	4.43	69,768	61,032	151.56	126.67	8,736	24.89
	BEXAR	4	10,298	148,138	126,397	649.67	515.92	23,262	143.11	3,081,076	2,727,140	6,433.74	5,394.47	353,936	1,039.27
	CALDWELL	4	84	1,282	1,074	5.76	4.51	223	1.33	23,685	20,891	51.62	43.15	2,794	8.48
	COMAL	4	2,182	31,401	26,786	137.72	109.34	4,937	30.36	652,016	577,022	1,363.22	1,143.01	74,994	220.21
	ELLIS	5	1,810	27,537	23,454	128.53	100.48	4,369	30.01	721,299	645,796	1,104.76	922.10	75,503	182.67
	GREGG	6	357	5,182	4,526	23.06	18.42	701	4.97	128,556	110,303	199.76	166.73	18,254	33.03
	GUADALUPE	4	1,531	22,030	18,795	96.60	76.71	3,461	21.27	458,063	405,443	956.50	801.99	52,620	154.51
	HARRISON	6	40	581	507	2.58	2.06	79	0.56	14,405	12,359	22.38	18.68	2,046	3.70
	HAYS	5	2,124	32,486	27,175	145.91	113.65	5,683	34.52	597,126	517,092	1,305.35	1,090.99	80,034	214.35
	HENDERSON	5	125	1,845	1,612	8.25	6.59	249	1.77	47,245	40,948	69.95	58.38	6,298	11.57
	HOOD	5	131	1,994	1,698	9.31	7.28	317	2.18	52,155	46,631	79.96	66.74	5,525	13.22
	HUNT	6	197	3,002	2,556	14.02	10.95	478	3.28	78,509	70,214	120.24	100.36	8,295	19.88
	JOHNSON	5	1,145	17,424	14,839	81.37	63.60	2,767	19.01	455,861	407,573	698.87	583.32	48,288	115.55
	KAUFMAN	6	914	13,906	11,878	64.90	50.74	2,170	15.16	364,661	312,273	557.87	465.63	52,388	92.24
	NUECES	3	1,553	23,959	20,184	98.21	78.53	4,039	21.05	381,164	329,049	879.25	735.57	52,115	143.68
	PARKER	6	480	7,310	6,241	34.15	26.69	1,144	7.99	190,887	163,591	292.98	244.53	27,296	48.44
	ROCKWALL	6	1,756	26,736	22,831	124.82	97.56	4,178	29.18	699,791	599,947	1,071.80	894.59	99,844	177.22
	RUSK	5	22	295	260	1.24	0.99	38	0.26	7,727	6,941	13.11	11.07	786	2.04
	SAN PATRICIO	3	332	5,127	4,317	21.02	16.80	866	4.51	81,485	70,344	187.97	157.25	11,141	30.72
	SMITH	5	604	8,769	7,665	39.06	31.24	1,182	8.37	217,048	190,624	337.98	282.09	26,424	55.88
	TRAVIS	5	9,425	144,315	120,658	647.96	504.50	25,314	153.50	2,649,676	2,290,288	5,792.32	4,841.15	359,388	951.17
	UPSHUR	6	7	102	89	0.45	0.36	14	0.10	2,518	2,163	3.92	3.27	355	0.65
	VICTORIA	3	123	1,717	1,490	7.27	5.85	244	1.52	33,857	29,953	71.55	60.17	3,904	11.38
	WILLIAMSON	5	5,444	83,432	69,728	374.56	291.55	14,664	88.82	1,530,487	1,322,864	3,345.72	2,796.31	207,623	549.41
	WILSON	4	36	518	442	2.27	1.80	81	0.50	10,771	9,550	22.49	18.86	1,221	3.63
Nonattainment County	BRAZORIA	3	3,989	57,623	49,321	249.79	198.79	8,884	54.58	1,033,930	913,070	2,269.89	1,900.83	120,860	369.06
	CHAMBERS	4	517	7,488	6,390	31.98	25.35	1,175	7.09	136,777	119,756	298.61	250.78	17,022	47.83
	COLLIN	6	12,558	191,777	163,118	896.61	699.95	30,666	210.43	4,989,355	4,470,132	7,664.97	6,397.62	519,223	1,267.35
	DALLAS	5	10,520	160,128	136,366	747.56	584.30	25,425	174.69	4,192,302	3,748,727	6,421.05	5,359.37	443,575	1,061.68
	DENTON	6	3,816	58,199	49,668	271.95	212.41	9,128	63.71	1,517,551	1,300,548	2,329.16	1,944.05	217,003	385.11
	EL PASO	6	4,333	60,839	52,070	242.50	193.56	9,383	52.36	1,523,342	1,305,939	2,832.04	2,394.76	217,404	437.29
	FORT BEND	4	4,097	59,245	50,726	256.90	204.07	9,115	56.53	1,061,841	923,458	2,331.35	1,952.29	138,384	379.05
	GALVESTON	3	3,148	45,481	38,923	197.12	156.87	7,017	43.07	816,860	721,926	1,791.33	1,500.08	94,934	291.25
	HARDIN	4	98	1,422	1,213	6.08	4.81	224	1.35	25,927	22,700	56.60	47.54	3,227	9.07
	HARRIS	4	32,465	469,441	401,933	2,035	1,617	72,234	447.83	8,414,772	7,317,564	18,473.80	15,470.13	1,097,208	3,003.66
	JEFFERSON	4	427	6,181	5,275	26	21	969	5.85	113,099	98,930	246.63	207.12	14,170	39.51
	LIBERTY	4	287	4,168	3,553	18	14	658	3.96	75,796	66,479	165.77	139.21	9,317	26.55
	MONTGOMERY	4	6,586	95,422	81,640	414.01	328.65	14,747	91.34	1,704,087	1,484,344	3,747.68	3,138.34	219,743	609.34
	ORANGE	4	283	4,099	3,497	18	14	643	3.88	74,966	65,567	163.46	137.27	9,400	26.18
	TARRANT	5	16,121	245,460	209,001	1,146	896	39,011	267.94	6,411,017	5,738,414	9,839.71	8,212.78	672,603	1,626.93
	WALLER	4	67	971	831	4.21	3.34	150	0.93	17,334	15,081	38.13	31.93	2,253	6.20
ERCOT	ANDERSON	5	23	308	272	1.30	1.04	39	0.28	8,078	7,256	13.70	11.58	822	2.13
	ANDREWS	6	24	341	294	1.34	1.06	51	0.30	12,028	10,544	16.27	13.85	1,485	2.42
	ANGELINA	5	104	1,395	1,228	5.87	4.70	178	1.24	36,528	32,811	61.97	52.35	3,717	9.62
	ARANSAS	3	256	3,949	3,327	16.19	12.95	666	3.47	62,832	54,241	144.94	121.25	8,591	23.69
	ARCHER	7	10	158	134	0.69	0.53	25	0.17	6,037	5,148	6.52	5.51	889	1.01
	ATASCOSA	3	64	920	785	4.03	3.21	144	0.89	19,148	17,051	39.98	33.53	2,097	6.46
	AUSTIN	4	46	665	570	2.88	2.29	102	0.63	11,923	10,368	26.18	21.92	1,555	4.26
	BANDERA	5	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	BAYLOR	7	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	BEE	3	11	154	133	0.65	0.52	22	0.14	3,028	2,679	6.40	5.38	349	1.02
	BELL	5	3,047	46,861	39,476	215.97	166.34	7,902	53.11	1,322,644	1,197,815	1,974.35	1,666.84	124,828	307.50
	BLANCO	5	25	383	320	1.72	1.34	67	0.41	7,028	6,075	15.36	12.84	953	2.52
	BORDEN	7	25	365	320	1.28	1.02	49	0.27	15,494	13,250	16.16	13.84	2,244	2.31
	BOSQUE	5	5	77	65	0.35	0.27	13	0.09	2,170	1,966	3.24	2.74	205	0.50
	BRAZOS	4	789	11,409	9,768	49.47	39.29	1,756	10.88	204,505	177,839	448.97	375.97	26,666	73.00
	BREWSTER	5	7	102	87	0.42	0.33	16	0.10	3,571	3,274	4.57	3.87	297	0.71
	BRISCOE	8	7	100	88	0.32	0.27	12	0.06	6,791	5,529	5.10	4.39	1,262	0.71
	BROOKS	2	3	50	42	0.20	0.16	9	0.04	758	666	1.69	1.41	92	0.28
	BROWN	5	41	631	531	2.91	2.24	106	0.71	17,797	16,118	26.57	22.43	1,680	4.14
	BURLESON	4	9	130	111	0.56	0.45	20	0.12	2,333	2,029	5.12	4.29	304	0.83
	BURNET	5	433	6,630	5,543	29.77	23.18	1,163	7.05	121,730	105,220	266.11	222.41	16,511	43.70
	CALHOUN	3	115	1,605	1,393	6.80	5.47	228	1.42	31,655	28,005	66.89	56.25	3,650	10.64
	CALLAHAN	6	31	465	398	1.94	1.53	72	0.44	16,544	14,456	20.46	17.33	2,088	3.13
	CAMERON	2	3,069	51,006	42,475	208.02	165.44	9,128	45.56	775,101	681,148	1,726.99	1,443.04	93,953	283.94
	CHEROKEE	5	28	375	331	1.58	1.27	48	0.33	9,834	8,834	16.68	14.09	1,001	2.59
	CHILDRESS	7	1	15	13	0.05	0.04	2	0.01	620	530	0.65	0.55	90	0.09
	CLAY	7	9	142	121	0.62	0.48	23	0.15	5,433	4,633	5.87	4.96	800	0.91
	COKE	6	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	COLEMAN	5	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	COLORADO	4	20	289	248	1.25	1.00	44	0.28	5,184	4,508	11.38	9.53	676	1.85
	COMANCHE	5	5	77	65	0.35	0.27	13	0.09	2,170	1,966	3.24	2.74	205	0.50
	CONCHO	5	5	73	62	0.30	0.23	11	0.07	2,551	2,339	3.27	2.76	212	0.50
	COOKE	6	42	640	545	2.99	2.34	102	0.70	16,738	14,970	25.64	21.40	1,768	4.24
	CORYELL	5	331	5,091	4,288	23.46	18.07	858	5.77	143,681	130,120	214.48	181.07	13,560	33.40
	COTTLE	7	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	CRANE	5	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	CROCKETT	5	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	CROSBY	7	1	15	13	0.05	0.04	2	0.01	620	530	0.65	0.55	90	0.09
	CULBERSON	6	18	253	217	1.01	0.80	39	0.22	6,426	5,524	11.76	9.95	902	1.82
	DAWSON	7	1	15	13	0.05	0.04	2	0.01	620	530	0.65	0.55	90	0.09
	DE WITT	3	1	14	12	0.06	0.05	2	0.01	275	244	0.58	0.49	32	0.09
	DELTA	6	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	DICKENS	7	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	DIMMIT	3	15	247	203	1.02	0.80	47	0.23	3,978	3,444	9.26	7.75	535	1.51
	DUVAL	3	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	EASTLAND	6	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	ECTOR	6	149	2,120	1,827	8.31	6.59	314	1.84	74,675	65,458	101.02	85.98	9,217	15.04
	EDWARDS	5	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	ERATH	6	45	675	578	2.82	2.22	104	0.65	24,016	20,985	29.69	25.15	3,031	4.54
	FALLS	5	18	277	233	1.28	0.98	47	0.31	7,813	7,076	11.66	9.85	737	1.82
	FANNIN	6	71	1,082	921	5.05	3.95	172	1.18	28,295	25,306	43.34	36.17	2,989	7.17
	FAYETTE	4	34	492	421	2.13	1.69	76	0.47	8,813	7,664	19.35	16.20	1,149	3.15
	FISHER	6	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	FOARD	7	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	FRANKLIN	6	6	92	78	0.43	0.33	15	0.10	2,384	2,136	3.66	3.06	248	0.61
	FREESTONE	5	25	384	324	1.77	1.36	65	0.44	10,852	9,828	16.20	13.68	1,024	2.52
	FRIO	3	19	273	233	1.20	0.95	43	0.26	5,685	5,062	11.87	9.95	623	1.92

Table 22: 2006 Annual and Peak-day Electricity Savings from Implementation of the IECC / IRC for Single-family Residences (2).

2006 Summary															
	County	Climate Zone	No. of Projected Units (2006)	Precode Total Annual Elec. Use (MWh/yr)	Code-compliant Total Annual Elec. Use (MWh/yr)	Precode OSD Elec. Use (MWh/day)	Code-compliant OSD Elec. Use (MWh/day)	Total Annual Elec. Savings (MWh/yr) w/ 7% of T&D Loss	Total OSD Elec. Savings (MWh/day) w/ 7% of T&D Loss	Precode Total NG Use (Therm/yr)	Code-compliant Total NG Use (Therm/yr)	Precode OSD NG Use (Therm/day)	Code-compliant OSD NG Use (Therm/day)	Total Annual NG Savings (Therm/yr)	Total OSD NG Savings (Therm/day)
	GILLESPIE	5	80	1,225	1,024	5.50	4.28	215	1.30	22,491	19,440	49.17	41.09	3,051	8.07
	GLASSCOCK	6	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	GOLIAD	3	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	GONZALES	4	9	129	110	0.57	0.45	20	0.13	2,693	2,383	5.62	4.71	309	0.91
	GRAYSON	6	423	6,446	5,487	30.11	23.52	1,026	7.05	168,575	150,765	258.18	215.50	17,810	42.69
	GRIMES	4	28	405	347	1.76	1.39	62	0.39	7,257	6,311	15.93	13.34	946	2.59
	HALL	8	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	HAMILTON	5	3	46	39	0.21	0.16	8	0.05	1,302	1,179	1.94	1.64	123	0.30
	HARDEMAN	7	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	HASKELL	6	2	30	26	0.13	0.10	5	0.03	1,067	933	1.32	1.12	135	0.20
	HIDALGO	2	6,763	112,399	93,599	458.40	364.56	20,115	100.41	1,708,050	1,501,011	3,805.67	3,179.96	207,039	625.71
	HILL	5	15	231	194	1.06	0.82	39	0.26	6,511	5,897	9.72	8.21	615	1.51
	HOPKINS	6	29	443	377	2.07	1.62	71	0.49	11,522	10,323	17.70	14.77	1,199	2.93
	HOUSTON	5	8	107	94	0.45	0.36	14	0.10	2,810	2,524	4.77	4.03	286	0.74
	HOWARD	6	2	28	25	0.11	0.09	4	0.02	1,002	879	1.36	1.15	124	0.20
	HUDSPETH	6	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	IRION	5	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	JACK	6	1	15	13	0.06	0.05	2	0.01	534	466	0.66	0.56	67	0.10
	JACKSON	3	20	279	242	1.18	0.95	40	0.25	5,505	4,870	11.63	9.78	635	1.85
	JEFF DAVIS	6	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	JIM HOGG	2	0	19,580	19,235	80.67	75.19	369	5.86	281,703	243,247	430.42	359.25	38,455	71.17
	JIM WELLS	3	82	1,358	1,144	5.56	4.45	229	1.19	21,598	18,645	49.82	41.68	2,953	8.14
	JONES	6	3	45	39	0.19	0.15	7	0.04	1,601	1,399	1.98	1.68	202	0.30
	KARNES	3	8	117	99	0.51	0.40	19	0.11	2,361	2,092	5.08	4.27	269	0.81
	KENDALL	5	552	7,956	6,774	34.94	27.60	1,265	7.85	164,693	142,354	344.87	289.16	22,339	55.71
	KENEDY	2	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	KENT	7	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	KERR	5	88	1,347	1,127	6.05	4.71	236	1.43	24,740	21,384	54.08	45.20	3,356	8.88
	KIMBLE	5	13	190	162	0.78	0.61	30	0.18	6,632	6,081	8.50	7.18	551	1.31
	KING	7	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	KINNEY	4	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	KLEBERG	2	7	108	91	0.44	0.35	18	0.09	1,718	1,500	3.96	3.32	218	0.65
	KNOX	7	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	LA SALLE	3	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	LAMAR	6	58	857	749	3.83	3.06	116	0.83	21,942	19,020	32.45	27.09	2,922	5.37
	LAMPASAS	5	27	415	350	1.91	1.47	70	0.47	11,720	10,614	17.50	14.77	1,106	2.72
	LAVACA	4	16	224	194	0.95	0.76	32	0.20	4,397	3,826	9.31	7.83	572	1.48
	LEE	4	23	352	294	1.58	1.24	61	0.37	6,466	5,710	14.14	11.81	756	2.32
	LEON	5	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	LIMESTONE	5	9	138	117	0.64	0.49	23	0.16	3,907	3,538	5.83	4.92	369	0.91
	LIVE OAK	3	3	46	39	0.19	0.15	8	0.04	736	636	1.70	1.42	101	0.28
	LLANO	5	252	3,859	3,226	17.32	13.49	677	4.10	70,845	61,236	154.87	129.44	9,609	25.43
	LOVING	6	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	MADISON	4	12	174	149	0.75	0.60	27	0.17	3,110	2,705	6.83	5.72	406	1.11
	MARTIN	6	10	142	123	0.56	0.44	21	0.12	5,012	4,393	6.78	5.77	619	1.01
	MASON	5	14	214	179	0.96	0.75	38	0.23	3,936	3,402	8.60	7.19	534	1.41
	MATAGORDA	3	97	1,354	1,175	5.73	4.61	192	1.20	26,701	23,622	56.42	47.45	3,079	8.97
	MAVERICK	3	213	3,507	2,879	14.47	11.38	671	3.31	56,495	48,904	131.54	110.05	7,590	21.50
	MCCULLOCH	5	213	3,113	2,661	12.77	9.97	484	2.99	108,662	99,637	139.21	117.71	9,025	21.50
	MCLENNAN	5	213	3,276	2,760	15.10	11.63	552	3.71	92,459	83,733	138.02	116.52	8,726	21.50
	MCMULLEN	3	213	3,507	2,879	14.47	11.38	671	3.31	56,495	48,904	131.54	110.05	7,590	21.50
ERCOT	MEDINA	4	43	619	528	2.71	2.15	97	0.60	12,865	11,387	26.86	22.52	1,478	4.34
	MENARD	5	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	MIDLAND	6	390	5,548	4,781	21.75	17.26	821	4.81	195,458	171,333	264.41	225.05	24,125	39.36
	MILAM	4	15	229	191	1.01	0.79	41	0.24	4,200	3,687	9.31	7.80	513	1.51
	MILLS	5	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	MITCHELL	6	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	MONTAGUE	6	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	MOTLEY	7	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	NACOGDOCHI	5	101	1,354	1,192	5.70	4.57	173	1.21	35,474	31,864	60.18	50.84	3,610	9.34
	NAVARRO	5	69	1,061	894	4.89	3.77	179	1.20	29,952	27,125	44.71	37.75	2,827	6.96
	NOLAN	6	4	60	51	0.25	0.20	9	0.06	2,135	1,865	2.64	2.24	269	0.40
	PALO PINTO	6	13	195	167	0.81	0.64	30	0.19	6,938	6,062	8.58	7.27	876	1.31
	PECOS	5	16	234	200	0.96	0.75	36	0.22	8,162	7,484	10.46	8.84	678	1.61
	PRESIDIO	5	101	1,476	1,262	6.06	4.73	230	1.42	51,525	47,246	66.01	55.82	4,279	10.19
	RAINS	6	14	214	182	1.00	0.78	34	0.23	5,562	4,983	8.55	7.13	579	1.41
	REAGAN	5	3	43	37	0.17	0.13	6	0.04	1,505	1,401	2.03	1.73	104	0.30
	REAL	5	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	RED RIVER	6	3	44	39	0.20	0.16	6	0.04	1,135	984	1.68	1.40	151	0.28
	REEVES	6	1	14	12	0.06	0.04	2	0.01	501	439	0.68	0.58	62	0.10
	REFUGIO	3	12	168	145	0.71	0.57	24	0.15	3,303	2,922	6.98	5.87	381	1.11
	ROBERTSON	4	4	58	50	0.25	0.20	9	0.06	1,037	902	2.28	1.91	135	0.37
	RUNNELS	5	1	15	12	0.06	0.05	2	0.01	510	468	0.65	0.55	42	0.10
	SAN SABA	5	1	15	13	0.07	0.05	3	0.02	281	243	0.61	0.51	38	0.10
	SCHLEICHER	5	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	SCURRY	7	7	102	90	0.36	0.29	14	0.08	4,338	3,710	4.52	3.88	628	0.65
	SHACKELFOR	6	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	SOMERVELL	5	24	365	311	1.71	1.33	58	0.40	9,564	8,552	14.65	12.23	1,012	2.42
	STARR	2	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	STEPHENS	6	1	15	13	0.06	0.05	2	0.01	534	466	0.66	0.56	67	0.10
	STERLING	6	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	STONEWALL	7	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	SUTTON	5	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	TAYLOR	6	276	4,140	3,544	17.29	13.59	637	3.96	147,299	128,709	182.13	154.27	18,590	27.85
	TERRELL	5	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	THROCKMORT	6	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	TITUS	6	46	680	594	3.04	2.43	92	0.65	17,402	15,084	25.74	21.48	2,317	4.26
	TOM GREEN	5	270	3,946	3,373	16.19	12.64	614	3.79	137,740	126,300	176.46	149.21	11,440	27.25
	UPTON	5	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	UVALDE	4	35	503	430	2.21	1.75	79	0.49	10,472	9,269	21.87	18.33	1,203	3.53
	VAL VERDE	4	148	2,129	1,817	9.34	7.41	334	2.06	44,280	39,194	92.46	77.53	5,087	14.94
	VAN ZANDT	6	47	718	610	3.36	2.62	115	0.79	18,673	16,730	28.69	23.94	1,943	4.74
	WARD	6	3	43	37	0.17	0.13	6	0.04	1,504	1,318	2.03	1.73	186	0.30
	WASHINGTON	4	64	925	792	4.01	3.19	142	0.88	16,588	14,426	36.42	30.50	2,163	5.92
	WEBB	3	1,886	31,048	25,492	128.12	100.77	5,945	29.26	500,230	433,023	1,164.73	974.40	67,207	190.34
	WHARTON	3	122	1,703	1,477	7.21	5.80	242	1.51	33,582	29,710	70.97	59.68	3,872	11.29
	WICHITA	7	260	4,104	3,488	17.90	13.88	659	4.30	156,962	133,856	169.51	143.27	23,105	26.24
	WILBARGER	7	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	WILLACY	2	36	598	498	2.44	1.94	107	0.53	9,092	7,990	20.26	16.93	1,102	3.33
	WINKLER	6	7	100	86	0.39	0.31	15	0.09	3,508	3,075	4.75	4.04	433	0.71
	WISE	6	172	2,627	2,234	12.28	9.59	420	2.88	68,336	61,225	104.98	87.62	7,112	17.36
	YOUNG	6	6	90	77	0.38	0.30	14	0.09	3,202	2,798	3.96	3.35	404	0.61
	ZAPATA	2	0	0	0	0.00	0.00	0	0.00	0	0	0.00	0.00	0	0.00
	ZAVALA	3	3	49	41	0.20	0.16	9	0.05	796	689	1.85	1.55	107	0.30
	TOTAL		163,002					393,069	2,465					6,251,154	15,956

Table 23: 2006 Allocation of PCA for each of 41 Non-attainment and Affected Counties, and ERCOT Counties (1).

County	Elec. Utilities 1	PCA	1998 Annual net Generation (MWh)	Percentage	Elec. Utilities 2	PCA	1998 Annual net Generation (MWh)	Percentage
ANDERSON	ONCOR	TXU Electric/PCA	97581030	100%	Trinity Valley EC			0%
ANDREWS	ONCOR	TXU Electric/PCA	97581030	100%	Cap Rock EC			0%
ANGELINA	ONCOR	TXU Electric/PCA	97581030	100%	Sam Houston EC			0%
ARANSAS	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	San Patricio EC			0%
ARCHER	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
ATASCOSA	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	54%	CPSB	San Antonio Public Service Bd/PCA	14,641,059	46%
AUSTIN	RELIANT(CENTER POINT)	Reliant Energy HL&P/PCA	74,386,176	100%	Bellville			0%
BANDERA*	Bandera EC							
BASTROP	ONCOR	TXU Electric/PCA	97581030	100%	Smithville			0%
BAYLOR	ONCOR	TXU Electric/PCA	97581030	100%	Seymour			0%
BEE	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	San Patricio EC			0%
BELL	ONCOR	TXU Electric/PCA	97581030	100%	Bartlett EC			0%
BEXAR	CPSB	San Antonio Public Service Bd/PCA	14,641,059	100%	Bandera EC			0%
BLANCO*	Pedernales EC				Central Texas EC			
BORDEN*	Lyntegar EC				Big Country EC			
BOSQUE	T-NMP	Texas-New Mexico Power Co/PCA	2067714	100%	United Coop Services			0%
BRAZORIA	RELIANT(CENTER POINT)	Reliant Energy HL&P/PCA	74,386,176	97%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	3%
BRAZOS*	BRYAN				College Station			
BREWSTER	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Rio Grande EC			0%
BRISCOE	XCEL(SPS)				WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%
BROOKS	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Medina EC			0%
BROWN	ONCOR	TXU Electric/PCA	97581030	85%	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	15%
BURLESON	ENTERGY	Entergy Electric System/PCA	32,288,113	100%	BRYAN			0%
BURNET	ONCOR	TXU Electric/PCA	97581030	100%	Pedernales EC			0%
CALDWELL	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Luling			0%
CALHOUN	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Victoria EC			0%
CALLAHAN	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Taylor EC			0%
CAMERON	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Magic Valley EC			0%
CHAMBERS	RELIANT(CENTER POINT)	Reliant Energy HL&P/PCA	74,386,176	70%	ENTERGY	Entergy Electric System/PCA	32,288,113	30%
CHEROKEE	ONCOR	TXU Electric/PCA	97581030	100%	Cherokee County EC			0%
CHILDRESS	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Greenbelt EC			0%
CLAY	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
COKE	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Concho Valley EC			0%
COLEMAN	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Coleman			0%
COLLIN	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
COLORADO	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Weimar			0%
COMAL	CPSB	San Antonio Public Service Bd/PCA	14,641,059	100%	New Braunfels			0%
COMANCHE	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
CONCHO	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Concho Valley EC			0%
COOKE	ONCOR	TXU Electric/PCA	97581030	100%	Cooke County EC			0%
CORYELL	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
COTTLE	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	South Plains EC			0%
CRANE	ONCOR	TXU Electric/PCA	97581030	100%				0%
CROCKETT	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Rio Grande EC			0%
CROSBY*	XCEL(SPS)				Crosbyton			
CULBERSON	EPEC	El Paso Electric Co/PCA	3066882	100%	Rio Grande EC			0%
DALLAS	ONCOR	TXU Electric/PCA	97581030	100%	Garland			0%
DAWSON	ONCOR	TXU Electric/PCA	97581030	100%	Lyntegar EC			0%
DELTA	ONCOR	TXU Electric/PCA	97581030	100%	Lamar County EC			0%
DENTON	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
DEWITT	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Yoakum			0%
DICKENS	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	South Plains EC			0%
DIMMIT	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Medina EC			0%
DUVAL	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Medina EC			0%
EASTLAND	ONCOR	TXU Electric/PCA	97581030	85%	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	15%
ECTOR	ONCOR	TXU Electric/PCA	97581030	100%	Goldsmith			0%
EDWARDS	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Rio Grande EC			0%
ELLIS	ONCOR	TXU Electric/PCA	97581030	100%	Navarro County EC			0%
ERATH	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
FALLS	ONCOR	TXU Electric/PCA	97581030	100%	Belfalls EC			0%
FANNIN	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
FAYETTE*	La Grange				Schulenburg			
FISHER	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Big Country EC			0%
FOARD*	XCEL(SPS)				Floydada			
FORT BEND	RELIANT(CENTER POINT)	Reliant Energy HL&P/PCA	74,386,176	100%				0%
FRANKLIN	SWEPCO(AEP)	Southwestern Public Service Co/PCA			FEC Electric			
FREESTONE	ONCOR	TXU Electric/PCA	97581030	100%	Navasota Valley EC			0%
FRIO	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Medina EC			0%
GALVESTON	RELIANT(CENTER POINT)	Reliant Energy HL&P/PCA	74,386,176	97%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	3%
GILLESPIE*	Fredericksburg				Pedernales EC			
GLASSCOCK	ONCOR	TXU Electric/PCA	97581030	100%	Cap Rock EC			0%
GOLIAD	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Karnes EC			0%
GONZALES	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Gonzales			0%
GRAYSON	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
GRIMES	ENTERGY	Entergy Electric System/PCA	32,288,113	100%	Mid-South EC			0%
GUADALUPE	CPSB	San Antonio Public Service Bd/PCA	14,641,059	100%	Seguin			0%
HALL	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Lighthouse EC			0%
HAMILTON	T-NMP	Texas-New Mexico Power Co/PCA	2067714	100%	United Coop Services			0%
HARDEMAN	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	South Plains EC			0%
HARRIS	RELIANT(CENTER POINT)	Reliant Energy HL&P/PCA	74,386,176	70%	ENTERGY	Entergy Electric System/PCA	32,288,113	30%
HASKELL	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Big Country EC			0%
HAYS	San Marcos	Lower Colorado River Authority/PCA		100%	Pedernales EC			0%
HENDERSON	ONCOR	TXU Electric/PCA	97581030	100%	Trinity Valley EC			0%
HIDALGO	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Magic Valley EC			0%
HILL	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
HOOD	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
HOPKINS	ONCOR	TXU Electric/PCA	97581030	100%	SWEPCO(AEP)			0%
HOUSTON	ONCOR	TXU Electric/PCA	97581030	100%	Houston County EC			0%
HOWARD	ONCOR	TXU Electric/PCA	97581030	100%	Cap Rock EC			0%
HUDSPETH	EPEC	El Paso Electric Co/PCA	3066882	100%	Rio Grande EC			0%
HUNT	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
IRION	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Cap Rock EC			0%
JACK	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
JACKSON	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Jackson EC			0%
JEFF DAVIS	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Rio Grande EC			0%
JIM HOGG	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Medina EC			0%
JIM WELLS	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Nueces EC			0%
JOHNSON	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
JONES	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Taylor EC			0%
KARNES	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Floresville			0%

Table 24: 2006 Allocation of PCA for each of 41 Non-attainment and Affected Counties, and ERCOT Counties (2).

County	Elec. Utilities 1	PCA	1998 Annual net Generation (MWh)	Percentage	Elec. Utilities 2	PCA	1998 Annual net Generation (MWh)	Percentage
KAUFMAN	ONCOR	TXU Electric/PCA	97581030	100%	Trinity Valley EC			0%
KENDALL*	Boerne				Central Texas EC			
KENEDY*	Nueces EC				Magic Valley EC			
KENT	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	South Plains EC			0%
KERR*	Kerrville				Bandera EC			
KIMBLE	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Central Texas EC			0%
KING	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	South Plains EC			0%
KINNEY	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Rio Grande EC			0%
KLEBERG	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Nueces EC			0%
KNOX	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Tri-County EC			0%
LA SALLE	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Medina EC			0%
LAMAR	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
LAMPASAS	ONCOR	TXU Electric/PCA	97581030	100%	Lampasas			0%
LAVACA*	Schulenburg				Yoakum			
LEE*	Giddings				Lexington			
LEON	ONCOR	TXU Electric/PCA	97581030	75%	ENTERGY	Entergy Electric System/PCA	32,288,113	25%
LIMESTONE	ONCOR	TXU Electric/PCA	97581030	75%	ENTERGY	Entergy Electric System/PCA	32,288,113	25%
LIVE OAK	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	San Patricio EC			0%
LLANO*	Llano				Pedernales EC			
LOVING	ONCOR	TXU Electric/PCA	97581030	100%				0%
MADISON	ENTERGY	Entergy Electric System/PCA	32,288,113	100%	Houston County EC			0%
MARTIN	ONCOR	TXU Electric/PCA	97581030	100%	Cap Rock EC			0%
MASON*	Mason				Cap Rock EC			
MATAGORDA	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	19%	RELIANT(CENTER POINT)	Reliant Energy HL&P/PCA	74,386,176	81%
MAVERICK	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Rio Grande EC			0%
McCULLOCH	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Brady			0%
McLENNAN	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
McMULLEN	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Karnes EC			0%
MEDINA	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	54%	CPSB	San Antonio Public Service Bd/PCA	14,641,059	46%
MENARD	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Cap Rock EC			0%
MIDLAND	ONCOR	TXU Electric/PCA	97581030	100%	Cap Rock EC			0%
MILAM	ONCOR	TXU Electric/PCA	97581030	75%	ENTERGY	Entergy Electric System/PCA	32,288,113	25%
MILLS*	Goldwaithe				Cap Rock EC			
MITCHELL	ONCOR	TXU Electric/PCA	97581030	100%	Cap Rock EC			0%
MONTAGUE	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
MONTGOMERY	ENTERGY	Entergy Electric System/PCA	32,288,113	30%	RELIANT(CENTER POINT)	Reliant Energy HL&P/PCA	74,386,176	70%
MOTLEY	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Lighthouse EC			0%
NACOGDOCHES	ONCOR	TXU Electric/PCA	97581030	100%	Cherokee County EC			0%
NAVARRO	ONCOR	TXU Electric/PCA	97581030	100%	Navarro County EC			0%
NOLAN	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	15%	ONCOR	TXU Electric/PCA	97,581,030	85%
NUECES	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Robstown			0%
PALO PINTO	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
PARKER	ONCOR	TXU Electric/PCA	97581030	100%	Weatherford			0%
PECOS	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	15%	ONCOR	TXU Electric/PCA	97,581,030	85%
PRESIDIO	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Rio Grande EC			0%
RAINS	T-NMP	Texas-New Mexico Power Co/PCA	2067714	100%	FEC Electric			0%
REAGAN	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Cap Rock EC			0%
REAL	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Bandera EC			0%
RED RIVER	ONCOR	TXU Electric/PCA	97581030	100%	SWEPCO(AEP)			0%
REEVES	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	15%	ONCOR	TXU Electric/PCA	97,581,030	85%
REFUGIO	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	San Patricio EC			0%
ROBERTSON	ENTERGY	Entergy Electric System/PCA	32,288,113	100%	Hearne			0%
ROCKWALL	ONCOR	TXU Electric/PCA	97581030	100%	FEC Electric			0%
RUNNELS	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Coleman County EC			0%
RUSK	SWEPCO(AEP)	Southwestern Public Service Co/PCA		0%	ONCOR	TXU Electric/PCA	97,581,030	100%
SAN PATRICIO	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	San Patricio EC			0%
SAN SABA*	San Saba				Central Texas EC			
SCHLEICHER	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Pedernales EC			0%
SCURRY	ONCOR	TXU Electric/PCA	97581030	100%	Cap Rock EC			0%
SHACKELFORD	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Fort Belknap EC			0%
SMITH	ONCOR	TXU Electric/PCA	97581030	100%	SWEPCO(AEP)			0%
SOMERVELL	T-NMP	Texas-New Mexico Power Co/PCA	2067714	100%	United Coop Services			0%
STARR	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Medina EC			0%
STEPHENS	ONCOR	TXU Electric/PCA	97581030	100%	Comanche EC			0%
STERLING	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Cap Rock EC			0%
STONEWALL	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Big Country EC			0%
SUTTON	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Pedernales EC			0%
TARRANT	ONCOR	TXU Electric/PCA	97581030	100%	Tri-County EC			0%
TAYLOR	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Taylor EC			0%
TERRELL	T-NMP	Texas-New Mexico Power Co/PCA	2067714	100%	Rio Grande EC			0%
THROCKMORTON	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Fort Belknap EC			0%
TITUS	SWEPCO(AEP)	Southwestern Public Service Co/PCA		0%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	100%
TOM GREEN	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Concho Valley EC			0%
TRAVIS	ONCOR	TXU Electric/PCA	97581030	97%	Austin Energy	Austin Energy/PCA	3,359,240	3%
UPTON	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	15%	ONCOR	TXU Electric/PCA	97,581,030	85%
UVALDE	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Bandera EC			0%
VAL VERDE	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Rio Grande EC			0%
VAN ZANDT	ONCOR	TXU Electric/PCA	97581030	100%	SWEPCO(AEP)			0%
VICTORIA	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Victoria EC			0%
WALLER	RELIANT(CENTER POINT)	Reliant Energy HL&P/PCA	74,386,176	100%	Hempstead			0%
WARD	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
WASHINGTON	ENTERGY	Entergy Electric System/PCA	32,288,113	100%	Bluebonnet EC			0%
WEBB	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Rio Grande EC			0%
WHARTON	RELIANT(CENTER POINT)	Reliant Energy HL&P/PCA	74,386,176	81%	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17162569	19%
WICHITA	ONCOR	TXU Electric/PCA	97581030	100%	Electra			0%
WILBARGER	WTU(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Vernon			0%
WILLACY	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Magic Valley EC			0%
WILLIAMSON	ONCOR	TXU Electric/PCA	97581030	97%	Austin Energy	Austin Energy/PCA	3,359,240	3%
WILSON	Floresville	San Antonio Public Service Bd/PCA		100%	Guadalupe Valley EC			
WINKLER	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
WISE	ONCOR	TXU Electric/PCA	97581030	100%	Bridgeport			0%
YOUNG	ONCOR	TXU Electric/PCA	97581030	98%	T-NMP	Texas-New Mexico Power Co/PCA	2,067,714	2%
ZAPATA	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Medina EC			0%
ZAVALA	CPL(AEP)	American Electric Power - West (ERCOT)/PCA	17,162,569	100%	Medina EC			0%

Table 25: 2005 Totalized Annual Electricity Savings from IECC / IRC by PCA for Single-family Residences.

PCA	Total Electricity Savings by PCA (MWh)
American Electric Power - West (ERCOT)/PCA	47,046.63
Austin Energy/PCA	1,382.51
Brownsville Public Utils Board/PCA	0.00
Lower Colorado River Authority/PCA	5,852.27
Reliant Energy HL&P/PCA	88,125.32
San Antonio Public Service Bd /PCA	32,058.15
South Texas Electric Coop Inc/PCA	0.00
Texas Municipal Power Pool/PCA	0.00
Texas-New Mexico Power Co/PCA	1,740.71
TXU Electric/PCA	176,683.89
El Paso Electric Co/PCA	81.74
Entergy Electric System/PCA	27,412.20
Total	380,383.43

Table 26: 2006 Annual NOx Reductions from IECC / IRC by PCA for Single-family Residences by County Using 2007 eGRID.

Area	County	American Electric Power - West (ERCOT) /PCA	NOx Reductions (lbs)	Austin Energy/PCA	NOx Reductions (lbs)	Brownsville Public Utils Board/PCA	NOx Reductions (lbs/year)	Lower Colorado River Auhotrity /PCA	NOx Reductions (lbs)	Reliant Energy HL&P/PCA	NOx Reductions (lbs)	San Antonio Public Service Bd/PCA	NOx Reductions (lbs)	South Texas Electric Coop INC/PCA	NOx Reductions (lbs)	Texas Municipal Power Pool/PCA	NOx Reductions (lbs)	Texas-New Mexico Power Co/PCA	NOx Reductions (lbs)	TXU Electric/PCA	NOx Reductions (lbs)	Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
Houston-Galveston Area	Brazoria	0.00883113	415.475045	0.010890729	15.05656906	0.006522185	0	0.003944232	23.08271246	0.0654443	5767.299341	0.014877	476.9429697	0.006262	0	0.0048171	0	0.121275	211.1044516	0.00816387	1442.424347	8351.385435	4.175692718
	Chambers	0.02176222	1023.8393	0.026955801	37.26673201	0.016072371	0	0.009076193	53.11633872	0.1649402	14535.41063	0.037472	1201.292333	0.015056	0	0.0095532	0	0.011519	20.05051422	0.01581859	2794.890462	19665.8663	9.83293315
	Fort Bend	0.07043123	3313.55245	0.087239726	120.6100134	0.052016606	0	0.029374182	171.9056643	0.5338124	47042.38808	0.121275	3887.861276	0.048726	0	0.030918	0	0.037279	64.89146371	0.05119528	9045.380632	63646.58958	31.82329479
	Galveston	0.03385674	1592.84561	0.041710519	57.66531392	0.025004711	0	0.015351589	89.84165271	0.2495874	21994.96838	0.056747	1819.20534	0.024143	0	0.0192972	0	0.567751	988.2898593	0.03283689	5801.748935	32344.56509	16.17228255
	Harris	0.06826733	3211.74818	0.084559408	116.9044391	0.050418468	0	0.028471701	166.6241028	0.5174117	45597.0764	0.117549	3768.412168	0.047229	0	0.0299681	0	0.036133	62.89776411	0.04962237	8767.473943	61691.13699	30.8455685
	Liberty	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Montgomery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Waller	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beaumont/ Port Arthur Area	Hardin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Jefferson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Orange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dallas/ Fort Worth Area	Collin	0.00203914	95.9344443	0.003716345	5.13789297	0.001505992	0	0.005950953	34.8265861	0.0024815	218.6810669	0.000717	22.98731828	0.019166	0	0.0766809	0	0.000864	1.504686829	0.0040002	706.7707828	1085.842778	0.542921389
	Dallas	0.00453947	213.566836	0.004683963	6.475636928	0.003352602	0	0.00774211	45.30892317	0.0020856	183.7951607	0.000681	21.83353241	0.007503	0	0.026717	0	0.007525	13.09872141	0.04037045	7132.808916	7616.887727	3.808443863
	Denton	0.00047388	22.2944725	0.000872802	1.206659024	0.000349982	0	0.001396994	8.175586125	0.0005854	51.59238518	0.000169	5.416881701	0.004544	0	0.0181872	0	0.000187	0.324825929	0.00084941	150.0762492	239.0870597	0.11954353
	Tarrant	0.01216249	572.204321	0.012266309	16.95832623	0.008982543	0	0.020308652	118.85173	0.0053165	468.5186767	0.001753	56.18209834	0.017326	0	0.0602168	0	0.020603	35.8646084	0.11064724	19549.58445	20818.16421	10.4090821
	Ellis	0.00327981	154.304186	0.003307809	4.573088012	0.002422289	0	0.005476558	32.05029873	0.0014337	126.3436683	0.000473	15.15041502	0.004672	0	0.0162384	0	0.005556	9.671473971	0.02983782	5271.862863	5613.955993	2.806977997
	Johnson	0.00028606	13.4580885	0.000526868	0.728401354	0.000211267	0	0.000843297	4.935203635	0.0003534	31.14381318	0.000102	3.269907974	0.002743	0	0.0109787	0	0.000113	0.196081612	0.00051274	90.59373108	144.3252274	0.072162614
	Kaufman	0.00632545	297.591247	0.006379446	8.819663318	0.004671629	0	0.010562096	61.81224662	0.002765	243.6665583	0.000911	29.21910955	0.009011	0	0.0313175	0	0.010715	18.65241692	0.05754527	10167.32138	10827.08262	5.413541311
	Parker	0.00021749	10.232148	0.000400576	0.55380156	0.000160626	0	0.000641157	3.752221848	0.0002687	23.67855612	7.75E-05	2.486102104	0.002085	0	0.0083471	0	8.56E-05	0.149080314	0.00038984	68.87816636	109.7300763	0.054865038
	Rockwall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Henderson	0.00081989	38.5732965	0.000826893	1.143190503	0.000605529	0	0.001369042	8.012003493	0.0003584	31.58366542	0.000118	3.787333749	0.001168	0	0.0040593	0	0.001389	2.417696131	0.00745892	1317.871762	1403.388948	0.701694474
	Hood	0.01252711	589.358351	0.012634039	17.46671743	0.009251829	0	0.020917482	122.4147687	0.0054759	482.5643301	0.001805	57.86637331	0.017846	0	0.062022	0	0.021221	36.93978829	0.11396431	20135.6586	21442.26893	10.72113447
	Hunt	0.00618756	291.103792	0.006240374	8.627395644	0.004569788	0	0.010331844	60.46474656	0.0027047	238.3546546	0.000892	28.58213622	0.008815	0	0.0306347	0	0.010482	18.24579632	0.05629078	9945.67491	10591.05343	5.295526715
El Paso Area	El Paso	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
San Antonio Area	Bexar	0.03341375	1572.0045	0.051775843	71.58075131	0.024677545	0	0.090663423	530.5868965	0.0011418	100.6251296	1.143572	36660.79192	0.046874	0	0.0046695	0	0.00052	0.904441816	0.00250387	442.3926437	39378.88628	19.68944314
	Comal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Guadalupe	0.00200047	94.1152461	0.076378745	105.5945701	0.001477434	0	0.133848731	783.3190052	0.0012371	109.0227248	0.003555	113.960183	0.001062	0	0.0018557	0	0.000402	0.699274853	0.00183516	324.2440616	1530.955066	0.765477533
	Wilson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Austin Area	Bastrop	0.00450233	211.819649	0.171901148	237.6554886	0.003325174	0	0.301245466	1762.970015	0.0027843	245.3710346	0.008001	256.4834815	0.00239	0	0.0041765	0	0.000904	1.573816786	0.0041303	729.7570394	3445.630525	1.722815263
	Caldwell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hays	0.0024586	115.668813	0.093870431	129.777046	0.001815785	0	0.164501762	962.7088445	0.0015205	133.9902909	0.004369	140.0584888	0.001305	0	0.0022807	0	0.000494	0.859417532	0.00225544	398.5000029	1881.562904	0.940781452
	Travis	0.00051001	23.9941131	0.299602906	414.204766	0.000376663	0	0.033939476	198.6230023	0.0003347	29.4963198	0.000906	29.04856094	0.000271	0	0.0004717	0	0.000103	0.179862046	0.00046734	82.57070239	778.1173266	0.389058663
	Williamson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North East Texas Area	Gregg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Harrison	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rusk	0.00068596	32.2723366	0.00069182	0.956449981	0.000506616	0	0.001145408	6.703240247	0.0002999	26.42446391	9.88E-05	3.168671611	0.000977	0	0.0033962	0	0.001162	2.022764721	0.00624051	1102.597003	1174.14493	0.587072465
	Smith	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Upshur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corpus Christi Area	Nueces	0.22756873	10706.3427	0.004556851	6.299903945	0.168069652	0	0.007612767	44.55197394	0.0016809	148.1287856	0.001627	52.15206548	0.046792	0	0.0072464	0	0.001609	2.801542831	0.00828339	1463.542412	12423.81936	6.211909679
	San Patricio	0.05031335	2367.07381	0.001007478	1.392850767	0.037158653	0	0.001683113	9.850031306	0.0003716	32.74991086	0.00036	11.53034158	0.010345	0	0.0016021	0	0.000356	0.61939533	0.00183138	323.5757544	2746.792091	1.373396045
Victoria Area	Victoria	0.02183674	1027.3449	0.002215582	3.063070069	0.016127403	0	0.003612695	21.14247066	0.0011996	105.7169987	0.000555	17.80473586	0.525456	0	0.0324127	0	0.000477	0.830066547	0.00225485	398.395525	1574.297771	0.787148886
Other ERCOT counties	Andrews	2.4742E-05	1.1640317	2.49533E-05	0.034498218	1.82731E-05	0	4.13138E-05	0.241779336	1.082E-05	0.953104635	3.57E-06	0.114290894	3.52E-05	0	0.0001225	0	4.19E-05	0.07295915	0.00022509	39.76959824	42.35026217	0.021175131
	Angelina	0.00031082	14.6230309	0.000313473	0.433380384	0.000229554	0	0.000519	3.03732855	0.0001359	11.97328094	4.48E-05	1.435767837	0.000443	0	0.0015389	0	0.000527	0.916541972	0.00282766	499.6015707	532.0209013	0.266010451
	Bosque	0.00059539	28.0111786	0.001096604	1.516068226	0.000439723	0	0.001755208	10.2719543	0.0007356	64.821606	0.000212	6.805868156	0.005709	0	0.0228507	0	0.000234	0.408117172	0.00106721	188.5585143	300.3933067	0.150196653
	Brazos	0.00193973	91.2575411	0.003572622	4.939194477	0.001432574	0	0.005718288	33.46497148	0.0023964	211.1821308	0.000692	22.17281903	0.018599	0	0.0744451	0	0.000764	1.329603807	0.00347685	614.3042619	978.6505226	0.489325261
	Calhoun	0.08269981	3890.7476	0.001655986	2.289421973	0.061077496	0	0.002766524	16.19044813	0.0006108	53.83086781	0.000591	18.95236589	0.017004	0	0.0026334	0	0.000585	1.018097065	0.00301023	531.8598801	4514.888683	2.257444342
	Cameron	0.04837175	2275.72786	0.000968599	1.339100322	0.297964476	0	0.001618161	9.469916233	0.0003573	31.48608394	0.000346	11.08538293	0.009946	0	0.0015403	0	0.000342	0.595492715	0.00176071	311.0888884	2640.792724	1.320396362
	Cherokee	0.0035039	164.846648	0.003533808	4.88553325	0.002587786	0	0.00585073	34.24005829	0.0015316	134.9757955	0.000505	16.18553068	0.004992	0	0.0173479	0	0.005936	10.33225417	0.03187642	5632.050212	5997.516032	2.998758016
	Coke	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coleman	0.00129879	61.1035505	2.6007E-05	0.035954995	0.000959212	0	4.34478E-05	0.254268322	9.593E-06	0.845404917	9.28E-06	0.297643786	0.000267	0	4.136E-05	0	9.19E-06	0.015989047	4.7275E-05	8.352771854	70.90558347	0.035452792
	Crockett	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ector	0.00353575	166.345024	0.003565928	4.929940368	0.002611307	0	0.005903911	34.55128375	0.0015456	136.2026598	0.000509	16.33264927	0.005037	0	0.0175056	0	0.00599	10.42616932	0.03216616	5683.242805	6052.030532	3.026015266
	Fannin	0.00705631	331.975853	0.007116546	9.838714264	0.005211403	0	0.011782473	68.95422315	0.0030845	271.8205397	0.001017	32.59517507	0.010052	0	0.034936	0	0.011954	20.80757437	0.06419422	11342.08487	12078.07695	6.039038475
	Fayette	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Freestone	0.00367718	172.998825	0.003708565	5.127137983	0.00271576	0	0.006140067	35.9333351	0.0016074	141.6507661	0.00053	16.98595524	0.005238	0	0.0182058	0	0.006229	10.8432161	0.03345281	5910.572518	6294.111753	3.147055876
	Frio	0.00858833	404.052234	0.000871383	1.204697955	0.006342868	0	0.001420864	8.315281922	0.0004718	41.57823664	0.000218	7.002559001	0.206661	0	0.0127478	0	0.000188	0.32646314	0.00088683	156.6879841	619.1674572	0.309583729
	Grimes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hardeman	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Haskell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hidalgo	0.18852746	8869.58216	0.003775086	5.219103975	0.139235931	0	0.006306735	36.90871897	0.0013925	122.7160827	0.001348	43.20495275	0.038764	0	0.0060032	0	0.001333	2.320915279	0.00686231	1212.459759	10292.41169	5.146205844
	Howard	0.00055511	26.1162002	0.000559851	0.77400157	0.000409976	0	0.000926915	5.424558082	0.0002427	21.38384334	8E-05	2.564229024	0.000791	0	0.0027484	0	0.00094	1.636910556	0.00505009	892.2701952	950.169938	0.475084969
	Jack	0.00212145	99.8070143	0.002139557	2.957964221	0.001566784	0	0.003542346	20.73077025	0.0009273	81.72159585	0.000306	9.799589563	0.003022	0	0.0105033	0	0.003594	6.255701594	0.0192997	3409.945683	3631.218319	1.815609159
	Jones	0.04071872	1915.67881	0.000815354	1.127237642	0.030072592	0	0.001362147	7.971655198	0.0003008	26.50458552	0.000291	9.331534546	0.008372	0	0.0012966	0	0.000288	0.501278204	0.00148214	261.8706748	2222.985772	1.111492886
	Lamar	0.00095084	44.7337198	0.000958954	1.325765965	0.000702236	0	0.001587687	9.291576089	0.0004156	36.62779612	0.000137	4.39219725	0.001355	0	0.0047076	0	0.001611	2.803818993	0.00865017	1528.345035	1627.519909	0.813759954
	Limestone	0.00071976	33.8621337	0.000891528	1.232547986	0.000531572	0	0.000300183	1.756752813	0.0054552	480.7395261	0.001239	39.73115873	0.000498	0	0.000316	0	0.000381	0.6631443	0.00052318	92.43731401	650.4225776	0.325211289
	Llano	0.00123817	58.2519164	0.047274044	65.35695676	0.000914447	0	0.082844655	484.8293458	0.0007657	67.47878702	0.0022	70.53478928	0.000657	0	0.0011486	0	0.000249	0.432810857	0.00113586	200.688398	947.5730041	0.473786502
	McLennan	0.02453432	1154.25704	0.024743738	34.20852773	0.018119687	0	0.040966843	239.7490557	0.0107245	945.1011808	0.003535	113.331165	0.034951	0	0.1214699	0	0.041562	72.34649424	0.22319886	39435.64315	41994.63661	20.9973183
	Milam	0.0022454	105.638742	0.002264571	3.130798201	0.001658332	0	0.003749326	21.94207007	0.0009815	86.4965923	0.000324	10.37218001	0.003199	0	0.011117	0	0.003804	6.621222514	0.02042738	3609.18896	3843.390565	1.921695283
	Mitchell	0.01494317	703.025785	0.015070721	20.83546065	0.011036196	0	0.024951762	146.0244667	0.006532	575.6347838	0.002153	69.02685344	0.021288	0	0.073984	0	0.025314	44.06423293	0.1359442	24019.15094	25577.76253	12.78888126
	Nolan	0.00056465	26.5650559	0.000569473	0.787304234	0.000417022	0	0.000942846	5.517789256	0.0002468	21.75136467	8.14E-05	2.608300095	0.000804	0	0.0027956	0	0.000957	1.665043924	0.00513689	907.6055269	966.500385	0.483250192
	Palo Pinto	0.003207	150.878476	0.005906709	8.166099231	0.002368511	0	0.009454195	55.32851139	0.003962	349.1529325	0.001144	36.65890082	0.03075	0	0.1230821	0	0.001263	2.198268701	0.00574838	1015.645281	1618.02847	0.809014235
	Pecos	4.0968E-05	1.92739138	4.13174E-05	0.057121784	3.02565E-05	0	6.84069E-05	0.40033567	1.791E-05	1.578140582	5.9E-06	0.189241654	5.84E-05	0	0.0002028	0	6.94E-05	0.12080499	0.0003727	65.85008049	70.12311656	0.035061558
	Presidio	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Robertson	0.00073771	34.7066654	0.000835096	1.154531214	0.00054483	0	0.000735917	4.306785842	0.0031497	277.566375	0.000731	23.43050801	0.000761	0	0.0018663	0	0.191633	333.5765173	0.00339774	600.3254668	1275.06685	0.637533425
	Taylor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Titus	0.00569644	267.998202	0.005745061	7.942619059	0.004207073	0	0.009511781	55.6655181	0.00249	219.4358878	0.000821	26.31350518	0.008115	0	0.0282032	0	0.00965	16.79758476	0.05182285	9156.263414	9750.416731	4.875208365
	Tom Green	0.00148245	69.7441904	2.96846E-05	0.041039383	0.001094854	0	4.95918E-05	0.290224351	1.095E-05	0.964953443	1.06E-05	0.33973353	0.000305	0	4.72E-05	0	1.05E-05	0.018250054	5.396E-05	9.533935518	80.93232671	0.040466163
	Upton	3.1166E-05	1.46626136	3.14322E-05	0.043455349	2.30176E-05	0	5.20405E-05	0.304555021	1.362E-05	1.200569106	4.49E-06	0.143965427	4.44E-05	0	0.0001543	0	5.28E-05	0.091902293	0.00028353	50.09539276	53.34610131	0.026673051
	Ward	0.01855953	873.163344	0.01871795	25.87779976	0.013707039	0	0.030990277	181.3634923	0.0081128	714.9427564	0.002674	85.73187418	0.02644	0	0.0918886	0	0.03144	54.72811066	0.16884373	29831.96719	31767.77456	15.88388728
	Webb	0.02001433	941.606722	0.000400768	0.554067069	0.014781473	0	0.000669531	3.918279042	0.0001478	13.02770371	0.000143	4.586695653	0.004115	0	0.0006373	0	0.000142	0.246391475	0.00072851	128.716352	1092.656211	0.546328105
	Wharton	0.00014434	6.79069685	0.000178787	0.247174611	0.000106601	0	6.01986E-05	0.352298408	0.001094	96.40728543	0.000249	7.96766846	9.99E-05	0	6.336E-05	0	7.64E-05	0.132986656	0.00010492	18.53733681	130.4354472	0.065217724
	Wichita	0.00020763	9.76844357	0.000209406	0.289505771	0.000153346	0	0.000346701	2.028989253	9.076E-05	7.998363675	2.99E-05	0.959118338	0.000296	0	0.001028	0	0.000352	0.612266267	0.00188893	333.7426956	355.3993825	0.177699691
	Wilbarger	0.02861682	1346.32496	0.000573025	0.792214313	0.021134796	0	0.000957307	5.602420569	0.0002114	18.62722752	0.000205	6.55813376	0.005884	0	0.0009112	0	0.000202	0.35229463	0.00104164	184.0407818	1562.29803	0.781149015
	Wise	0.00284449	133.823564	0.002882008	3.984412173	0.002100781	0	0.00476997	27.91515848	0.0012561	110.6920462	0.000413	13.24775016	0.004182	0	0.0146143	0	0.004798	8.351827034	0.02576141	4551.626376	4849.641134	2.424820567
	Young	0.00623586	293.376048	0.006289085	8.694738134	0.004605458	0	0.010412491	60.93671362	0.0027258	240.2151692	0.000899	28.80523857	0.008883	0	0.0308739	0	0.010564	18.38821674	0.05673017	10023.30744	10673.72356	5.33686178
	Total	1.12183722	52778.6647	1.172570094	1621.092826	1.090766584	0	1.189130767	6959.115155	1.62936	143587.877	1.542363	49445.28903	1.359386	0	1.2316428	0	1.221806	2126.809284	1.52878695	270112.0265	526630.8746	263.3154373
Energy Savings by PCA (MWh)		47,046.63		1,382.51		0.00		5,852.27		88,125.32		32,058.15		0.00		0.00		1,740.71		176,683.89			

Table 27: 2005 Totalized OSD Electricity Savings from IECC / IRC by PCA for Single-family Residences.

PCA	Total Electricity Savings by PCA (MWh)
American Electric Power - West (ERCOT)/PCA	244.54
Austin Energy/PCA	8.38
Brownsville Public Utils Board/PCA	0.00
Lower Colorado River Authority/PCA	35.56
Reliant Energy HL&P/PCA	545.23
San Antonio Public Service Bd /PCA	197.20
South Texas Electric Coop Inc/PCA	0.00
Texas Municipal Power Pool/PCA	0.00
Texas-New Mexico Power Co/PCA	11.57
TXU Electric/PCA	1,178.71
El Paso Electric Co/PCA	0.48
Entergy Electric System/PCA	169.84
Total	2,391.51

Table 28: 2006 OSD NOx Reductions from IECC / IRC by PCA for Single-family Residences by County Using 2007 eGRID.

Area	County	American Electric Power - West (ERCOT) /PCA	NOx Reductions (lbs)	Austin Energy/PCA	NOx Reductions (lbs)	Brownsville Public Utils Board/PCA	NOx Reductions (lbs/year)	Lower Colorado River Auhotrity /PCA	NOx Reductions (lbs)	Reliant Energy HL&P/PCA	NOx Reductions (lbs)	San Antonio Public Service Bd/PCA	NOx Reductions (lbs)	South Texas Electric Coop INC/PCA	NOx Reductions (lbs)	Texas Municipal Power Pool/PCA	NOx Reductions (lbs)	Texas-New Mexico Power Co/PCA	NOx Reductions (lbs)	TXU Electric/PCA	NOx Reductions (lbs)	Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
Houston-Galveston Area	Brazoria	0.00957217	2.34075501	0.011806715	0.098993441	0.007069474	0	0.004263638	0.151595666	0.0710018	38.7119386	0.01614	3.182827415	0.006781	0	0.0051797	0	0.126288	1.461166579	0.008772	10.33928222	56.28655893	0.028143279
	Chambers	0.0218814	5.3508231	0.027103415	0.227248676	0.016160386	0	0.009125896	0.324475559	0.1658435	90.42200232	0.037677	7.429868134	0.015138	0	0.0096055	0	0.011582	0.134001143	0.015905	18.74771229	122.6361312	0.061318066
	Fort Bend	0.05569551	13.6196448	0.068987309	0.578424327	0.041133619	0	0.023228475	0.825899453	0.4221274	230.1544143	0.095902	18.91151384	0.038531	0	0.0244493	0	0.029479	0.341077987	0.040484	47.7192346	312.1502093	0.156075105
	Galveston	0.02755599	6.73847344	0.033893644	0.28418137	0.020351324	0	0.012791501	0.454807907	0.2014466	109.8337415	0.045813	9.034064445	0.019824	0	0.0167751	0	0.594657	6.880241032	0.028709	33.84025126	167.0657609	0.08353288
	Harris	0.07736057	18.9175659	0.09582276	0.803426261	0.057134232	0	0.032264145	1.147167017	0.5863312	319.6824408	0.133207	26.26792505	0.05352	0	0.0339599	0	0.040946	0.4737543	0.056232	66.28159376	433.5738731	0.216786937
	Liberty	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Montgomery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Waller	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beaumont/ Port Arthur Area	Hardin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Jefferson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Orange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dallas/ Fort Worth Area	Collin	0.00176365	0.4312784	0.003151138	0.026420724	0.001302533	0	0.005050143	0.179560225	0.0020858	1.137203735	0.000604	0.119122417	0.015958	0	0.0637888	0	0.000846	0.009789886	0.004013	4.730426406	6.633801793	0.003316901
	Dallas	0.00504555	1.2338272	0.005305276	0.044482104	0.003726366	0	0.008757286	0.311369478	0.0024131	1.315675221	0.000782	0.154259527	0.00931	0	0.033672	0	0.008209	0.094981107	0.044002	51.86601675	55.02061139	0.027510306
	Denton	0.00063576	0.15546667	0.001170951	0.009817839	0.000469535	0	0.001874207	0.06663832	0.0007854	0.428236526	0.000227	0.044702626	0.006096	0	0.0243999	0	0.00025	0.002896576	0.00114	1.343218739	2.050977293	0.001025489
	Tarrant	0.01557224	3.8079984	0.015705165	0.131680013	0.011500796	0	0.026002176	0.924519744	0.006807	3.711338337	0.002244	0.442473414	0.022184	0	0.0770985	0	0.02638	0.305215022	0.141667	166.9851472	176.3083722	0.088154186
	Ellis	0.00350282	0.85657195	0.003532723	0.029620129	0.002586991	0	0.005848935	0.207961662	0.0015312	0.834829214	0.000505	0.099530061	0.00499	0	0.0173426	0	0.005934	0.06865513	0.031867	37.56167358	39.65884172	0.019829421
	Johnson	0.00033718	0.0824522	0.000621017	0.00520692	0.00024902	0	0.000993991	0.03534183	0.0004166	0.227116504	0.00012	0.02370817	0.003233	0	0.0129406	0	0.000133	0.001536208	0.000604	0.712380017	1.087741852	0.000543871
	Kaufman	0.00649275	1.58772188	0.006548174	0.054903184	0.004795187	0	0.01084145	0.385472909	0.0028381	1.547420047	0.000936	0.184486611	0.009249	0	0.0321458	0	0.010999	0.127257555	0.059067	69.62344603	73.51070822	0.036755354
	Parker	0.00047595	0.11638804	0.000876616	0.007349994	0.000351511	0	0.0014031	0.049887889	0.000588	0.320593556	0.00017	0.033466024	0.004564	0	0.0182667	0	0.000187	0.002168483	0.000853	1.00558277	1.53543676	0.000767718
	Rockwall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Henderson	0.00095027	0.23237697	0.000958382	0.008035561	0.000701818	0	0.001586741	0.056417328	0.0004154	0.226478441	0.000137	0.027001227	0.001354	0	0.0047048	0	0.00161	0.018625255	0.008645	10.18999952	10.7589343	0.005379467
	Hood	0.01232788	3.0146302	0.012433111	0.10424546	0.00910469	0	0.020584816	0.731902919	0.0053888	2.938108547	0.001776	0.350287363	0.017562	0	0.0610356	0	0.020884	0.241625738	0.112152	132.1950315	139.5758317	0.069787916
	Hunt	0.00635121	1.55310972	0.006405424	0.053706301	0.004690653	0	0.010605108	0.377069643	0.0027763	1.513686463	0.000915	0.180464823	0.009048	0	0.031445	0	0.010759	0.124483355	0.05778	68.10566269	71.908183	0.035954091
El Paso Area	El Paso	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
San Antonio Area	Bexar	0.03112811	7.61199305	0.048234164	0.404419512	0.0229895	0	0.084461674	3.00307498	0.0010637	0.579974722	1.065347	210.0825792	0.043667	0	0.0043501	0	0.000484	0.005600405	0.002333	2.74945859	224.4371004	0.11221855
	Comal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Guadalupe	0.00200761	0.4909362	0.076651484	0.642684628	0.00148271	0	0.134326688	4.776049251	0.0012416	0.676924327	0.003567	0.703496294	0.001066	0	0.0018623	0	0.000403	0.004664522	0.001842	2.170859892	9.465615115	0.004732808
	Wilson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Austin Area	Bastrop	0.00446951	1.0929642	0.170648096	1.430799542	0.003300936	0	0.299049574	10.63284975	0.002764	1.507026893	0.007942	1.56618368	0.002372	0	0.0041461	0	0.000898	0.010384559	0.0041	4.83295415	21.07316277	0.010536581
	Caldwell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hays	0.00246935	0.60384953	0.094281013	0.790499475	0.001823727	0	0.165221279	5.874521127	0.0015271	0.832614166	0.004388	0.865297577	0.001311	0	0.0022907	0	0.000496	0.005737343	0.002265	2.670148825	11.64266804	0.005821334
	Travis	0.00050761	0.1241295	0.298194277	2.500210934	0.000374892	0	0.033779905	1.201060565	0.0003331	0.181633585	0.000902	0.177843719	0.00027	0	0.0004695	0	0.000103	0.001189882	0.000465	0.548265572	4.734333759	0.002367167
	Williamson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North East Texas Area	Gregg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Harrison	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rusk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Smith	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Upshur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corpus Christi Area	Nueces	0.22352453	54.6601425	0.00447587	0.037527946	0.165082827	0	0.007477478	0.265865282	0.001651	0.900175311	0.001598	0.315097338	0.04596	0	0.0071176	0	0.001581	0.01829031	0.008136	9.590243216	65.78734188	0.032893671
	San Patricio	0.05533089	13.53048	0.001107949	0.009289605	0.040864326	0	0.001850962	0.065811846	0.0004087	0.222827887	0.000396	0.077998667	0.011377	0	0.0017619	0	0.000391	0.004527553	0.002014	2.373952722	16.28488828	0.008142444
Victoria Area	Victoria	0.02060475	5.03863583	0.002090584	0.017528505	0.015217528	0	0.003408874	0.121204151	0.0011319	0.617162515	0.000524	0.103341756	0.495811	0	0.0305841	0	0.00045	0.005205996	0.002128	2.507874736	8.410953493	0.004205477
Other ERCOT counties	Andrews	2.5653E-05	0.00627304	2.58716E-05	0.000216921	1.89456E-05	0	4.28342E-05	0.001522991	1.121E-05	0.006113808	3.7E-06	0.000728901	3.65E-05	0	0.000127	0	4.35E-05	0.000502791	0.000233	0.275080068	0.29043852	0.000145219
	Angelina	0.00032149	0.07861642	0.000324234	0.002718544	0.000237435	0	0.000536817	0.019086782	0.0001405	0.076620867	4.63E-05	0.009134898	0.000458	0	0.0015917	0	0.000545	0.006301188	0.002925	3.44742127	3.639899969	0.00181995
	Bosque	0.00093945	0.22973147	0.001730301	0.014507718	0.000693828	0	0.002769496	0.09847075	0.0011606	0.63280064	0.000335	0.066056604	0.009008	0	0.0360555	0	0.00037	0.00428024	0.001684	1.984860294	3.030707714	0.001515354
	Brazos	0.00191393	0.46802688	0.003525105	0.029556256	0.00141352	0	0.005642234	0.200612298	0.0023645	1.289190864	0.000682	0.13457567	0.018351	0	0.073455	0	0.000754	0.00872004	0.003431	4.043712346	6.174394357	0.003087197
	Calhoun	0.08852525	21.6477478	0.001772635	0.014862667	0.065379841	0	0.0029614	0.105293992	0.0006539	0.356507818	0.000633	0.124791986	0.018202	0	0.0028189	0	0.000626	0.007243743	0.003222	3.798145366	26.05459341	0.013027297
	Cameron	0.05467229	13.3694279	0.001094762	0.009179032	0.285623104	0	0.001828931	0.065028494	0.0004038	0.220175586	0.000391	0.077070256	0.011242	0	0.0017409	0	0.000387	0.004473662	0.00199	2.345695775	16.09105071	0.008045525
	Cherokee	0.003513	0.85905927	0.003542982	0.02970614	0.002594504	0	0.005865919	0.208565543	0.0015356	0.837253395	0.000506	0.099819077	0.005005	0	0.0173929	0	0.005951	0.068854491	0.031959	37.67074536	39.77400327	0.019887002
	Coke	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coleman	0.0013551	0.33137269	2.71346E-05	0.00022751	0.001000801	0	4.53316E-05	0.001611787	1.001E-05	0.00545724	9.69E-06	0.001910251	0.000279	0	4.315E-05	0	9.58E-06	0.000110884	4.93E-05	0.058140073	0.398830437	0.000199415
	Crockett	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ector	0.00362926	0.88749127	0.003660242	0.030689315	0.002680373	0	0.006060061	0.215468367	0.0015864	0.864963693	0.000523	0.103122756	0.00517	0	0.0179686	0	0.006148	0.071133346	0.033017	38.91752154	41.09039028	0.020545195
	Fannin	0.00762852	1.86545875	0.007693632	0.064507284	0.005633999	0	0.012737922	0.45290288	0.0033346	1.818107006	0.001099	0.216758469	0.010867	0	0.0377689	0	0.012923	0.149518454	0.0694	81.80253011	86.36978296	0.043184891
	Fayette	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Freestone	0.00377443	0.92299092	0.003806652	0.031916887	0.002787588	0	0.006302464	0.224087102	0.0016499	0.899562241	0.000544	0.107247666	0.005377	0	0.0186873	0	0.006394	0.07397868	0.034338	40.4742224	42.73400589	0.021367003
	Frio	0.01476384	3.61031301	0.001497957	0.012559628	0.010903753	0	0.002442547	0.086845912	0.0008111	0.442212918	0.000375	0.074047043	0.355262	0	0.0219143	0	0.000322	0.003730231	0.001525	1.796957168	6.026665906	0.003013333
	Grimes	0.00055442	0.13557755	0.001021149	0.008561826	0.000409467	0	0.001634436	0.058113165	0.0006849	0.373451487	0.000198	0.038983742	0.005316	0	0.0212784	0	0.000218	0.002526012	0.000994	1.171378444	1.788592224	0.000894296
	Hardeman	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Haskell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hidalgo	0.239737	58.6247004	0.004800509	0.040249888	0.177056459	0	0.008019827	0.285148772	0.0017708	0.965465978	0.001714	0.337951681	0.049294	0	0.0076338	0	0.001695	0.019616926	0.008726	10.2858337	70.55896736	0.035279484
	Howard	0.00058508	0.14307425	0.000590075	0.004947486	0.000432108	0	0.000976955	0.034736088	0.0002558	0.139442533	8.43E-05	0.016624627	0.000833	0	0.0028967	0	0.000991	0.011467549	0.005323	6.273971764	6.624264296	0.003312132
	Jack	0.00217756	0.53249476	0.002196145	0.018413589	0.001608224	0	0.003636037	0.12928102	0.0009519	0.518978216	0.000314	0.061873654	0.003102	0	0.0107811	0	0.003689	0.042680007	0.01981	23.35051292	24.65423417	0.012327117
	Jones	0.04250012	10.3928766	0.000851025	0.007135424	0.031388236	0	0.00142174	0.050550638	0.0003139	0.171155993	0.000304	0.059911438	0.008739	0	0.0013533	0	0.000301	0.003477652	0.001547	1.823453253	12.50856103	0.006254281
	Lamar	0.00107998	0.26409579	0.001089199	0.009132393	0.000797614	0	0.001803327	0.064118139	0.0004721	0.257392133	0.000156	0.030686821	0.001539	0	0.005347	0	0.00183	0.021167552	0.009825	11.58090675	12.22749958	0.00611375
	Limestone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Llano	0.00124346	0.30407265	0.047475864	0.398061541	0.000918351	0	0.083198331	2.958156211	0.000769	0.419268688	0.00221	0.435726648	0.00066	0	0.0011535	0	0.00025	0.002889079	0.001141	1.344572121	5.862746943	0.002931373
	McLennan	0.02303137	5.63203469	0.023227961	0.194754914	0.017009692	0	0.038457253	1.367365927	0.0100675	5.489074324	0.003319	0.654418766	0.03281	0	0.1140288	0	0.039015	0.451413423	0.209526	246.9712543	260.7603163	0.130380158
	Milam	0.00165249	0.40409639	0.001666598	0.013973592	0.001220439	0	0.002759294	0.098107996	0.0007223	0.393839036	0.000238	0.046954303	0.002354	0	0.0081815	0	0.002799	0.032388745	0.015033	17.72009543	18.70945549	0.009354728
	Mitchell	0.01696145	4.14771237	0.017106233	0.143427271	0.012526789	0	0.028321847	1.00699674	0.0074142	4.042429198	0.002444	0.48194675	0.024163	0	0.0839765	0	0.028733	0.332443449	0.154305	181.8819988	192.0369546	0.096018477
	Nolan	0.00060327	0.14752288	0.000608422	0.005101319	0.000445544	0	0.001007331	0.035816143	0.0002637	0.143778245	8.69E-05	0.017141539	0.000859	0	0.0029868	0	0.001022	0.011824112	0.005488	6.469049506	6.830233747	0.003415117
	Palo Pinto	0.00307488	0.75192349	0.00566337	0.047484544	0.002270935	0	0.00906471	0.322300076	0.0037988	2.071190633	0.001096	0.216206827	0.029483	0	0.1180115	0	0.001211	0.014009458	0.005512	6.496554826	9.919669855	0.004959835
	Pecos	4.2262E-05	0.01033459	4.26225E-05	0.000357369	3.12122E-05	0	7.05678E-05	0.00250907	1.847E-05	0.010072266	6.09E-06	0.001200836	6.02E-05	0	0.0002092	0	7.16E-05	0.000828328	0.000384	0.453183893	0.478486355	0.000239243
	Presidio	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Robertson	0.00035926	0.08785195	0.000406685	0.003409851	0.000265328	0	0.000358385	0.012742565	0.0015339	0.836302471	0.000356	0.070188153	0.000371	0	0.0009089	0	0.093323	1.079762322	0.001655	1.950383289	4.0406406	0.00202032
	Taylor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Titus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tom Green	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Upton	3.2238E-05	0.00788339	3.25131E-05	0.000272606	2.38092E-05	0	5.38302E-05	0.001913958	1.409E-05	0.007683282	4.65E-06	0.000916017	4.59E-05	0	0.0001596	0	5.46E-05	0.000631862	0.000293	0.345695786	0.364996901	0.000182498
	Ward	0.01980763	4.84370849	0.0199767	0.167494712	0.014628815	0	0.033074321	1.175973218	0.0086584	4.720758551	0.002854	0.562818575	0.028218	0	0.098068	0	0.033554	0.388228261	0.180198	212.4022361	224.2612179	0.112130609
	Webb	0.01418005	3.46755379	0.000283942	0.002380714	0.010472596	0	0.000474359	0.016866077	0.0001047	0.057105711	0.000101	0.019989281	0.002916	0	0.0004515	0	0.0001	0.001160309	0.000516	0.608390002	4.173445881	0.002086723
	Wharton	0.00015439	0.03775415	0.000191235	0.001603413	0.000114024	0	6.43902E-05	0.002289423	0.0011702	0.637996405	0.000266	0.052423404	0.000107	0	6.777E-05	0	8.17E-05	0.000945481	0.000112	0.132279453	0.86529173	0.000432646
	Wichita	0.00021984	0.05375986	0.000221719	0.001859008	0.000162364	0	0.000367089	0.013052014	9.61E-05	0.052395248	3.17E-05	0.00624667	0.000313	0	0.0010884	0	0.000372	0.004308908	0.002	2.357432118	2.489053823	0.001244527
	Wilbarger	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Wise	0.00291847	0.71367576	0.002955932	0.02478402	0.002155421	0	0.004892446	0.173953246	0.0012878	0.702115174	0.000424	0.083557137	0.004281	0	0.0149528	0	0.004924	0.056975292	0.026441	31.16583588	32.92089651	0.016460448
	Young	0.00549666	1.34413988	0.005543579	0.046480155	0.004059529	0	0.009178198	0.326335184	0.0024027	1.310020999	0.000792	0.156183406	0.00783	0	0.0272141	0	0.009311	0.107734206	0.050005	58.94209298	62.23298681	0.031116493
	Total	**1.14303735**	**279.515568**	**1.154658244**	**9.681235987**	**1.089429227**	**0**	**1.180868675**	**41.98634706**	**1.5393506**	**839.292446**	**1.443965**	**284.7447532**	**1.481727**	**0**	**1.2697054**	**0**	**1.151969**	**13.32840261**	**1.517783**	**1789.03256**	**3257.581313**	**1.628790656**

Energy Savings by PCA (MWh)																					
		244.54		8.38		0.00		35.56		545.23		197.20		0.00		0.00		11.57		1,178.71	

6.1.2 2006 Results for New Multi-family Residential Construction.

In this section of the report, calculations are provided regarding the potential electricity reductions and associated emissions reductions from the implementation of the IECC / IRC to new multi-family residences in all the counties in ERCOT region as well as the 41 non-attainment and affected counties. To calculate the NOx emissions reductions from the implementation of the IECC /IRC in multi-family residences, new construction activity by county had to be determined. Then, energy savings attributable to the IECC / IRC had to be modeled using the code-traceable, DOE-2 simulation that the Laboratory has developed for the TERP. Next, these estimates were applied to the NAHB's survey data to determine the appropriate number of housing types. In addition, estimates of the NOx reduction potential from the electricity reductions in each county were calculated using the US EPA's 2007 eGRID database[72].

In Table 29 and Table 30, the 1999 and IECC / IRC code-compliant building characteristics for multi-family are shown for each county. The IECC / IRC code-compliant characteristics are the minimum building code characteristics required by the IECC / IRC for each county for multi-family residences (i.e., Type A.2). In Table 29 and Table 30, the rows are sorted first by the US EPA's non-attainment and affected designation, then alphabetically. Next, in the third column, the location of the TMY2 weather file is listed, followed by the NAHB survey classification. The fifth column in Table 29 and Table 30 lists the window area for the average house as defined by the NAHB survey[73]. The sixth, seventh, eighth and ninth columns show the NAHB's average glazing U-value, Solar Heat Gain Coefficient (SHGC), roof insulation and wall insulation, respectively. In columns ten through fourteen of Table 29 and Table 30, the corresponding values from the IECC / IRC code-compliant house are listed for each county (i.e., percent area, glazing U-value, SHGC, roof and wall insulation R-value). For each county the identical window percent area was used for the 1999 and code-compliant calculation (i.e., window-to-wall area).

The IECC / IRC SHGC is 0.4 for all non-attainment and affected counties since they all fall below the 3,500 HDD_{65}, as required by the IECC / IRC. All houses were assumed to have an air conditioner efficiency[74] equal to a SEER 11, and a furnace efficiency (AFUE) or 0.80. The values shown in Table 29 and Table 30, represent the only changes that were made to the simulation to obtain the savings calculations. All other variables in the simulation remained the same for the 1999 and IECC / IRC code-compliant simulation. In cases where the 1999 values were more efficient than the IECC / IRC code-compliant simulation, the 1999 values were used in both simulations, since this indicates that the prevailing practice is already above code.

In Table 31 and Table 32, the code-traceable simulation results for multi-family are shown for each county. In a similar fashion as Table 29 and Table 30, this table is first divided into US EPA affected and then non-attainment classifications, followed by an alphabetical listing of counties. In the third column, the IECC / IRC climate zone is listed followed by the number of projected new housing units[75] in the fourth column. In the fifth column, the total simulated energy use is listed if all new construction had been built to pre-code specifications, and, in the sixth column, the total county-wide energy use for code-compliant construction is shown. In a similar fashion as the 2005 report, the values in the fifth and sixth columns come from the associated tables in the 2006 Volume III Appendix to the 2006 Volume II Technical report. As previously explained, in the 2006 report, 18 simulations were run for each county, which were then

[72] This analysis assumes transmission and distribution losses of 7%. Counties were assigned to utility service districts as indicated in a fashion similar to the 2004 report.
[73] In a similar fashion as single-family, this value represents the NAHB's reported number of window units times an average window size of 3 x 5 feet, which was determined by surveying local building suppliers. Additional information about the procedures used to determine these values can be found in Im (2003).
[74] In a similar fashion as single-family, the choice of a SEER 11 efficiency for the air conditioner was based on ARI sales numbers for Texas which show an average SEER 11 for houses built in 1999.
[75] The number of projected new housing units uses the published values for the new housing units in 2004. A vacancy rate of 0% was assumed for 2005 calculations, based on information suggested by the Real Estate Center at Texas A&M University.

distributed according to the NAHB's survey data to account for 1, 2 or 3 story, and 3 fuel options (i.e., central air conditioning with electric resistance heating, heat pump heating, or a natural gas-fired furnace).

In the seventh and eighth columns, the total pre-code and code-compliant peak-day energy use is reported for peak OSD, Episode Day for the 2005 annual report across all counties. In a similar fashion as the annual pre-code and code-compliant energy use, these values are from the associated tables for each county in the Volume III Appendix to this report.

In the ninth and tenth columns, the total annual electricity and Ozone Season Day savings are shown for each county, respectively. In similar fashion as the 2005 report, a 7% transmission and distribution loss is used in the 2006 report, which represents a fixed 1.07 multiplier for the electricity use. In the eleventh and twelfth columns, the total annual pre-code and code-compliant natural gas use is shown for those residences that had natural gas-fired furnaces and domestic water heaters. Similarly, in columns thirteen and fourteen, the simulated total peak OSD natural gas use on the OSD, is shown for each county. Finally, in columns fifteen and sixteen, the total annual and peak-day natural gas savings are shown for each county.

In Table 33, the annual electricity savings from Table 31 and Table 32 are assigned to PCA provider(s) in a similar fashion as the single-family residential assignments. The total electricity savings for each PCA, as shown in Table 33, are then entered into the bottom row of Table 34 and Table 36, the 2007 US EPA eGRID database for Texas. eGRID then proportions each MWh of electricity savings according to the 1999 measured data from the power plants assigned to that PCA. For each county in which there is a power plant, the lbs-NOx/MWh are calculated and displayed as NOx reductions (lbs) in the column adjacent to the PCA column. In a similar fashion as the single-family residences, adding across the rows then totals the NOx reductions in each county from multiple PCAs that have power plants in that county. Counties that do not show NOx reductions represent counties that do not have power plants in eGRID's database. In Table 34, the PCA assignments for peak OSD reductions are shown for each county, and, in Table 36, the peak OSD NOx reductions are shown calculated with the 2007 eGRID.

Table 29: 1999 and IECC / IRC Code-compliant Building Characteristics used in the DOE-2 Simulation for Multi-family Residential (1).

		Climate Zone	1999 Average					2000 IECC				
			Area %	Glazing U-value (Btu/ hr-ft2-F)	SHGC	Roof Insulation (hr-ft2-F/Btu)	Wall Insulation (hr-ft2-F/Btu)	Area %	Glazing U-value (Btu/ hr-ft2-F)	SHGC	Roof Insulation (hr-ft2-F/Btu)	Wall Insulation (hr-ft2-F/Btu)
Non-attainment	BRAZORIA	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	CHAMBERS	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	COLLIN	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	DALLAS	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	DENTON	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	EL PASO	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	FORT BEND	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	GALVESTON	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	HARDIN	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	HARRIS	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	JEFFERSON	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	LIBERTY	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	MONTGOMERY	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	ORANGE	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	TARRANT	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	WALLER	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
Affected	BASTROP	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	BEXAR	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	CALDWELL	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	COMAL	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	ELLIS	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	GREGG	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	GUADALUPE	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	HARRISON	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	HAYS	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	HENDERSON	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	HOOD	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	HUNT	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	JOHNSON	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	KAUFMAN	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	NUECES	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	PARKER	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	ROCKWALL	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	RUSK	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	SAN PATRICIO	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	SMITH	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	TRAVIS	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	UPSHUR	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	VICTORIA	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	WILLIAMSON	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	WILSON	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
ERCOT	ANDERSON	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	ANDREWS	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	ANGELINA	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	ARANSAS	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	ARCHER	7	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	ATASCOSA	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	AUSTIN	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	BANDERA	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	BAYLOR	7	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	BEE	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	BELL	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	BLANCO	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	BORDEN	7	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	BOSQUE	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	BRAZOS	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	BREWSTER	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	BRISCOE	8	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	BROOKS	2	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	BROWN	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	BURLESON	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	BURNET	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	CALHOUN	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	CALLAHAN	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	CAMERON	2	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	CHEROKEE	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	CHILDRESS	7	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	CLAY	7	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	COKE	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	COLEMAN	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	COLORADO	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	COMANCHE	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	CONCHO	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	COOKE	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	CORYELL	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	COTTLE	7	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	CRANE	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	CROCKETT	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	CROSBY	7	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	CULBERSON	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	DAWSON	7	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	DE WITT	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	DELTA	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	DICKENS	7	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	DIMMIT	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	DUVAL	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	EASTLAND	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	ECTOR	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	EDWARDS	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	ERATH	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	FALLS	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	FANNIN	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	FAYETTE	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	FISHER	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	FOARD	7	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	FRANKLIN	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	FREESTONE	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00

Table 30: 1999 and IECC / IRC Code-compliant Building Characteristics used in the DOE-2 Simulation for Multi-family Residential (2).

		Climate Zone	1999 Average					2000 IECC				
			Area %	Glazing U-value (Btu/ hr-ft2-F)	SHGC	Roof Insulation (hr-ft2-F/Btu)	Wall Insulation (hr-ft2-F/Btu)	Area %	Glazing U-value (Btu/ hr-ft2-F)	SHGC	Roof Insulation (hr-ft2-F/Btu)	Wall Insulation (hr-ft2-F/Btu)
	FRIO	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	GILLESPIE	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	GLASSCOCK	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	GOLIAD	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	GONZALES	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	GRAYSON	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	GRIMES	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	HALL	8	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	HAMILTON	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	HARDEMAN	7	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	HASKELL	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	HIDALGO	2	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	HILL	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	HOPKINS	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	HOUSTON	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	HOWARD	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	HUDSPETH	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	IRION	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	JACK	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	JACKSON	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	JEFF DAVIS	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	JIM HOGG	2	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	JIM WELLS	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	JONES	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	KARNES	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	KENDALL	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	KENEDY	2	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	KENT	7	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	KERR	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	KIMBLE	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	KING	7	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	KINNEY	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	KLEBERG	2	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	KNOX	7	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	LA SALLE	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	LAMAR	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	LAMPASAS	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	LAVACA	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	LEE	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	LEON	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	LIMESTONE	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	LIVE OAK	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	LLANO	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	LOVING	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	MADISON	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	MARTIN	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	MASON	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	MATAGORDA	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	MAVERICK	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	MCCULLOCH	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	MCLENNAN	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	MCMULLEN	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
ERCOT	MEDINA	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	MENARD	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	MIDLAND	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	MILAM	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	MILLS	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	MITCHELL	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	MONTAGUE	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	MOTLEY	7	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	NACOGDOCHES	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	NAVARRO	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	NOLAN	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	PALO PINTO	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	PECOS	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	PRESIDIO	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	RAINS	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	REAGAN	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	REAL	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	RED RIVER	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	REEVES	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	REFUGIO	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	ROBERTSON	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	RUNNELS	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	SAN SABA	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	SCHLEICHER	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	SCURRY	7	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	SHACKELFORD	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	SOMERVELL	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	STARR	2	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	STEPHENS	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	STERLING	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	STONEWALL	7	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	SUTTON	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	TAYLOR	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	TERRELL	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	THROCKMORTON	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	TITUS	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	TOM GREEN	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	UPTON	5	7.5%	0.75	0.61	36.08	21.41	7.5%	0.70	0.40	19.00	11.00
	UVALDE	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	VAL VERDE	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	VAN ZANDT	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	WARD	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	WASHINGTON	4	7.5%	0.75	0.61	36.08	21.41	7.5%	0.85	0.40	19.00	11.00
	WEBB	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	WHARTON	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	WICHITA	7	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	WILBARGER	7	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	WILLACY	2	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	WINKLER	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	WISE	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	YOUNG	6	7.5%	0.75	0.61	36.08	21.41	7.5%	0.55	0.40	30.00	13.00
	ZAPATA	2	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00
	ZAVALA	3	7.5%	0.75	0.61	36.08	21.41	7.5%	any	0.40	19.00	11.00

Table 31: 2006 Annual and OSD Electricity and Natural Gas Savings from Implementation of the IECC / IRC for Multi-family Residences (1).

2006 Summary															
	County	Climate Zone	No. of Projected Units (2006)	Precode Total Annual Elec. Use (MWh/yr)	Code-compliant Total Annual Elec. Use (MWh/yr)	Precode OSD Elec. Use (MWh/day)	Code-compliant OSD Elec. Use (MWh/day)	Total Annual Elec. Savings (MWh/yr) w/ 7% of T&D Loss	Total OSD Elec. Savings (MWh/day) w/ 7% of T&D Loss	Precode Total NG Use (Therm/yr)	Code-compliant Total NG Use (Therm/yr)	Precode OSD NG Use (Therm/day)	Code-compliant OSD NG Use (Therm/day)	Total Annual NG Savings (Therm/yr)	Total OSD NG Savings (Therm/day)
Affected County	BASTROP	4	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0.00	0.00
	BEXAR	4	7,510	52,577	50,183	178.07	162.76	2,562.26	16.37	295,987	235,309	692.95	517.22	60,678.27	175.73
	CALDWELL	4	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0.00	0.00
	COMAL	4	23	161	154	0.55	0.50	7.85	0.05	906	721	2.12	1.58	185.89	0.54
	ELLIS	5	22	168	161	0.56	0.51	7.17	0.06	1,018	852	2.00	1.48	166.86	0.51
	GREGG	6	10	75	71	0.25	0.23	4.05	0.03	448	361	0.91	0.67	87.01	0.23
	GUADALUPE	4	2	14	13	0.05	0.04	0.68	0.00	79	63	0.18	0.14	16.16	0.05
	HARRISON	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0.00	0.00
	HAYS	5	531	3,771	3,575	13.06	11.87	209.49	1.28	20,510	16,140	48.41	35.99	4,369.35	12.43
	HENDERSON	5	36	275	264	0.92	0.83	11.71	0.09	1,668	1,393	3.27	2.42	274.61	0.84
	HOOD	5	14	107	103	0.36	0.32	4.56	0.04	648	542	1.27	0.94	106.19	0.33
	HUNT	6	238	1,819	1,727	6.08	5.48	97.73	0.64	11,018	8,969	21.59	16.02	2,048.19	5.57
	JOHNSON	5	6	46	44	0.15	0.14	1.96	0.02	278	232	0.54	0.40	45.51	0.14
	KAUFMAN	6	4	31	29	0.10	0.09	1.64	0.01	185	151	0.36	0.27	34.60	0.09
	NUECES	3	466	3,391	3,189	11.41	10.41	216.57	1.07	17,398	13,535	42.64	31.73	3,862.05	10.90
	PARKER	6	61	466	443	1.56	1.41	24.99	0.16	2,824	2,299	5.53	4.11	524.96	1.43
	ROCKWALL	6	245	1,872	1,778	6.26	5.64	100.36	0.65	11,342	9,233	22.23	16.49	2,108.43	5.73
	RUSK	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0.00	0.00
	SAN PATRICI	3	6	44	41	0.15	0.13	2.79	0.01	224	174	0.55	0.41	49.73	0.14
	SMITH	5	141	1,054	1,011	3.54	3.21	45.99	0.35	6,314	5,231	12.79	9.49	1,083.19	3.30
	TRAVIS	5	4,809	34,157	32,380	118.28	107.46	1,901.41	11.58	185,538	146,176	438.46	325.93	39,362.11	112.53
	UPSHUR	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0.00	0.00
	VICTORIA	3	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0.00	0.00
	WILLIAMSON	5	555	3,943	3,737	13.66	12.41	219.90	1.34	21,413	16,868	50.60	37.62	4,544.22	12.99
	WILSON	4	8	56	53	0.19	0.17	2.73	0.02	315	251	0.74	0.55	64.64	0.19
Nonattainment County	BRAZORIA	3	699	4,944	4,690	16.74	15.28	272.61	1.56	26,868	21,181	64.19	47.84	5,687.25	16.36
	CHAMBERS	4	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0.00	0.00
	COLLIN	6	1,286	9,829	9,434	32.88	29.80	422.61	3.30	59,529	49,719	116.67	86.58	9,809.81	30.09
	DALLAS	5	3,884	29,670	28,486	99.15	89.90	1,266.75	9.90	179,800	150,341	352.37	261.48	29,459.05	90.89
	DENTON	6	1,449	11,072	10,515	37.03	33.40	595.33	3.88	67,074	54,541	131.46	97.55	12,532.82	33.91
	EL PASO	6	1,072	7,739	7,383	23.48	21.54	380.56	2.07	47,825	38,806	102.24	77.15	9,019.68	25.08
	FORT BEND	4	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0.00	0.00
	GALVESTON	3	170	22,268	21,120	75.40	68.82	1,228.22	7.04	121,002	95,389	289.09	215.43	25,612.95	73.66
	HARDIN	4	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0.00	0.00
	HARRIS	4	9,041	63,972	60,667	216.65	197.73	3,535.56	20.24	347,515	273,955	830.27	618.71	73,559.94	211.56
	JEFFERSON	4	392	2,790	2,644	9.44	8.61	156.76	0.89	15,276	12,107	36.39	27.22	3,169.28	9.17
	LIBERTY	4	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0.00	0.00
	MONTGOMER	4	855	6,054	5,740	20.51	18.72	336.28	1.92	32,862	25,905	78.52	58.51	6,956.64	20.01
	ORANGE	4	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0.00	0.00
	TARRANT	5	3,191	24,374	23,401	81.47	73.87	1,041.58	8.14	147,719	123,516	289.50	214.83	24,202.84	74.67
	WALLER	4	152	1,076	1,020	3.65	3.33	59.76	0.34	5,842	4,605	13.96	10.40	1,236.74	3.56
ERCOT	ANDERSON	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	ANDREWS	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	ANGELINA	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	ARANSAS	3	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	ARCHER	7	6	54	53	0.15	0.15	1.27	0.01	294	252	0.57	0.43	**42**	**0.14**
	ATASCOSA	3	4	31	30	0.11	0.10	1.08	0.00	152	120	0.37	0.28	**32**	**0.09**
	AUSTIN	4	3	21	20	0.07	0.07	1.17	0.01	115	91	0.28	0.21	**24**	**0.07**
	BANDERA	5	52	410	397	1.37	1.32	13.72	0.05	1,982	1,556	4.80	3.58	**426**	**1.22**
	BAYLOR	7	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	BEE	3	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	BELL	5	622	5,164	5,059	16.34	15.75	112.67	0.63	27,051	22,600	58.94	44.39	**4,451**	**14.55**
	BLANCO	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	BORDEN	7	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	BOSQUE	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	BRAZOS	4	821	5,809	5,509	19.67	17.96	321.06	1.84	31,557	24,877	75.40	56.18	**6,680**	**19.21**
	BREWSTER	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	BRISCOE	8	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	BROOKS	2	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	BROWN	5	86	714	699	2.26	2.18	15.58	0.09	3,740	3,125	8.15	6.14	**615**	**2.01**
	BURLESON	4	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	BURNET	5	128	909	862	3.15	2.86	50.61	0.31	4,938	3,891	11.67	8.68	**1,048**	**3.00**
	CALHOUN	3	3	21	20	0.07	0.06	1.06	0.01	118	94	0.28	0.21	**24**	**0.07**
	CALLAHAN	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	CAMERON	2	625	5,080	4,889	16.25	15.63	203.54	0.66	22,969	17,791	56.93	42.31	**5,178**	**14.63**
	CHEROKEE	5	4	29	28	0.09	0.08	1.10	0.01	178	147	0.38	0.29	**31**	**0.09**
	CHILDRESS	7	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	CLAY	7	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	COKE	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	COLEMAN	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	COLORADO	4	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	COMANCHE	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	CONCHO	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	COOKE	6	4	31	29	0.10	0.09	1.64	0.01	185	151	0.36	0.27	**34**	**0.09**
	CORYELL	5	202	1,677	1,643	5.31	5.12	36.59	0.20	8,785	7,339	19.14	14.42	**1,446**	**4.73**
	COTTLE	7	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	CRANE	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	CROCKETT	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	CROSBY	7	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	CULBERSON	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	DAWSON	7	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	DE WITT	3	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	DELTA	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	DICKENS	7	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	DIMMIT	3	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	DUVAL	3	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	EASTLAND	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	ECTOR	6	106	900	879	2.68	2.58	22.68	0.10	4,943	4,164	10.39	7.91	**778**	**2.48**
	EDWARDS	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	ERATH	6	22	191	187	0.57	0.55	4.65	0.02	1,032	873	2.11	1.60	**159**	**0.51**
	FALLS	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	FANNIN	6	14	107	102	0.36	0.32	5.75	0.04	648	528	1.27	0.94	**120**	**0.33**
	FAYETTE	4	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	FISHER	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	FOARD	7	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	FRANKLIN	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**
	FREESTONE	5	16	133	130	0.42	0.41	2.90	0.02	696	581	1.52	1.14	**115**	**0.37**
	FRIO	3	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	**0**	**0.00**

Table 32: 2006 Annual and OSD Electricity and Natural Gas Savings from Implementation of the IECC / IRC for Multi-family Residences (2).

2006 Summary															
	County	Climate Zone	No. of Projected Units (2006)	Precode Total Annual Elec. Use (MWh/yr)	Code-compliant Total Annual Elec. Use (MWh/yr)	Precode OSD Elec. Use (MWh/day)	Code-compliant OSD Elec. Use (MWh/day)	Total Annual Elec. Savings (MWh/yr) w/ 7% of T&D Loss	Total OSD Elec. Savings (MWh/day) w/ 7% of T&D Loss	Precode Total NG Use (Therm/yr)	Code-compliant Total NG Use (Therm/yr)	Precode OSD NG Use (Therm/day)	Code-compliant OSD NG Use (Therm/day)	Total Annual NG Savings (Therm/yr)	Total OSD NG Savings (Therm/day)
	GILLESPIE	5	64	455	431	1.57	1.43	25.30	0.15	2,469	1,945	5.84	4.34	524	1.50
	GLASSCOCK	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	GOLIAD	3	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	GONZALES	4	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	GRAYSON	6	321	2,453	2,330	8.20	7.40	131.81	0.86	14,860	12,097	29.12	21.61	2,762	7.51
	GRIMES	4	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	HALL	8	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	HAMILTON	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	HARDEMAN	7	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	HASKELL	6	4	35	34	0.10	0.10	0.85	0.00	188	159	0.38	0.29	29	0.09
	HIDALGO	2	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	HILL	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	HOPKINS	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	HOUSTON	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	HOWARD	6	64	543	531	1.62	1.56	13.69	0.06	2,984	2,514	6.27	4.77	470	1.50
	HUDSPETH	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	IRION	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	JACK	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	JACKSON	3	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	JEFF DAVIS	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	JIM HOGG	2	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	JIM WELLS	3	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	JONES	6	14	122	119	0.36	0.35	2.96	0.01	656	556	1.34	1.02	101	0.33
	KARNES	3	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	KENDALL	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	KENEDY	2	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	KENT	7	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	KERR	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	KIMBLE	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	KING	7	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	KINNEY	4	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	KLEBERG	2	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	KNOX	7	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	LA SALLE	3	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	LAMAR	6	2	15	15	0.05	0.05	0.66	0.01	93	77	0.18	0.13	15	0.05
	LAMPASAS	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	LAVACA	4	4	31	30	0.10	0.10	0.95	0.00	152	119	0.37	0.28	34	0.09
	LEE	4	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	LEON	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	LIMESTONE	5	2	17	16	0.05	0.05	0.36	0.00	87	73	0.19	0.14	14	0.05
	LIVE OAK	3	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	LLANO	5	68	483	458	1.67	1.52	26.89	0.16	2,624	2,067	6.20	4.61	557	1.59
	LOVING	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	MADISON	4	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	MARTIN	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	MASON	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	MATAGORDA	3	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	MAVERICK	3	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	MCCULLOCH	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	MCLENNAN	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	MCMULLEN	3	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
ERCOT	MEDINA	4	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	MENARD	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	MIDLAND	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	MILAM	4	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	MILLS	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	MITCHELL	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	MONTAGUE	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	MOTLEY	7	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	NACOGDOCH	5	2	14	14	0.05	0.04	0.55	0.00	89	74	0.19	0.14	15	0.05
	NAVARRO	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	NOLAN	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	PALO PINTO	6	2	17	17	0.05	0.05	0.42	0.00	94	79	0.19	0.15	14	0.05
	PECOS	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	PRESIDIO	5	2	17	17	0.05	0.05	0.34	0.00	93	79	0.19	0.14	14	0.05
	RAINS	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	REAGAN	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	REAL	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	RED RIVER	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	REEVES	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	REFUGIO	3	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	ROBERTSON	4	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	RUNNELS	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	SAN SABA	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	SCHLEICHER	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	SCURRY	7	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	SHACKELFOR	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	SOMERVELL	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	STARR	2	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	STEPHENS	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	STERLING	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	STONEWALL	7	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	SUTTON	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	TAYLOR	6	22	191	187	0.57	0.55	4.65	0.02	1,032	873	2.11	1.60	159	0.51
	TERRELL	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	THROCKMOR	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	TITUS	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	TOM GREEN	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	UPTON	5	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	UVALDE	4	4	28	27	0.09	0.09	1.36	0.01	158	125	0.37	0.28	32	0.09
	VAL VERDE	4	8	56	53	0.19	0.17	2.73	0.02	315	251	0.74	0.55	65	0.19
	VAN ZANDT	6	8	61	59	0.20	0.19	2.63	0.02	370	309	0.73	0.54	61	0.19
	WARD	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	WASHINGTON	4	76	538	510	1.82	1.66	29.72	0.17	2,921	2,303	6.98	5.20	618	1.78
	WEBB	3	290	2,110	1,984	7.10	6.48	134.77	0.66	10,827	8,423	26.53	19.75	2,403	6.79
	WHARTON	3	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	WICHITA	7	244	2,187	2,139	6.29	6.07	51.70	0.23	11,960	10,251	23.23	17.52	1,709	5.71
	WILBARGER	7	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	WILLACY	2	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	WINKLER	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	WISE	6	20	153	147	0.51	0.46	6.57	0.05	926	773	1.81	1.35	153	0.47
	YOUNG	6	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	ZAPATA	2	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	ZAVALA	3	0	0	0	0.00	0.00	0.00	0.00	0	0	0.00	0.00	0	0.00
	TOTAL		40,817					15,956	99.50					351,811	1,025

Table 33: 2006 Totalized Annual Electricity Savings from IECC / IRC by PCA for Multi-family Residences.

PCA	Total Electricity Savings by PCA (MWh)
American Electric Power - West(ERCOT)/PCA	614.69
Austin Energy/PCA	75.11
Brownsville Public Utils Board/PCA	0.00
Lower Colorado River Authority/PCA	224.12
Reliant Energy HL&P/PCA	4,347.83
San Antonio Public Service Bd /PCA	2,591.83
South Texas Electric Coop Inc/PCA	0.00
Texas Municipal Power Pool/PCA	0.00
Texas-New Mexico Power Co/PCA	80.10
TXU Electric/PCA	6,236.10
El Paso Electric Co/PCA	3.73
Entergy Electric System/PCA	1,240.99
Total	15,414.50

Table 34: 2006 Annual NOx Reductions from IECC / IRC by PCA for Multi-family Residences by County using 2007 eGRID.

Area	County	American Electric Power - West (ERCOT) /PCA	NOx Reductions (lbs)	Austin Energy/PCA	NOx Reductions (lbs)	Brownsville Public Utils Board/PCA	NOx Reductions (lbs/year)	Lower Colorado River Auhotrity /PCA	NOx Reductions (lbs)	Reliant Energy HL&P/PCA	NOx Reductions (lbs)	San Antonio Public Service Bd/PCA	NOx Reductions (lbs)	South Texas Electric Coop INC/PCA	NOx Reductions (lbs)	Texas Municipal Power Pool/PCA	NOx Reductions (lbs)	Texas-New Mexico Power Co/PCA	NOx Reductions (lbs)	TXU Electric/PCA	NOx Reductions (lbs)	Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
Houston-Galveston Area	Brazoria	0.00883113	5.42836459	0.010890729	0.817998067	0.006522185	0	0.003944232	0.88399931	0.0654443	284.5407995	0.014877	38.55970684	0.006262	0	0.0048171	0	0.121275	9.714675559	0.00816387	50.91072806	390.8562719	0.195428136
	Chambers	0.02176222	13.3769117	0.026955801	2.024638855	0.016072371	0	0.009076193	2.034197968	0.1649402	717.1324247	0.037472	97.12163324	0.015056	0	0.0095532	0	0.011519	0.922691298	0.01581859	98.64635783	931.2588556	0.465629428
	Fort Bend	0.07043123	43.2930233	0.087239726	6.552539119	0.052016606	0	0.029374182	6.583476224	0.5338124	2320.926646	0.121275	314.3243545	0.048726	0	0.030918	0	0.037279	2.986197173	0.05119528	319.2589716	3013.925208	1.506962604
	Galveston	0.03385674	20.8112299	0.041710519	3.132859493	0.025004711	0	0.015351589	3.440668386	0.2495874	1085.164046	0.056747	147.078433	0.024143	0	0.0192972	0	0.567751	45.47945469	0.03283689	204.7741796	1509.880871	0.754940436
	Harris	0.06826733	41.9629056	0.084559408	6.351221505	0.050418468	0	0.028471701	6.381208111	0.5174117	2249.619416	0.117549	304.6671776	0.047229	0	0.0299681	0	0.036133	2.894450435	0.04962237	309.4501855	2921.326565	1.460663282
	Liberty	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Montgomery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Waller	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beaumont/ Port Arthur Area	Hardin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Jefferson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Orange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dallas/ Fort Worth Area	Collin	0.00203914	1.2534258	0.003716345	0.279133081	0.001505992	0	0.005950953	1.33375478	0.0024815	10.78905081	0.000717	1.858470112	0.019166	0	0.0766809	0	0.000864	0.069243184	0.0040002	24.94565154	40.5287293	0.020264365
	Dallas	0.00453947	2.79034485	0.004683963	0.35181046	0.003352602	0	0.00774211	1.735197148	0.0020856	9.067887565	0.000681	1.765189263	0.007503	0	0.026717	0	0.007525	0.602781362	0.04037045	251.7542746	268.0674852	0.134033743
	Denton	0.00047388	0.29128711	0.000872802	0.065555755	0.000349982	0	0.001396994	0.31310066	0.0005854	2.545409499	0.000169	0.437942026	0.004544	0	0.0181872	0	0.000187	0.014947949	0.00084941	5.29697875	8.965221749	0.004482611
	Tarrant	0.01216249	7.47610167	0.012266309	0.921317334	0.008982543	0	0.020308652	4.551668159	0.0053165	23.11526955	0.001753	4.542189275	0.017326	0	0.0602168	0	0.020603	1.650429595	0.11064724	690.0074722	732.2644478	0.366132224
	Ellis	0.00327981	2.0160522	0.003307809	0.248448178	0.002422289	0	0.005476558	1.227431222	0.0014337	6.233407747	0.000473	1.224875087	0.004672	0	0.0162384	0	0.005556	0.445065138	0.02983782	186.0717182	197.4669978	0.098733499
	Johnson	0.00028606	0.17583586	0.000526868	0.03957282	0.000211267	0	0.000843297	0.189003637	0.0003534	1.536539891	0.000102	0.264364297	0.002743	0	0.0109787	0	0.000113	0.009023349	0.00051274	3.197528395	5.411868249	0.002705934
	Kaufman	0.00632545	3.88816082	0.006379446	0.47915747	0.004671629	0	0.010562096	2.367225406	0.002765	12.02175806	0.000911	2.362295641	0.009011	0	0.0313175	0	0.010715	0.858353187	0.05754527	358.8581508	380.8351014	0.190417551
	Parker	0.00021749	0.13368752	0.000400576	0.030087107	0.000160626	0	0.000641157	0.143698949	0.0002687	1.168227083	7.75E-05	0.200995453	0.002085	0	0.0083471	0	8.56E-05	0.006860428	0.00038984	2.431072108	4.114628652	0.002057314
	Rockwall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Henderson	0.00081989	0.50397712	0.000826893	0.062107617	0.000605529	0	0.001369042	0.306835931	0.0003584	1.558240847	0.000118	0.306196943	0.001168	0	0.0040593	0	0.001389	0.111258353	0.00745892	46.51461344	49.36323026	0.024681615
	Hood	0.01252711	7.70022664	0.012634039	0.948937373	0.009251829	0	0.020917482	4.688121958	0.0054759	23.80823886	0.001805	4.678358908	0.017846	0	0.062022	0	0.021221	1.699907585	0.11396431	710.6931061	754.2168974	0.377108449
	Hunt	0.00618756	3.80339935	0.006240374	0.468711891	0.004569788	0	0.010331844	2.315620157	0.0027047	11.75968507	0.000892	2.31079786	0.008815	0	0.0306347	0	0.010482	0.839641183	0.05629078	351.0350833	372.5329388	0.186266469
El Paso Area	El Paso	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
San Antonio Area	Bexar	0.03341375	20.5389318	0.051775843	3.888861796	0.024677545	0	0.090663423	20.3199018	0.0011418	4.964534201	1.143572	2963.937994	0.046874	0	0.0046695	0	0.00052	0.041620907	0.00250387	15.614359	3029.306204	1.514653102
	Comal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Guadalupe	0.00200047	1.22965718	0.076378745	5.736775349	0.001477434	0	0.133848731	29.99879072	0.0012371	5.378845701	0.003555	9.213410257	0.001062	0	0.0018557	0	0.000402	0.032179465	0.00183516	11.44427524	63.03393391	0.031516967
	Wilson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Austin Area	Bastrop	0.00450233	2.76751708	0.171901148	12.91142288	0.003325174	0	0.301245466	67.51651392	0.0027843	12.10585167	0.008001	20.73608059	0.00239	0	0.0041765	0	0.000904	0.072424429	0.0041303	25.75695721	141.8667678	0.070933384
	Caldwell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hays	0.0024586	1.51126403	0.093870431	7.050568582	0.001815785	0	0.164501762	36.86888861	0.0015205	6.610668573	0.004369	11.32339632	0.001305	0	0.0022807	0	0.000494	0.039548965	0.00225544	14.06515727	77.46949235	0.038734746
	Travis	0.00051001	0.31349366	0.299602906	22.5030481	0.000376663	0	0.033939476	7.606670895	0.0003347	1.455257638	0.000906	2.348507191	0.000271	0	0.0004717	0	0.000103	0.008276952	0.00046734	2.914353591	37.14960803	0.018574804
	Williamson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North East Texas Area	Gregg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Harrison	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rusk	0.00068596	0.4216523	0.00069182	0.051962318	0.000506616	0	0.001145408	0.256714187	0.0002999	1.303701723	9.88E-05	0.256179577	0.000977	0	0.0033962	0	0.001162	0.093084266	0.00624051	38.91643697	41.29973134	0.020649866
	Smith	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Upshur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corpus Christi Area	Nueces	0.22756873	139.883086	0.004556851	0.342263183	0.168069652	0	0.007612767	1.706208241	0.0016809	7.308218385	0.001627	4.216370686	0.046792	0	0.0072464	0	0.001609	0.128922339	0.00828339	51.65609546	205.2411645	0.102620582
	San Patricio	0.05031335	30.9268627	0.001007478	0.075671239	0.037158653	0	0.001683113	0.377226935	0.0003716	1.615779808	0.00036	0.932200744	0.010345	0	0.0016021	0	0.000356	0.028503542	0.00183138	11.42068718	45.3769321	0.022688466
Victoria Area	Victoria	0.02183674	13.422714	0.002215582	0.166411444	0.016127403	0	0.003612695	0.809693814	0.0011996	5.215751352	0.000555	1.439470626	0.525456	0	0.0324127	0	0.000477	0.038198281	0.00225485	14.06146969	35.15370922	0.017576855
Other ERCOT counties	Andrews	2.4742E-05	0.01520859	2.49533E-05	0.00187423	1.82731E-05	0	4.13138E-05	0.00925943	1.082E-05	0.047023249	3.57E-06	0.009240147	3.52E-05	0	0.0001225	0	4.19E-05	0.003357459	0.00022509	1.403677916	1.489641019	0.000744821
	Angelina	0.00031082	0.19105634	0.000313473	0.023544827	0.000229554	0	0.000519	0.11632066	0.0001359	0.590724831	4.48E-05	0.116078421	0.000443	0	0.0015389	0	0.000527	0.042177736	0.00282766	17.63356239	18.71346521	0.009356733
	Bosque	0.00059539	0.36597839	0.001096604	0.082365436	0.000439723	0	0.001755208	0.393385332	0.0007356	3.198098539	0.000212	0.550238283	0.005709	0	0.0228507	0	0.000234	0.018780873	0.00106721	6.655219919	11.26406678	0.005632033
	Brazos	0.00193973	1.19232	0.003572622	0.268338127	0.001432574	0	0.005718288	1.281608986	0.0023964	10.41907638	0.000692	1.792619781	0.018599	0	0.0744451	0	0.000764	0.061186155	0.00347685	21.68202256	36.69717198	0.018348586
	Calhoun	0.08269981	50.8343324	0.001655986	0.124380444	0.061077496	0	0.002766524	0.620046063	0.0006108	2.655849343	0.000591	1.53225379	0.017004	0	0.0026334	0	0.000585	0.046851133	0.00301023	18.77212748	74.58584067	0.03729292
	Cameron	0.04837175	29.7333876	0.000968599	0.072751068	0.297964476	0	0.001618161	0.362669657	0.0003573	1.553426477	0.000346	0.896226894	0.009946	0	0.0015403	0	0.000342	0.027403584	0.00176071	10.97996012	43.62582539	0.021812913
	Cherokee	0.0035039	2.15379412	0.003533808	0.265422802	0.002587786	0	0.00585073	1.311292508	0.0015316	6.659290337	0.000505	1.308561731	0.004992	0	0.0173479	0	0.005936	0.475473143	0.03187642	198.7846208	210.9584554	0.105479228
	Coke	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coleman	0.00129879	0.79834482	2.6007E-05	0.001953374	0.000959212	0	4.34478E-05	0.009737721	9.593E-06	0.041709677	9.28E-06	0.024063794	0.000267	0	4.136E-05	0	9.19E-06	0.000735789	4.7275E-05	0.294813172	1.171358348	0.000585679
	Crockett	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ector	0.00353575	2.17337106	0.003565928	0.267835366	0.002611307	0	0.005903911	1.323211518	0.0015456	6.719820042	0.000509	1.32045592	0.005037	0	0.0175056	0	0.00599	0.479794962	0.03216616	200.5914762	212.875965	0.106437983
	Fannin	0.00705631	4.33741085	0.007116546	0.534520794	0.005211403	0	0.011782473	2.640741889	0.0030845	13.41078885	0.001017	2.635242524	0.010052	0	0.034936	0	0.011954	0.957529946	0.06419422	400.321722	424.8379569	0.212418978
	Fayette	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Freestone	0.00367718	2.2603059	0.003708565	0.278548781	0.00271576	0	0.006140067	1.376139979	0.0016074	6.988612844	0.00053	1.373274157	0.005238	0	0.0182058	0	0.006229	0.49898676	0.03345281	208.6151352	221.3910036	0.110695502
	Frio	0.00858833	5.27912054	0.000871383	0.065449213	0.006342868	0	0.001420864	0.318450594	0.0004718	2.051342231	0.000218	0.566140271	0.206661	0	0.0127478	0	0.000188	0.01502329	0.00088683	5.530341585	13.82586773	0.006912934
	Grimes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hardeman	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Haskell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hidalgo	0.18852746	115.885	0.003775086	0.283545139	0.139235931	0	0.006306735	1.413494284	0.0013925	6.054433838	0.001348	3.493017862	0.038764	0	0.0060032	0	0.001333	0.106804659	0.00686231	42.79407043	170.0303667	0.085015183
	Howard	0.00055511	0.34121967	0.000559851	0.042050203	0.000409976	0	0.000926915	0.207744459	0.0002427	1.055013017	8E-05	0.207311829	0.000791	0	0.0027484	0	0.00094	0.0753279	0.00505009	31.49289969	33.42156677	0.016710783
	Jack	0.00212145	1.30402263	0.002139557	0.16070122	0.001566784	0	0.003542346	0.793926911	0.0009273	4.031892025	0.000306	0.792273552	0.003022	0	0.0105033	0	0.003594	0.287876977	0.0192997	120.3548857	127.725579	0.06386279
	Jones	0.04071872	25.029188	0.000815354	0.061240925	0.030072592	0	0.001362147	0.305290711	0.0003008	1.307654677	0.000291	0.754432415	0.008372	0	0.0012966	0	0.000288	0.023067989	0.00148214	9.242790958	36.72366568	0.018361833
	Lamar	0.00095084	0.58446577	0.000958954	0.072026635	0.000702236	0	0.001587687	0.35583976	0.0004156	1.807102731	0.000137	0.355098721	0.001355	0	0.0047076	0	0.001611	0.129027084	0.00865017	53.94332023	57.24688093	0.02862344
	Limestone	0.00071976	0.4424237	0.000891528	0.066962259	0.000531572	0	0.000300183	0.067278414	0.0054552	23.71820865	0.001239	3.212169862	0.000498	0	0.000316	0	0.000381	0.030516797	0.00052318	3.262598116	30.8001578	0.015400079
	Llano	0.00123817	0.76108696	0.047274044	3.550733508	0.000914447	0	0.082844655	18.56752355	0.0007657	3.329195673	0.0022	5.702570265	0.000657	0	0.0011486	0	0.000249	0.019917235	0.00113586	7.083347197	39.01437439	0.019507187
	McLennan	0.02453432	15.080877	0.024743738	1.858491761	0.018119687	0	0.040966843	9.181676559	0.0107245	46.62838353	0.003535	9.162555647	0.034951	0	0.1214699	0	0.041562	3.329265271	0.22319886	1391.890888	1477.132137	0.738566069
	Milam	0.0022454	1.38021673	0.002264571	0.170090999	0.001658332	0	0.003749326	0.840316095	0.0009815	4.267475654	0.000324	0.838566131	0.003199	0	0.011117	0	0.003804	0.304697642	0.02042738	127.387227	135.1885902	0.067594295
	Mitchell	0.01494317	9.18534176	0.015070721	1.131955525	0.011036196	0	0.024951762	5.592303246	0.006532	28.40004861	0.002153	5.580657232	0.021288	0	0.073984	0	0.025314	2.027762671	0.1359442	847.7619396	899.6800086	0.449840004
	Nolan	0.00056465	0.34708417	0.000569473	0.042772915	0.000417022	0	0.000942846	0.211314936	0.0002468	1.073145389	8.14E-05	0.210874871	0.000804	0	0.0027956	0	0.000957	0.076622551	0.00513689	32.03416406	33.99597888	0.016997989
	Palo Pinto	0.003207	1.9712938	0.005906709	0.443650433	0.002368511	0	0.009454195	2.118917609	0.003962	17.22613111	0.001144	2.963785103	0.03075	0	0.1230821	0	0.001263	0.101160667	0.00574838	35.84745419	60.6723929	0.030336196
	Pecos	4.0968E-05	0.02518222	4.13174E-05	0.00310333	3.02565E-05	0	6.84069E-05	0.015331667	1.791E-05	0.077860599	5.9E-06	0.015299738	5.84E-05	0	0.0002028	0	6.94E-05	0.005559245	0.0003727	2.32419506	2.466531857	0.001233266
	Presidio	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Robertson	0.00073771	0.45345788	0.000835096	0.062723739	0.00054483	0	0.000735917	0.164937103	0.0031497	13.69427068	0.000731	1.894300949	0.000761	0	0.0018663	0	0.191633	15.35063622	0.00339774	21.18863749	52.80896405	0.026404482
	Taylor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Titus	0.00569644	3.50151464	0.005745061	0.431509131	0.004207073	0	0.009511781	2.131823965	0.00249	10.82629135	0.000821	2.127384426	0.008115	0	0.0282032	0	0.00965	0.772996897	0.05182285	323.1726071	342.9641275	0.171482064
	Tom Green	0.00148245	0.91123859	2.96846E-05	0.002229601	0.001094854	0	4.95918E-05	0.01111473	1.095E-05	0.047607833	1.06E-05	0.027466649	0.000305	0	4.72E-05	0	1.05E-05	0.000839837	5.396E-05	0.336502638	1.33699879	0.0006685
	Upton	3.1166E-05	0.01915735	3.14322E-05	0.002360856	2.30176E-05	0	5.20405E-05	0.011663552	1.362E-05	0.059232385	4.49E-06	0.011639263	4.44E-05	0	0.0001543	0	5.28E-05	0.004229191	0.00028353	1.768129416	1.876412014	0.000938206
	Ward	0.01855953	11.408264	0.01871795	1.405897326	0.013707039	0	0.030990277	6.945682939	0.0081128	35.27307523	0.002674	6.931218502	0.02644	0	0.0918886	0	0.03144	2.518496578	0.16884373	1052.926743	1117.409377	0.558704689
	Webb	0.02001433	12.3025069	0.000400768	0.030101532	0.014781473	0	0.000669531	0.150058446	0.0001478	0.642746806	0.000143	0.370823455	0.004115	0	0.0006373	0	0.000142	0.011338526	0.00072851	4.543075836	18.05065147	0.009025326
	Wharton	0.00014434	0.08872345	0.000178787	0.013428581	0.000106601	0	6.01986E-05	0.013491982	0.001094	4.756438751	0.000249	0.64416708	9.99E-05	0	6.336E-05	0	7.64E-05	0.006119825	0.00010492	0.654279939	6.176649605	0.003088325
	Wichita	0.00020763	0.12762902	0.000209406	0.015728361	0.000153346	0	0.000346701	0.07770426	9.076E-05	0.394614647	2.99E-05	0.077542441	0.000296	0	0.001028	0	0.000352	0.028175475	0.00188893	11.77953191	12.50092611	0.006250463
	Wilbarger	0.02861682	17.590329	0.000573025	0.043039671	0.021134796	0	0.000957307	0.214556063	0.0002114	0.919010077	0.000205	0.530209546	0.005884	0	0.0009112	0	0.000202	0.016212013	0.00104164	6.49576542	25.8091218	0.012904561
	Wise	0.00284449	1.74846385	0.002882008	0.21646641	0.002100781	0	0.00476997	1.069067636	0.0012561	5.461204884	0.000413	1.071049151	0.004182	0	0.0146143	0	0.004798	0.384337182	0.02576141	160.6507913	170.6013804	0.08530069
	Young	0.00623586	3.83308738	0.006289085	0.472370495	0.004605458	0	0.010412491	2.333695093	0.0027258	11.85147714	0.000899	2.328835155	0.008883	0	0.0308739	0	0.010564	0.846195134	0.05673017	353.7751427	375.4408031	0.187720402
	Total	**1.12183722**	**689.576519**	**1.172570094**	**88.07124604**	**1.090766584**	**0**	**1.189130767**	**266.5134354**	**1.62936**	**7084.183934**	**1.542363**	**3997.534236**	**1.359386**	**0**	**1.2316428**	**0**	**1.221806**	**97.872224**	**1.52878695**	**9533.671529**	**21757.42312**	**10.87871156**

Energy Savings by PCA (MWh)		American Electric Power - West (ERCOT) /PCA		Austin Energy/PCA		Brownsville Public Utils Board/PCA		Lower Colorado River Auhotrity /PCA		Reliant Energy HL&P/PCA		San Antonio Public Service Bd/PCA		South Texas Electric Coop INC/PCA		Texas Municipal Power Pool/PCA		Texas-New Mexico Power Co/PCA		TXU Electric/PCA
		614.69		75.11		0.00		224.12		4,347.83		2,591.83		0.00		0.00		80.10		6,236.10

Table 35: 2006 Totalized OSD Electricity Savings from IECC / IRC by PCA for Multi-family Residences.

PCA	Total Electricity Savings by PCA (MWh)
American Electric Power - West(ERCOT)/PCA	2.72
Austin Energy/PCA	0.46
Brownsville Public Utils Board/PCA	0.00
Lower Colorado River Authority/PCA	1.36
Reliant Energy HL&P/PCA	24.89
San Antonio Public Service Bd /PCA	16.55
South Texas Electric Coop Inc/PCA	0.00
Texas Municipal Power Pool/PCA	0.00
Texas-New Mexico Power Co/PCA	0.49
TXU Electric/PCA	42.92
El Paso Electric Co/PCA	0.02
Entergy Electric System/PCA	7.10
Total	96.51

Table 36: 2006 OSD NOx Reductions from IECC / IRC by PCA for Multi-family Residences by County using 2007 eGRID.

Area	County	American Electric Power - West (ERCOT) /PCA	NOx Reductions (lbs)	Austin Energy/PCA	NOx Reductions (lbs)	Brownsville Public Utils Board/PCA	NOx Reductions (lbs/year)	Lower Colorado River Auhotrity /PCA	NOx Reductions (lbs)	Reliant Energy HL&P/PCA	NOx Reductions (lbs)	San Antonio Public Service Bd/PCA	NOx Reductions (lbs)	South Texas Electric Coop INC/PCA	NOx Reductions (lbs)	Texas Municipal Power Pool/PCA	NOx Reductions (lbs)	Texas-New Mexico Power Co/PCA	NOx Reductions (lbs)	TXU Electric/PCA	NOx Reductions (lbs)	Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
Houston-Galveston Area	Brazoria	0.00883113	5.42836459	0.010890729	0.817998067	0.006522185	0	0.003944232	0.88399931	0.0654443	284.5407995	0.014877	38.55970684	0.006262	0	0.0048171	0	0.121275	9.714675559	0.00816387	50.91072806	390.8562719	0.195428136
	Chambers	0.02176222	13.3769117	0.026955801	2.024638855	0.016072371	0	0.009076193	2.034197968	0.1649402	717.1324247	0.037472	97.12163324	0.015056	0	0.0095532	0	0.011519	0.922691298	0.01581859	98.64635783	931.2588556	0.465629428
	Fort Bend	0.07043123	43.2930233	0.087239726	6.552539119	0.052016606	0	0.029374182	6.583476224	0.5338124	2320.926646	0.121275	314.3243545	0.048726	0	0.030918	0	0.037279	2.986197173	0.05119528	319.2589716	3013.925208	1.506962604
	Galveston	0.03385674	20.8112299	0.041710519	3.132859493	0.025004711	0	0.015351589	3.440668386	0.2495874	1085.164046	0.056747	147.078433	0.024143	0	0.0192972	0	0.567751	45.47945469	0.03283689	204.7741796	1509.880871	0.754940436
	Harris	0.06826733	41.9629056	0.084559408	6.351221505	0.050418468	0	0.028471701	6.381208111	0.5174117	2249.619416	0.117549	304.6671776	0.047229	0	0.0299681	0	0.036133	2.894450435	0.04962237	309.4501855	2921.326565	1.460663282
	Liberty	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Montgomery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Waller	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beaumont/ Port Arthur Area	Hardin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Jefferson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Orange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dallas/ Fort Worth Area	Collin	0.00203914	1.2534258	0.003716345	0.279133081	0.001505992	0	0.005950953	1.33375478	0.0024815	10.78905081	0.000717	1.858470112	0.019166	0	0.0766809	0	0.000864	0.069243184	0.0040002	24.94565154	40.5287293	0.020264365
	Dallas	0.00453947	2.79034485	0.004683963	0.35181046	0.003352602	0	0.00774211	1.735197148	0.0020856	9.067887565	0.000681	1.765189263	0.007503	0	0.026717	0	0.007525	0.602781362	0.04037045	251.7542746	268.0674852	0.134033743
	Denton	0.00047388	0.29128711	0.000872802	0.065555755	0.000349982	0	0.001396994	0.31310066	0.0005854	2.545409499	0.000169	0.437942026	0.004544	0	0.0181872	0	0.000187	0.014947949	0.00084941	5.29697875	8.965221749	0.004482611
	Tarrant	0.01216249	7.47610167	0.012266309	0.921317334	0.008982543	0	0.020308652	4.551668159	0.0053165	23.11526955	0.001753	4.542189275	0.017326	0	0.0602168	0	0.020603	1.650429595	0.11064724	690.0074722	732.2644478	0.366132224
	Ellis	0.00327981	2.0160522	0.003307809	0.248448178	0.002422289	0	0.005476558	1.227431222	0.0014337	6.233407747	0.000473	1.224875087	0.004672	0	0.0162384	0	0.005556	0.445065138	0.02983782	186.0717182	197.4669978	0.098733499
	Johnson	0.00028606	0.17583586	0.000526868	0.03957282	0.000211267	0	0.000843297	0.189003637	0.0003534	1.536539891	0.000102	0.264364297	0.002743	0	0.0109787	0	0.000113	0.009023349	0.00051274	3.197528395	5.411868249	0.002705934
	Kaufman	0.00632545	3.88816082	0.006379446	0.47915747	0.004671629	0	0.010562096	2.367225406	0.002765	12.02175806	0.000911	2.362295641	0.009011	0	0.0313175	0	0.010715	0.858353187	0.05754527	358.8581508	380.8351014	0.190417551
	Parker	0.00021749	0.13368752	0.000400576	0.030087107	0.000160626	0	0.000641157	0.143698949	0.0002687	1.168227083	7.75E-05	0.200995453	0.002085	0	0.0083471	0	8.56E-05	0.006860428	0.00038984	2.431072108	4.114628652	0.002057314
	Rockwall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Henderson	0.00081989	0.50397712	0.000826893	0.062107617	0.000605529	0	0.001369042	0.306835931	0.0003584	1.558240847	0.000118	0.306196943	0.001168	0	0.0040593	0	0.001389	0.111258353	0.00745892	46.51461344	49.36323026	0.024681615
	Hood	0.01252711	7.70022664	0.012634039	0.948937373	0.009251829	0	0.020917482	4.688121958	0.0054759	23.80823886	0.001805	4.678358908	0.017846	0	0.062022	0	0.021221	1.699907585	0.11396431	710.6931061	754.2168974	0.377108449
	Hunt	0.00618756	3.80339935	0.006240374	0.468711891	0.004569788	0	0.010331844	2.315620157	0.0027047	11.75968507	0.000892	2.31079786	0.008815	0	0.0306347	0	0.010482	0.839641183	0.05629078	351.0350833	372.5329388	0.186266469
El Paso Area	El Paso	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
San Antonio Area	Bexar	0.03341375	20.5389318	0.051775843	3.888861796	0.024677545	0	0.090663423	20.3199018	0.0011418	4.964534201	1.143572	2963.937994	0.046874	0	0.0046695	0	0.00052	0.041620907	0.00250387	15.614359	3029.306204	1.514653102
	Comal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Guadalupe	0.00200047	1.22965718	0.076378745	5.736775349	0.001477434	0	0.133848731	29.99879072	0.0012371	5.378845701	0.003555	9.213410257	0.001062	0	0.0018557	0	0.000402	0.032179465	0.00183516	11.44427524	63.03393391	0.031516967
	Wilson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Austin Area	Bastrop	0.00450233	2.76751708	0.171901148	12.91142288	0.003325174	0	0.301245466	67.51651392	0.0027843	12.10585167	0.008001	20.73608059	0.00239	0	0.0041765	0	0.000904	0.072424429	0.0041303	25.75695721	141.8667678	0.070933384
	Caldwell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hays	0.0024586	1.51126403	0.093870431	7.050568582	0.001815785	0	0.164501762	36.86888861	0.0015205	6.610668573	0.004369	11.32339632	0.001305	0	0.0022807	0	0.000494	0.039548965	0.00225544	14.06515727	77.46949235	0.038734746
	Travis	0.00051001	0.31349366	0.299602906	22.5030481	0.000376663	0	0.033939476	7.606670895	0.0003347	1.455257638	0.000906	2.348507191	0.000271	0	0.0004717	0	0.000103	0.008276952	0.00046734	2.914353591	37.14960803	0.018574804
	Williamson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North East Texas Area	Gregg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Harrison	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rusk	0.00068596	0.4216523	0.00069182	0.051962318	0.000506616	0	0.001145408	0.256714187	0.0002999	1.303701723	9.88E-05	0.256179577	0.000977	0	0.0033962	0	0.001162	0.093084266	0.00624051	38.91643697	41.29973134	0.020649866
	Smith	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Upshur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corpus Christi Area	Nueces	0.22756873	139.883086	0.004556851	0.342263183	0.168069652	0	0.007612767	1.706208241	0.0016809	7.308218385	0.001627	4.216370686	0.046792	0	0.0072464	0	0.001609	0.128922339	0.00828339	51.65609546	205.2411645	0.102620582
	San Patricio	0.05031335	30.9268627	0.001007478	0.075671239	0.037158653	0	0.001683113	0.377226935	0.0003716	1.615779808	0.00036	0.932200744	0.010345	0	0.0016021	0	0.000356	0.028503542	0.00183138	11.42068718	45.3769321	0.022688466
Victoria Area	Victoria	0.02183674	13.422714	0.002215582	0.166411444	0.016127403	0	0.003612695	0.809693814	0.0011996	5.215751352	0.000555	1.439470626	0.525456	0	0.0324127	0	0.000477	0.038198281	0.00225485	14.06146969	35.15370922	0.017576855
Other ERCOT counties	Andrews	2.4742E-05	0.01520859	2.49533E-05	0.00187423	1.82731E-05	0	4.13138E-05	0.00925943	1.082E-05	0.047023249	3.57E-06	0.009240147	3.52E-05	0	0.0001225	0	4.19E-05	0.003357459	0.00022509	1.403677916	1.489641019	0.000744821
	Angelina	0.00031082	0.19105634	0.000313473	0.023544827	0.000229554	0	0.000519	0.11632066	0.0001359	0.590724831	4.48E-05	0.116078421	0.000443	0	0.0015389	0	0.000527	0.042177736	0.00282766	17.63356239	18.71346521	0.009356733
	Bosque	0.00059539	0.36597839	0.001096604	0.082365436	0.000439723	0	0.001755208	0.393385332	0.0007356	3.198098539	0.000212	0.550238283	0.005709	0	0.0228507	0	0.000234	0.018780873	0.00106721	6.655219919	11.26406678	0.005632033
	Brazos	0.00193973	1.19232	0.003572622	0.268338127	0.001432574	0	0.005718288	1.281608986	0.0023964	10.41907638	0.000692	1.792619781	0.018599	0	0.0744451	0	0.000764	0.061186155	0.00347685	21.68202256	36.69717198	0.018348586
	Calhoun	0.08269981	50.8343324	0.001655986	0.124380444	0.061077496	0	0.002766524	0.620046063	0.0006108	2.655849343	0.000591	1.53225379	0.017004	0	0.0026334	0	0.000585	0.046851133	0.00301023	18.77212748	74.58584067	0.03729292
	Cameron	0.04837175	29.7333876	0.000968599	0.072751068	0.297964476	0	0.001618161	0.362669657	0.0003573	1.553426477	0.000346	0.896226894	0.009946	0	0.0015403	0	0.000342	0.027403584	0.00176071	10.97996012	43.62582539	0.021812913
	Cherokee	0.0035039	2.15379412	0.003533808	0.265422802	0.002587786	0	0.00585073	1.311292508	0.0015316	6.659290337	0.000505	1.308561731	0.004992	0	0.0173479	0	0.005936	0.475473143	0.03187642	198.7846208	210.9584554	0.105479228
	Coke	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coleman	0.00129879	0.79834482	2.6007E-05	0.001953374	0.000959212	0	4.34478E-05	0.009737721	9.593E-06	0.041709677	9.28E-06	0.024063794	0.000267	0	4.136E-05	0	9.19E-06	0.000735789	4.7275E-05	0.294813172	1.171358348	0.000585679
	Crockett	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ector	0.00353575	2.17337106	0.003565928	0.267835366	0.002611307	0	0.005903911	1.323211518	0.0015456	6.719820042	0.000509	1.32045592	0.005037	0	0.0175056	0	0.00599	0.479794962	0.03216616	200.5914762	212.875965	0.106437983
	Fannin	0.00705631	4.33741085	0.007116546	0.534520794	0.005211403	0	0.011782473	2.640741889	0.0030845	13.41078885	0.001017	2.635242524	0.010052	0	0.034936	0	0.011954	0.957529946	0.06419422	400.321722	424.8379569	0.212418978
	Fayette	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Freestone	0.00367718	2.2603059	0.003708565	0.278548781	0.00271576	0	0.006140067	1.376139979	0.0016074	6.988612844	0.00053	1.373274157	0.005238	0	0.0182058	0	0.006229	0.49898676	0.03345281	208.6151352	221.3910036	0.110695502
	Frio	0.00858833	5.27912054	0.000871383	0.065449213	0.006342868	0	0.001420864	0.318450594	0.0004718	2.051342231	0.000218	0.566140271	0.206661	0	0.0127478	0	0.000188	0.01502329	0.00088683	5.530341585	13.82586773	0.006912934
	Grimes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hardeman	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Haskell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hidalgo	0.18852746	115.885	0.003775086	0.283545139	0.139235931	0	0.006306735	1.413494284	0.0013925	6.054433838	0.001348	3.493017862	0.038764	0	0.0060032	0	0.001333	0.106804659	0.00686231	42.79407043	170.0303667	0.085015183
	Howard	0.00055511	0.34121967	0.000559851	0.042050203	0.000409976	0	0.000926915	0.207744459	0.0002427	1.055013017	8E-05	0.207311829	0.000791	0	0.0027484	0	0.00094	0.0753279	0.00505009	31.49289969	33.42156677	0.016710783
	Jack	0.00212145	1.30402263	0.002139557	0.16070122	0.001566784	0	0.003542346	0.793926911	0.0009273	4.031892025	0.000306	0.792273552	0.003022	0	0.0105033	0	0.003594	0.287876977	0.0192997	120.3548857	127.725579	0.06386279
	Jones	0.04071872	25.029188	0.000815354	0.061240925	0.030072592	0	0.001362147	0.305290711	0.0003008	1.307654677	0.000291	0.754432415	0.008372	0	0.0012966	0	0.000288	0.023067989	0.00148214	9.242790958	36.72366568	0.018361833
	Lamar	0.00095084	0.58446577	0.000958954	0.072026635	0.000702236	0	0.001587687	0.35583976	0.0004156	1.807102731	0.000137	0.355098721	0.001355	0	0.0047076	0	0.001611	0.129027084	0.00865017	53.94332023	57.24688093	0.02862344
	Limestone	0.00071976	0.4424237	0.000891528	0.066962259	0.000531572	0	0.000300183	0.067278414	0.0054552	23.71820865	0.001239	3.212169862	0.000498	0	0.000316	0	0.000381	0.030516797	0.00052318	3.262598116	30.8001578	0.015400079
	Llano	0.00123817	0.76108696	0.047274044	3.550733508	0.000914447	0	0.082844655	18.56752355	0.0007657	3.329195673	0.0022	5.702570265	0.000657	0	0.0011486	0	0.000249	0.019917235	0.00113586	7.083347197	39.01437439	0.019507187
	McLennan	0.02453432	15.080877	0.024743738	1.858491761	0.018119687	0	0.040966843	9.181676559	0.0107245	46.62838353	0.003535	9.162555647	0.034951	0	0.1214699	0	0.041562	3.329265271	0.22319886	1391.890888	1477.132137	0.738566069
	Milam	0.0022454	1.38021673	0.002264571	0.170090999	0.001658332	0	0.003749326	0.840316095	0.0009815	4.267475654	0.000324	0.838566131	0.003199	0	0.011117	0	0.003804	0.304697642	0.02042738	127.387227	135.1885902	0.067594295
	Mitchell	0.01494317	9.18534176	0.015070721	1.131955525	0.011036196	0	0.024951762	5.592303246	0.006532	28.40004861	0.002153	5.580657232	0.021288	0	0.073984	0	0.025314	2.027762671	0.1359442	847.7619396	899.6800086	0.449840004
	Nolan	0.00056465	0.34708417	0.000569473	0.042772915	0.000417022	0	0.000942846	0.211314936	0.0002468	1.073145389	8.14E-05	0.210874871	0.000804	0	0.0027956	0	0.000957	0.076622551	0.00513689	32.03416406	33.99597888	0.016997989
	Palo Pinto	0.003207	1.9712938	0.005906709	0.443650433	0.002368511	0	0.009454195	2.118917609	0.003962	17.22613111	0.001144	2.963785103	0.03075	0	0.1230821	0	0.001263	0.101160667	0.00574838	35.84745419	60.6723929	0.030336196
	Pecos	4.0968E-05	0.02518222	4.13174E-05	0.00310333	3.02565E-05	0	6.84069E-05	0.015331667	1.791E-05	0.077860599	5.9E-06	0.015299738	5.84E-05	0	0.0002028	0	6.94E-05	0.005559245	0.0003727	2.32419506	2.466531857	0.001233266
	Presidio	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Robertson	0.00073771	0.45345788	0.000835096	0.062723739	0.00054483	0	0.000735917	0.164937103	0.0031497	13.69427068	0.000731	1.894300949	0.000761	0	0.0018663	0	0.191633	15.35063622	0.00339774	21.18863749	52.80896405	0.026404482
	Taylor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Titus	0.00569644	3.50151464	0.005745061	0.431509131	0.004207073	0	0.009511781	2.131823965	0.00249	10.82629135	0.000821	2.127384426	0.008115	0	0.0282032	0	0.00965	0.772996897	0.05182285	323.1726071	342.9641275	0.171482064
	Tom Green	0.00148245	0.91123859	2.96846E-05	0.002229601	0.001094854	0	4.95918E-05	0.01111473	1.095E-05	0.047607833	1.06E-05	0.027466649	0.000305	0	4.72E-05	0	1.05E-05	0.000839837	5.396E-05	0.336502638	1.336999879	0.0006685
	Upton	3.1166E-05	0.01915735	3.14322E-05	0.002360856	2.30176E-05	0	5.20405E-05	0.011663552	1.362E-05	0.059232385	4.49E-06	0.011639263	4.44E-05	0	0.0001543	0	5.28E-05	0.004229191	0.00028353	1.768129416	1.876412014	0.000938206
	Ward	0.01855953	11.408264	0.01871795	1.405897326	0.013707039	0	0.030990277	6.945682939	0.0081128	35.27307523	0.002674	6.931218502	0.02644	0	0.0918886	0	0.03144	2.518496578	0.16884373	1052.926743	1117.409377	0.558704689
	Webb	0.02001433	12.3025069	0.000400768	0.030101532	0.014781473	0	0.000669531	0.150058446	0.0001478	0.642746806	0.000143	0.370823455	0.004115	0	0.0006373	0	0.000142	0.011338526	0.00072851	4.543075836	18.05065147	0.009025326
	Wharton	0.00014434	0.08872345	0.000178787	0.013428581	0.000106601	0	6.01986E-05	0.013491982	0.001094	4.756438751	0.000249	0.64416708	9.99E-05	0	6.336E-05	0	7.64E-05	0.006119825	0.00010492	0.654279939	6.176649605	0.003088325
	Wichita	0.00020763	0.12762902	0.000209406	0.015728361	0.000153346	0	0.000346701	0.07770426	9.076E-05	0.394614647	2.99E-05	0.077542441	0.000296	0	0.001028	0	0.000352	0.028175475	0.00188893	11.77953191	12.50092611	0.006250463
	Wilbarger	0.02861682	17.590329	0.000573025	0.043039671	0.021134796	0	0.000957307	0.214556063	0.0002114	0.919010077	0.000205	0.530209546	0.005884	0	0.0009112	0	0.000202	0.016212013	0.00104164	6.49576542	25.8091218	0.012904561
	Wise	0.00284449	1.74846385	0.002882008	0.21646641	0.002100781	0	0.00476997	1.069067636	0.0012561	5.461204884	0.000413	1.071049151	0.004182	0	0.0146143	0	0.004798	0.384337182	0.02576141	160.6507913	170.6013804	0.08530069
	Young	0.00623586	3.83308738	0.006289085	0.472370495	0.004605458	0	0.010412491	2.333695093	0.0027258	11.85147714	0.000899	2.328835155	0.008883	0	0.0308739	0	0.010564	0.846195134	0.05673017	353.7751427	375.4408031	0.187720402
	Total	**1.12183722**	**689.576519**	**1.172570094**	**88.07124604**	**1.090766584**	**0**	**1.189130767**	**266.5134354**	**1.62936**	**7084.183934**	**1.542363**	**3997.534236**	**1.359386**	**0**	**1.2316428**	**0**	**1.221806**	**97.872224**	**1.52878695**	**9533.671529**	**21757.42312**	**10.87871156**
Energy Savings by PCA (MWh)		614.69		75.11		0.00		224.12		4,347.83		2,591.83		0.00		0.00		80.10		6,236.10			

6.1.3 2006 Results for New Residential Construction (Single-family and Multi-family), using 2007 eGRID.

In Table 37 and Table 38, the combined NOx emissions reductions are listed from single-family electricity savings, multi-family electricity savings, and natural gas savings (single-family and multi-family), which also show the 2006 annual and peak-day electricity savings are shown for the combined single-family and multi-family savings.

Using the 2007 eGRID the total NOx reductions from electricity and natural gas savings from new construction in 2006 are calculated to be 304.57 tons NOx/year, which represents 263.32 tons NOx/year (86.5%) from single-family residential electricity savings, 10.88 tons NOx/year (3.6%) from multi-family residential electricity savings, and 30.37 tons NOx/year (10.0%) from natural gas savings from single-family and multi-family residential. On a peak Ozone Season Day (OSD), the NOx reductions in 2006 are calculated to be 1.77 tons of NOx/day, which represents 1.63 tons NOx/day (91.6%) from single-family residential electricity savings, 0.07 tons NOx/day (3.9%) from multi-family residential electricity savings, and 0.08 tons NOx/day (4.5%) from natural gas savings from single-family and multi-family residential.

Figure 123 through Figure 128 show the electricity and NOx reductions tabulated in Table 37 and Table 38. Figure 123 shows the annual electricity savings by county as a stacked bar chart, and Figure 124 shows the OSD electricity savings by county in a similar fashion. Figure 125 shows the spatial distribution of the electricity savings by county across the state.

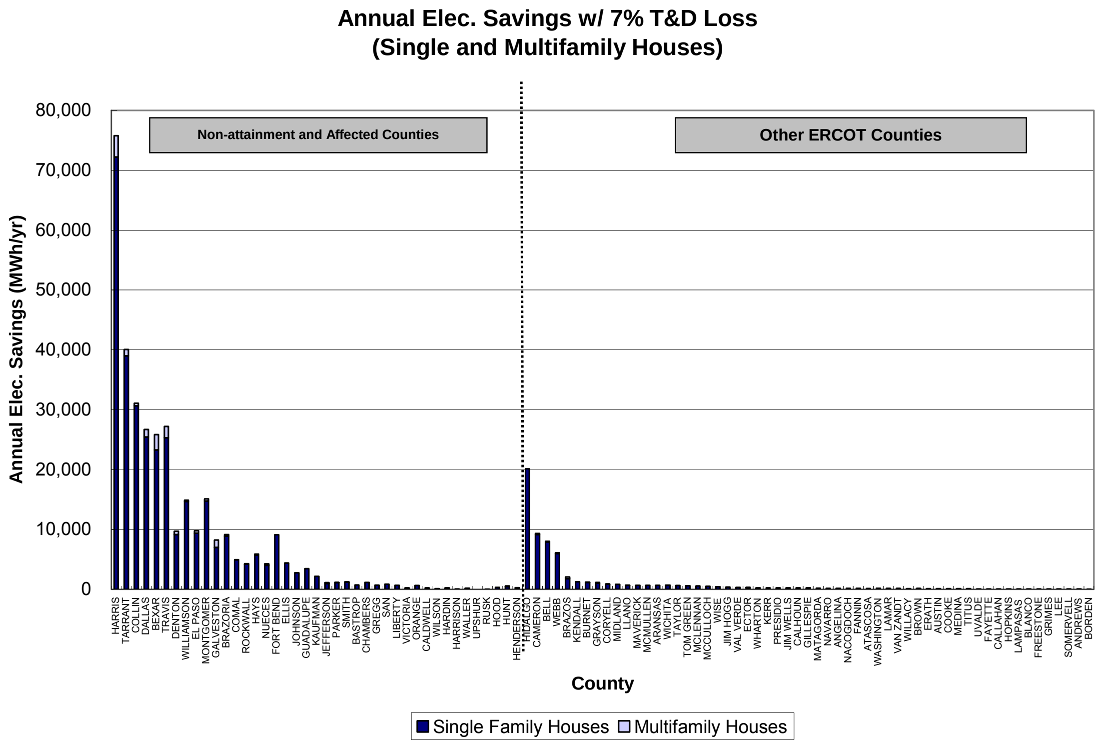
Figure 126 shows the annual NOx reductions in a similar format at the electricity savings using a stacked bar chart with the ordering of the counties determined by Figure 123. Figure 127 shows the OSD NOx reductions, also as a stacked bar chart, and Figure 128 shows the spatial distribution of the NOx savings by county across the state.

Table 37: 2006 Annual and OSD NOx Reductions from Electricity and Natural Gas Savings Due to the IECC / IRC for Single-family and Multi-family Residences by County (Using 1999 Base year and 2007 eGRID) (1).

	Electricity Savings and Resultant NOx Reductions (Single Family Houses)				Electricity Savings and Resultant NOx Reductions (Multifamily Houses)				Total Electricity Savings and Resultant NOx Reductions (Single and Multi-Family Houses)				Total Natural Gas Savings and Resultant NOx Reductions (Single and Multi-Family Houses)				Total Nox Reductions	
County	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	OSD Electricity Savings per County w/ 7% T&D Loss (MWh/County)	OSD Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	OSD Electricity Savings per County w/ 7% T&D Loss (MWh/County)	OSD Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	OSD Electricity Savings per County w/ 7% T&D Loss (MWh/County)	OSD Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Total OSD N.G. Savings (Therm/County)	OSD Nox Reductions (Tons)	Annual Nox Reductions (Tons)	OSD Nox Reductions (Tons)
HARRIS	72,234.29	30.85	447.83	0.22	3,535.56	1.46	20.24	0.01	75,769.85	32.31	468.0756	0.2266	1,170,767.96	5.39	3,215.2212	0.0148	37.69	0.2413
TARRANT	39,010.75	10.41	267.94	0.09	1,041.58	0.37	8.14	0.00	40,052.32	10.78	276.0815	0.0913	696,805.67	3.21	1,701.6007	0.0078	13.98	0.0992
COLLIN	30,665.79	0.54	210.43	0.00	422.61	0.02	3.30	0.00	31,088.39	0.56	213.7251	0.0034	529,032.92	2.43	1,297.4458	0.0060	3.00	0.0094
DALLAS	25,425.21	3.81	174.69	0.03	1,266.75	0.13	9.90	0.00	26,691.96	3.94	184.5892	0.0285	473,033.95	2.18	1,152.5640	0.0053	6.12	0.0338
BEXAR	23,262.26	19.69	143.11	0.11	2,562.26	1.51	16.37	0.01	25,824.52	21.20	159.4856	0.1212	414,614.25	1.91	1,215.0081	0.0056	23.11	0.1268
TRAVIS	25,313.85	0.39	153.50	0.00	1,901.41	0.02	11.58	0.00	27,215.26	0.41	165.0741	0.0025	398,750.14	1.83	1,063.7016	0.0049	2.24	0.0074
DENTON	9,128.29	0.12	63.71	0.00	595.33	0.00	3.88	0.00	9,723.62	0.12	67.5889	0.0011	229,536.26	1.06	419.0173	0.0019	1.18	0.0030
WILLIAMSON	14,663.92	0.00	88.82	0.00	219.90	0.00	1.34	0.00	14,883.82	0.00	90.1542	0.0000	212,166.74	0.98	562.3955	0.0026	0.98	0.0026
EL PASO	9,382.60	0.00	52.36	0.00	380.56	0.00	2.07	0.00	9,763.16	0.00	54.4387	0.0000	226,423.40	1.04	462.3712	0.0021	1.04	0.0021
MONTGOMERY	14,747.16	0.00	91.34	0.00	336.28	0.00	1.92	0.00	15,083.44	0.00	93.2582	0.0000	226,699.14	1.04	629.3437	0.0029	1.04	0.0029
GALVESTON	7,016.66	16.17	43.07	0.08	1,228.22	0.75	7.04	0.00	8,244.88	16.93	50.1087	0.0872	120,546.62	0.55	364.9161	0.0017	17.48	0.0889
BRAZORIA	8,883.57	4.18	54.58	0.03	272.61	0.20	1.56	0.00	9,156.18	4.37	56.1411	0.0294	126,547.02	0.58	385.4189	0.0018	4.95	0.0312
COMAL	4,937.34	0.00	30.36	0.00	7.85	0.00	0.05	0.00	4,945.19	0.00	30.4135	0.0000	75,179.91	0.35	220.7456	0.0010	0.35	0.0010
ROCKWALL	4,178.06	0.00	29.18	0.00	100.36	0.00	0.65	0.00	4,278.42	0.00	29.8309	0.0000	101,952.73	0.47	182.9485	0.0008	0.47	0.0008
HAYS	5,683.45	0.94	34.52	0.01	209.49	0.04	1.28	0.00	5,892.94	0.98	35.7939	0.0061	84,403.37	0.39	226.7795	0.0010	1.37	0.0071
NUECES	4,039.39	6.21	21.05	0.03	216.57	0.10	1.07	0.00	4,255.96	6.31	22.1185	0.0334	55,976.73	0.26	154.5880	0.0007	6.57	0.0341
FORT BEND	9,114.82	31.82	56.53	0.16	0.00	1.51	0.00	0.01	9,114.82	33.33	56.5303	0.1631	138,383.58	0.64	379.0544	0.0017	33.97	0.1648
ELLIS	4,368.83	2.81	30.01	0.02	7.17	0.10	0.06	0.00	4,376.00	2.91	30.0697	0.0205	75,669.86	0.35	183.1800	0.0008	3.25	0.0214
JOHNSON	2,766.52	0.07	19.01	0.00	1.96	0.00	0.02	0.00	2,768.48	0.07	19.0303	0.0006	48,333.26	0.22	115.6938	0.0005	0.30	0.0011
GUADALUPE	3,460.86	0.77	21.27	0.00	0.68	0.03	0.00	0.00	3,461.54	0.80	21.2793	0.0049	52,635.70	0.24	154.5553	0.0007	1.04	0.0056
KAUFMAN	2,169.92	5.41	15.16	0.04	1.64	0.19	0.01	0.00	2,171.56	5.60	15.1663	0.0381	52,422.59	0.24	92.3345	0.0004	5.85	0.0385
JEFFERSON	969.04	0.00	5.85	0.00	156.76	0.00	0.89	0.00	1,125.80	0.00	6.7414	0.0000	17,339.05	0.08	48.6788	0.0002	0.08	0.0002
PARKER	1,143.59	0.05	7.99	0.00	24.99	0.00	0.16	0.00	1,168.58	0.06	8.1523	0.0008	27,820.99	0.13	49.8690	0.0002	0.18	0.0010
SMITH	1,181.53	0.00	8.37	0.00	45.99	0.00	0.35	0.00	1,227.52	0.00	8.7185	0.0000	27,507.03	0.13	59.1815	0.0003	0.13	0.0003
BASTROP	739.17	1.72	4.43	0.01	0.00	0.07	0.00	0.00	739.17	1.79	4.4317	0.0110	8,735.66	0.04	24.8879	0.0001	1.83	0.0111
CHAMBERS	1,174.87	9.83	7.09	0.06	0.00	0.47	0.00	0.00	1,174.87	10.30	7.0899	0.0641	17,021.64	0.08	47.8328	0.0002	10.38	0.0643
GREGG	701.44	0.00	4.97	0.00	4.05	0.00	0.03	0.00	705.49	0.00	4.9986	0.0000	18,340.84	0.08	33.2636	0.0002	0.08	0.0002
SAN PATRICIO	866.45	1.37	4.51	0.01	2.79	0.02	0.01	0.00	869.24	1.40	4.5267	0.0083	11,190.79	0.05	30.8570	0.0001	1.45	0.0084
LIBERTY	658.16	0.00	3.96	0.00	0.00	0.00	0.00	0.00	658.16	0.00	3.9631	0.0000	9,316.83	0.04	26.5532	0.0001	0.04	0.0001
VICTORIA	243.58	0.79	1.52	0.00	0.00	0.02	0.00	0.00	243.58	0.80	1.5238	0.0043	3,904.21	0.02	11.3800	0.0001	0.82	0.0044
ORANGE	643.14	0.00	3.88	0.00	0.00	0.00	0.00	0.00	643.14	0.00	3.8800	0.0000	9,399.56	0.04	26.1832	0.0001	0.04	0.0001
CALDWELL	222.51	0.00	1.33	0.00	0.00	0.00	0.00	0.00	222.51	0.00	1.3339	0.0000	2,793.90	0.01	8.4773	0.0000	0.01	0.0000
WILSON	81.20	0.00	0.50	0.00	2.73	0.00	0.02	0.00	83.93	0.00	0.5170	0.0000	1,285.72	0.01	3.8203	0.0000	0.01	0.0000
HARDIN	224.12	0.00	1.35	0.00	0.00	0.00	0.00	0.00	224.12	0.00	1.3504	0.0000	3,226.54	0.01	9.0670	0.0000	0.01	0.0000
HARRISON	78.58	0.00	0.56	0.00	0.00	0.00	0.00	0.00	78.58	0.00	0.5569	0.0000	2,046.04	0.01	3.7008	0.0000	0.01	0.0000
WALLER	150.04	0.00	0.93	0.00	59.76	0.00	0.34	0.00	209.80	0.00	1.2714	0.0000	3,489.66	0.02	9.7556	0.0000	0.02	0.0000
UPSHUR	13.77	0.00	0.10	0.00	0.00	0.00	0.00	0.00	13.77	0.00	0.0976	0.0000	354.90	0.00	0.6476	0.0000	0.00	0.0000
RUSK	37.73	0.59	0.26	0.00	0.00	0.02	0.00	0.00	37.73	0.61	0.2632	0.0000	786.33	0.00	2.0354	0.0000	0.61	0.0000
HOOD	316.71	10.72	2.18	0.07	4.56	0.38	0.04	0.00	321.27	11.10	2.2124	0.0723	5,630.81	0.03	13.5481	0.0001	11.12	0.0724
HUNT	477.86	5.30	3.28	0.04	97.73	0.19	0.64	0.00	575.59	5.48	3.9177	0.0373	10,342.84	0.05	25.4504	0.0001	5.53	0.0374
HENDERSON	249.15	0.70	1.77	0.01	11.71	0.02	0.09	0.00	260.86	0.73	1.8653	0.0056	6,572.12	0.03	12.4074	0.0001	0.76	0.0056
HIDALGO	20,115.23	5.15	100.41	0.04	0.00	0.09	0.00	0.00	20,115.23	5.23	100.4087	0.0358	207,039.34	0.95	625.7128	0.0029	6.18	0.0387
CAMERON	9,128.14	1.32	45.56	0.01	203.54	0.02	0.66	0.00	9,331.68	1.34	46.2281	0.0082	99,130.94	0.46	298.5689	0.0014	1.80	0.0095
BELL	7,902.40		53.11		112.67		0.63		8,015.07	0.00	53.7393	0.0000	129,279.39	0.59	322.0580	0.0015	0.59	0.0015
WEBB	5,945.12	0.55	29.26	0.00	134.77	0.01	0.66	0.00	6,079.90	0.56	29.9280	0.0021	69,610.89	0.32	197.1211	0.0009	0.88	0.0030
BRAZOS	1,755.52	0.49	10.88	0.00	321.06	0.02	1.84	0.00	2,076.58	0.51	12.7218	0.0032	33,345.42	0.15	92.2097	0.0004	0.66	0.0036
KENDALL	1,264.91		7.85		0.00		0.00		1,264.91	0.00	7.8456	0.0000	22,338.83	0.10	55.7078	0.0003	0.10	0.0003
BURNET	1,162.96		7.05		50.61		0.31		1,213.57	0.00	7.3601	0.0000	17,558.57	0.08	46.6936	0.0002	0.08	0.0002
GRAYSON	1,026.07		7.05		131.81		0.86		1,157.89	0.00	7.9042	0.0000	20,572.81	0.09	50.2006	0.0002	0.09	0.0002
CORYELL	858.45		5.77		36.59		0.20		895.04	0.00	5.9741	0.0000	15,005.84	0.07	38.1313	0.0002	0.07	0.0002
MIDLAND	820.78		4.81		0.00		0.00		820.78	0.00	4.8068	0.0000	24,124.77	0.11	39.3588	0.0002	0.11	0.0002
LLANO	676.83	0.47	4.10	0.00	26.89	0.02	0.16	0.00	703.71	0.49	4.2678	0.0031	10,165.69	0.05	27.0230	0.0001	0.54	0.0032
MAVERICK	671.43		3.31		0.00		0.00		671.43	0.00	3.3050	0.0000	7,590.24	0.03	21.4960	0.0001	0.03	0.0001
MCMULLEN	671.43		3.31		0.00		0.00		671.43	0.00	3.3050	0.0000	7,590.24	0.03	21.4960	0.0001	0.03	0.0001
ARANSAS	665.86		3.47		0.00		0.00		665.86	0.00	3.4703	0.0000	8,590.70	0.04	23.6851	0.0001	0.04	0.0001
WICHITA	659.44	0.18	4.30	0.00	51.70	0.01	0.23	0.00	711.15	0.18	4.5316	0.0013	24,813.95	0.11	31.9488	0.0001	0.30	0.0014
TAYLOR	637.44	0.00	3.96	0.00	4.65	0.00	0.02	0.00	642.09	0.00	3.9782	0.0000	18,748.71	0.09	28.3687	0.0001	0.09	0.0001
TOM GREEN	613.85	0.04	3.79	0.00	0.00	0.00	0.00	0.00	613.85	0.04	3.7931	0.0000	11,440.15	0.05	27.2484	0.0001	0.09	0.0001
MCLENNAN	552.42	21.00	3.71	0.13	0.00	0.74	0.00	0.00	552.42	21.74	3.7126	0.1351	8,726.09	0.04	21.4960	0.0001	21.78	0.1352
MCCULLOCH	484.26		2.99		0.00		0.00		484.26	0.00	2.9923	0.0000	9,025.00	0.04	21.4960	0.0001	0.04	0.0001
WISE	420.01	2.42	2.88	0.02	6.57	0.09	0.05	0.00	426.58	2.51	2.9334	0.0171	7,264.08	0.03	17.8262	0.0001	2.54	0.0171
JIM HOGG	368.98		5.86		0.00		0.00		368.98	0.00	5.8594	0.0000	38,455.49	0.18	71.1663	0.0003	0.18	0.0003
VAL VERDE	334.32		2.06		2.73		0.02		337.05	0.00	2.0742	0.0000	5,151.31	0.02	15.1234	0.0001	0.02	0.0001
ECTOR	313.58	3.03	1.84	0.02	22.68	0.11	0.10	0.00	336.26	3.13	1.9405	0.0213	9,995.07	0.05	17.5175	0.0001	3.18	0.0214
WHARTON	241.60	0.07	1.51	0.00	0.00	0.00	0.00	0.00	241.60	0.07	1.5114	0.0005	3,872.47	0.02	11.2874	0.0001	0.09	0.0005
KERR	236.35		1.43		0.00		0.00		236.35	0.00	1.4332	0.0000	3,355.56	0.02	8.8810	0.0000	0.02	0.0000
PRESIDIO	229.62	0.00	1.42	0.00	0.34	0.00	0.00	0.00	229.96	0.00	1.4211	0.0000	4,292.98	0.02	10.2397	0.0000	0.02	0.0000
JIM WELLS	228.89		1.19		0.00		0.00		228.89	0.00	1.1929	0.0000	2,953.05	0.01	8.1418	0.0000	0.01	0.0000
CALHOUN	227.74	2.26	1.42	0.01	1.06	0.04	0.01	0.00	228.80	2.29	1.4312	0.0132	3,674.54	0.02	10.7100	0.0000	2.31	0.0133
GILLESPIE	214.87		1.30		25.30		0.15		240.17	0.00	1.4570	0.0000	3,574.35	0.02	9.5712	0.0000	0.02	0.0000
MATAGORDA	192.09		1.20		0.00		0.00		192.09	0.00	1.2017	0.0000	3,078.93	0.01	8.9744	0.0000	0.01	0.0000
NAVARRO	178.95		1.20		0.00		0.00		178.95	0.00	1.2027	0.0000	2,826.76	0.01	6.9635	0.0000	0.01	0.0000
ANGELINA	178.35	0.27	1.24	0.00	0.00	0.01	0.00	0.00	178.35	0.28	1.2443	0.0019	3,717.20	0.02	9.6221	0.0000	0.29	0.0019
NACOGDOCHES	173.20		1.21		0.55		0.00		173.76	0.00	1.2125	0.0000	3,625.43	0.02	9.3913	0.0000	0.02	0.0000
FANNIN	172.22	6.04	1.18	0.04	5.75	0.21	0.04	0.00	177.97	6.25	1.2201	0.0447	3,109.92	0.01	7.4929	0.0000	6.27	0.0448
ATASCOSA	144.13		0.89		1.08		0.00		145.21	0.00	0.8899	0.0000	2,129.29	0.01	6.5525	0.0000	0.01	0.0000
WASHINGTON	142.40		0.88		29.72		0.17		172.12	0.00	1.0530	0.0000	2,781.34	0.01	7.6997	0.0000	0.01	0.0000
LAMAR	116.10	0.81	0.83	0.01	0.66	0.03	0.01	0.00	116.76	0.84	0.8310	0.0063	2,937.30	0.01	5.4130	0.0000	0.86	0.0064
VAN ZANDT	114.77		0.79		2.63		0.02		117.40	0.00	0.8081	0.0000	2,004.29	0.01	4.9304	0.0000	0.01	0.0000
WILLACY	107.07		0.53		0.00		0.00		107.07	0.00	0.5345	0.0000	1,102.09	0.01	3.3307	0.0000	0.01	0.0000
BROWN	106.33		0.71		15.58		0.09		121.91	0.00	0.8018	0.0000	2,295.12	0.01	6.1501	0.0000	0.01	0.0000
ERATH	103.93		0.65		4.65		0.02		108.58	0.00	0.6660	0.0000	3,189.53	0.01	5.0562	0.0000	0.01	0.0000
AUSTIN	102.35		0.63		1.17		0.01		103.52	0.00	0.6413	0.0000	1,579.05	0.01	4.3261	0.0000	0.01	0.0000
COOKE	101.88		0.70		1.64		0.01		103.52	0.00	0.7103	0.0000	1,802.83	0.01	4.3322	0.0000	0.01	0.0000
MEDINA	97.13		0.60		0.00		0.00		97.13	0.00	0.5976	0.0000	1,477.88	0.01	4.3396	0.0000	0.01	0.0000
TITUS	92.08	4.88	0.65	0.00	0.00	0.17	0.00	0.00	92.08	5.05	0.6550	0.0000	2,317.48	0.01	4.2559	0.0000	5.06	0.0000
UVALDE	79.06		0.49		1.36		0.01		80.43	0.00	0.4951	0.0000	1,235.25	0.01	3.6258	0.0000	0.01	0.0000
FAYETTE	75.65	0.00	0.47	0.00	0.00	0.00	0.00	0.00	75.65	0.00	0.4690	0.0000	1,149.09	0.01	3.1457	0.0000	0.01	0.0000
CALLAHAN	71.60		0.44		0.00		0.00		71.60	0.00	0.4445	0.0000	2,088.03	0.01	3.1285	0.0000	0.01	0.0000
HOPKINS	70.82		0.49		0.00		0.00		70.82	0.00	0.4859	0.0000	1,199.03	0.01	2.9267	0.0000	0.01	0.0000
LAMPASAS	70.02		0.47		0.00		0.00		70.02	0.00	0.4706	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
BLANCO	67.15		0.41		0.00		0.00		67.15	0.00	0.4072	0.0000	953.28	0.00	2.5230	0.0000	0.00	0.0000
FREESTONE	64.84	3.15	0.44	0.02	2.90	0.11	0.02	0.00	67.74	3.26	0.4520	0.0221	1,138.69	0.01	2.8974	0.0000	3.26	0.0222
GRIMES	62.30	0.00	0.39	0.00	0.00	0.00	0.00	0.00	62.30	0.00	0.3862	0.0009	946.31	0.00	2.5906	0.0000	0.00	0.0009
LEE	61.30		0.37		0.00		0.00		61.30	0.00	0.3662	0.0000	756.20	0.00	2.3212	0.0000	0.00	0.0000
SOMERVELL	58.00		0.40		0.00		0.00		58.00	0.00	0.3985	0.0000	1,011.96	0.00	2.4221	0.0000	0.00	0.0000
ANDREWS	50.51	0.02	0.30	0.00	0.00	0.00	0.00	0.00	50.51	0.02	0.2958	0.0002	1,484.60	0.01	2.4221	0.0000	0.03	0.0002
BORDEN	48.88		0.27		0.00		0.00		48.88	0.00	0.2683	0.0000	2,244.01	0.01	2.3130	0.0000	0.01	0.0000

Table 38: 2006 Annual and OSD NOx Reductions from Electricity and Natural Gas Savings Due to the IECC / IRC for Single-family and Multi-family Residences by County (Using 1999 Base year and 2007 eGRID) (2).

	Electricity Savings and Resultant NOx Reductions (Single Family Houses)				Electricity Savings and Resultant NOx Reductions (Multifamily Houses)				Total Electricity Savings and Resultant NOx Reductions (Single and Multi-Family Houses)				Total Natural Gas Savings and Resultant NOx Reductions (Single and Multi-Family Houses)				Total Nox Reductions	
County	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	OSD Electricity Savings per County w/ 7% T&D Loss (MWh/County)	OSD Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	OSD Electricity Savings per County w/ 7% T&D Loss (MWh/County)	OSD Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	OSD Electricity Savings per County w/ 7% T&D Loss (MWh/County)	OSD Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Total OSD N.G. Savings (Therm/County)	OSD Nox Reductions (Tons)	Annual Nox Reductions (Tons)	OSD Nox Reductions (Tons)
CHEROKEE	48.02	3.00	0.33	0.02	1.10	0.11	0.01	0.00	49.12	3.10	0.3433	0.0206	1,031.70	0.00	2.6842	0.0000	3.11	0.0206
DIMMIT	47.28		0.23		0.00		0.00		47.28	0.00	0.2327	0.0000	534.52	0.00	1.5138	0.0000	0.00	0.0000
FALLS	46.68		0.31		0.00		0.00		46.68	0.00	0.3137	0.0000	737.42	0.00	1.8166	0.0000	0.00	0.0000
COLORADO	44.50		0.28		0.00		0.00		44.50	0.00	0.2759	0.0000	675.93	0.00	1.8504	0.0000	0.00	0.0000
FRIO	42.79	0.31	0.26	0.00	0.00	0.01	0.00	0.00	42.79	0.32	0.2631	0.0031	622.52	0.00	1.9175	0.0000	0.32	0.0031
MILAM	40.75	1.92	0.24	0.01	0.00	0.07	0.00	0.00	40.75	1.99	0.2368	0.0097	513.17	0.00	1.5138	0.0000	1.99	0.0097
JACKSON	39.61		0.25		0.00		0.00		39.61	0.00	0.2478	0.0000	634.83	0.00	1.8504	0.0000	0.00	0.0000
ANDERSON	39.44		0.28		0.00		0.00		39.44	0.00	0.2752	0.0000	822.07	0.00	2.1280	0.0000	0.00	0.0000
HILL	38.90		0.26		0.00		0.00		38.90	0.00	0.2614	0.0000	614.51	0.00	1.5138	0.0000	0.00	0.0000
CULBERSON	38.73		0.22		0.00		0.00		38.73	0.00	0.2172	0.0000	901.79	0.00	1.8166	0.0000	0.00	0.0000
MASON	37.60		0.23		0.00		0.00		37.60	0.00	0.2280	0.0000	533.84	0.00	1.4129	0.0000	0.00	0.0000
PECOS	36.38	0.04	0.22	0.00	0.00	0.00	0.00	0.00	36.38	0.04	0.2248	0.0002	677.93	0.00	1.6147	0.0000	0.04	0.0003
RAINS	34.19		0.23		0.00		0.00		34.19	0.00	0.2346	0.0000	578.84	0.00	1.4129	0.0000	0.00	0.0000
LAVACA	31.88		0.20		0.95		0.00		32.83	0.00	0.2037	0.0000	605.37	0.00	1.5739	0.0000	0.00	0.0000
PALO PINTO	30.02	0.81	0.19	0.00	0.42	0.03	0.00	0.00	30.45	0.84	0.1883	0.0051	890.04	0.00	1.3588	0.0000	0.84	0.0052
KIMBLE	29.56		0.18		0.00		0.00		29.56	0.00	0.1826	0.0000	550.82	0.00	1.3120	0.0000	0.00	0.0000
MADISON	26.70		0.17		0.00		0.00		26.70	0.00	0.1655	0.0000	405.56	0.00	1.1102	0.0000	0.00	0.0000
ARCHER	25.36		0.17		1.27		0.01		26.63	0.00	0.1711	0.0000	930.68	0.00	1.1496	0.0000	0.00	0.0000
REFUGIO	23.76		0.15		0.00		0.00		23.76	0.00	0.1487	0.0000	380.90	0.00	1.1102	0.0000	0.00	0.0000
LIMESTONE	23.34	0.33	0.16	0.00	0.36	0.02	0.00	0.00	23.70	0.34	0.1589	0.0000	383.02	0.00	0.9551	0.0000	0.34	0.0000
CLAY	22.83		0.15		0.00		0.00		22.83	0.00	0.1489	0.0000	799.80	0.00	0.9083	0.0000	0.00	0.0000
BEE	21.78		0.14		0.00		0.00		21.78	0.00	0.1363	0.0000	349.16	0.00	1.0177	0.0000	0.00	0.0000
MARTIN	21.05		0.12		0.00		0.00		21.05	0.00	0.1233	0.0000	618.58	0.00	1.0092	0.0000	0.00	0.0000
GONZALES	20.33		0.13		0.00		0.00		20.33	0.00	0.1251	0.0000	309.32	0.00	0.9083	0.0000	0.00	0.0000
BURLESON	20.02		0.12		0.00		0.00		20.02	0.00	0.1241	0.0000	304.17	0.00	0.8327	0.0000	0.00	0.0000
KARNES	19.19		0.11		0.00		0.00		19.19	0.00	0.1144	0.0000	269.22	0.00	0.8074	0.0000	0.00	0.0000
KLEBERG	18.30		0.09		0.00		0.00		18.30	0.00	0.0947	0.0000	218.21	0.00	0.6476	0.0000	0.00	0.0000
BREWSTER	15.91		0.10		0.00		0.00		15.91	0.00	0.0983	0.0000	296.60	0.00	0.7064	0.0000	0.00	0.0000
WINKLER	14.73		0.09		0.00		0.00		14.73	0.00	0.0863	0.0000	433.01	0.00	0.7064	0.0000	0.00	0.0000
FRANKLIN	14.65		0.10		0.00		0.00		14.65	0.00	0.1005	0.0000	248.08	0.00	0.6055	0.0000	0.00	0.0000
YOUNG	13.86	5.34	0.09	0.03	0.00	0.19	0.00	0.00	13.86	5.52	0.0860	0.0322	404.13	0.00	0.6055	0.0000	5.53	0.0322
HOUSTON	13.72		0.10		0.00		0.00		13.72	0.00	0.0957	0.0000	285.94	0.00	0.7402	0.0000	0.00	0.0000
SCURRY	13.69		0.08		0.00		0.00		13.69	0.00	0.0751	0.0000	628.32	0.00	0.6476	0.0000	0.00	0.0000
BOSQUE	12.97	0.15	0.09	0.00	0.00	0.01	0.00	0.00	12.97	0.16	0.0871	0.0016	204.84	0.00	0.5046	0.0000	0.16	0.0016
COMANCHE	12.97		0.09		0.00		0.00		12.97	0.00	0.0871	0.0000	204.84	0.00	0.5046	0.0000	0.00	0.0000
BRISCOE	12.09		0.06		0.00		0.00		12.09	0.00	0.0565	0.0000	1,262.23	0.01	0.7064	0.0000	0.01	0.0000
CONCHO	11.37		0.07		0.00		0.00		11.37	0.00	0.0702	0.0000	211.85	0.00	0.5046	0.0000	0.00	0.0000
ZAVALA	9.46		0.05		0.00		0.00		9.46	0.00	0.0465	0.0000	106.90	0.00	0.3028	0.0000	0.00	0.0000
NOLAN	9.24	0.48	0.06	0.00	0.00	0.02	0.00	0.00	9.24	0.50	0.0574	0.0035	269.42	0.00	0.4037	0.0000	0.50	0.0035
BROOKS	8.92		0.04		0.00		0.00		8.92	0.00	0.0445	0.0000	91.84	0.00	0.2776	0.0000	0.00	0.0000
ROBERTSON	8.90	0.64	0.06	0.00	0.00	0.03	0.00	0.00	8.90	0.66	0.0552	0.0021	135.19	0.00	0.3701	0.0000	0.66	0.0021
LIVE OAK	7.80		0.04		0.00		0.00		7.80	0.00	0.0407	0.0000	100.67	0.00	0.2776	0.0000	0.00	0.0000
HAMILTON	7.78		0.05		0.00		0.00		7.78	0.00	0.0523	0.0000	122.90	0.00	0.3028	0.0000	0.00	0.0000
JONES	6.93	1.11	0.04	0.01	2.96	0.02	0.01	0.00	9.89	1.13	0.0563	0.0064	302.94	0.00	0.6304	0.0000	1.13	0.0064
REAGAN	6.48		0.04		0.00		0.00		6.48	0.00	0.0390	0.0000	103.55	0.00	0.3028	0.0000	0.00	0.0000
WARD	6.31	15.88	0.04	0.11	0.00	0.56	0.00	0.00	6.31	16.44	0.0370	0.1162	185.58	0.00	0.3028	0.0000	16.44	0.1162
RED RIVER	6.01	0.00	0.04	0.00	0.00	0.00	0.00	0.00	6.01	0.00	0.0427	0.0000	151.14	0.00	0.2776	0.0000	0.00	0.0000
HASKELL	4.62	0.00	0.03	0.00	0.85	0.00	0.00	0.00	5.47	0.00	0.0325	0.0000	163.53	0.00	0.2954	0.0000	0.00	0.0000
HOWARD	4.21	0.48	0.02	0.00	13.69	0.02	0.06	0.00	17.90	0.49	0.0875	0.0034	593.55	0.00	1.6994	0.0000	0.49	0.0034
SAN SABA	2.69		0.02		0.00		0.00		2.69	0.00	0.0163	0.0000	38.13	0.00	0.1009	0.0000	0.00	0.0000
JACK	2.31	1.82	0.01	0.01	0.00	0.06	0.00	0.00	2.31	1.88	0.0143	0.0128	67.36	0.00	0.1009	0.0000	1.88	0.0128
STEPHENS	2.31		0.01		0.00		0.00		2.31	0.00	0.0143	0.0000	67.36	0.00	0.1009	0.0000	0.00	0.0000
RUNNELS	2.27		0.01		0.00		0.00		2.27	0.00	0.0140	0.0000	42.37	0.00	0.1009	0.0000	0.00	0.0000
REEVES	2.10		0.01		0.00		0.00		2.10	0.00	0.0123	0.0000	61.86	0.00	0.1009	0.0000	0.00	0.0000
DE WITT	1.98		0.01		0.00		0.00		1.98	0.00	0.0124	0.0000	31.74	0.00	0.0925	0.0000	0.00	0.0000
CHILDRESS	1.96		0.01		0.00		0.00		1.96	0.00	0.0107	0.0000	89.76	0.00	0.0925	0.0000	0.00	0.0000
CROSBY	1.96		0.01		0.00		0.00		1.96	0.00	0.0107	0.0000	89.76	0.00	0.0925	0.0000	0.00	0.0000
DAWSON	1.96		0.01		0.00		0.00		1.96	0.00	0.0107	0.0000	89.76	0.00	0.0925	0.0000	0.00	0.0000
MITCHELL	0.00	12.79	0.00	0.10	0.00	0.45	0.00	0.00	0.00	13.24	0.0000	0.0995	0.00	0.00	0.0000	0.0000	13.24	0.0995
WILBARGER	0.00	0.78	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.79	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.79	0.0000
COLEMAN	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.0000	0.0002	0.00	0.00	0.0000	0.0000	0.04	0.0002
UPTON	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.0000	0.0002	0.00	0.00	0.0000	0.0000	0.03	0.0002
COKE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
CROCKETT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
HARDEMAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
BANDERA	0.00		0.00		13.72		0.05		13.72	0.00	0.0486	0.0000	425.76	0.00	1.2168	0.0000	0.00	0.0000
BAYLOR	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
COTTLE	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
CRANE	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
DELTA	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
DICKENS	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
DUVAL	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
EASTLAND	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
EDWARDS	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
FISHER	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
FOARD	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
GLASSCOCK	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
GOLIAD	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
HALL	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
HUDSPETH	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
IRION	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
JEFF DAVIS	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
KENEDY	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
KENT	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
KING	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
KINNEY	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
KNOX	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
LA SALLE	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
LEON	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
LOVING	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
MENARD	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
MILLS	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
MONTAGUE	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
MOTLEY	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
REAL	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
SCHLEICHER	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
SHACKELFORD	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
STARR	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
STERLING	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
STONEWALL	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
SUTTON	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
TERRELL	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
THROCKMORTON	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
ZAPATA	0.00		0.00		0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.00	0.0000
TOTAL	**393,068.92**	**263.32**	**2,464.64**	**1.63**	**15,955.87**	**10.88**	**99.50**	**0.07**	**409,024.79**	**274.19**	**2,564.14**	**1.70**	**6,601,859.44**	**30.37**	**16,977.62**	**0.08**	**304.56**	**1.77**



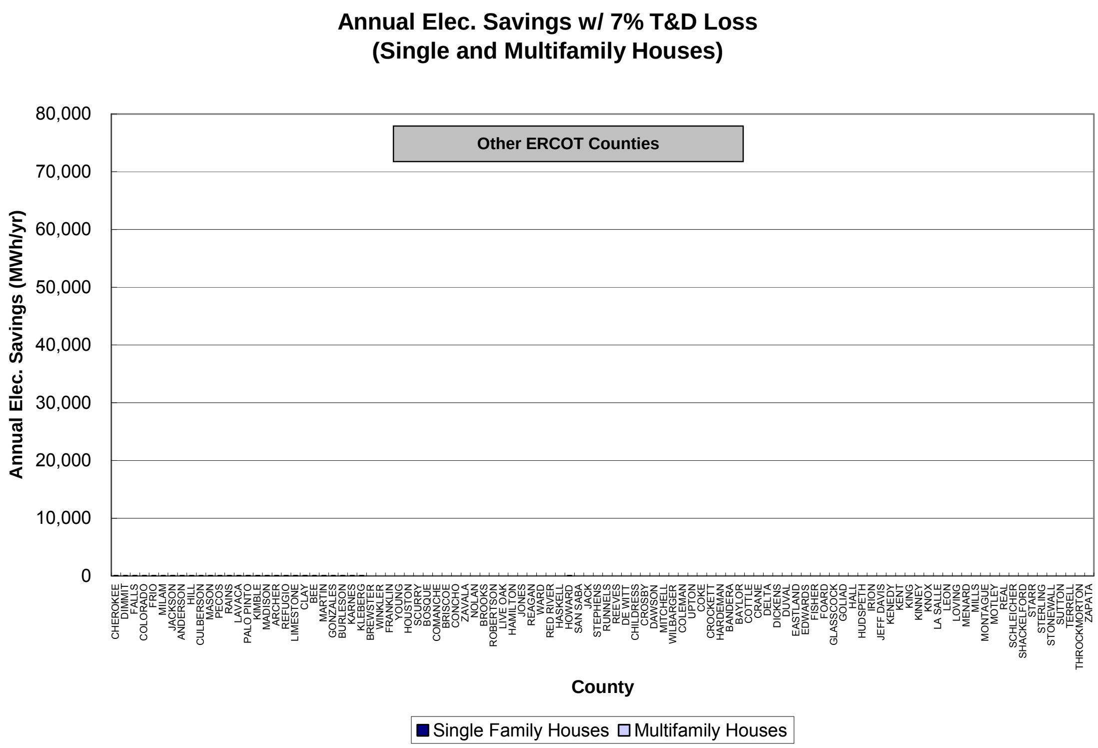
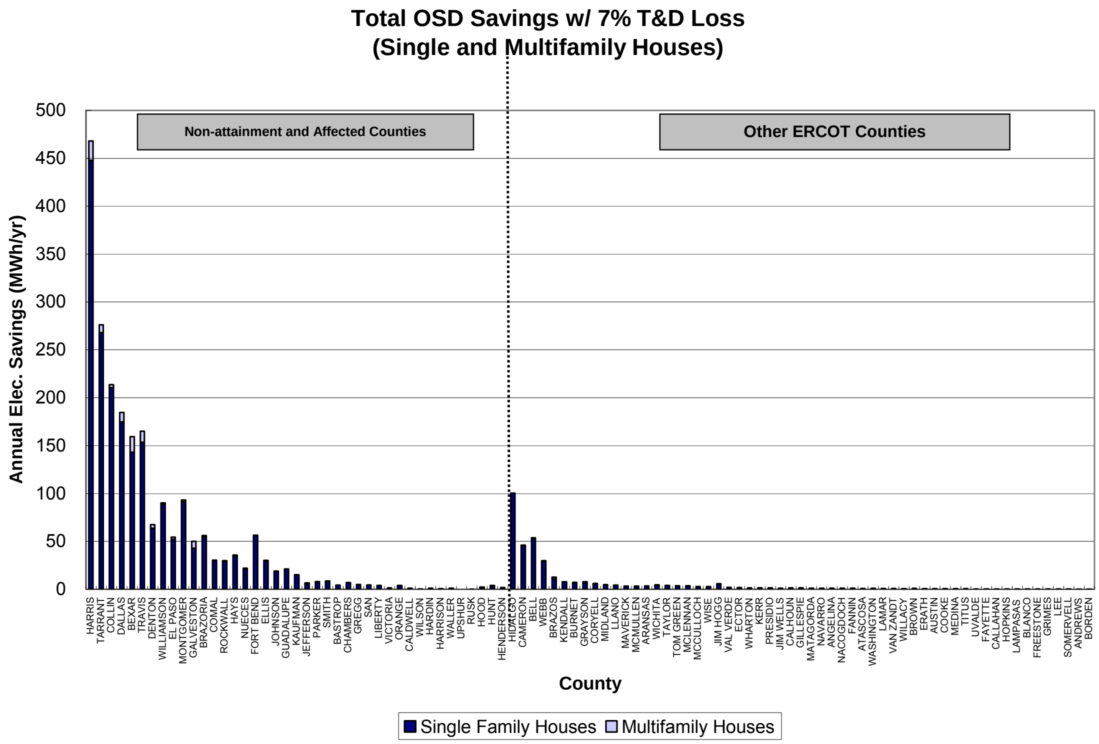


Figure 123: 2006 Annual Electricity Reductions from IECC / IRC by PCA for Single-family and Multi-family Residences by County.



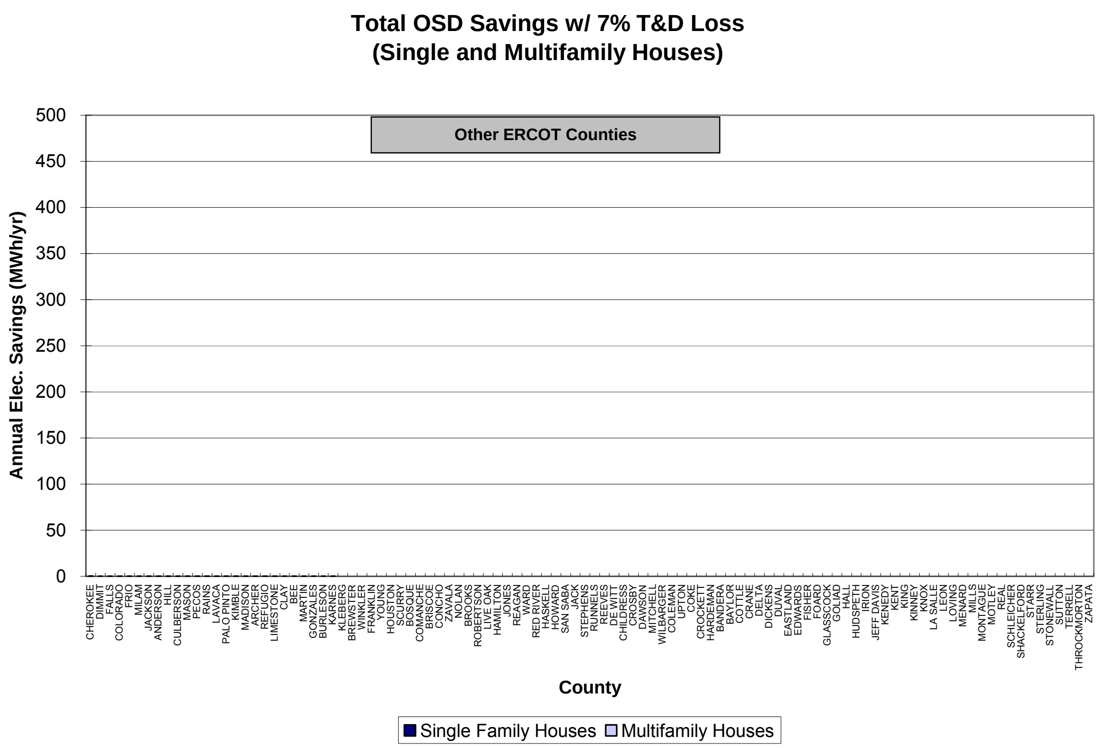
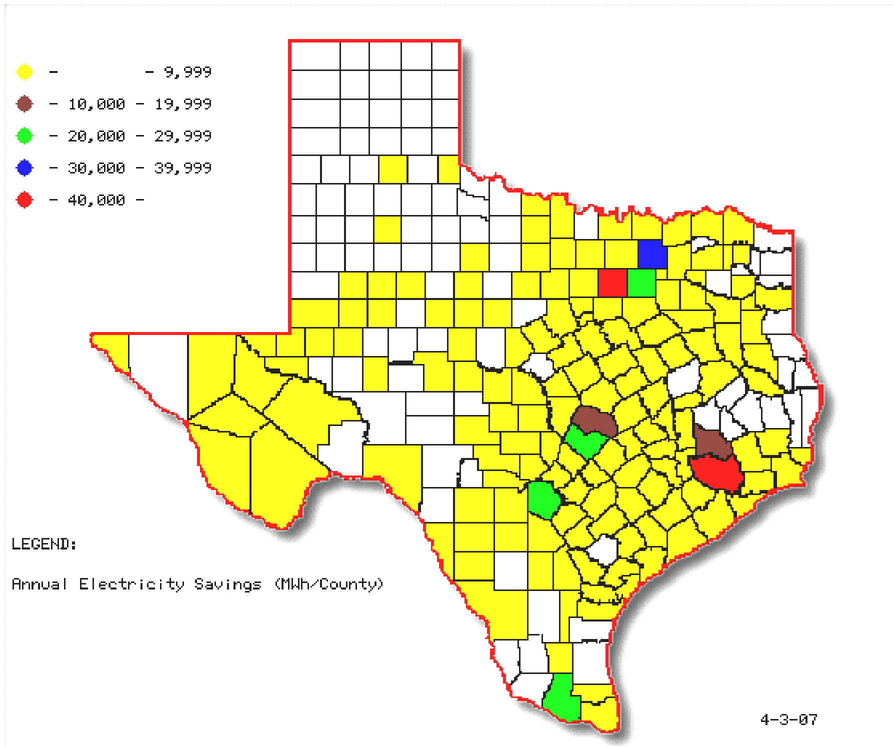


Figure 124: 2006 Annual Electricity Reductions from IECC / IRC by PCA for Single-family and Multi-family Residences by County.



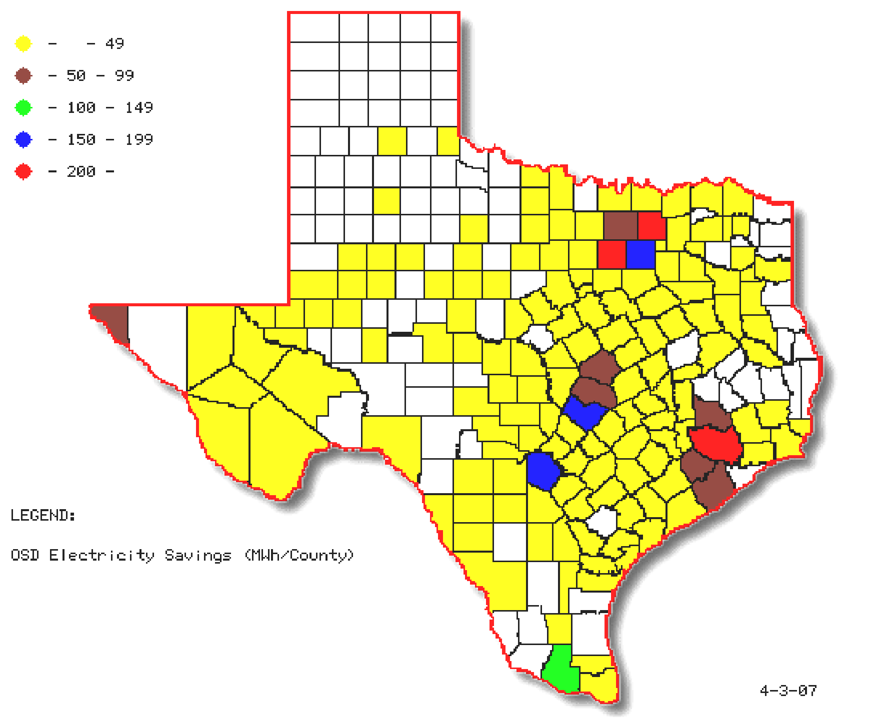
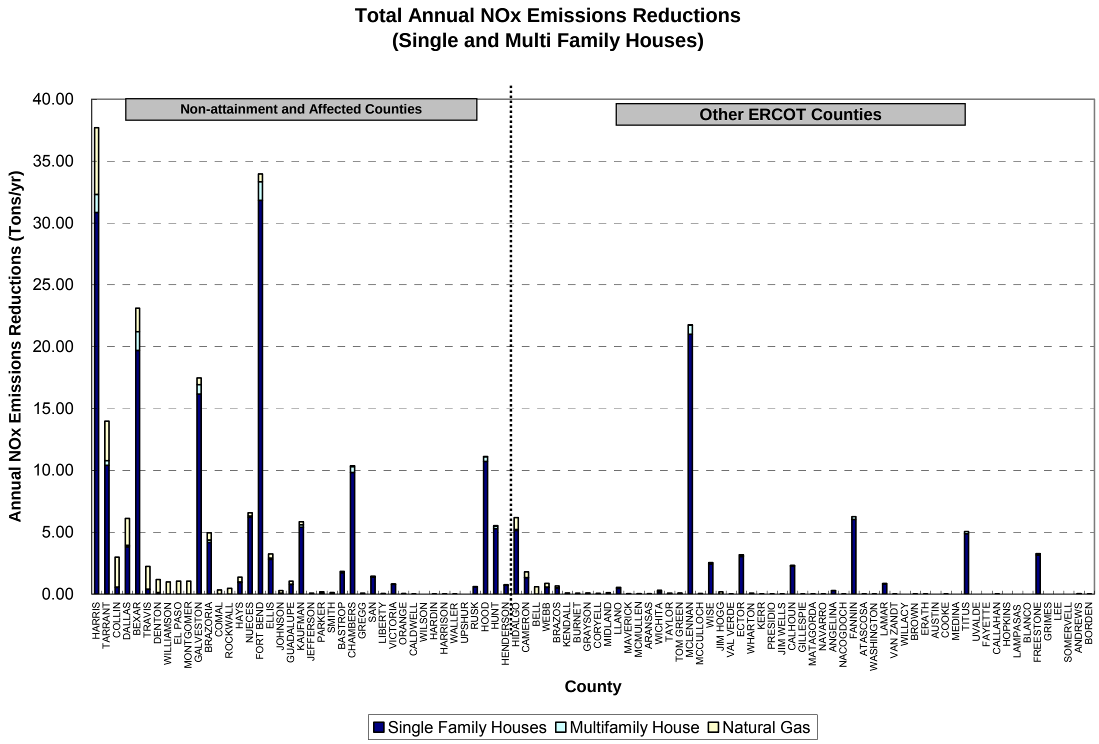


Figure 125: 2006 Annual and OSD Electricity Reductions from IECC / IRC by PCA for Single-family and Multi-family Residences by County.



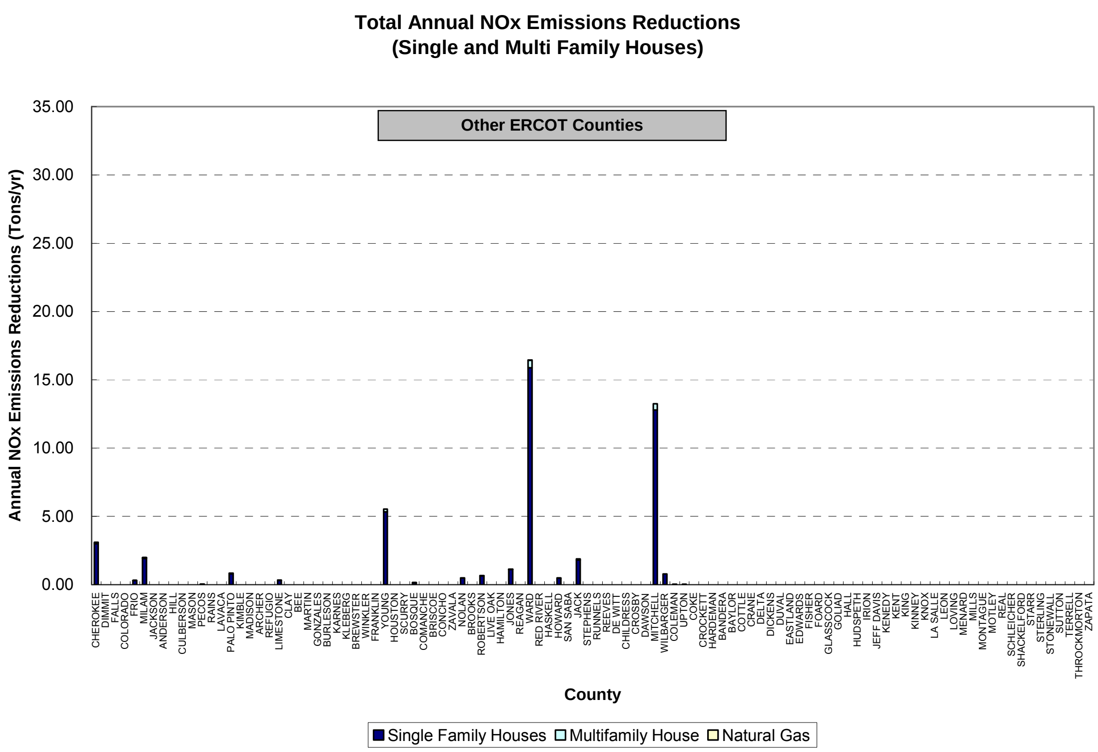
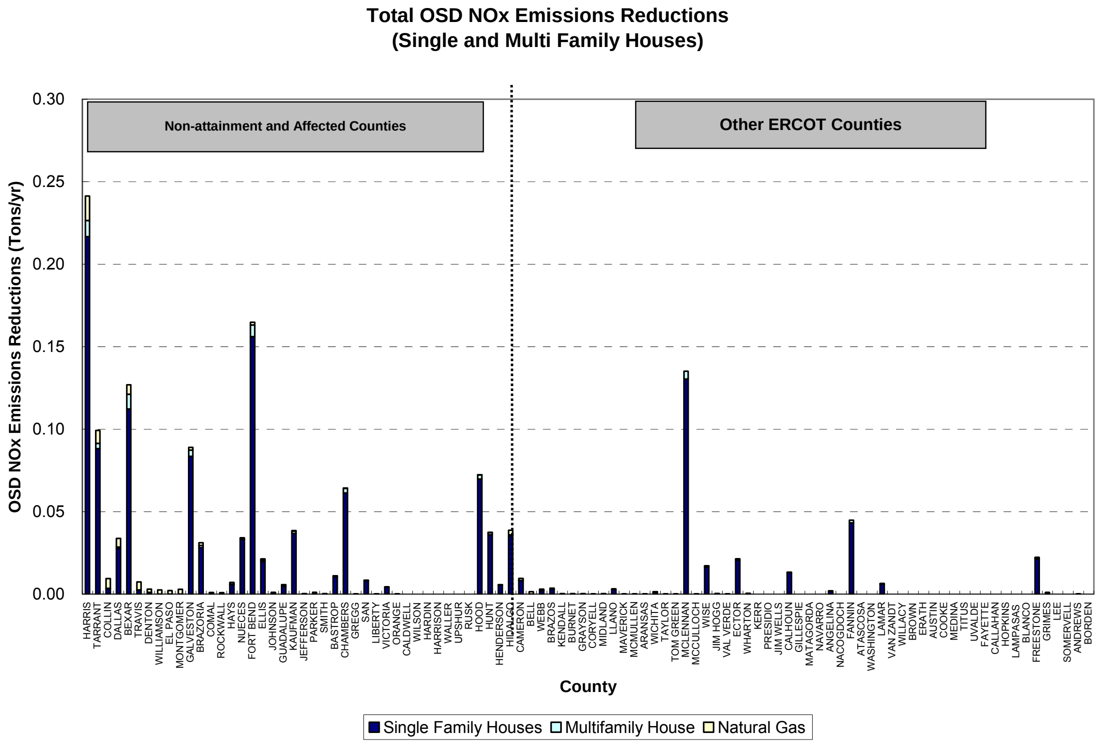


Figure 126: 2006 Annual NOx Reductions from Electricity and Natural Gas Savings Due to the IECC / IRC for Single-family and Multi-family Residences by County (using 1999 Base Year and 2007 eGRID).



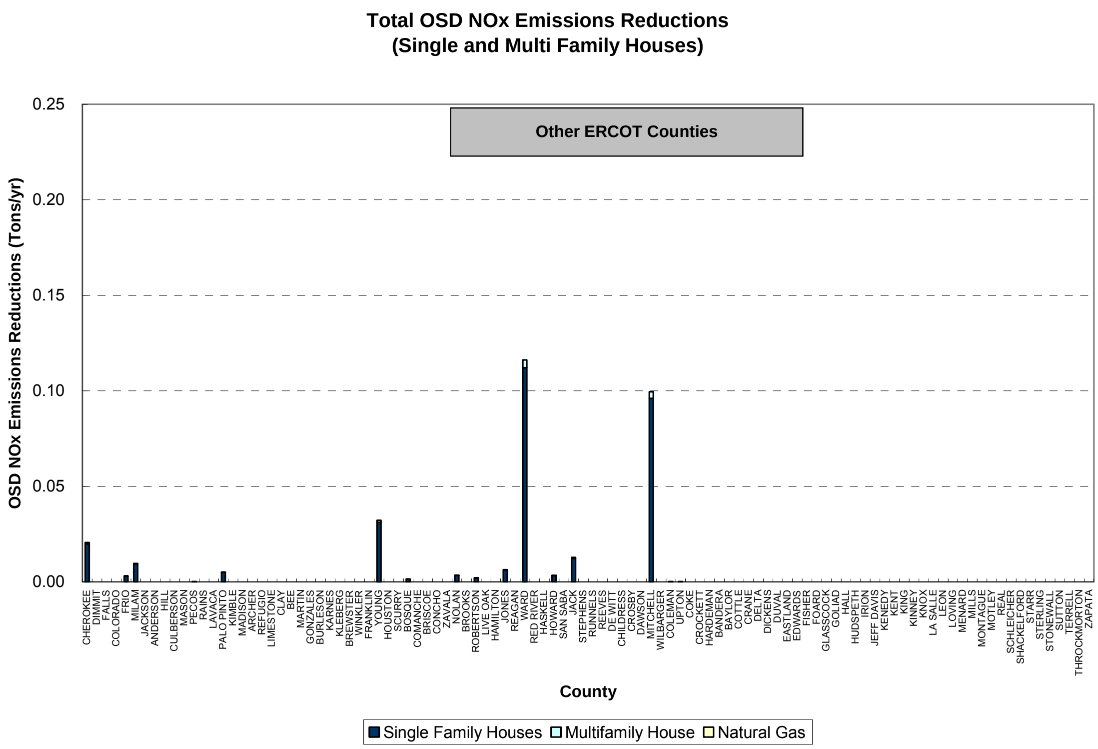
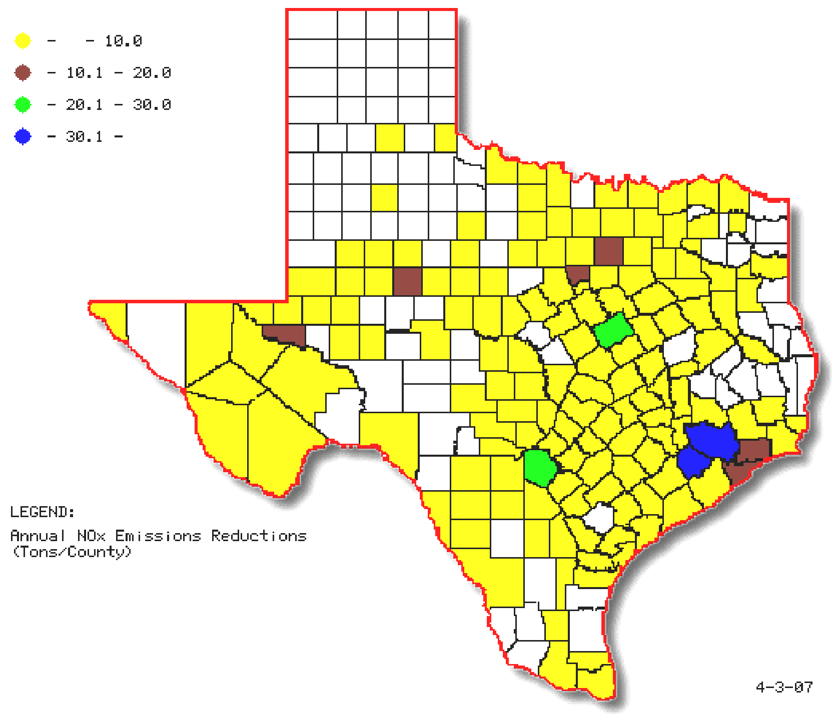


Figure 127: 2006 OSD NOx Reductions from Electricity and Natural Gas Savings Due to the IECC / IRC for Single-family and Multi-family Residences by County (using 1999 Base Year and 2007 eGRID).



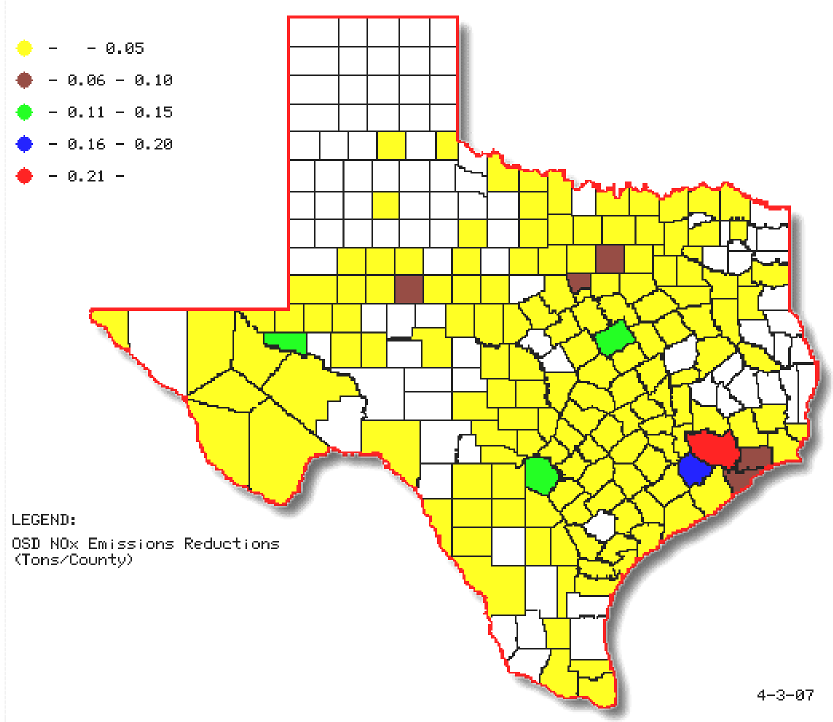


Figure 128: 2006 Annual and OSD NOx Reductions from Electricity and Natural Gas Savings Due to the IECC / IRC for Single-family and Multi-family Residences by County (Using 1999 Base year and 2007 eGRID).

6.1.4 2006 Results for Commercial Construction.

This section reports on the calculated energy and emissions savings from new commercial construction in 2006 that was built to meet the new ASHRAE Standard 90.1-1999 energy code. Construction prior to September 2001 was assumed to comply to ASHRAE Standard 90.1-1989, which was determined from a survey of engineers and architects reported in the Laboratory's 2004 Annual report to the TCEQ. To determine the energy and emissions savings from new commercial construction in all counties in ERCOT region as well as the 41 non-attainment and affected counties, data from two sources were merged into one analysis as shown in Figure 129. In this figure, the analysis is described that covers results shown in Figure 130 to Figure 135 and in Table 39 to Table 64.

Beginning in the upper left of Figure 129, the Dodge database of the square footage of new commercial construction in Texas (Dodge 2005) was merged with the energy savings calculations published by the Pacific Northwest National Laboratory (PNNL) in a report prepared for the U.S.D.O.E. (USDOE 2004). This allowed for the new construction to be tracked by county, and energy savings to be calculated by building type. In the next block in Figure 129 and Table 39, the merged categories from the Dodge and PNNL database can be seen. This resulted in 12 Dodge categories being merged into 7 PNNL energy use categories. In the 4th and 5th PNNL category, the Dodge "stores and restaurant" category had to be split into two categories to match the two PNNL categories for "retail" and "food." To accomplish this, information published in the 1999 and 2003 CBEC database (Table 40) by the U.S.D.O.E's Energy Information Agency (EIA) was used to determine the percentages used to split the Dodge conditioned area for each county as shown (i.e., 21.06% for food and 78.94% for retail). Table 41 shows the Dodge data for 1999 to 2003 prior to merging into the PNNL categories, which are shown by category in Figure 130 and Figure 131. Table 43 shows the Dodge data for 1999 to 2003 after merging into the required PNNL categories for the energy savings calculations, which were then used with the Dodge data from Table 43 for 2003 in the 2006 calculations. The square footage of all PNNL building types are shown for each county, followed by individual graphs of each building type in the lower seven graphs.

In the next step the PNNL energy savings, which represent buildings built to ASHRAE Standard 90.1-1989 versus Standard 90.1-1999, which are expressed per square foot, were then multiplied by the published square feet of new construction. For the 2006 results, the values for 2004 were assumed[76] for 2006. , and Table 49 show the annual and OSD energy use calculated for new construction, by building type, for Standard 90.1-1989, and 90.1-1999. Table 55 shows the county-wide annual electricity and natural gas savings by building type[77] [78].

In order to calculate the Ozone Season Day electricity and natural gas savings, simulations were performed on a typical office building that simulated a 6-story, 90,000-sq. ft. office building in Central Texas. Figure 134 provides an image of the office building (3-story shown). Table 63 (building LOADS) and Table 64 (building SYSTEM and PLANT information) provide the input characteristics used to simulate the office building. The results of these simulations show about a 13% annual energy use reduction (Haberl et al. 2005). The simulations were also used to simulate the electricity and natural gas used during the Ozone Season Day (July 15 to Sept. 15) as shown in Figure 136, Figure 137, and Table 65. In the bottom row of Table 65, a ratio was calculated to allow for the conversion of annual savings to OSD savings. This ratio was then used in the remaining building types to accomplish this conversion.

In the next calculation step, electric utility providers were assigned to each county according to the published 1998 sales data from the Texas Public Utilities Commission as shown in Table 66. In the case where more than one utility was shown selling electricity in a county, a percentage of electricity use was allocated according to the PUCT's 1998 sales data. In the lower half of Table 66, the total electricity savings by utility provider is shown for 2005 for all estimated new commercial construction. Table 67 shows the calculated annual NOx emissions reductions from electricity using the 1999 eGRID table for Texas.

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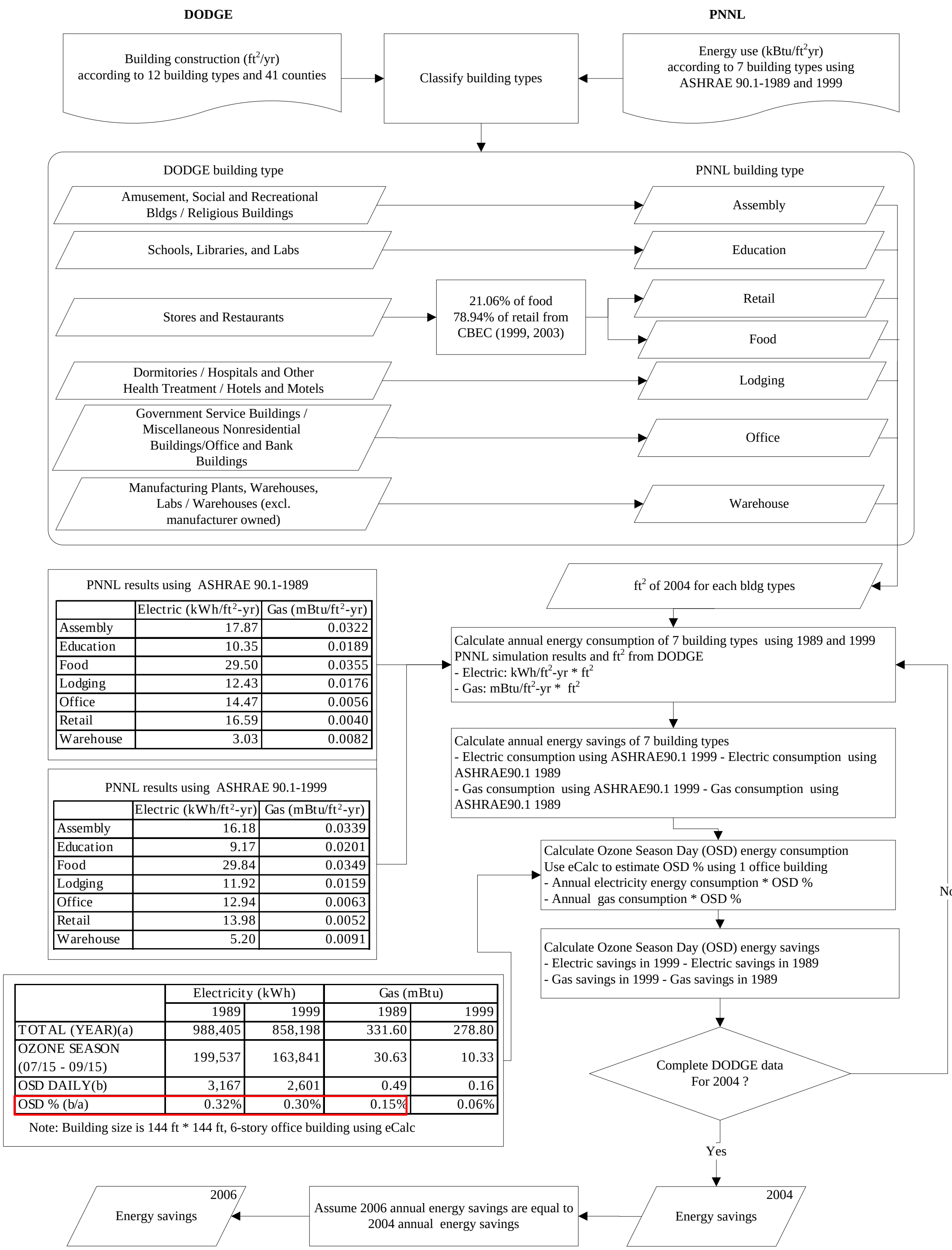
[76] This assumption is based on conversations with Texas State demographer's office.
[77] In this table (-) values are savings, (+) values are increased energy use.
[78] In a similar fashion as the preceeding table, in this table (-) values are savings, (+) values are increased energy use.

In a similar fashion as the annual calculations, electric utility providers were assigned to each county to calculate the OSD electricity savings by utility, as shown in Table 68. Table 69 shows the calculated NOx emissions reductions from electricity savings using the 1999 eGRID table for Texas. Table 70 shows the data transformation required to present the data in the bar charts that follow.

Table 71 shows the transformation of the annual and OSD county-wide electricity and natural gas savings, along with the associated 1999 NOx emissions reductions with 7% T&D losses. Figure 138 shows the data transformed which uses the 1999 eGRID and 7% T&D losses. In Figure 140 and Figure 141 the NOx emissions reductions from the electricity use savings are shown using the 2007 eGRID for Texas.

6.1.5 2006 Results for New Commercial Construction using 2007 eGRID.

Using the 2007 eGRID, the total NOx reductions from electricity and natural gas savings from new commercial construction in 2006 are calculated to be 56.67 tons NOx/year which represents 60.52 tons NOx/year from electricity savings and -3.85 tons NOx/year (i.e., an increase) from natural gas savings. On a peak Ozone Season Day (OSD), the NOx reductions in 2006 are calculated to be 0.45 tons of NOx/day which represents 0.38 tons NOx/day from electricity savings and 0.07 tons NOx/day from natural gas savings.



PNNL results using ASHRAE 90.1-1989

	Electric (kWh/ft²-yr)	Gas (mBtu/ft²-yr)
Assembly	17.87	0.0322
Education	10.35	0.0189
Food	29.50	0.0355
Lodging	12.43	0.0176
Office	14.47	0.0056
Retail	16.59	0.0040
Warehouse	3.03	0.0082

PNNL results using ASHRAE 90.1-1999

	Electric (kWh/ft²-yr)	Gas (mBtu/ft²-yr)
Assembly	16.18	0.0339
Education	9.17	0.0201
Food	29.84	0.0349
Lodging	11.92	0.0159
Office	12.94	0.0063
Retail	13.98	0.0052
Warehouse	5.20	0.0091

	Electricity (kWh)		Gas (mBtu)	
	1989	1999	1989	1999
TOTAL (YEAR)(a)	988,405	858,198	331.60	278.80
OZONE SEASON (07/15 - 09/15)	199,537	163,841	30.63	10.33
OSD DAILY(b)	3,167	2,601	0.49	0.16
OSD % (b/a)	0.32%	0.30%	0.15%	0.06%

Note: Building size is 144 ft * 144 ft, 6-story office building using eCalc

Figure 129: Analysis Method for Calculating the 2006 Energy and Emissions Savings from Commercial Buildings (Updated)

Table 39: Commercial Building Descriptions from USDOE (2004) Report and Dodge (2005).

No	PNNL Bldg Types	Dodge Bldg Types
1	Assembly	Amusement, Social and Recreational Bldgs
2		Religious Buildings
3	Education	Schools, Libraries, and Labs (nonmfg)
4	Retail	Stores and Restaurants
5	Food	Stores and Restaurants
6	Lodging	Dormitories
7		Hospitals and Other Health Treatment
8		Hotels and Motels
9	Office	Government Service Buildings
10		Miscellaneous Nonresidential Buildings
11		Office and Bank Buildings
12	Warehouse	Manufacturing Plants, Warehouses, Labs
13		Warehouses (excl. manufacturer owned)

Table 40: Floor Area from CBEC (1999, 2003) Database for Retail and Food Type Commercial Buildings.

		CBEC (1999)		CBEC (2003)	
		All (million square feet)	South (million square feet)	All (million square feet)	South (million square feet)
Food	Food Sales	994	392	1,255	487
	Food Service	1851	676	1,654	764
Retail	Retail (Other Than Mall)	4766	1566	4,317	1,844
	Enclosed and Strip Malls	5631	2513	6,875	3,251

	South		All	
	Food %	Retail %	Food %	Retail %
CBEC (1999)[1]	20.75	79.25	21.48	78.52
CBEC (2003)[2]	19.71	80.29	20.63	79.37
Average	20.23	79.77	21.06	78.94

Note1: http://www.eia.doe.gov/emeu/cbecs/pdf/alltables.pdf, page 4.
Note2: http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/pdf2003/seta.pdf, Page 1.

Table 41: 2004 New Commercial Building Construction (sq. ft. x 1000) (Source: Dodge/McGraw-Hill 2006). Table shows Dodge data before merging into PNNL building types (sq. ft. x 1000) (Part 1).

County	Amusement, Social and Recreational Bldgs	Dormitories	Government Service Buildings	Hospitals and Other Health Treatment	Hotels and Motels	Manufacturing Plants, Warehouses, Labs	Miscellaneous Nonresidential Buildings	Office and Bank Buildings	Parking Garages and Automotive Services	Religious Buildings	Schools, Libraries, and Labs	Stores and Restaurants	Warehouses (excl. manufacturer owned)
HARRIS	887	345	290	1368	583	373	503	1362	2201	792	5534	4778	6500
TARRANT	442	30	264	707	224	921	188	859	351	355	1090	2836	1819
COLLIN	332	62	90	680	122	354	11	665	873	205	1688	1580	379
DALLAS	932	34	141	1159	393	260	97	2208	1966	531	4137	2004	3252
BEXAR	236	710	187	1303	415	2208	141	1535	817	261	1932	1735	373
TRAVIS	260	85	72	600	372	9	28	509	851	251	426	1436	438
DENTON	231	0	17	251	0	0	6	196	92	274	1448	907	573
WILLIAMSON	37	0	0	163	0	120	21	144	5	88	325	946	11
EL PASO	233	0	18	161	34	11	37	132	287	125	649	537	784
MONTGOMERY	87	0	7	294	0	8	18	74	210	210	531	452	144
GALVESTON	189	0	512	0	30	0	8	215	292	92	238	426	63
BRAZORIA	184	0	45	91	0	0	10	64	125	29	644	514	169
COMAL	45	0	0	18	0	4	0	82	0	0	341	152	13
ROCKWALL	0	0	0	40	0	0	2	44	75	19	239	152	29
HAYS	61	0	9	6	0	250	0	7	0	0	66	405	55
NUECES	51	0	42	72	0	0	1	10	41	120	325	103	0
FORT BEND	42	3	0	73	59	0	32	326	13	249	1107	370	580
ELLIS	28	0	0	99	0	97	4	28	42	44	252	87	14
JOHNSON	10	0	0	0	0	0	0	0	0	0	96	193	0
GUADALUPE	26	0	15	5	59	0	0	32	2	0	123	387	506
KAUFMAN	30	0	0	0	0	0	0	9	2	13	105	194	0
JEFFERSON	13	0	0	195	0	1	2	33	77	43	119	195	7
PARKER	0	0	0	0	0	0	0	5	0	0	14	532	0
SMITH	77	71	63	5	25	24	14	94	21	53	54	64	49
BASTROP	0	0	0	28	544	0	2	33	20	0	77	29	0
CHAMBERS	0	0	0	0	0	0	0	0	0	0	12	0	0
GREGG	7	0	0	32	0	63	0	28	81	69	50	13	6
SAN PATRICIO	43	0	14	0	0	0	0	0	2	0	21	161	0
LIBERTY	0	0	0	0	0	0	1	0	0	0	382	9	0
VICTORIA	5	0	0	10	36	0	7	24	0	0	0	15	0
ORANGE	0	0	0	1	0	0	0	4	0	25	52	104	0
CALDWELL	0	0	0	0	0	0	0	0	0	0	65	4	0
WILSON	0	0	0	82	0	0	0	0	0	0	0	74	0
HARDIN	0	0	0	0	0	0	0	0	4	0	0	0	0
HARRISON	55	0	0	2	0	0	0	0	0	12	26	4	0
WALLER	0	0	0	0	0	0	0	0	0	0	0	22	0
UPSHUR	0	0	0	0	0	0	0	0	0	0	77	0	0
RUSK	0	0	0	0	0	0	0	0	0	0	0	140	0
HOOD	0	0	0	0	0	0	0	0	0	66	0	0	0
HUNT	16	0	46	0	0	0	0	0	0	0	106	15	2
HENDERSON	9	0	0	0	0	0	0	8	0	5	20	2	0
HIDALGO	107	11	38	169	0	9	8	427	76	60	469	943	224
CAMERON	40	0	7	126	114	16	8	178	23	53	363	512	283
BELL	47	390	237	50	50	0	0	31	22	61	199	510	5
WEBB	8	0	11	11	284	0	7	77	0	20	730	33	0
BRAZOS	44	0	9	16	248	0	0	301	8	175	192	158	0
KENDALL	0	0	0	0	0	0	0	0	23	15	0	9	0
BURNET	0	0	0	0	0	18	0	20	0	0	0	28	0
GRAYSON	6	0	0	28	0	123	0	0	0	0	111	103	0
CORYELL	0	0	0	0	0	0	0	0	0	0	0	155	0
MIDLAND	172	0	0	9	0	2	0	22	3	21	109	188	22
LLANO	0	0	0	0	0	0	0	0	0	0	0	0	0
MAVERICK	30	0	43	200	0	0	0	7	0	0	26	30	0
MCMULLEN	0	0	4	0	0	0	0	0	0	0	0	0	0
ARANSAS	0	0	0	0	0	0	0	5	2	0	0	160	0
WICHITA	3	100	0	1	126	0	0	34	5	109	88	103	0
TAYLOR	0	0	0	74	42	140	0	23	0	36	29	384	0
TOM GREEN	43	190	0	21	55	0	3	14	20	30	89	158	46
MCLENNAN	48	0	0	0	70	0	0	0	3	0	0	148	0
MCCULLOCH	0	0	0	0	0	0	0	0	0	0	0	0	0
WISE	30	0	0	135	0	0	0	6	0	0	332	0	0
JIM HOGG	0	0	0	0	0	0	0	0	0	0	10	0	0
VAL VERDE	0	0	0	11	0	0	70	0	0	7	31	5	0
ECTOR	38	0	5	0	0	0	0	5	94	0	115	26	0
WHARTON	24	0	0	0	39	0	0	9	0	20	0	29	0
KERR	12	0	0	0	0	0	0	0	0	37	0	0	0
PRESIDIO	0	0	9	0	0	0	0	4	0	0	0	0	0
JIM WELLS	0	0	0	0	0	0	0	15	0	0	10	3	0
CALHOUN	0	0	88	0	0	0	0	5	2	0	0	155	0
GILLESPIE	22	0	0	5	0	0	0	0	0	0	0	155	0
MATAGORDA	0	0	0	0	0	0	0	0	0	0	0	0	0
NAVARRO	0	12	0	0	0	0	0	0	0	0	28	215	0
ANGELINA	56	0	0	63	0	7	1	17	0	38	2	134	0
NACOGDOCHES	0	0	0	0	0	0	0	7	133	5	63	0	6
FANNIN	24	0	0	0	0	0	0	0	0	0	0	0	0
ATASCOSA	0	0	0	0	0	0	0	0	0	4	2	3	0
WASHINGTON	0	0	5	0	0	0	0	0	0	2	0	253	0
LAMAR	8	0	0	0	0	0	0	0	0	0	30	10	0
VAN ZANDT	0	0	0	0	0	0	5	6	0	0	16	0	0
WILLACY	0	0	37	0	0	0	0	0	0	0	0	4	0
BROWN	0	0	3	65	0	0	0	0	0	0	19	105	0
ERATH	0	0	0	0	0	0	0	0	0	0	0	15	0
AUSTIN	0	0	0	31	0	0	0	0	0	0	0	0	1200
COOKE	0	0	0	0	0	0	0	2	0	0	26	0	0
MEDINA	0	0	0	0	0	0	122	0	36	0	79	0	0
TITUS	0	0	0	0	0	0	0	0	0	0	0	0	0
UVALDE	15	0	0	0	0	0	0	8	2	0	0	236	0
FAYETTE	0	0	0	94	0	0	26	0	0	0	15	0	0
CALLAHAN	0	0	0	0	0	0	0	0	0	0	0	0	0
HOPKINS	0	0	0	0	0	0	0	0	0	0	0	3	0
LAMPASAS	0	0	0	30	0	0	0	5	0	0	0	2	0
BLANCO	0	0	0	0	0	0	0	0	0	0	77	0	0
FREESTONE	0	0	0	0	0	0	0	0	0	0	0	0	0
GRIMES	0	0	0	0	0	0	0	0	0	0	0	0	0
LEE	0	0	0	0	0	0	0	0	0	0	0	12	0
SOMERVELL	0	0	0	0	0	0	0	0	0	0	12	0	0
ANDREWS	0	0	0	0	0	0	0	0	0	0	17	0	0
BORDEN	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 42: 2004 New Commercial Building Construction (sq. ft. x 1000) (Source: Dodge/McGraw-Hill 2006). Table shows Dodge data before merging into PNNL building types (sq. ft. x 1000) (Part 2).

County	Amusement, Social and Recreational Bldgs	Dormitories	Government Service Buildings	Hospitals and Other Health Treatment	Hotels and Motels	Manufacturing Plants, Warehouses, Labs	Miscellaneous Nonresidential Buildings	Office and Bank Buildings	Parking Garages and Automotive Services	Religious Buildings	Schools, Libraries, and Labs	Stores and Restaurants	Warehouses (excl. manufacturer owned)
CHEROKEE	69	0	0	0	0	0	0	20	0	0	8	6	0
DIMMIT	0	0	0	0	0	0	0	0	0	0	0	0	0
FALLS	0	0	0	0	0	0	0	0	0	0	0	0	0
COLORADO	0	0	1	0	0	0	0	0	0	0	123	0	0
FRIO	0	0	0	0	0	0	0	0	0	0	0	0	0
MILAM	0	0	0	0	0	0	0	0	3	0	0	100	0
JACKSON	0	0	0	0	0	0	0	0	0	0	0	0	0
ANDERSON	0	0	35	0	0	0	0	0	0	0	0	28	0
HILL	0	0	0	0	0	0	0	0	0	0	12	0	0
CULBERSON	0	0	0	0	0	0	0	0	0	0	0	0	0
MASON	0	0	0	0	0	0	0	0	0	0	0	0	0
PECOS	0	0	0	0	40	0	0	0	0	0	0	0	0
RAINS	0	0	0	0	0	0	0	0	0	0	14	0	0
LAVACA	0	0	20	0	0	0	3	0	0	0	0	0	0
PALO PINTO	5	0	0	0	0	0	0	0	0	0	0	203	0
KIMBLE	0	0	0	0	0	0	0	0	0	0	0	0	0
MADISON	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCHER	4	0	0	0	0	0	0	0	0	0	0	0	0
REFUGIO	0	0	0	0	0	0	0	0	0	0	0	0	0
LIMESTONE	0	0	0	0	0	0	0	0	0	0	8	0	0
CLAY	0	0	0	0	0	0	0	3	0	0	0	0	0
BEE	53	0	10	0	0	0	0	0	0	0	0	0	0
MARTIN	0	0	0	0	0	0	0	0	0	0	0	0	0
GONZALES	0	0	0	0	0	0	0	0	0	0	18	7	0
BURLESON	0	0	1	0	0	0	0	0	0	0	0	0	0
KARNES	0	0	0	0	0	0	0	0	0	0	0	0	0
KLEBERG	0	0	0	0	0	0	10	3	0	0	110	160	0
BREWSTER	0	0	0	0	0	45	0	0	0	0	0	0	0
WINKLER	0	0	0	0	0	0	0	0	0	0	0	0	0
FRANKLIN	0	0	0	0	0	0	0	0	0	0	0	0	0
YOUNG	3	0	0	0	0	0	0	0	0	0	0	0	0
HOUSTON	0	0	0	0	0	0	0	0	0	0	0	0	0
SCURRY	0	0	0	0	0	0	0	0	0	0	0	0	0
BOSQUE	0	0	0	0	0	0	6	0	0	0	0	0	0
COMANCHE	0	0	0	70	0	0	0	0	0	0	16	0	0
BRISCOE	0	0	0	0	0	0	0	0	0	0	0	0	0
CONCHO	0	0	0	0	0	0	0	0	0	0	0	0	0
ZAVALA	0	0	0	0	0	0	0	0	0	0	0	0	0
NOLAN	0	0	0	0	0	0	0	0	0	0	0	100	0
BROOKS	0	0	0	0	0	0	0	0	0	0	0	0	0
ROBERTSON	0	0	0	0	0	0	0	0	0	0	3	0	0
LIVE OAK	0	0	0	0	0	0	0	0	0	0	0	0	0
HAMILTON	0	0	0	35	0	0	0	0	0	0	0	0	0
JONES	0	0	0	0	0	0	0	0	0	0	0	0	0
REAGAN	0	0	0	0	0	0	0	0	0	0	0	0	0
WARD	0	0	0	0	0	0	0	0	0	0	0	0	0
RED RIVER	1	0	0	0	0	0	0	0	0	0	0	0	0
HASKELL	0	0	0	0	0	0	0	0	0	0	0	0	0
HOWARD	23	0	0	0	0	0	0	0	0	0	0	6	0
SAN SABA	21	0	0	0	0	0	0	0	0	0	0	0	0
JACK	0	0	0	0	0	0	0	0	0	0	0	0	0
STEPHENS	0	0	0	0	0	0	0	0	0	0	20	0	0
RUNNELS	0	0	0	0	0	0	0	0	0	0	0	0	0
REEVES	10	0	0	0	0	0	0	0	0	0	0	5	0
DE WITT	0	0	0	0	0	0	0	0	0	0	0	0	0
CHILDRESS	0	0	0	0	0	0	0	0	0	0	0	0	0
CROSBY	0	0	0	10	0	0	0	0	0	0	0	0	0
DAWSON	0	0	0	0	0	0	0	0	0	0	0	0	0
MITCHELL	0	0	0	0	0	0	0	0	0	0	0	0	0
WILBARGER	1	0	0	0	0	0	0	0	0	0	0	0	0
COLEMAN	0	0	0	0	0	0	0	0	0	0	6	0	0
UPTON	0	0	0	0	0	0	0	0	0	0	0	0	0
COKE	19	0	0	0	0	0	0	0	0	0	0	0	0
CROCKETT	11	0	0	0	0	0	0	0	0	0	0	0	0
HARDEMAN	0	0	0	0	0	0	0	0	0	0	0	0	0
BANDERA	0	0	0	0	0	0	0	0	0	0	0	0	0
BAYLOR	0	0	0	0	0	0	0	0	0	0	0	0	0
COTTLE	0	0	0	0	0	0	0	0	0	0	0	0	0
CRANE	0	0	0	0	0	0	0	0	0	0	0	0	0
DELTA	0	0	0	0	0	0	0	0	0	0	0	0	0
DICKENS	0	0	0	0	0	0	0	0	0	0	0	0	0
DUVAL	0	0	0	0	0	0	0	4	0	0	0	0	0
EASTLAND	0	0	0	0	0	0	0	0	0	38	0	0	0
EDWARDS	0	0	0	0	0	0	0	0	0	0	0	0	0
FISHER	0	0	0	11	0	0	0	0	0	0	0	0	0
FOARD	0	0	0	0	0	0	0	0	0	0	0	0	0
GLASSCOCK	0	0	0	0	0	0	0	0	0	0	0	0	0
GOLIAD	0	0	0	0	0	0	0	0	0	0	0	0	0
HALL	0	0	0	0	0	0	0	0	0	0	0	0	0
HUDSPETH	0	0	0	0	0	0	0	0	0	0	0	0	0
IRION	0	0	0	0	0	0	0	0	0	0	0	0	0
JEFF DAVIS	0	0	0	0	0	0	0	0	0	21	0	0	0
KENEDY	0	0	0	0	0	0	0	0	0	0	0	0	0
KENT	0	0	0	0	0	0	0	0	0	0	0	0	0
KING	0	0	0	0	0	0	0	0	0	0	0	0	0
KINNEY	0	0	0	0	0	0	0	0	0	0	9	0	0
KNOX	0	0	0	0	0	0	0	0	0	0	0	0	0
LA SALLE	0	0	0	0	0	0	0	0	0	0	0	0	0
LEON	22	0	0	0	0	0	0	0	0	0	0	0	0
LOVING	0	0	0	0	0	0	0	0	0	0	0	0	0
MENARD	0	0	0	0	0	0	0	0	0	0	5	0	0
MILLS	0	0	0	0	0	0	0	0	0	0	0	0	0
MONTAGUE	0	0	0	0	0	0	0	0	2	0	0	100	0
MOTLEY	0	0	0	0	0	0	0	0	0	0	0	0	0
REAL	0	0	0	0	0	0	0	0	0	0	0	0	0
SCHLEICHER	0	0	0	0	0	0	0	0	0	0	0	0	0
SHACKELFORD	0	0	0	0	0	0	0	0	0	0	0	0	0
STARR	19	0	0	0	0	0	0	0	0	0	77	0	0
STERLING	0	0	0	0	0	0	0	0	0	0	0	0	0
STONEWALL	0	0	0	0	0	0	0	0	0	0	0	0	0
SUTTON	0	0	0	10	0	0	0	15	0	0	0	0	0
TERRELL	0	0	50	0	0	0	0	0	0	0	0	0	0
THROCKMORTON	0	0	0	0	0	0	0	0	0	0	0	0	0
ZAPATA	0	0	0	0	0	0	0	0	0	0	146	0	0
TOTAL	**5604**	**2042**	**2443**	**8716**	**3962**	**5061**	**1398**	**10000**	**8904**	**4679**	**26233**	**27277**	**17553**

Table 43: 2004 New Commercial Building Construction (sq. ft. x 1000) (Source: Dodge/McGraw-Hill 2005). Table shows Dodge data merged into PNNL building types (sq. ft. x 1000) (Part 1)

(square feet in thousands)

Non-attainment Counties	**Assembly**	**Education**	**Retail**	**Food**	**Lodging**	**Office**	**Warehouse**	**Stores and Restaurants**
BRAZORIA	213	644	406	108	91	119	169	514
CHAMBERS	0	12	0	0	0	0	0	0
COLLINS	537	1,688	1,248	333	864	766	733	1,580
DALLAS	1,464	4,137	1,582	422	1,586	2,446	3,512	2,004
DENTON	504	1,448	716	191	251	218	573	907
EL PASO	358	649	424	113	195	187	795	537
FORT BEND	291	1,107	292	78	135	358	580	370
GALVESTON	280	238	336	90	30	736	63	426
HARDIN	0	0	0	0	0	0	0	0
HARRIS	1,679	5,534	3,772	1,006	2,296	2,156	6,872	4,778
JEFFERSON	56	119	154	41	195	35	8	195
LIBERTY	0	382	7	2	0	1	0	9
MONTGOMERY	298	531	356	95	294	98	152	452
ORANGE	25	52	82	22	1	4	0	104
TARRANT	797	1,090	2,239	597	961	1,311	2,740	2,836
WALLER	0	0	17	5	0	0	0	22
TOTAL (NON-ATTAINMENT)	6,501	17,631	11,631	3,103	6,897	8,433	16,197	14,734

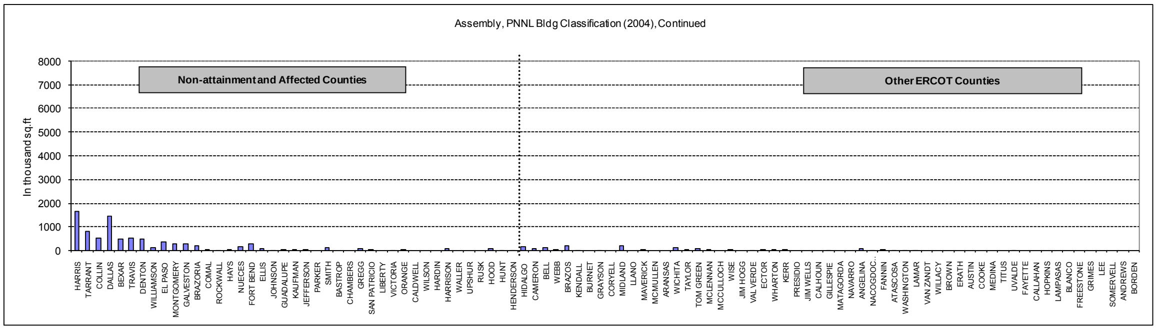
Affected Counties	**Assembly**	**Education**	**Retail**	**Food**	**Lodging**	**Office**	**Warehouse**	**Stores and Restaurants**
BASTROP	0	77	23	6	572	34	0	29
BEXAR	497	1,932	1,370	365	2,428	1,862	2,581	1,735
CALDWELL	0	65	3	1	0	0	0	4
COMAL	45	341	120	32	18	82	17	152
ELLIS	72	252	69	18	99	32	111	87
GREGG	76	50	10	3	32	28	69	13
GUADALUPE	26	123	306	82	64	47	506	387
HARRISON	67	26	3	1	2	0	0	4
HAYS	61	66	319	85	6	16	305	405
HENDERSON	15	20	2	1	0	8	0	2
HOOD	66	0	0	0	0	0	0	0
HUNT	16	106	12	3	0	46	2	15
JOHNSON	10	96	152	41	0	0	0	193
KAUFMAN	43	105	153	41	0	9	0	194
NUECES	171	325	81	22	72	53	0	103
PARKER	0	14	420	112	0	5	0	532
ROCKWALL	19	239	120	32	40	46	29	152
RUSK	0	0	111	30	0	0	0	140
SAN PATRICIO	43	21	127	34	0	14	0	161
SMITH	130	54	50	13	102	171	74	64
TRAVIS	511	426	1,134	302	1,057	608	447	1,436
UPSHUR	0	77	0	0	0	0	0	0
VICTORIA	5	0	12	3	46	31	0	15
WILLIAMSON	125	325	747	199	163	166	131	946
WILSON	0	0	59	16	82	0	0	74
TOTAL (AFFECTED)	1,998	4,738	5,402	1,441	4,783	3,257	4,272	6,843

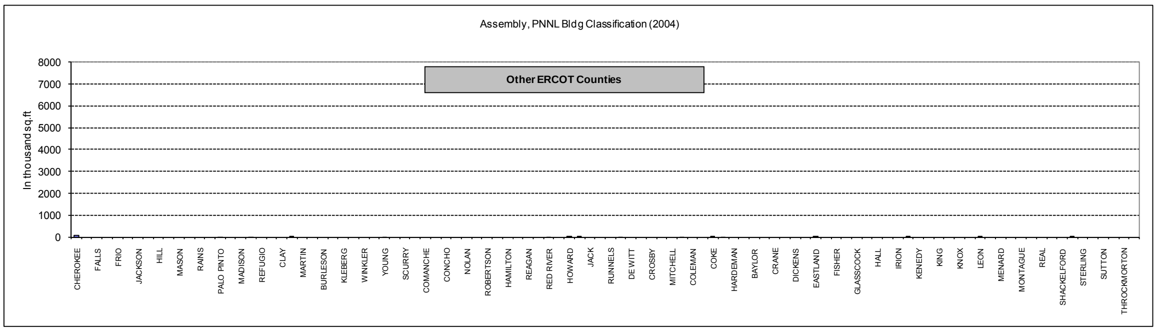
Table 44: 2004 New Commercial Building Construction (sq. ft. x 1000) (Source: Dodge/McGraw-Hill 2005). Table shows Dodge data merged into PNNL building types (sq. ft. x 1000) (Part 2).

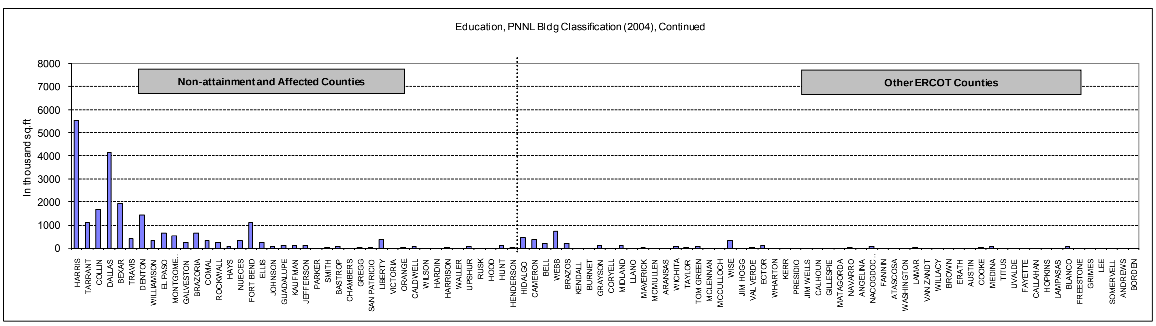
ERCOT Counties	Assembly	Education	Retail	Food	Lodging	Office	Warehouse	Stores and Restaurants
ANDERSON	0	0	22	6	0	35	0	28
ANDREWS	0	17	0	0	0	0	0	0
ANGELINA	93	2	106	28	63	18	7	134
ARANSAS	0	0	126	34	0	5	0	160
ARCHER	4	0	0	0	0	0	0	0
ATASCOSA	4	2	2	1	0	0	0	3
AUSTIN	0	0	0	0	31	0	1,200	0
BANDERA	0	0	0	0	0	0	0	0
BASTROP	0	77	23	6	572	34	0	29
BAYLOR	0	0	0	0	0	0	0	0
BEE	53	0	0	0	0	10	0	0
BELL	108	199	403	107	490	268	5	510
BEXAR	497	1,932	1,370	365	2,428	1,862	2,581	1,735
BLANCO	0	77	0	0	0	0	0	0
BORDEN	0	0	0	0	0	0	0	0
BOSQUE	0	0	0	0	0	6	0	0
BRAZORIA	213	644	406	108	91	119	169	514
BRAZOS	219	192	125	33	263	310	0	158
BREWSTER	0	0	0	0	0	0	45	0
BRISCOE	0	0	0	0	0	0	0	0
BROOKS	0	0	0	0	0	0	0	0
BROWN	0	19	83	22	65	3	0	105
BURLESON	0	0	0	0	0	1	0	0
BURNET	0	0	22	6	0	20	18	28
CALDWELL	0	65	3	1	0	0	0	4
CALHOUN	0	0	122	33	0	93	0	155
CALLAHAN	0	0	0	0	0	0	0	0
CAMERON	93	363	404	108	240	192	299	512
CHAMBERS	0	12	0	0	0	0	0	0
CHEROKEE	69	8	4	1	0	20	0	6
CHILDRESS	0	0	0	0	0	0	0	0
CLAY	0	0	0	0	0	3	0	0
COKE	19	0	0	0	0	0	0	0
COLEMAN	0	6	0	0	0	0	0	0
COLLIN	537	1,688	1,248	333	864	766	733	1,580
COLORADO	0	123	0	0	0	1	0	0
COMAL	45	341	120	32	18	82	17	152
COMANCHE	0	16	0	0	70	0	0	0
CONCHO	0	0	0	0	0	0	0	0
COOKE	0	26	0	0	0	2	0	0
CORYELL	0	0	122	33	0	0	0	155
COTTLE	0	0	0	0	0	0	0	0
CRANE	0	0	0	0	0	0	0	0
CROCKETT	11	0	0	0	0	0	0	0
CROSBY	0	0	0	0	10	0	0	0
CULBERSON	0	0	0	0	0	0	0	0
DALLAS	1,464	4,137	1,582	422	1,586	2,446	3,512	2,004
DAWSON	0	0	0	0	0	0	0	0
DE WITT	0	0	0	0	0	0	0	0
DELTA	0	0	0	0	0	0	0	0
DENTON	504	1,448	716	191	251	218	573	907
DICKENS	0	0	0	0	0	0	0	0
DIMMIT	0	0	0	0	0	0	0	0
DUVAL	0	0	0	0	0	4	0	0
EASTLAND	38	0	0	0	0	0	0	0
ECTOR	38	115	21	6	0	10	0	26
EDWARDS	0	0	0	0	0	0	0	0
ELLIS	72	252	69	18	99	32	111	87
ERATH	0	0	12	3	0	0	0	15
FALLS	0	0	0	0	0	0	0	0
FANNIN	24	0	0	0	0	0	0	0
FAYETTE	0	15	0	0	94	26	0	0
FISHER	0	0	0	0	11	0	0	0
FOARD	0	0	0	0	0	0	0	0
FORT BEND	291	1,107	292	78	135	358	580	370
FRANKLIN	0	0	0	0	0	0	0	0
FREESTONE	0	0	0	0	0	0	0	0
FRIO	0	0	0	0	0	0	0	0
GALVESTON	280	238	336	90	30	736	63	426
GILLESPIE	22	0	122	33	5	0	0	155
GLASSCOCK	0	0	0	0	0	0	0	0
GOLIAD	0	0	0	0	0	0	0	0
GONZALES	0	18	5	1	0	0	0	7
GRAYSON	6	111	82	22	28	0	123	103
GRIMES	0	0	0	0	0	0	0	0
GUADALUPE	26	123	306	82	64	47	506	387
HALL	0	0	0	0	0	0	0	0
HAMILTON	0	0	0	0	35	0	0	0
HARDEMAN	0	0	0	0	0	0	0	0
HARRIS	1,679	5,534	3,772	1,006	2,296	2,156	6,872	4,778
HASKELL	0	0	0	0	0	0	0	0
HAYS	61	66	319	85	6	16	305	405
HENDERSON	15	20	2	1	0	8	0	2
HIDALGO	167	469	745	199	179	473	233	943
HILL	0	12	0	0	0	0	0	0
HOOD	66	0	0	0	0	0	0	0
HOPKINS	0	0	2	1	0	0	0	3
HOUSTON	0	0	0	0	0	0	0	0
HOWARD	23	0	5	1	0	0	0	6
HUDSPETH	0	0	0	0	0	0	0	0
HUNT	16	106	12	3	0	46	2	15
IRION	0	0	0	0	0	0	0	0
JACK	0	0	0	0	0	0	0	0
JACKSON	0	0	0	0	0	0	0	0
JEFF DAVIS	21	0	0	0	0	0	0	0
JIM HOGG	0	10	0	0	0	0	0	0
JIM WELLS	0	10	2	1	0	15	0	3
JOHNSON	10	96	152	41	0	0	0	193

Table 45: 2004 New Commercial Building Construction (sq. ft. x 1000) (Source: Dodge/McGraw-Hill 2005). Table shows Dodge data merged into PNNL building types (sq. ft. x 1000) (Part 3).

ERCOT Counties	Assembly	Education	Retail	Food	Lodging	Office	Warehouse	Stores and Restaurants
JONES	0	0	0	0	0	0	0	0
KARNES	0	0	0	0	0	0	0	0
KAUFMAN	43	105	153	41	0	9	0	194
KENDALL	15	0	7	2	0	0	0	9
KENEDY	0	0	0	0	0	0	0	0
KENT	0	0	0	0	0	0	0	0
KERR	49	0	0	0	0	0	0	0
KIMBLE	0	0	0	0	0	0	0	0
KING	0	0	0	0	0	0	0	0
KINNEY	0	9	0	0	0	0	0	0
KLEBERG	0	110	126	34	0	13	0	160
KNOX	0	0	0	0	0	0	0	0
LA SALLE	0	0	0	0	0	0	0	0
LAMAR	8	30	7	2	0	0	0	10
LAMPASAS	0	0	1	0	30	5	0	2
LAVACA	0	0	0	0	0	22	0	0
LEE	0	0	9	2	0	0	0	12
LEON	22	0	0	0	0	0	0	0
LIMESTONE	0	8	0	0	0	0	0	0
LIVE OAK	0	0	0	0	0	0	0	0
LLANO	0	0	0	0	0	0	0	0
LOVING	0	0	0	0	0	0	0	0
MADISON	0	0	0	0	0	0	0	0
MARTIN	0	0	0	0	0	0	0	0
MASON	0	0	0	0	0	0	0	0
MATAGORDA	0	0	0	0	0	0	0	0
MAVERICK	30	26	24	6	200	50	0	30
MCCULLOCH	0	0	0	0	0	0	0	0
MCLENNAN	48	0	117	31	70	0	0	148
MCMULLEN	0	0	0	0	0	4	0	0
MEDINA	0	79	0	0	0	122	0	0
MENARD	0	5	0	0	0	0	0	0
MIDLAND	192	109	148	40	9	22	24	188
MILAM	0	0	79	21	0	0	0	100
MILLS	0	0	0	0	0	0	0	0
MITCHELL	0	0	0	0	0	0	0	0
MONTAGUE	0	0	79	21	0	0	0	100
MONTGOMERY	298	531	356	95	294	98	152	452
MOTLEY	0	0	0	0	0	0	0	0
NACOGDOCHES	5	63	0	0	0	7	6	0
NAVARRO	0	28	169	45	12	0	0	215
NOLAN	0	0	79	21	0	0	0	100
NUECES	171	325	81	22	72	53	0	103
PALO PINTO	5	0	160	43	0	0	0	203
PARKER	0	14	420	112	0	5	0	532
PECOS	0	0	0	0	40	0	0	0
PRESIDIO	0	0	0	0	0	13	0	0
RAINS	0	14	0	0	0	0	0	0
REAGAN	0	0	0	0	0	0	0	0
REAL	0	0	0	0	0	0	0	0
RED RIVER	1	0	0	0	0	0	0	0
REEVES	10	0	4	1	0	0	0	5
REFUGIO	0	0	0	0	0	0	0	0
ROBERTSON	0	3	0	0	0	0	0	0
ROCKWALL	19	239	120	32	40	46	29	152
RUNNELS	0	0	0	0	0	0	0	0
RUSK	0	0	111	30	0	0	0	140
SAN PATRICIO	43	21	127	34	0	14	0	161
SAN SABA	21	0	0	0	0	0	0	0
SCHLEICHER	0	0	0	0	0	0	0	0
SCURRY	0	0	0	0	0	0	0	0
SHACKELFORD	0	0	0	0	0	0	0	0
SMITH	130	54	50	13	102	171	74	64
SOMERVELL	0	12	0	0	0	0	0	0
STARR	19	77	0	0	0	0	0	0
STEPHENS	0	20	0	0	0	0	0	0
STERLING	0	0	0	0	0	0	0	0
STONEWALL	0	0	0	0	0	0	0	0
SUTTON	0	0	0	0	10	15	0	0
TARRANT	797	1,090	2,239	597	961	1,311	2,740	2,836
TAYLOR	36	29	303	81	116	23	140	384
TERRELL	0	0	0	0	0	50	0	0
THROCKMORTON	0	0	0	0	0	0	0	0
TITUS	0	0	0	0	0	0	0	0
TOM GREEN	73	89	125	33	266	17	46	158
TRAVIS	511	426	1,134	302	1,057	608	447	1,436
UPTON	0	0	0	0	0	0	0	0
UVALDE	15	0	187	50	0	8	0	236
VAL VERDE	7	31	4	1	11	70	0	5
VAN ZANDT	0	16	0	0	0	11	0	0
VICTORIA	5	0	12	3	46	31	0	15
WALLER	0	0	17	5	0	0	0	22
WARD	0	0	0	0	0	0	0	0
WASHINGTON	2	0	199	53	0	5	0	253
WEBB	27	730	26	7	294	95	0	33
WHARTON	44	0	23	6	39	9	0	29
WICHITA	111	88	82	22	227	34	0	103
WILBARGER	1	0	0	0	0	0	0	0
WILLACY	0	0	3	1	0	37	0	4
WILLIAMSON	125	325	747	199	163	166	131	946
WILSON	0	0	59	16	82	0	0	74
WINKLER	0	0	0	0	0	0	0	0
WISE	30	332	0	0	135	6	0	0
YOUNG	3	0	0	0	0	0	0	0
ZAPATA	0	146	0	0	0	0	0	0
ZAVALA	0	0	0	0	0	0	0	0
TOTAL (ERCOT COUNTIES)	9,701	24,878	20,852	5,563	14,294	13,587	21,742	26,415







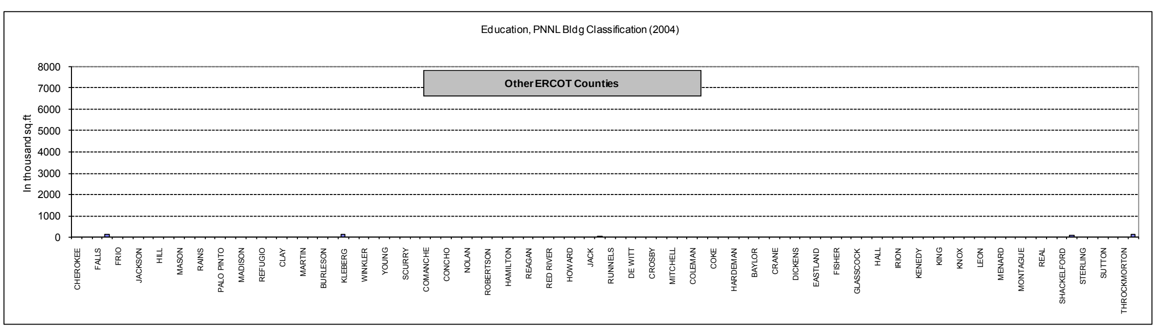
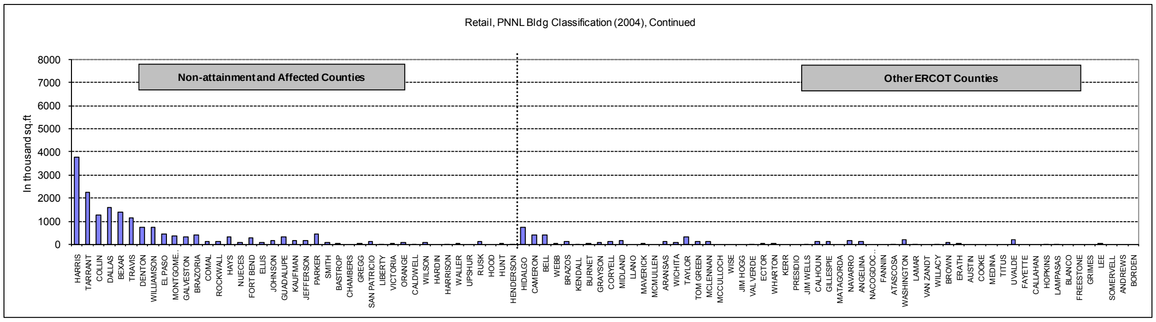
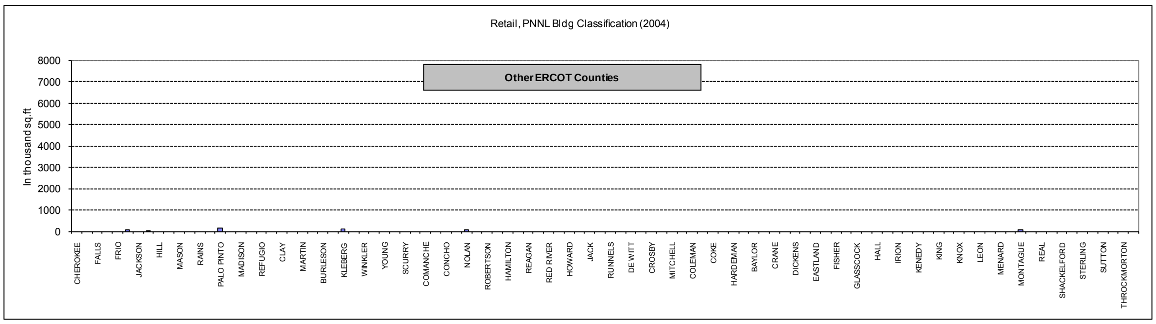
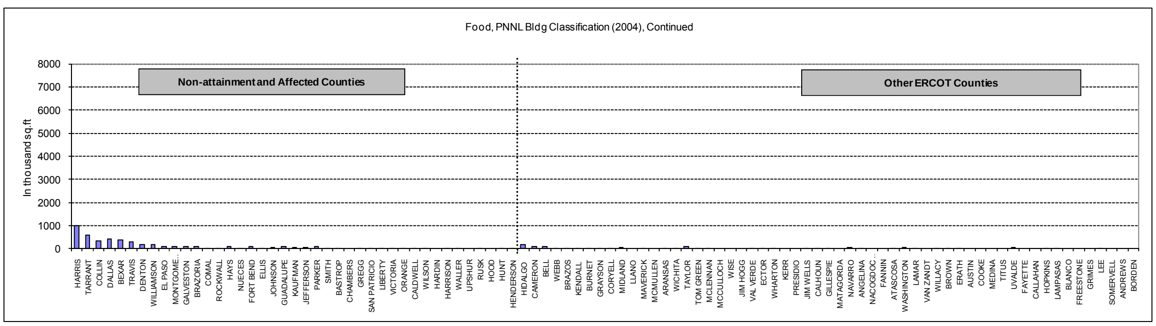


Figure 130: 2004 New Commercial Building Construction (sq. ft. x 1000), Part 1 (Dodge 2006).







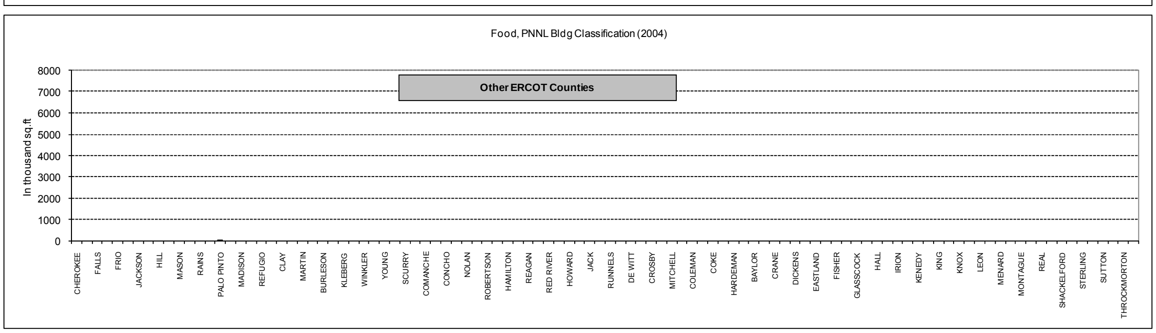
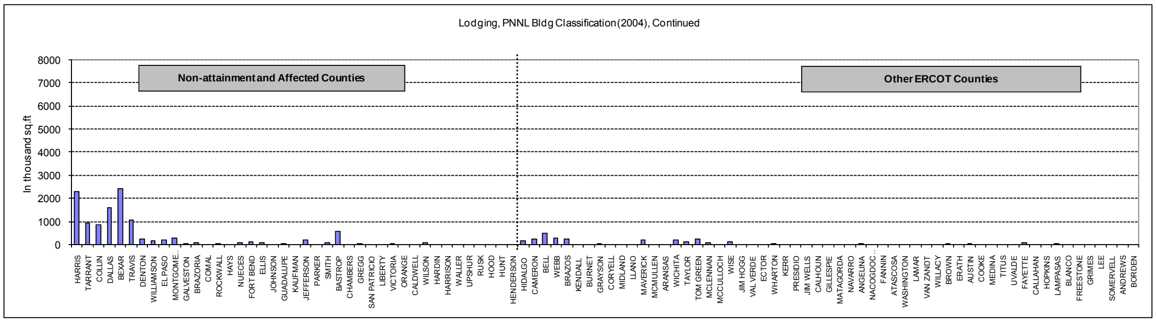
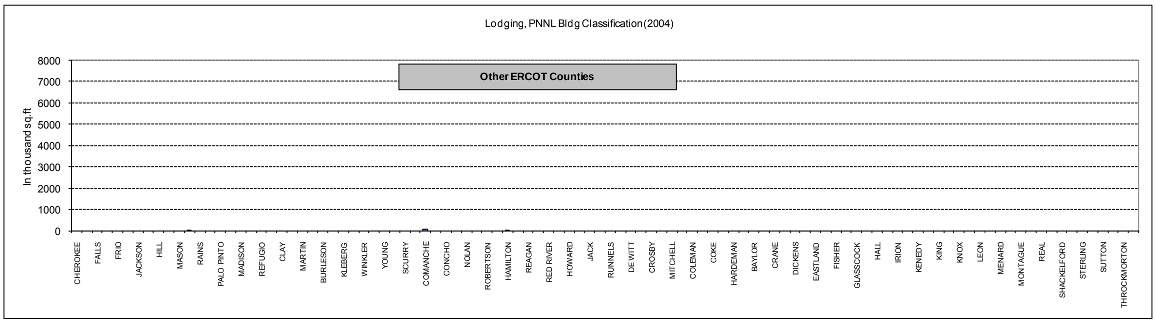
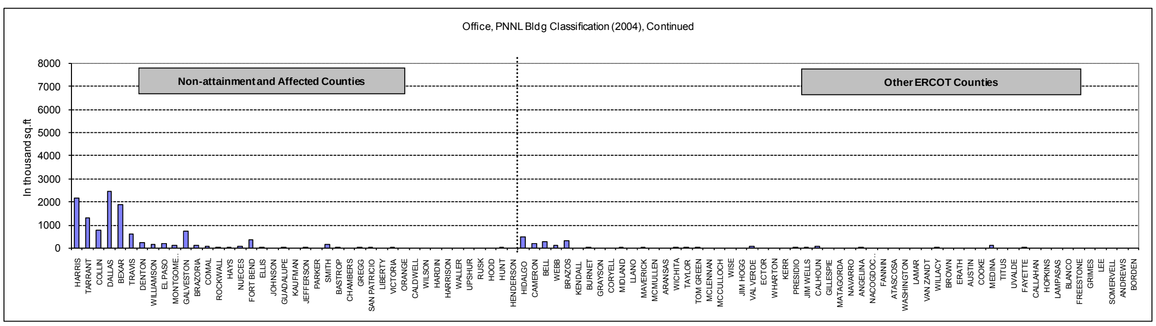


Figure 131: 2004 New Commercial Building Construction (sq. ft. x 1000), Part 2 (Dodge 2006).







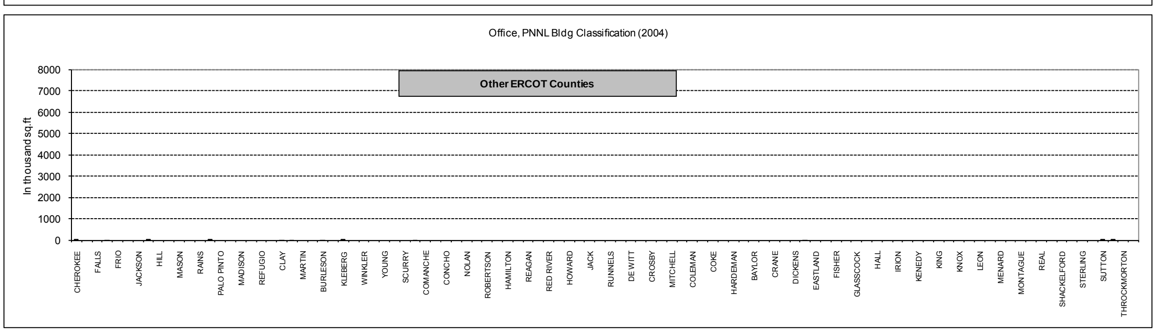


Figure 132: 2004 New Commercial Building Construction (sq. ft. x 1000), Part 3 (Dodge 2006).

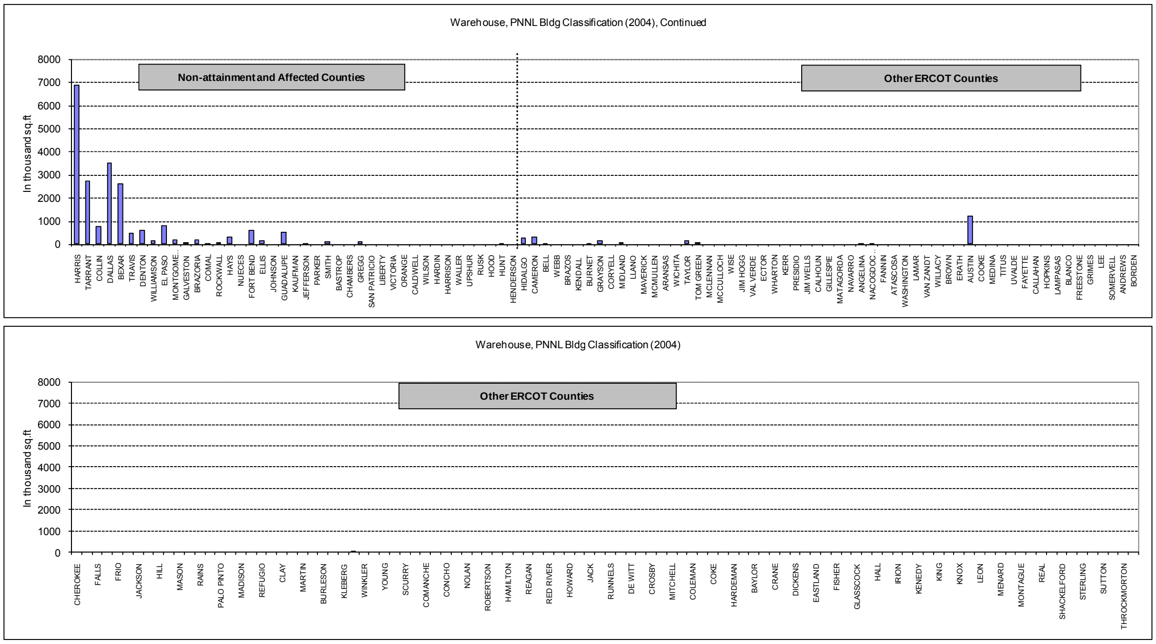


Figure 133: 2004 New Commercial Building Construction (sq. ft. x 1000), Part 4(Dodge 2006).

Table 46: Calculated ASHRAE Standard 90.1-1989 and 1999 Energy Use for Assembly, Education, and Retail Building Types (USDOE 2004) (Part 1)

Non-attainment Counties	Assembly: In thousand sq.ft	Electricity (kWh/yr), PNNL: 1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	Gas (mBtu/yr), PNNL: 1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)
Brazoria	213	3803233	12796.5	3442374	10953	6848	11	7210	4
Chambers	0	0	0.0	0	0	0	0	0	0
Collin	537	9593869	32279.8	8683582	27630	17274	27	18187	11
Dallas	1464	26157950	88011.8	23676026	75334	47099	73	49587	31
Denton	504	9007657	30307.4	8152990	25942	16219	25	17076	11
El Paso	358	6400083	21533.9	5792829	18432	11524	18	12132	7
Fort Bend	291	5206211	17517.0	4712234	14994	9374	14	9869	6
Galveston	280	5004254	16837.5	4529439	14412	9010	14	9486	6
Hardin	0	0	0.0	0	0	0	0	0	0
Harris	1679	29998714	100934.6	27152370	86396	54014	83	56868	35
Jefferson	56	1002638	3373.5	907505	2888	1805	3	1901	1
Liberty	0	0	0.0	0	0	0	0	0	0
Montgomery	298	5322381	17907.8	4817382	15328	9583	15	10089	6
Orange	25	439659	1479.3	397944	1266	792	1	833	1
Tarrant	797	14242464	47920.6	12891107	41018	25644	39	26999	17
Waller	0	0	0.0	0	0	0	0	0	0
Total (Non-attainment)	6501	116179114	390900	105155783	334594	209186	322	220237	136

Non-attainment Counties	Education: In thousand sq.ft	Electricity (kWh/yr), PNNL: 1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	Gas (mBtu/yr), PNNL: 1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)
Brazoria	644	6661336	22413	5902710	18782	12136	19	12902	8
Chambers	12	125256	421	110991	353	228	0	243	0
Collin	1688	17472679	58789	15482803	49265	31834	49	33842	21
Dallas	4137	42821986	144080	37945204	120737	78018	120	82941	51
Denton	1448	14988264	50430	13281326	42260	27307	42	29030	18
El Paso	649	6718270	22604	5953160	18942	12240	19	13012	8
Fort Bend	1107	11455220	38543	10150642	32298	20870	32	22187	14
Galveston	238	2467852	8303	2186800	6958	4496	7	4780	3
Hardin	0	0	0	0	0	0	0	0	0
Harris	5534	57285417	192744	50761468	161517	104369	161	110955	69
Jefferson	119	1231855	4145	1091566	3473	2244	3	2386	1
Liberty	382	3954359	13305	3504017	11149	7205	11	7659	5
Montgomery	531	5496767	18495	4870767	15498	10015	15	10647	7
Orange	52	541395	1822	479738	1526	986	2	1049	1
Tarrant	1090	11286487	37975	10001126	31822	20563	32	21861	14
Waller	0	0	0	0	0	0	0	0	0
Total (Non-attainment)	17631	182507143	614069	161722318	514582	332513	512	353494	218

Non-attainment Counties	Retail: In thousand sq.ft	Electricity (kWh/yr), PNNL: 1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	Gas (mBtu/yr), PNNL: 1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)
Brazoria	406	6737388	22669	5676196	18061	1604	2	2099	1
Chambers	0	0	0	0	0	0	0	0	0
Collin	1248	20699393	69646	17439076	55489	4928	8	6450	4
Dallas	1582	26244903	88304	22111124	70355	6248	10	8178	5
Denton	716	11882112	39979	10010586	31853	2829	4	3702	2
El Paso	424	7032083	23660	5924475	18851	1674	3	2191	1
Fort Bend	292	4843480	16297	4080594	12984	1153	2	1509	1
Galveston	336	5580873	18778	4701841	14961	1329	2	1739	1
Hardin	0	0	0	0	0	0	0	0	0
Harris	3772	62577551	210550	52721094	167752	14898	23	19499	12
Jefferson	154	2557955	8607	2155057	6857	609	1	797	0
Liberty	7	121807	410	102622	327	29	0	38	0
Montgomery	356	5913551	19897	4982120	15853	1408	2	1843	1
Orange	82	1355598	4561	1142081	3634	323	0	422	0
Tarrant	2239	37144697	124978	31294115	99574	8843	14	11574	7
Waller	17	284217	956	239451	762	68	0	89	0
Total (Non-attainment)	11631	192975609	649292	162580431	517312	45942	71	60131	37

Affected Counties	Assembly: In thousand sq.ft	Electricity (kWh/yr), PNNL: 1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	Gas (mBtu/yr), PNNL: 1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)
Bastrop	0	0	0.0	0	0	0	0	0	0
Bexar	497	8887912	29904.5	8044607	25597	16003	25	16849	10
Caldwell	0	0	0.0	0	0	0	0	0	0
Comal	45	806042	2712.0	729563	2321	1451	2	1528	1
Ellis	72	1279659	4305.6	1158242	3685	2304	4	2426	1
Gregg	76	1360085	4576.2	1231037	3917	2449	4	2578	2
Guadalupe	26	464681	1563.5	420591	1338	837	1	881	1
Harrison	67	1195659	4023.0	1082212	3443	2153	3	2267	1
Hays	61	1090212	3668.2	986771	3140	1963	3	2067	1
Henderson	15	262723	884.0	237796	757	473	1	498	0
Hood	66	1183149	3980.9	1070889	3407	2130	3	2243	1
Hunt	16	289532	974.2	262060	834	521	1	549	0
Johnson	10	171574	577.3	155295	494	309	0	325	0
Kaufman	43	764936	2573.7	692357	2203	1377	2	1450	1
Nueces	171	3059744	10294.9	2769429	8812	5509	8	5800	4
Parker	0	0	0.0	0	0	0	0	0	0
Rockwall	19	343149	1154.6	310590	988	618	1	650	0
Rusk	0	0	0.0	0	0	0	0	0	0
San Patricio	43	773872	2603.8	700445	2229	1393	2	1467	1
Smith	130	2328765	7835.4	2107807	6707	4193	6	4415	3
Travis	511	9130976	30722.4	8264609	26297	16441	25	17309	11
Upshur	0	0	0.0	0	0	0	0	0	0
Victoria	5	89362	300.7	80883	257	161	0	169	0
Williamson	125	2234042	7516.7	2022071	6434	4023	6	4235	3
Wilson	0	0	0.0	0	0	0	0	0	0
Total (Affected)	1998	35716074	120171	32327254	102862	64309	99	67706	42

Affected Counties	Education: In thousand sq.ft	Electricity (kWh/yr), PNNL: 1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	Gas (mBtu/yr), PNNL: 1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)
Bastrop	77	797083	2682	706307	2247	1452	2	1544	1
Bexar	1932	20003676	67305	17725557	56401	36445	56	38745	24
Caldwell	65	672862	2264	596233	1897	1226	2	1303	1
Comal	341	3528903	11873	3127014	9950	6429	10	6835	4
Ellis	252	2603459	8760	2306964	7340	4743	7	5043	3
Gregg	50	517586	1741	458641	1459	943	1	1003	1
Guadalupe	123	1277403	4298	1131926	3602	2327	4	2474	2
Harrison	26	268110	902	237576	756	488	1	519	0
Hays	66	687355	2313	609075	1938	1252	2	1331	1
Henderson	20	207035	697	183456	584	377	1	401	0
Hood	0	0	0	0	0	0	0	0	0
Hunt	106	1097283	3692	972319	3094	1999	3	2125	1
Johnson	96	991695	3337	878756	2796	1807	3	1921	1
Kaufman	105	1082791	3643	959477	3053	1973	3	2097	1
Nueces	325	3359135	11302	2976580	9471	6120	9	6506	4
Parker	14	143889	484	127502	406	262	0	279	0
Rockwall	239	2468887	8307	2187718	6961	4498	7	4782	3
Rusk	0	0	0	0	0	0	0	0	0
San Patricio	21	213246	717	188960	601	389	1	413	0
Smith	54	555888	1870	492580	1567	1013	2	1077	1
Travis	426	4407765	14831	3905787	12428	8031	12	8537	5
Upshur	77	795013	2675	704473	2242	1448	2	1540	1
Victoria	0	0	0	0	0	0	0	0	0
Williamson	325	3364311	11320	2981166	9486	6130	9	6516	4
Wilson	0	0	0	0	0	0	0	0	0
Total (Affected)	4738	49043373	165013	43458069	138279	89353	138	94991	59

Affected Counties	Retail: In thousand sq.ft	Electricity (kWh/yr), PNNL: 1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	Gas (mBtu/yr), PNNL: 1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)
Bastrop	23	385068	1296	324417	1032	92	0	120	0
Bexar	1370	22725587	76463	19146128	60921	5410	8	7081	4
Caldwell	3	48461	163	40828	130	12	0	15	0
Comal	120	1993450	6707	1679466	5344	475	1	621	0
Ellis	69	1143418	3847	963320	3065	272	0	356	0
Gregg	10	167649	564	141243	449	40	0	52	0
Guadalupe	306	5071378	17063	4272596	13595	1207	2	1580	1
Harrison	3	49771	167	41931	133	12	0	16	0
Hays	319	5297965	17826	4463494	14202	1261	2	1651	1
Henderson	2	31434	106	26483	84	7	0	10	0
Hood	0	0	0	0	0	0	0	0	0
Hunt	12	191224	643	161105	513	46	0	60	0
Johnson	152	2526520	8501	2128574	6773	601	1	787	0
Kaufman	153	2543547	8558	2142919	6819	606	1	793	0
Nueces	81	1351669	4548	1138770	3623	322	0	421	0
Parker	420	6971834	23458	5873716	18689	1660	3	2172	1
Rockwall	120	1985591	6681	1672845	5323	473	1	619	0
Rusk	111	1838898	6187	1549257	4930	438	1	573	0
San Patricio	127	2103469	7077	1772156	5639	501	1	655	0
Smith	50	835625	2812	704007	2240	199	0	260	0
Travis	1134	18808105	63282	15845680	50419	4478	7	5861	4
Upshur	0	0	0	0	0	0	0	0	0
Victoria	12	196463	661	165519	527	47	0	61	0
Williamson	747	12390298	41689	10438728	33215	2950	5	3861	2
Wilson	59	971839	3270	818767	2605	231	0	303	0
Total (Affected)	5402	89629264	301569	75511949	240270	21338	33	27928	17

Table 47: Calculated ASHRAE Standard 90.1-1989 and 1999 Energy Use for Assembly, Education, and Retail Building Types (USDOE 2004). (Part 2)

ERCOT Counties	Assembly									Education									Retail								
	In thousand	Electricity (kWh/yr), PNNL				Gas (mBtu/yr), PNNL				In thousand	Electricity (kWh/yr), PNNL				Gas (mBtu/yr), PNNL				In thousand	Electricity (kWh/yr), PNNL				Gas (mBtu/yr), PNNL			
	sq.ft	1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	sq.ft	1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	sq.ft	1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)
ANDERSON	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	366732	1234	308969	983	87	0	114	0
ANDREWS	0	0	0.0	0	0	0	0	0	0	17	175979	592	155938	496	321	0	341	0	0	0	0	0	0	0	0	0	0
ANGELINA	93	1669276	5616.5	1510891	4807	3006	5	3164	2	2	24844	84	22015	70	45	0	48	0	106	1753764	5901	1477532	4701	418	1	546	0
ARANSAS	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	126	2092991	7042	1763328	5611	498	1	652	0
ARCHER	4	78638	264.6	71177	226	142	0	149	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ATASCOSA	4	71489	240.5	64706	206	129	0	136	0	2	24844	84	22015	70	45	0	48	0	2	40602	137	34207	109	10	0	13	0
AUSTIN	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BANDERA	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bastrop	0	0	0.0	0	0	0	0	0	0	77	797083	2682	706307	2247	1452	2	1544	1	23	385068	1296	324417	1032	92	0	120	0
BAYLOR	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BEE	53	947234	3187.1	857358	2728	1706	3	1796	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BELL	108	1937361	6518.5	1753540	5580	3488	5	3673	2	199	2062064	6938	1827226	5814	3757	6	3994	2	403	6683688	22488	5630954	17917	1591	2	2083	1
Bexar	497	8887912	29904.5	8044607	25597	16003	25	16849	10	1932	20003676	67305	17725557	56401	36445	56	38745	24	1370	22725587	76463	19146128	60921	5410	8	7081	4
BLANCO	0	0	0.0	0	0	0	0	0	0	77	797083	2682	706307	2247	1452	2	1544	1	0	0	0	0	0	0	0	0	0
BORDEN	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BOSQUE	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazoria	213	3803233	12796.5	3442374	10953	6848	11	7210	4	644	6661336	22413	5902710	18782	12136	19	12902	8	406	6737388	22669	5676196	18061	1604	2	2099	1
BRAZOS	219	3905105	13139.2	3534580	11247	7031	11	7403	5	192	1987531	6687	1761181	5604	3621	6	3850	2	125	2070725	6967	1744570	5551	493	1	645	0
BREWSTER	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BRISCOE	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BROOKS	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BROWN	0	0	0.0	0	0	0	0	0	0	19	194612	655	172449	549	355	1	377	0	83	1373935	4623	1157529	3683	327	1	428	0
BURLESON	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BURNET	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	366732	1234	308969	983	87	0	114	0
Caldwell	0	0	0.0	0	0	0	0	0	0	65	672862	2264	596233	1897	1226	2	1303	1	3	48461	163	40828	130	12	0	15	0
CALHOUN	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	122	2031432	6835	1711466	5446	484	1	633	0
CALLAHAN	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMERON	93	1658553	5580.4	1501186	4777	2986	5	3144	2	363	3761817	12657	3333403	10607	6854	11	7286	5	404	6704644	22559	5648610	17973	1596	2	2089	1
Chambers	0	0	0.0	0	0	0	0	0	0	12	125256	421	110991	353	228	0	243	0	0	0	0	0	0	0	0	0	0
CHEROKEE	69	1224255	4119.2	1108095	3526	2204	3	2321	1	8	82814	279	73383	233	151	0	160	0	4	72037	242	60690	193	17	0	22	0
CHILDRESS	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLAY	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COKE	19	334213	1124.5	302502	963	602	1	634	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COLEMAN	0	0	0.0	0	0	0	0	0	0	6	57970	195	51368	163	106	0	112	0	0	0	0	0	0	0	0	0	0
Collin	537	9593869	32279.8	8683582	27630	17274	27	18187	11	1688	17472679	58789	15482803	49265	31834	49	33842	21	1248	20699393	69646	17439076	55489	4928	8	6450	4
COLORADO	0	0	0.0	0	0	0	0	0	0	123	1273262	4284	1128257	3590	2320	4	2466	2	0	0	0	0	0	0	0	0	0
Comal	45	806042	2712.0	729563	2321	1451	2	1528	1	341	3528903	11873	3127014	9950	6429	10	6835	4	120	1993450	6707	1679466	5344	475	1	621	0
COMANCHE	0	0	0.0	0	0	0	0	0	0	16	167698	564	148600	473	306	0	325	0	0	0	0	0	0	0	0	0	0
CONCHO	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COOKE	0	0	0.0	0	0	0	0	0	0	26	266039	895	235741	750	485	1	515	0	0	0	0	0	0	0	0	0	0
CORYELL	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	122	2030123	6831	1710362	5442	483	1	633	0
COTTLE	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CRANE	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CROCKETT	11	189447	637.4	171472	546	341	1	359	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CROSBY	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CULBERSON	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dallas	1464	26157950	88011.8	23676026	75334	47099	73	49587	31	4137	42821986	144080	37945204	120737	78018	120	82941	51	1582	26244903	88304	22111124	70355	6248	10	8178	5
DAWSON	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DE WITT	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DELTA	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Denton	504	9007657	30307.4	8152990	25942	16219	25	17076	11	1448	14988264	50430	13281326	42260	27307	42	29030	18	716	11882112	39979	10010586	31853	2829	4	3702	2
DICKENS	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIMMIT	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DUVAL	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EASTLAND	38	670213	2255.0	606621	1930	1207	2	1271	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ECTOR	38	673787	2267.0	609857	1940	1213	2	1277	1	115	1190449	4005	1054874	3356	2169	3	2306	1	21	345776	1163	291313	927	82	0	108	0
EDWARDS	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ellis	72	1279659	4305.6	1158242	3685	2304	4	2426	1	252	2603459	8760	2306964	7340	4743	7	5043	3	69	1143418	3847	963320	3065	272	0	356	0
ERATH	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	193844	652	163312	520	46	0	60	0
FALLS	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FANNIN	24	428936	1443.2	388238	1235	772	1	813	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FAYETTE	0	0	0.0	0	0	0	0	0	0	15	158381	533	140344	447	289	0	307	0	0	0	0	0	0	0	0	0	0
FISHER	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FOARD	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fort Bend	291	5206211	17517.0	4712234	14994	9374	14	9869	6	1107	11455220	38543	10150642	32298	20870	32	22187	14	292	4843480	16297	4080594	12984	1153	2	1509	1
FRANKLIN	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FREESTONE	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRIO	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galveston	280	5004254	16837.5	4529439	14412	9010	14	9486	6	238	2467852	8303	2186800	6958	4496	7	4780	3	336	5580873	18778	4701841	14961	1329	2	1739	1
GILLESPIE	22	394979	1329.0	357502	1138	711	1	749	0	0	0	0	0	0	0	0	0	0	122	2030123	6831	1710362	5442	483	1	633	0
GLASSCOCK	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOLIAD	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GONZALES	0	0	0.0	0	0	0	0	0	0	18	182190	613	161442	514	332	1	353	0	5	85134	286	71725	228	20	0	27	0
GRAYSON	6	107234	360.8	97059	309	193	0	203	0	111	1146971	3859	1016348	3234	2090	3	2222	1	82	1354288	4557	1140977	3630	322	0	422	0
GRIMES	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Guadalupe	26	464681	1563.5	420591	1338	837	1	881	1	123	1277403	4298	1131926	3602	2327	4	2474	2	306	5071378	17063	4272596	13595	1207	2	1580	1
HALL	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAMILTON	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HARDEMAN	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harris	1679	29998714	100934.6	27152370	86396	54014	83	56868	35	5534	57285417	192744	50761468	161517	104369	161	110955	69	3772	62577551	210550	52721094	167752	14898	23	19499	12
HASKELL	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hays	61	1090212	3668.2	986771	3140	1963	3	2067	1	66	687355	2313	609075	1938	1252	2	1331	1	319	5297965	17826	4463494	14202	1261	2	1651	1
Henderson	15	262723	884.0	237796	757	473	1	498	0	20	207035	697	183456	584	377	1	401	0	2	31434	106	26483	84	7	0	10	0
HIDALGO	167	2975744	10012.3	2693399	8570	5358	8	5641	3	469	4859100	16349	4305722	13700	8853	14	9411	6	745	12356244	41574	10410038	33124	2942	5	3850	2
HILL	0	0	0.0	0	0	0	0	0	0	12	124221	418	110074	350	226	0	241	0	0	0	0	0	0	0	0	0	0
Hood	66	1183149	3980.9	1070889	3407	2130	3	2243	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOPKINS	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	39293	132	33104	105	9	0	12	0
HOUSTON	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOWARD	23	411064	1383.1	372061	1184	740	1	779	0	0	0	0	0	0	0	0	0	0	5	83824	282	70621	225	20	0	26	0
HUDSPETH	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hunt	16	289532	974.2	262060	834	521	1	549	0	106	1097283	3692	972319	3094	1999	3	2125	1	12	191224	643	161105	513	46	0	60	0
IRION	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JACK	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JACKSON	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JEFF DAVIS	21	371745	1250.8	336473	1071	669	1	705	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JIM HOGG	0	0	0.0	0	0	0	0	0	0	10	103517	348	91728	292	189	0	201	0	0	0	0	0	0	0	0	0	0

Table 48: Calculated ASHRAE Standard 90.1-1989 and 1999 Energy Use for Assembly, Education, and Retail Building Types (USDOE 2004). (Part 3)

Assembly

ERCOT Counties	In thousand sq.ft	Electricity (kWh/yr), PNNL 1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	Gas (mBtu/yr), PNNL 1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)
JIM WELLS	0	0	0.0	0	0	0	0	0	0
Johnson	10	171574	577.3	155295	494	309	0	325	0
JONES	0	0	0.0	0	0	0	0	0	0
KARNES	0	0	0.0	0	0	0	0	0	0
Kaufman	43	764936	2573.7	692357	2203	1377	2	1450	1
KENDALL	15	268085	902.0	242649	772	483	1	508	0
KENEDY	0	0	0.0	0	0	0	0	0	0
KENT	0	0	0.0	0	0	0	0	0	0
KERR	49	872170	2934.5	789417	2512	1570	2	1653	1
KIMBLE	0	0	0.0	0	0	0	0	0	0
KING	0	0	0.0	0	0	0	0	0	0
KINNEY	0	0	0.0	0	0	0	0	0	0
KLEBERG	0	0	0.0	0	0	0	0	0	0
KNOX	0	0	0.0	0	0	0	0	0	0
LA SALLE	0	0	0.0	0	0	0	0	0	0
LAMAR	8	142979	481.1	129413	412	257	0	271	0
LAMPASAS	0	0	0.0	0	0	0	0	0	0
LAVACA	0	0	0.0	0	0	0	0	0	0
LEE	0	0	0.0	0	0	0	0	0	0
LEON	22	393191	1322.9	355885	1132	708	1	745	0
LIMESTONE	0	0	0.0	0	0	0	0	0	0
LIVE OAK	0	0	0.0	0	0	0	0	0	0
LLANO	0	0	0.0	0	0	0	0	0	0
LOVING	0	0	0.0	0	0	0	0	0	0
MADISON	0	0	0.0	0	0	0	0	0	0
MARTIN	0	0	0.0	0	0	0	0	0	0
MASON	0	0	0.0	0	0	0	0	0	0
MATAGORDA	0	0	0.0	0	0	0	0	0	0
MAVERICK	30	536170	1804.0	485297	1544	965	1	1016	1
MCCULLOCH	0	0	0.0	0	0	0	0	0	0
MCLENNAN	48	856085	2880.4	774858	2466	1541	2	1623	1
MCMULLEN	0	0	0.0	0	0	0	0	0	0
MEDINA	0	0	0.0	0	0	0	0	0	0
MENARD	0	0	0.0	0	0	0	0	0	0
MIDLAND	192	3436850	11563.7	3110754	9898	6188	10	6515	4
MILAM	0	0	0.0	0	0	0	0	0	0
MILLS	0	0	0.0	0	0	0	0	0	0
MITCHELL	0	0	0.0	0	0	0	0	0	0
MONTAGUE	0	0	0.0	0	0	0	0	0	0
Montgomery	298	5322381	17907.8	4817382	15328	9583	15	10089	6
MOTLEY	0	0	0.0	0	0	0	0	0	0
NACOGDOCHES	5	91149	306.7	82500	263	164	0	173	0
NAVARRO	0	0	0.0	0	0	0	0	0	0
NOLAN	0	0	0.0	0	0	0	0	0	0
Nueces	171	3059744	10294.9	2769429	8812	5509	8	5800	4
PALO PINTO	5	89362	300.7	80883	257	161	0	169	0
Parker	0	0	0.0	0	0	0	0	0	0
PECOS	0	0	0.0	0	0	0	0	0	0
PRESIDIO	0	0	0.0	0	0	0	0	0	0
RAINS	0	0	0.0	0	0	0	0	0	0
REAGAN	0	0	0.0	0	0	0	0	0	0
REAL	0	0	0.0	0	0	0	0	0	0
RED RIVER	1	19660	66.1	17794	57	35	0	37	0
REEVES	10	178723	601.3	161766	515	322	0	339	0
REFUGIO	0	0	0.0	0	0	0	0	0	0
ROBERTSON	0	0	0.0	0	0	0	0	0	0
Rockwall	19	343149	1154.6	310590	988	618	1	650	0
RUNNELS	0	0	0.0	0	0	0	0	0	0
Rusk	0	0	0.0	0	0	0	0	0	0
San Patricio	43	773872	2603.8	700445	2229	1393	2	1467	1
SAN SABA	21	373532	1256.8	338090	1076	673	1	708	0
SCHLEICHER	0	0	0.0	0	0	0	0	0	0
SCURRY	0	0	0.0	0	0	0	0	0	0
SHACKELFORD	0	0	0.0	0	0	0	0	0	0
Smith	130	2328765	7835.4	2107807	6707	4193	6	4415	3
SOMERVELL	0	0	0.0	0	0	0	0	0	0
STARR	19	339574	1142.5	307355	978	611	1	644	0
STEPHENS	0	0	0.0	0	0	0	0	0	0
STERLING	0	0	0.0	0	0	0	0	0	0
STONEWALL	0	0	0.0	0	0	0	0	0	0
SUTTON	0	0	0.0	0	0	0	0	0	0
Tarrant	797	14242464	47920.6	12891107	41018	25644	39	26999	17
TAYLOR	36	646979	2176.8	585592	1863	1165	2	1226	1
TERRELL	0	0	0.0	0	0	0	0	0	0
THROCKMORTON	0	0	0.0	0	0	0	0	0	0
TITUS	0	0	0.0	0	0	0	0	0	0
TOM GREEN	73	1301106	4377.7	1177654	3747	2343	4	2466	2
Travis	511	9130976	30722.4	8264609	26297	16441	25	17309	11
UPTON	0	0	0.0	0	0	0	0	0	0
UVALDE	15	268085	902.0	242649	772	483	1	508	0
VAL VERDE	7	123319	414.9	111618	355	222	0	234	0
VAN ZANDT	0	0	0.0	0	0	0	0	0	0
Victoria	5	89362	300.7	80883	257	161	0	169	0
Waller	0	0	0.0	0	0	0	0	0	0
WARD	0	0	0.0	0	0	0	0	0	0
WASHINGTON	2	30383	102.2	27500	88	55	0	58	0
WEBB	27	486128	1635.6	440003	1400	875	1	922	1
WHARTON	44	793532	2669.9	718240	2285	1429	2	1504	1
WICHITA	111	1987404	6686.9	1798834	5724	3578	6	3767	2
WILBARGER	1	23234	78.2	21030	67	42	0	44	0
WILLACY	0	0	0.0	0	0	0	0	0	0
Williamson	125	2234042	7516.7	2022071	6434	4023	6	4235	3
Wilson	0	0	0.0	0	0	0	0	0	0
WINKLER	0	0	0.0	0	0	0	0	0	0
WISE	30	536170	1804.0	485297	1544	965	1	1016	1
YOUNG	3	46468	156.3	42059	134	84	0	88	0
ZAPATA	0	0	0.0	0	0	0	0	0	0
ZAVALA	0	0	0.0	0	0	0	0	0	0
Total	9701	173386671	583382	156935361	499350	312191	481	328683	203

Education

ERCOT Counties	In thousand sq.ft	Electricity (kWh/yr), PNNL 1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	Gas (mBtu/yr), PNNL 1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)
JIM WELLS	10	104552	352	92645	295	190	0	203	0
Johnson	96	991695	3337	878756	2796	1807	3	1921	1
JONES	0	0	0	0	0	0	0	0	0
KARNES	0	0	0	0	0	0	0	0	0
Kaufman	105	1082791	3643	959477	3053	1973	3	2097	1
KENDALL	0	0	0	0	0	0	0	0	0
KENEDY	0	0	0	0	0	0	0	0	0
KENT	0	0	0	0	0	0	0	0	0
KERR	0	0	0	0	0	0	0	0	0
KIMBLE	0	0	0	0	0	0	0	0	0
KING	0	0	0	0	0	0	0	0	0
KINNEY	9	94201	317	83473	266	172	0	182	0
KLEBERG	110	1135584	3821	1006258	3202	2069	3	2199	1
KNOX	0	0	0	0	0	0	0	0	0
LA SALLE	0	0	0	0	0	0	0	0	0
LAMAR	30	310552	1045	275185	876	566	1	602	0
LAMPASAS	0	0	0	0	0	0	0	0	0
LAVACA	0	0	0	0	0	0	0	0	0
LEE	0	0	0	0	0	0	0	0	0
LEON	0	0	0	0	0	0	0	0	0
LIMESTONE	8	82814	279	73383	233	151	0	160	0
LIVE OAK	0	0	0	0	0	0	0	0	0
LLANO	0	0	0	0	0	0	0	0	0
LOVING	0	0	0	0	0	0	0	0	0
MADISON	0	0	0	0	0	0	0	0	0
MARTIN	0	0	0	0	0	0	0	0	0
MASON	0	0	0	0	0	0	0	0	0
MATAGORDA	0	0	0	0	0	0	0	0	0
MAVERICK	26	273286	920	242162	771	498	1	529	0
MCCULLOCH	0	0	0	0	0	0	0	0	0
MCLENNAN	0	0	0	0	0	0	0	0	0
MCMULLEN	0	0	0	0	0	0	0	0	0
MEDINA	79	818822	2755	725570	2309	1492	2	1586	1
MENARD	5	51759	174	45864	146	94	0	100	0
MIDLAND	109	1127303	3793	998920	3178	2054	3	2183	1
MILAM	0	0	0	0	0	0	0	0	0
MILLS	0	0	0	0	0	0	0	0	0
MITCHELL	0	0	0	0	0	0	0	0	0
MONTAGUE	0	0	0	0	0	0	0	0	0
Montgomery	531	5496767	18495	4870767	15498	10015	15	10647	7
MOTLEY	0	0	0	0	0	0	0	0	0
NACOGDOCHES	63	650088	2187	576053	1833	1184	2	1259	1
NAVARRO	28	289848	975	256839	817	528	1	561	0
NOLAN	0	0	0	0	0	0	0	0	0
Nueces	325	3359135	11302	2976580	9471	6120	9	6506	4
PALO PINTO	0	0	0	0	0	0	0	0	0
Parker	14	143889	484	127502	406	262	0	279	0
PECOS	0	0	0	0	0	0	0	0	0
PRESIDIO	0	0	0	0	0	0	0	0	0
RAINS	14	144924	488	128419	409	264	0	281	0
REAGAN	0	0	0	0	0	0	0	0	0
REAL	0	0	0	0	0	0	0	0	0
RED RIVER	0	0	0	0	0	0	0	0	0
REEVES	0	0	0	0	0	0	0	0	0
REFUGIO	0	0	0	0	0	0	0	0	0
ROBERTSON	3	33126	111	29353	93	60	0	64	0
Rockwall	239	2468887	8307	2187718	6961	4498	7	4782	3
RUNNELS	0	0	0	0	0	0	0	0	0
Rusk	0	0	0	0	0	0	0	0	0
San Patricio	21	213246	717	188960	601	389	1	413	0
SAN SABA	0	0	0	0	0	0	0	0	0
SCHLEICHER	0	0	0	0	0	0	0	0	0
SCURRY	0	0	0	0	0	0	0	0	0
SHACKELFORD	0	0	0	0	0	0	0	0	0
Smith	54	555888	1870	492580	1567	1013	2	1077	1
SOMERVELL	12	124221	418	110074	350	226	0	241	0
STARR	77	798118	2685	707224	2250	1454	2	1546	1
STEPHENS	20	202894	683	179787	572	370	1	393	0
STERLING	0	0	0	0	0	0	0	0	0
STONEWALL	0	0	0	0	0	0	0	0	0
SUTTON	0	0	0	0	0	0	0	0	0
Tarrant	1090	11286487	37975	10001126	31822	20563	32	21861	14
TAYLOR	29	300200	1010	266012	846	547	1	581	0
TERRELL	0	0	0	0	0	0	0	0	0
THROCKMORTON	0	0	0	0	0	0	0	0	0
TITUS	0	0	0	0	0	0	0	0	0
TOM GREEN	89	916128	3082	811795	2583	1669	3	1774	1
Travis	426	4407765	14831	3905787	12428	8031	12	8537	5
UPTON	0	0	0	0	0	0	0	0	0
UVALDE	0	0	0	0	0	0	0	0	0
VAL VERDE	31	322974	1087	286192	911	588	1	626	0
VAN ZANDT	16	167698	564	148600	473	306	0	325	0
Victoria	0	0	0	0	0	0	0	0	0
Waller	0	0	0	0	0	0	0	0	0
WARD	0	0	0	0	0	0	0	0	0
WASHINGTON	0	0	0	0	0	0	0	0	0
WEBB	730	7558830	25433	6697993	21312	13772	21	14641	9
WHARTON	0	0	0	0	0	0	0	0	0
WICHITA	88	910952	3065	807208	2568	1660	3	1764	1
WILBARGER	0	0	0	0	0	0	0	0	0
WILLACY	0	0	0	0	0	0	0	0	0
Williamson	325	3364311	11320	2981166	9486	6130	9	6516	4
Wilson	0	0	0	0	0	0	0	0	0
WINKLER	0	0	0	0	0	0	0	0	0
WISE	332	3436773	11563	3045376	9690	6262	10	6657	4
YOUNG	0	0	0	0	0	0	0	0	0
ZAPATA	146	1511352	5085	1339232	4261	2754	4	2927	2
ZAVALA	0	0	0	0	0	0	0	0	0
Total	24878	257532314	866501	228203248	726117	469203	722	498808	308

Retail

ERCOT Counties	In thousand sq.ft	Electricity (kWh/yr), PNNL 1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	Gas (mBtu/yr), PNNL 1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)
JIM WELLS	2	39293	132	33104	105	9	0	12	0
Johnson	152	2526520	8501	2128574	6773	601	1	787	0
JONES	0	0	0	0	0	0	0	0	0
KARNES	0	0	0	0	0	0	0	0	0
Kaufman	153	2543547	8558	2142919	6819	606	1	793	0
KENDALL	7	117878	397	99311	316	28	0	37	0
KENEDY	0	0	0	0	0	0	0	0	0
KENT	0	0	0	0	0	0	0	0	0
KERR	0	0	0	0	0	0	0	0	0
KIMBLE	0	0	0	0	0	0	0	0	0
KING	0	0	0	0	0	0	0	0	0
KINNEY	0	0	0	0	0	0	0	0	0
KLEBERG	126	2092991	7042	1763328	5611	498	1	652	0
KNOX	0	0	0	0	0	0	0	0	0
LA SALLE	0	0	0	0	0	0	0	0	0
LAMAR	7	124427	419	104829	334	30	0	39	0
LAMPASAS	1	19646	66	16552	53	5	0	6	0
LAVACA	0	0	0	0	0	0	0	0	0
LEE	9	153242	516	129105	411	36	0	48	0
LEON	0	0	0	0	0	0	0	0	0
LIMESTONE	0	0	0	0	0	0	0	0	0
LIVE OAK	0	0	0	0	0	0	0	0	0
LLANO	0	0	0	0	0	0	0	0	0
LOVING	0	0	0	0	0	0	0	0	0
MADISON	0	0	0	0	0	0	0	0	0
MARTIN	0	0	0	0	0	0	0	0	0
MASON	0	0	0	0	0	0	0	0	0
MATAGORDA	0	0	0	0	0	0	0	0	0
MAVERICK	24	398166	1340	335452	1067	95	0	124	0
MCCULLOCH	0	0	0	0	0	0	0	0	0
MCLENNAN	117	1939750	6527	1634224	5200	462	1	604	0
MCMULLEN	0	0	0	0	0	0	0	0	0
MEDINA	0	0	0	0	0	0	0	0	0
MENARD	0	0	0	0	0	0	0	0	0
MIDLAND	148	2457103	8267	2070090	6587	585	1	766	0
MILAM	79	1305827	4394	1100149	3501	311	0	407	0
MILLS	0	0	0	0	0	0	0	0	0
MITCHELL	0	0	0	0	0	0	0	0	0
MONTAGUE	79	1305827	4394	1100149	3501	311	0	407	0
Montgomery	356	5913551	19897	4982120	15853	1408	2	1843	1
MOTLEY	0	0	0	0	0	0	0	0	0
NACOGDOCHES	0	0	0	0	0	0	0	0	0
NAVARRO	169	2809428	9453	2366921	7531	669	1	875	1
NOLAN	79	1305827	4394	1100149	3501	311	0	407	0
Nueces	81	1351669	4548	1138770	3623	322	0	421	0
PALO PINTO	160	2660116	8950	2241127	7131	633	1	829	1
Parker	420	6971834	23458	5873716	18689	1660	3	2172	1
PECOS	0	0	0	0	0	0	0	0	0
PRESIDIO	0	0	0	0	0	0	0	0	0
RAINS	0	0	0	0	0	0	0	0	0
REAGAN	0	0	0	0	0	0	0	0	0
REAL	0	0	0	0	0	0	0	0	0
RED RIVER	0	0	0	0	0	0	0	0	0
REEVES	4	65488	220	55173	176	16	0	20	0
REFUGIO	0	0	0	0	0	0	0	0	0
ROBERTSON	0	0	0	0	0	0	0	0	0
Rockwall	120	1985591	6681	1672845	5323	473	1	619	0
RUNNELS	0	0	0	0	0	0	0	0	0
Rusk	111	1838898	6187	1549257	4930	438	1	573	0
San Patricio	127	2103469	7077	1772156	5639	501	1	655	0
SAN SABA	0	0	0	0	0	0	0	0	0
SCHLEICHER	0	0	0	0	0	0	0	0	0
SCURRY	0	0	0	0	0	0	0	0	0
SHACKELFORD	0	0	0	0	0	0	0	0	0
Smith	50	835625	2812	704007	2240	199	0	260	0
SOMERVELL	0	0	0	0	0	0	0	0	0
STARR	0	0	0	0	0	0	0	0	0
STEPHENS	0	0	0	0	0	0	0	0	0
STERLING	0	0	0	0	0	0	0	0	0
STONEWALL	0	0	0	0	0	0	0	0	0
SUTTON	0	0	0	0	0	0	0	0	0
Tarrant	2239	37144697	124978	31294115	99574	8843	14	11574	7
TAYLOR	303	5025536	16909	4233975	13472	1196	2	1566	1
TERRELL	0	0	0	0	0	0	0	0	0
THROCKMORTON	0	0	0	0	0	0	0	0	0
TITUS	0	0	0	0	0	0	0	0	0
TOM GREEN	125	2072035	6972	1745673	5555	493	1	646	0
Travis	1134	18808105	63282	15845680	50419	4478	7	5861	4
UPTON	0	0	0	0	0	0	0	0	0
UVALDE	187	3096265	10418	2608579	8300	737	1	965	1
VAL VERDE	4	65488	220	55173	176	16	0	20	0
VAN ZANDT	0	0	0	0	0	0	0	0	0
Victoria	12	196463	661	165519	527	47	0	61	0
Waller	17	284217	956	239451	762	68	0	89	0
WARD	0	0	0	0	0	0	0	0	0
WASHINGTON	199	3308445	11132	2787339	8869	788	1	1031	1
WEBB	26	437459	1472	368556	1173	104	0	136	0
WHARTON	23	374590	1260	315589	1004	89	0	117	0
WICHITA	82	1354288	4557	1140977	3630	322	0	422	0
WILBARGER	0	0	0	0	0	0	0	0	0
WILLACY	3	52390	176	44138	140	12	0	16	0
Williamson	747	12390298	41689	10438728	33215	2950	5	3861	2
Wilson	59	971839	3270	818767	2605	231	0	303	0
WINKLER	0	0	0	0	0	0	0	0	0
WISE	0	0	0	0	0	0	0	0	0
YOUNG	0	0	0	0	0	0	0	0	0
ZAPATA	0	0	0	0	0	0	0	0	0
ZAVALA	0	0	0	0	0	0	0	0	0
Total	20852	345977447	1164086	291483274	927466	82367	127	107806	67

Table 49: Calculated ASHRAE Standard 90.1-1989 and 1999 Energy Use for Food and Lodging Building Types (USDOE 2004) (Part 1).

Non-attainment Counties	Food									Lodging								
	In thousand sq.ft	Electricity (kWh/yr), PNNL				Gas (mBtu/yr), PNNL				In thousand sq.ft	Electricity (kWh/yr), PNNL				Gas (mBtu/yr), PNNL			
		1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)		1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)
Brazoria	108	3195996	10753	3233115	10287	3848	6	3782	2	91	1127209	3793	1080856	3439	1597	2	1446	1
Chambers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collin	333	9819115	33038	9933156	31606	11822	18	11619	7	864	10733959	36116	10292562	32750	15210	23	13767	9
Dallas	422	12449723	41889	12594316	40074	14989	23	14732	9	1586	19709373	66315	18898894	60134	27928	43	25279	16
Denton	191	5636485	18965	5701948	18143	6786	10	6670	4	251	3114426	10479	2986357	9502	4413	7	3995	2
El Paso	113	3335790	11224	3374533	10737	4016	6	3947	2	195	2422194	8150	2322589	7390	3432	5	3107	2
Fort Bend	78	2297588	7731	2324273	7396	2766	4	2719	2	135	1674035	5633	1605196	5108	2372	4	2147	1
Galveston	90	2647383	8907	2678131	8522	3187	5	3133	2	30	372836	1254	357505	1138	528	1	478	0
Hardin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harris	1006	29684742	99878	30029506	95550	35740	55	35127	22	2296	28529439	95991	27356265	87045	40426	62	36592	23
Jefferson	41	1213410	4083	1227503	3906	1461	2	1436	1	195	2419708	8141	2320206	7383	3429	5	3104	2
Liberty	2	57781	194	58453	186	70	0	68	0	0	0	0	0	0	0	0	0	0
Montgomery	95	2805195	9438	2837775	9029	3377	5	3319	2	294	3658768	12310	3508314	11163	5184	8	4693	3
Orange	22	643051	2164	650520	2070	774	1	761	0	1	16156	54	15492	49	23	0	21	0
Tarrant	597	17620229	59286	17824873	56717	21215	33	20850	13	961	11939463	40172	11448495	36428	16918	26	15314	9
Waller	5	134823	454	136389	434	162	0	160	0	0	0	0	0	0	0	0	0	0
Total (Non-attainment)	3103	91541313	308003	92604490	294657	110216	170	108323	67	6897	85717566	288408	82192731	261528	121460	187	109941	68

Affected Counties	Food									Lodging								
	In thousand sq.ft	Electricity (kWh/yr), PNNL				Gas (mBtu/yr), PNNL				In thousand sq.ft	Electricity (kWh/yr), PNNL				Gas (mBtu/yr), PNNL			
		1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)		1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)
Bastrop	6	182664	615	184785	588	220	0	216	0	572	7108747	23918	6816424	21689	10073	16	9118	6
Bexar	365	10780275	36272	10905479	34700	12979	20	12757	8	2428	30176133	101532	28935245	92069	42759	66	38704	24
Caldwell	1	22988	77	23255	74	28	0	27	0	0	0	0	0	0	0	0	0	0
Comal	32	945627	3182	956610	3044	1139	2	1119	1	18	223702	753	214503	683	317	0	287	0
Ellis	18	542400	1825	548699	1746	653	1	642	0	99	1225389	4123	1174999	3739	1736	3	1572	1
Gregg	3	79527	268	80451	256	96	0	94	0	32	401420	1351	384913	1225	569	1	515	0
Guadalupe	82	2405696	8094	2433636	7744	2896	4	2847	2	64	791656	2664	759102	2415	1122	2	1015	1
Harrison	1	23610	79	23884	76	28	0	28	0	2	28584	96	27409	87	41	0	37	0
Hays	85	2513181	8456	2542370	8090	3026	5	2974	2	6	75810	255	72693	231	107	0	97	0
Henderson	1	14911	50	15085	48	18	0	18	0	0	0	0	0	0	0	0	0	0
Hood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hunt	3	90711	305	91764	292	109	0	107	0	0	0	0	0	0	0	0	0	0
Johnson	41	1198499	4033	1212418	3858	1443	2	1418	1	0	0	0	0	0	0	0	0	0
Kaufman	41	1206576	4060	1220589	3884	1453	2	1428	1	0	0	0	0	0	0	0	0	0
Nueces	22	641187	2157	648634	2064	772	1	759	0	72	891079	2998	854436	2719	1263	2	1143	1
Parker	112	3307210	11128	3345621	10645	3982	6	3913	2	0	0	0	0	0	0	0	0	0
Rockwall	32	941899	3169	952839	3032	1134	2	1115	1	40	497115	1673	476673	1517	704	1	638	0
Rusk	30	872313	2935	882444	2808	1050	2	1032	1	0	0	0	0	0	0	0	0	0
San Patricio	34	997817	3357	1009406	3212	1201	2	1181	1	0	0	0	0	0	0	0	0	0
Smith	13	396393	1334	400997	1276	477	1	469	0	102	1263915	4253	1211941	3856	1791	3	1621	1
Travis	302	8921949	30019	9025570	28718	10742	17	10558	7	1057	13132540	44186	12592510	40068	18608	29	16844	10
Upshur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Victoria	3	93196	314	94278	300	112	0	110	0	46	574168	1932	550557	1752	814	1	736	0
Williamson	199	5877552	19776	5945815	18919	7077	11	6955	4	163	2028230	6824	1944826	6188	2874	4	2601	2
Wilson	16	461009	1551	466363	1484	555	1	546	0	82	1019086	3429	977180	3109	1444	2	1307	1
Total (Affected)	1441	42517189	143055	43010991	136856	51191	79	50312	31	4783	59437573	199985	56993411	181347	84222	130	76235	47

Table 50: Calculated ASHRAE Standard 90.1-1989 and 1999 Energy Use for Food and Lodging Building Types (USDOE 2004) (Part 2).

ERCOT Counties	Food									Lodging								
	In thousand sq.ft	Electricity (kWh/yr), PNNL				Gas (mBtu/yr), PNNL				In thousand sq.ft	Electricity (kWh/yr), PNNL				Gas (mBtu/yr), PNNL			
		1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)		1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)
ANDERSON	6	173966	585	175986	560	209	0	206	0	0	0	0	0	0	0	0	0	0
ANDREWS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANGELINA	28	831928	2799	841590	2678	1002	2	984	1	63	776742	2613	744802	2370	1101	2	996	1
ARANSAS	34	992846	3341	1004378	3196	1195	2	1175	1	0	0	0	0	0	0	0	0	0
ARCHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ATASCOSA	1	19260	65	19484	62	23	0	23	0	0	0	0	0	0	0	0	0	0
AUSTIN	0	0	0	0	0	0	0	0	0	31	390235	1313	374188	1191	553	1	501	0
BANDERA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bastrop	6	182664	615	184785	588	220	0	216	0	572	7108747	23918	6816424	21689	10073	16	9118	6
BAYLOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BELL	107	3170523	10668	3207346	10205	3817	6	3752	2	490	6083447	20469	5833286	18561	8620	13	7803	5
Bexar	365	10780275	36272	10905479	34700	12979	20	12757	8	2428	30176133	101532	28935245	92069	42759	66	38704	24
BLANCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BORDEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BOSQUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazoria	108	3195996	10753	3233115	10287	3848	6	3782	2	91	1127209	3793	1080856	3439	1597	2	1446	1
BRAZOS	33	982284	3305	993693	3162	1183	2	1162	1	263	3272260	11010	3137700	9984	4637	7	4197	3
BREWSTER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BRISCOE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BROOKS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BROWN	22	651750	2193	659319	2098	785	1	771	0	65	801598	2697	768635	2446	1136	2	1028	1
BURLESON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BURNET	6	173966	585	175986	560	209	0	206	0	0	0	0	0	0	0	0	0	0
Caldwell	1	22988	77	23255	74	28	0	27	0	0	0	0	0	0	0	0	0	0
CALHOUN	33	963645	3242	974837	3102	1160	2	1140	1	0	0	0	0	0	0	0	0	0
CALLAHAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMERON	108	3180464	10701	3217402	10237	3829	6	3764	2	240	2976477	10015	2854080	9081	4218	6	3818	2
Chambers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHEROKEE	1	34172	115	34569	110	41	0	40	0	0	0	0	0	0	0	0	0	0
CHILDRESS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLAY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COKE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COLEMAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collin	333	9819115	33038	9933156	31606	11822	18	11619	7	864	10733959	36116	10292562	32750	15210	23	13767	9
COLORADO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Comal	32	945627	3182	956610	3044	1139	2	1119	1	18	223702	753	214503	683	317	0	287	0
COMANCHE	0	0	0	0	0	0	0	0	0	70	869952	2927	834178	2654	1233	2	1116	1
CONCHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COOKE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CORYELL	33	963024	3240	974209	3100	1159	2	1140	1	0	0	0	0	0	0	0	0	0
COTTLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CRANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CROCKETT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CROSBY	0	0	0	0	0	0	0	0	0	10	124279	418	119168	379	176	0	159	0
CULBERSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dallas	422	12449723	41889	12594316	40074	14989	23	14732	9	1586	19709373	66315	18898894	60134	27928	43	25279	16
DAWSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DE WITT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DELTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Denton	191	5636485	18965	5701948	18143	6786	10	6670	4	251	3114426	10479	2986357	9502	4413	7	3995	2
DICKENS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIMMIT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DUVAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EASTLAND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ECTOR	6	164025	552	165930	528	197	0	194	0	0	0	0	0	0	0	0	0	0
EDWARDS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ellis	18	542400	1825	548699	1746	653	1	642	0	99	1225389	4123	1174999	3739	1736	3	1572	1
ERATH	3	91953	309	93021	296	111	0	109	0	0	0	0	0	0	0	0	0	0
FALLS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FANNIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FAYETTE	0	0	0	0	0	0	0	0	0	94	1168221	3931	1120182	3564	1655	3	1498	1
FISHER	0	0	0	0	0	0	0	0	0	11	136707	460	131085	417	194	0	175	0
FOARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fort Bend	78	2297588	7731	2324273	7396	2766	4	2719	2	135	1674035	5633	1605196	5108	2372	4	2147	1
FRANKLIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FREESTONE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galveston	90	2647383	8907	2678131	8522	3187	5	3133	2	30	372836	1254	357505	1138	528	1	478	0
GILLESPIE	33	963024	3240	974209	3100	1159	2	1140	1	5	62139	209	59584	190	88	0	80	0
GLASSCOCK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOLIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GONZALES	1	40385	136	40854	130	49	0	48	0	0	0	0	0	0	0	0	0	0
GRAYSON	22	642430	2162	649891	2068	773	1	760	0	28	345495	1162	331288	1054	490	1	443	0
GRIMES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Guadalupe	82	2405696	8094	2433636	7744	2896	4	2847	2	64	791656	2664	759102	2415	1122	2	1015	1
HALL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAMILTON	0	0	0	0	0	0	0	0	0	35	434976	1464	417089	1327	616	1	558	0
HARDEMAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harris	1006	29684742	99878	30029506	95550	35740	55	35127	22	2296	28529439	95991	27356265	87045	40426	62	36592	23
HASKELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hays	85	2513181	8456	2542370	8090	3026	5	2974	2	6	75810	255	72693	231	107	0	97	0
Henderson	1	14911	50	15085	48	18	0	18	0	0	0	0	0	0	0	0	0	0
HIDALGO	199	5861398	19721	5929473	18867	7057	11	6936	4	179	2225833	7489	2134304	6791	3154	5	2855	2
HILL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOPKINS	1	18639	63	18856	60	22	0	22	0	0	0	0	0	0	0	0	0	0
HOUSTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOWARD	1	39764	134	40225	128	48	0	47	0	0	0	0	0	0	0	0	0	0
HUDSPETH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hunt	3	90711	305	91764	292	109	0	107	0	0	0	0	0	0	0	0	0	0
IRION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JACKSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JEFF DAVIS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JIM HOGG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 51: Calculated ASHRAE Standard 90.1-1989 and 1999 Energy Use for Food and Lodging Building Types (USDOE 2004) (Part 3).

ERCOT Counties	Food									Lodging								
	In thousand sq.ft	Electricity (kWh/yr), PNNL				Gas (mBtu/yr), PNNL				In thousand sq.ft	Electricity (kWh/yr), PNNL				Gas (mBtu/yr), PNNL			
		1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)		1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)
JIM WELLS	1	18639	63	18856	60	22	0	22	0	0	0	0	0	0	0	0	0	0
Johnson	41	1198499	4033	1212418	3858	1443	2	1418	1	0	0	0	0	0	0	0	0	0
JONES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KARNES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kaufman	41	1206576	4060	1220589	3884	1453	2	1428	1	0	0	0	0	0	0	0	0	0
KENDALL	2	55918	188	56567	180	67	0	66	0	0	0	0	0	0	0	0	0	0
KENEDY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KERR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KIMBLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KINNEY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KLEBERG	34	992846	3341	1004378	3196	1195	2	1175	1	0	0	0	0	0	0	0	0	0
KNOX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LA SALLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAMAR	2	59024	199	59710	190	71	0	70	0	0	0	0	0	0	0	0	0	0
LAMPASAS	0	9320	31	9428	30	11	0	11	0	30	372836	1254	357505	1138	528	1	478	0
LAVACA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LEE	2	72693	245	73537	234	88	0	86	0	0	0	0	0	0	0	0	0	0
LEON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIMESTONE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIVE OAK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LLANO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOVING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MADISON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MARTIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MASON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MATAGORDA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAVERICK	6	188877	636	191071	608	227	0	224	0	200	2485576	8363	2383365	7584	3522	5	3188	2
MCCULLOCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MCLENNAN	31	920154	3096	930841	2962	1108	2	1089	1	70	869952	2927	834178	2654	1233	2	1116	1
MCMULLEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEDINA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MENARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MIDLAND	40	1165569	3922	1179107	3752	1403	2	1379	1	9	108123	364	103676	330	153	0	139	0
MILAM	21	619442	2084	626636	1994	746	1	733	0	0	0	0	0	0	0	0	0	0
MILLS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MITCHELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MONTAGUE	21	619442	2084	626636	1994	746	1	733	0	0	0	0	0	0	0	0	0	0
Montgomery	95	2805195	9438	2837775	9029	3377	5	3319	2	294	3658768	12310	3508314	11163	5184	8	4693	3
MOTLEY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NACOGDOCHES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NAVARRO	45	1332701	4484	1348179	4290	1605	2	1577	1	12	149135	502	143002	455	211	0	191	0
NOLAN	21	619442	2084	626636	1994	746	1	733	0	0	0	0	0	0	0	0	0	0
Nueces	22	641187	2157	648634	2064	772	1	759	0	72	891079	2998	854436	2719	1263	2	1143	1
PALO PINTO	43	1261872	4246	1276527	4062	1519	2	1493	1	0	0	0	0	0	0	0	0	0
Parker	112	3307210	11128	3345621	10645	3982	6	3913	2	0	0	0	0	0	0	0	0	0
PECOS	0	0	0	0	0	0	0	0	0	40	497115	1673	476673	1517	704	1	638	0
PRESIDIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RAINS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REAGAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RED RIVER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REEVES	1	31065	105	31426	100	37	0	37	0	0	0	0	0	0	0	0	0	0
REFUGIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROBERTSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rockwall	32	941899	3169	952839	3032	1134	2	1115	1	40	497115	1673	476673	1517	704	1	638	0
RUNNELS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rusk	30	872313	2935	882444	2808	1050	2	1032	1	0	0	0	0	0	0	0	0	0
San Patricio	34	997817	3357	1009406	3212	1201	2	1181	1	0	0	0	0	0	0	0	0	0
SAN SABA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCHLEICHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCURRY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHACKELFORD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smith	13	396393	1334	400997	1276	477	1	469	0	102	1263915	4253	1211941	3856	1791	3	1621	1
SOMERVELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STARR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STEPHENS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STERLING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STONEWALL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUTTON	0	0	0	0	0	0	0	0	0	10	123036	414	117977	375	174	0	158	0
Tarrant	597	17620229	59286	17824873	56717	21215	33	20850	13	961	11939463	40172	11448495	36428	16918	26	15314	9
TAYLOR	81	2383950	8021	2411637	7674	2870	4	2821	2	116	1441634	4851	1382352	4398	2043	3	1849	1
TERRELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
THROCKMORTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TITUS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOM GREEN	33	982906	3307	994321	3164	1183	2	1163	1	266	3299602	11102	3163917	10067	4675	7	4232	3
Travis	302	8921949	30019	9025570	28718	10742	17	10558	7	1057	13132540	44186	12592510	40068	18608	29	16844	10
UPTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UVALDE	50	1468767	4942	1485825	4728	1768	3	1738	1	0	0	0	0	0	0	0	0	0
VAL VERDE	1	31065	105	31426	100	37	0	37	0	11	134221	452	128702	410	190	0	172	0
VAN ZANDT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Victoria	3	93196	314	94278	300	112	0	110	0	46	574168	1932	550557	1752	814	1	736	0
Waller	5	134823	454	136389	434	162	0	160	0	0	0	0	0	0	0	0	0	0
WARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WASHINGTON	53	1569418	5281	1587646	5052	1890	3	1857	1	0	0	0	0	0	0	0	0	0
WEBB	7	207516	698	209926	668	250	0	246	0	294	3656282	12302	3505930	11155	5181	8	4690	3
WHARTON	6	177693	598	179757	572	214	0	210	0	39	479716	1614	459989	1464	680	1	615	0
WICHITA	22	642430	2162	649891	2068	773	1	760	0	227	2818643	9484	2702736	8600	3994	6	3615	2
WILBARGER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WILLACY	1	24852	84	25141	80	30	0	29	0	0	0	0	0	0	0	0	0	0
Williamson	199	5877552	19776	5945815	18919	7077	11	6955	4	163	2028230	6824	1944826	6188	2874	4	2601	2
Wilson	16	461009	1551	466363	1484	555	1	546	0	82	1019086	3429	977180	3109	1444	2	1307	1
WINKLER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WISE	0	0	0	0	0	0	0	0	0	135	1672792	5628	1604005	5104	2370	4	2146	1
YOUNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZAPATA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZAVALA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	5563	164120377	552204	166026500	528277	197601	304	194207	120	14294	177644100	597707	170339109	542000	251717	388	227846	141

Table 52: Calculated ASHRAE Standard 90.1-1989 and 1999 Energy Use for Office and Warehouse Building Types (USDOE 2004) (Part 1).

Non-attainment Counties	**Office**									**Warehouse**								
	In thousand sq.ft	**Electricity (kWh/yr), PNNL**				**Gas (mBtu/yr), PNNL**				**In thousand sq.ft**	**Electricity (kWh/yr), PNNL**				**Gas (mBtu/yr), PNNL**			
		1989 (Annual)	**1989 (OSD)**	**1999 (Annual)**	**1999 (OSD)**	**1989 (Annual)**	**1989 (OSD)**	**1999 (Annual)**	**1999 (OSD)**		**1989 (Annual)**	**1989 (OSD)**	**1999 (Annual)**	**1999 (OSD)**	**1989 (Annual)**	**1989 (OSD)**	**1999 (Annual)**	**1999 (OSD)**
Brazoria	119	1722524	5796	1539733	4899	668	1	752	0	169	511525	1721	878372	2795	1383	2	1539	1
Chambers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collin	766	11092188	37321	9915103	31549	4299	7	4843	3	733	2219639	7468	3811479	12128	6002	9	6677	4
Dallas	2446	35398599	119103	31642158	100682	13719	21	15456	10	3512	10635125	35783	18262232	58108	28760	44	31991	20
Denton	218	3158444	10627	2823275	8983	1224	2	1379	1	573	1734765	5837	2978872	9478	4691	7	5218	3
El Paso	187	2701034	9088	2414405	7682	1047	2	1179	1	795	2408016	8102	4134953	13157	6512	10	7243	4
Fort Bend	358	5174810	17411	4625668	14718	2006	3	2259	1	580	1757782	5914	3018396	9604	4753	7	5287	3
Galveston	736	10646358	35821	9516584	30281	4126	6	4648	3	63	192011	646	329715	1049	519	1	578	0
Hardin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harris	2156	31200850	104979	27889867	88742	12092	19	13623	8	6872	20812936	70028	35739183	113718	56283	87	62606	39
Jefferson	35	505177	1700	451569	1437	196	0	221	0	8	24834	84	42644	136	67	0	75	0
Liberty	1	18817	63	16821	54	7	0	8	0	0	0	0	0	0	0	0	0	0
Montgomery	98	1411312	4749	1261546	4014	547	1	616	0	152	460343	1549	790483	2515	1245	2	1385	1
Orange	4	59347	200	53050	169	23	0	26	0	0	0	0	0	0	0	0	0	0
Tarrant	1311	18972375	63835	16959058	53962	7353	11	8284	5	2740	8297978	27920	14248972	45339	22440	35	24960	15
Waller	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (Non-attainment)	8433	122061837	410693	109108836	347172	47307	73	53294	33	16197	49054952	165052	84235301	268027	132657	204	147558	91

Affected Counties	**Office**									**Warehouse**								
	In thousand sq.ft	**Electricity (kWh/yr), PNNL**				**Gas (mBtu/yr), PNNL**				**In thousand sq.ft**	**Electricity (kWh/yr), PNNL**				**Gas (mBtu/yr), PNNL**			
		1989 (Annual)	**1989 (OSD)**	**1999 (Annual)**	**1999 (OSD)**	**1989 (Annual)**	**1989 (OSD)**	**1999 (Annual)**	**1999 (OSD)**		**1989 (Annual)**	**1989 (OSD)**	**1999 (Annual)**	**1999 (OSD)**	**1989 (Annual)**	**1989 (OSD)**	**1999 (Annual)**	**1999 (OSD)**
Bastrop	34	493597	1661	441218	1404	191	0	216	0	0	0	0	0	0	0	0	0	0
Bexar	1862	26956782	90700	24096173	76671	10448	16	11770	7	2581	7817647	26303	13424166	42714	21141	33	23516	15
Caldwell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Comal	82	1189845	4003	1063580	3384	461	1	520	0	17	52697	177	90489	288	143	0	159	0
Ellis	32	466095	1568	416634	1326	181	0	204	0	111	337080	1134	578821	1842	912	1	1014	1
Gregg	28	403852	1359	360996	1149	157	0	176	0	69	207457	698	356237	1134	561	1	624	0
Guadalupe	47	680325	2289	608130	1935	264	0	297	0	506	1532456	5156	2631476	8373	4144	6	4610	3
Harrison	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hays	16	227257	765	203141	646	88	0	99	0	305	924925	3112	1588246	5054	2501	4	2782	2
Henderson	8	111457	375	99630	317	43	0	49	0	0	0	0	0	0	0	0	0	0
Hood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hunt	46	658612	2216	588721	1873	255	0	288	0	2	4846	16	8321	26	13	0	15	0
Johnson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kaufman	9	128827	433	115156	366	50	0	56	0	0	0	0	0	0	0	0	0	0
Nueces	53	764280	2572	683176	2174	296	0	334	0	0	0	0	0	0	0	0	0	0
Parker	5	70927	239	63401	202	27	0	31	0	0	0	0	0	0	0	0	0	0
Rockwall	46	664402	2235	593897	1890	257	0	290	0	29	87829	296	150816	480	238	0	264	0
Rusk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
San Patricio	14	206992	696	185027	589	80	0	90	0	0	0	0	0	0	0	0	0	0
Smith	171	2475224	8328	2212557	7040	959	1	1081	1	74	223508	752	383800	1221	604	1	672	0
Travis	608	8805139	29626	7870752	25044	3413	5	3844	2	447	1353165	4553	2323603	7393	3659	6	4070	3
Upshur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Victoria	31	447277	1505	399813	1272	173	0	195	0	0	0	0	0	0	0	0	0	0
Williamson	166	2395612	8060	2141393	6814	928	1	1046	1	131	396743	1335	681271	2168	1073	2	1193	1
Wilson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (Affected)	3257	47146504	158631	42143395	134095	18272	28	20585	13	4272	12938352	43533	22217247	70693	34988	54	38919	24

Table 53: Calculated ASHRAE Standard 90.1-1989 and 1999 Energy Use for Office and Warehouse Building Types (USDOE 2004) (Part 2).

ERCOT Counties	Office									Warehouse								
	In thousand sq.ft	Electricity (kWh/yr), PNNL				Gas (mBtu/yr), PNNL				In thousand sq.ft	Electricity (kWh/yr), PNNL				Gas (mBtu/yr), PNNL			
		1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)		1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)
ANDERSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANDREWS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANGELINA	63	904687	3044	808683	2573	351	1	395	0	7	21200	71	36404	116	57	0	64	0
ARANSAS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ATASCOSA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AUSTIN	31	454515	1529	406282	1293	176	0	198	0	1200	3634283	12228	6240654	19857	9828	15	10932	7
BANDERA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bastrop	572	8279697	27858	7401069	23549	3209	5	3615	2	0	0	0	0	0	0	0	0	0
BAYLOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BELL	490	7085510	23840	6333607	20153	2746	4	3094	2	5	14537	49	24963	79	39	0	44	0
Bexar	2428	35146734	118256	31417020	99965	13622	21	15346	9	2581	7817647	26303	13424166	42714	21141	33	23516	15
BLANCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BORDEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BOSQUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazoria	91	1312882	4417	1173561	3734	509	1	573	0	169	511525	1721	878372	2795	1383	2	1539	1
BRAZOS	263	3811266	12824	3406821	10840	1477	2	1664	1	0	0	0	0	0	0	0	0	0
BREWSTER	0	0	0	0	0	0	0	0	0	45	136286	459	234025	745	369	1	410	0
BRISCOE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BROOKS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BROWN	65	933637	3141	834561	2655	362	1	408	0	0	0	0	0	0	0	0	0	0
BURLESON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BURNET	0	0	0	0	0	0	0	0	0	18	53000	178	91010	290	143	0	159	0
Caldwell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CALHOUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CALLAHAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMERON	240	3466761	11664	3098874	9860	1344	2	1514	1	299	905239	3046	1554443	4946	2448	4	2723	2
Chambers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHEROKEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHILDRESS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLAY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COKE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COLEMAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collin	864	12502053	42065	11175355	35559	4845	7	5459	3	733	2219639	7468	3811479	12128	6002	9	6677	4
COLORADO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Comal	18	260550	877	232901	741	101	0	114	0	17	52697	177	90489	288	143	0	159	0
COMANCHE	70	1013250	3409	905725	2882	393	1	442	0	0	0	0	0	0	0	0	0	0
CONCHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COOKE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CORYELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTTLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CRANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CROCKETT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CROSBY	10	144750	487	129389	412	56	0	63	0	0	0	0	0	0	0	0	0	0
CULBERSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dallas	1586	22955894	77238	20519852	65292	8897	14	10023	6	3512	10635125	35783	18262232	58108	28760	44	31991	20
DAWSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DE WITT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DELTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Denton	251	3627434	12205	3242496	10317	1406	2	1584	1	573	1734765	5837	2978872	9478	4691	7	5218	3
DICKENS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIMMIT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DUVAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EASTLAND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ECTOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EDWARDS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ellis	99	1427234	4802	1275779	4059	553	1	623	0	111	337080	1134	578821	1842	912	1	1014	1
ERATH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FALLS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FANNIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FAYETTE	94	1360649	4578	1216260	3870	527	1	594	0	0	0	0	0	0	0	0	0	0
FISHER	11	159225	536	142328	453	62	0	70	0	0	0	0	0	0	0	0	0	0
FOARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fort Bend	135	1949782	6560	1742874	5546	756	1	851	1	580	1757782	5914	3018396	9604	4753	7	5287	3
FRANKLIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FREESTONE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galveston	30	434250	1461	388168	1235	168	0	190	0	63	192011	646	329715	1049	519	1	578	0
GILLESPIE	5	72375	244	64695	206	28	0	32	0	0	0	0	0	0	0	0	0	0
GLASSCOCK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOLIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GONZALES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRAYSON	28	402405	1354	359702	1145	156	0	176	0	123	372514	1253	639667	2035	1007	2	1121	1
GRIMES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Guadalupe	64	922057	3102	824210	2623	357	1	403	0	506	1532456	5156	2631476	8373	4144	6	4610	3
HALL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAMILTON	35	506625	1705	452863	1441	196	0	221	0	0	0	0	0	0	0	0	0	0
HARDEMAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harris	2296	33228797	111803	29702612	94510	12878	20	14508	9	6872	20812936	70028	35739183	113718	56283	87	62606	39
HASKELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hays	6	88297	297	78927	251	34	0	39	0	305	924925	3112	1588246	5054	2501	4	2782	2
Henderson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HIDALGO	179	2592471	8723	2317363	7374	1005	2	1132	1	233	704748	2371	1210167	3851	1906	3	2120	1
HILL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOPKINS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOUSTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOWARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HUDSPETH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hunt	0	0	0	0	0	0	0	0	0	2	4846	16	8321	26	13	0	15	0
IRION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JACKSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JEFF DAVIS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JIM HOGG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 54: Calculated ASHRAE Standard 90.1-1989 and 1999 Energy Use for Office and Warehouse Building Types (USDOE 2004) (Part 3).

ERCOT Counties	Office									Warehouse								
	In thousand sq.ft	Electricity (kWh/yr), PNNL				Gas (mBtu/yr), PNNL				In thousand sq.ft	Electricity (kWh/yr), PNNL				Gas (mBtu/yr), PNNL			
		1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)		1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)	1989 (Annual)	1989 (OSD)	1999 (Annual)	1999 (OSD)
JIM WELLS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Johnson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JONES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KARNES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kaufman	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KENDALL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KENEDY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KERR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KIMBLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KINNEY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KLEBERG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KNOX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LA SALLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAMAR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAMPASAS	30	434250	1461	388168	1235	168	0	190	0	0	0	0	0	0	0	0	0	0
LAVACA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LEON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIMESTONE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIVE OAK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LLANO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOVING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MADISON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MARTIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MASON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MATAGORDA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAVERICK	200	2894999	9741	2587786	8234	1122	2	1264	1	0	0	0	0	0	0	0	0	0
MCCULLOCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MCLENNAN	70	1013250	3409	905725	2882	393	1	442	0	0	0	0	0	0	0	0	0	0
MCMULLEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEDINA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MENARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MIDLAND	9	125932	424	112569	358	49	0	55	0	24	72686	245	124813	397	197	0	219	0
MILAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MILLS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MITCHELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MONTAGUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Montgomery	294	4261438	14338	3809222	12121	1652	3	1861	1	152	460343	1549	790483	2515	1245	2	1385	1
MOTLEY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NACOGDOCHES	0	0	0	0	0	0	0	0	0	6	18171	61	31203	99	49	0	55	0
NAVARRO	12	173700	584	155267	494	67	0	76	0	0	0	0	0	0	0	0	0	0
NOLAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nueces	72	1037857	3492	927721	2952	402	1	453	0	0	0	0	0	0	0	0	0	0
PALO PINTO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PECOS	40	579000	1948	517557	1647	224	0	253	0	0	0	0	0	0	0	0	0	0
PRESIDIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RAINS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REAGAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RED RIVER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REEVES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REFUGIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROBERTSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rockwall	40	579000	1948	517557	1647	224	0	253	0	29	87829	296	150816	480	238	0	264	0
RUNNELS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rusk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
San Patricio	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAN SABA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCHLEICHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCURRY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHACKELFORD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smith	102	1472107	4953	1315889	4187	571	1	643	0	74	223508	752	383800	1221	604	1	672	0
SOMERVELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STARR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STEPHENS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STERLING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STONEWALL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUTTON	10	143302	482	128095	408	56	0	63	0	0	0	0	0	0	0	0	0	0
Tarrant	961	13906127	46789	12430432	39552	5390	8	6072	4	2740	8297978	27920	14248972	45339	22440	35	24960	15
TAYLOR	116	1679099	5650	1500916	4776	651	1	733	0	140	424000	1427	728076	2317	1147	2	1275	1
TERRELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
THROCKMORTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TITUS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOM GREEN	266	3843111	12931	3435286	10931	1489	2	1678	1	46	138103	465	237145	755	373	1	415	0
Travis	1057	15295727	51464	13672569	43505	5928	9	6678	4	447	1353165	4553	2323603	7393	3659	6	4070	3
UPTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UVALDE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VAL VERDE	11	156330	526	139740	445	61	0	68	0	0	0	0	0	0	0	0	0	0
VAN ZANDT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Victoria	46	668745	2250	597779	1902	259	0	292	0	0	0	0	0	0	0	0	0	0
Waller	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WASHINGTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WEBB	294	4258543	14328	3806634	12112	1650	3	1859	1	0	0	0	0	0	0	0	0	0
WHARTON	39	558735	1880	499443	1589	217	0	244	0	0	0	0	0	0	0	0	0	0
WICHITA	227	3282929	11046	2934550	9337	1272	2	1433	1	0	0	0	0	0	0	0	0	0
WILBARGER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WILLACY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Williamson	163	2362319	7948	2111634	6719	916	1	1031	1	131	396743	1335	681271	2168	1073	2	1193	1
Wilson	82	1186950	3994	1060992	3376	460	1	518	0	0	0	0	0	0	0	0	0	0
WINKLER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WISE	135	1948334	6555	1741580	5542	755	1	851	1	0	0	0	0	0	0	0	0	0
YOUNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZAPATA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZAVALA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	14294	206905569	696161	184949091	588487	80189	123	90338	56	21742	65847764	221553	113071281	359780	178069	274	198071	122

Table 55: Calculated ASHRAE Standard 90.1-1989 and 1999 Annual Electricity and Natural Gas Savings (USDOE 2004). A decrease in energy use is negative (i.e., savings); a positive value represents an energy use increase (+). (Part 1)

Counties	Assembly		Education		Retail		Food		Lodging		Office		Warehouse		Total		Total*1.07 (T&D loss) for eGrid	
	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	MWh/yr	Therm/yr
Non-attainment Counties																		
(square feet in thousands)																		
Brazoria	-360859	362	-758626	766	-1061192	495	37119	-66	-46353	-151	-182791	84	366847	155	-2005855	1645	2146	-17604
Chambers	0	0	-14265	14	0	0	0	0	0	0	0	0	0	0	-14265	14	15	-154
Collin	-910288	913	-1989876	2009	-3260317	1522	114041	-203	-441396	-1442	-1177085	544	1591841	674	-6073081	4016	6498	-42973
Dallas	-2481924	2488	-4876782	4923	-4133779	1930	144593	-257	-810479	-2648	-3756441	1736	7627108	3231	-8287704	11402	8868	-121998
Denton	-854666	857	-1706938	1723	-1871526	874	65463	-117	-128070	-419	-335169	155	1244107	527	-3586799	3600	3838	-38524
El Paso	-607254	609	-765110	772	-1107608	517	38742	-69	-99604	-325	-286629	132	1726937	731	-1100526	2368	1178	-25334
Fort Bend	-493977	495	-1304578	1317	-762886	356	26685	-48	-68839	-225	-549142	254	1260614	534	-1892123	2684	2025	-28714
Galveston	-474815	476	-281051	284	-879031	410	30747	-55	-15332	-50	-1129774	522	137703	58	-2611553	1646	2794	-17610
Hardin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harris	-2846344	2853	-6523949	6585	-9856457	4601	344764	-614	-1173173	-3834	-3310983	1530	14926247	6322	-8439896	17446	9031	-186667
Jefferson	-95133	95	-140290	142	-402898	188	14093	-25	-99502	-325	-53609	25	17810	8	-759528	107	813	-1147
Liberty	0	0	-450342	455	-19186	9	671	-1	0	0	-1997	1	0	0	-470854	463	504	-4957
Montgomery	-504999	506	-625999	632	-931431	435	32580	-58	-150454	-492	-149766	69	330140	140	-1999929	1232	2140	-13187
Orange	-41716	42	-61657	62	-213517	100	7469	-13	-664	-2	-6298	3	0	0	-316384	191	339	-2046
Tarrant	-1351356	1355	-1285361	1297	-5850582	2731	204644	-364	-490969	-1604	-2013317	931	5950995	2521	-4835947	6866	5174	-73467
Waller	0	0	0	0	-44766	21	1566	-3	0	0	0	0	0	0	-43201	18	46	-194
Total (Non-attainment)	-11023331	11051	-20784825	20980	-30395178	14190	1063177	-1893	-3524834	-11518	-12953001	5987	35180349	14902	-42437644	53698	45408	-574574
Affected Counties																		
(square feet in thousands)																		
Bastrop	0	0	-90776	92	-60651	28	2121	-4	-292322	-955	-52380	24	0	0	-494008	-815	529	8719
Bexar	-843305	845	-2278118	2300	-3579459	1671	125204	-223	-1240888	-4055	-2860609	1322	5606519	2375	-5070656	4235	5426	-45316
Caldwell	0	0	-76629	77	-7633	4	267	0	0	0	0	0	0	0	-83995	80	90	-861
Comal	-76479	77	-401889	406	-313984	147	10983	-20	-9199	-30	-126264	58	37792	16	-879040	654	941	-6994
Ellis	-121417	122	-296495	299	-180097	84	6300	-11	-50390	-165	-49461	23	241741	102	-449820	454	481	-4863
Gregg	-129048	129	-58945	60	-26406	12	924	-2	-16507	-54	-42856	20	148780	63	-124058	228	133	-2444
Guadalupe	-44090	44	-145477	147	-798782	373	27940	-50	-32554	-106	-72195	33	1099019	466	33862	907	-36	-9702
Harrison	-113447	114	-30534	31	-7839	4	274	0	-1175	-4	0	0	0	0	-152721	144	163	-1540
Hays	-103442	104	-78279	79	-834471	390	29189	-52	-3117	-10	-24116	11	663321	281	-350916	802	375	-8584
Henderson	-24928	25	-23578	24	-4951	2	173	0	0	0	-11828	5	0	0	-65112	56	70	-602
Hood	-112260	113	0	0	0	0	0	0	0	0	0	0	0	0	-112260	113	120	-1204
Hunt	-27471	28	-124964	126	-30119	14	1054	-2	0	0	-69891	32	3475	1	-247917	200	265	-2136
Johnson	-16279	16	-112939	114	-397947	186	13920	-25	0	0	0	0	0	0	-513246	291	549	-3117
Kaufman	-72579	73	-123314	124	-400629	187	14013	-25	0	0	-13671	6	0	0	-596179	366	638	-3912
Nueces	-290315	291	-382555	386	-212898	99	7447	-13	-36642	-120	-81104	37	0	0	-996069	681	1066	-7288
Parker	0	0	-16387	17	-1098119	513	38411	-68	0	0	-7527	3	0	0	-1083622	464	1159	-4968
Rockwall	-32559	33	-281169	284	-312746	146	10939	-19	-20442	-67	-70505	33	62987	27	-643495	435	689	-4659
Rusk	0	0	0	0	-289641	135	10131	-18	0	0	0	0	0	0	-279510	117	299	-1254
San Patricio	-73427	74	-24285	25	-331313	155	11589	-21	0	0	-21966	10	0	0	-439402	242	470	-2593
Smith	-220958	222	-63307	64	-131617	61	4604	-8	-51974	-170	-262667	121	160292	68	-565628	358	605	-3832
Travis	-866367	869	-501978	507	-2962425	1383	103621	-184	-540030	-1765	-934387	432	970438	411	-4731127	1652	5062	-17676
Upshur	0	0	-90540	91	0	0	0	0	0	0	0	0	0	0	-90540	91	97	-978
Victoria	-8479	9	0	0	-30945	14	1082	-2	-23611	-77	-47464	22	0	0	-109416	-34	117	366
Williamson	-211971	213	-383145	387	-1951569	911	68263	-122	-83404	-273	-254218	118	284529	121	-2531515	1354	2709	-14491
Wilson	0	0	0	0	-153072	71	5354	-10	-41906	-137	0	0	0	0	-189624	-75	203	803
Total (Affected)	-3388820	3397	-5585304	5638	-14117315	6590	493802	-879	-2444162	-7987	-5003109	2313	9278895	3930	-20766014	13002	22220	-139126

Table 56: Calculated ASHRAE Standard 90.1-1989 and 1999 Annual Electricity and Natural Gas Savings (USDOE 2004). A decrease in energy use is negative (i.e., savings); a positive value represents an energy use increase (+). (Part 2)

ERCOT Counties																		
Counties	Assembly		Education		Retail		Food		Lodging		Office		Warehouse		Total		Total*1.07 (T&D loss) for eGrid	
	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	MWh/yr	Therm/yr
(square feet in thousands)																		
ANDERSON	0	0	0	0	-57763	27	2020	-4	0	0	0	0	0	0	-55743	23	60	-250
ANDREWS	0	0	-20041	20	0	0	0	0	0	0	0	0	0	0	-20041	20	21	-216
ANGELINA	-158385	159	-2829	3	-276232	129	9662	-17	-31941	-104	-96004	44	15204	6	-540524	220	578	-2352
ARANSAS	0	0	0	0	-329663	154	11531	-21	0	0	0	0	0	0	-318131	133	340	-1427
ARCHER	-7461	7	0	0	0	0	0	0	0	0	0	0	0	0	-7461	7	8	-80
ATASCOSA	-6783	7	-2829	3	-6395	3	224	0	0	0	0	0	0	0	-15784	12	17	-131
AUSTIN	0	0	0	0	0	0	0	0	-16047	-52	-48232	22	2606370	1104	2542091	1074	-2720	-11490
BANDERA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bastrop	0	0	-90776	92	-60651	28	2121	-4	-292322	-955	-878628	406	0	0	-1320256	-433	1413	4633
BAYLOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BEE	-89876	90	0	0	0	0	0	0	0	0	0	0	0	0	-89876	90	96	-964
BELL	-183821	184	-234838	237	-1052733	491	36823	-66	-250160	-817	-751903	348	10425	4	-2426207	382	2596	-4084
Bexar	-843305	845	-2278118	2300	-3579459	1671	125204	-223	-1240888	-4055	-3729714	1724	5606519	2375	-5939760	4637	6356	-49615
BLANCO	0	0	-90776	92	0	0	0	0	0	0	0	0	0	0	-90776	92	97	-980
BORDEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BOSQUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazoria	-360859	362	-758626	766	-1061192	495	37119	-66	-46353	-151	-139321	64	366847	155	-1962385	1625	2100	-17389
BRAZOS	-370525	371	-226350	228	-326156	152	11408	-20	-134560	-440	-404445	187	0	0	-1450628	479	1552	-5127
BREWSTER	0	0	0	0	0	0	0	0	0	0	0	0	97739	41	97739	41	-105	-443
BRISCOE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BROOKS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BROWN	0	0	-22163	22	-216406	101	7570	-13	-32963	-108	-99076	46	0	0	-363038	48	388	-514
BURLESON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BURNET	0	0	0	0	-57763	27	2020	-4	0	0	0	0	38010	16	-17733	39	19	-422
Caldwell	0	0	-76629	77	-7633	4	267	0	0	0	0	0	0	0	-83995	80	90	-861
CALHOUN	0	0	0	0	-319967	149	11192	-20	0	0	0	0	0	0	-308775	129	330	-1385
CALLAHAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMERON	-157367	158	-428415	432	-1056034	493	36938	-66	-122397	-400	-367887	170	649203	275	-1445958	1063	1547	-11369
Chambers	0	0	-14265	14	0	0	0	0	0	0	0	0	0	0	-14265	14	15	-154
CHEROKEE	-116160	116	-9431	10	-11346	5	397	-1	0	0	0	0	0	0	-136541	131	146	-1397
CHILDRESS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLAY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COKE	-31711	32	0	0	0	0	0	0	0	0	0	0	0	0	-31711	32	34	-340
COLEMAN	0	0	-6602	7	0	0	0	0	0	0	0	0	0	0	-6602	7	7	-71
Collin	-910288	913	-1989876	2009	-3260317	1522	114041	-203	-441396	-1442	-1326697	613	1591841	674	-6222693	4085	6658	-43713
COLORADO	0	0	-145005	146	0	0	0	0	0	0	0	0	0	0	-145005	146	155	-1566
Comal	-76479	77	-401889	406	-313984	147	10983	-20	-9199	-30	-27649	13	37792	16	-780425	608	835	-6507
COMANCHE	0	0	-19098	19	0	0	0	0	-35774	-117	-107524	50	0	0	-162396	-48	174	513
CONCHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COOKE	0	0	-30298	31	0	0	0	0	0	0	0	0	0	0	-30298	31	32	-327
CORYELL	0	0	0	0	-319760	149	11185	-20	0	0	0	0	0	0	-308576	129	330	-1384
COTTLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CRANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CROCKETT	-17975	18	0	0	0	0	0	0	0	0	0	0	0	0	-17975	18	19	-193
CROSBY	0	0	0	0	0	0	0	0	-5111	-17	-15361	7	0	0	-20471	-10	22	103
CULBERSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dallas	-2481924	2488	-4876782	4923	-4133779	1930	144593	-257	-810479	-2648	-2436042	1126	7627108	3231	-6967304	10791	7455	-115468
DAWSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DE WITT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DELTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Denton	-854666	857	-1706938	1723	-1871526	874	65463	-117	-128070	-419	-384937	178	1244107	527	-3636568	3623	3891	-38770
DICKENS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIMMIT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DUVAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EASTLAND	-63591	64	0	0	0	0	0	0	0	0	0	0	0	0	-63591	64	68	-682
ECTOR	-63930	64	-135574	137	-54462	25	1905	-3	0	0	0	0	0	0	-252062	223	270	-2386
EDWARDS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ellis	-121417	122	-296495	299	-180097	84	6300	-11	-50390	-165	-151456	70	241741	102	-551814	502	590	-5367
ERATH	0	0	0	0	-30532	14	1068	-2	0	0	0	0	0	0	-29464	12	32	-132
FALLS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FANNIN	-40698	41	0	0	0	0	0	0	0	0	0	0	0	0	-40698	41	44	-437
FAYETTE	0	0	-18037	18	0	0	0	0	-48039	-157	-144390	67	0	0	-210466	-72	225	771
FISHER	0	0	0	0	0	0	0	0	-5622	-18	-16897	8	0	0	-22518	-11	24	113
FOARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fort Bend	-493977	495	-1304578	1317	-762886	356	26685	-48	-68839	-225	-206908	96	1260614	534	-1549888	2525	1658	-27021
FRANKLIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 57: Calculated ASHRAE Standard 90.1-1989 and 1999 Annual Electricity and Natural Gas Savings (USDOE 2004). A decrease in energy use is negative (i.e., savings); a positive value represents an energy use increase (+). (Part 3)

Counties	Assembly		Education		Retail		Food		Lodging		Office		Warehouse		Total		Total*1.07 (T&D loss) for eGrid	
	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	MWh/yr	Therm/yr
FREESTONE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galveston	-474815	476	-281051	284	-879031	410	30747	-55	-15332	-50	-46082	21	137703	58	-1527860	1145	1635	-12250
GILLESPIE	-37476	38	0	0	-319760	149	11185	-20	-2555	-8	-7680	4	0	0	-356288	162	381	-1735
GLASSCOCK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOLIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GONZALES	0	0	-20749	21	-13409	6	469	-1	0	0	0	0	0	0	-33689	26	36	-282
GRAYSON	-10175	10	-130623	132	-213311	100	7461	-13	-14207	-46	-42703	20	267153	113	-136404	315	146	-3369
GRIMES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Guadalupe	-44090	44	-145477	147	-798782	373	27940	-50	-32554	-106	-97847	45	1099019	466	8209	919	-9	-9829
HALL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAMILTON	0	0	0	0	0	0	0	0	-17887	-58	-53762	25	0	0	-71649	-34	77	360
HARDEMAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harris	-2846344	2853	-6523949	6585	-9856457	4601	344764	-614	-1173173	-3834	-3526185	1630	14926247	6322	-8655098	17545	9261	-187732
HASKELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hays	-103442	104	-78279	79	-834471	390	29189	-52	-3117	-10	-9370	4	663321	281	-336170	795	360	-8511
Henderson	-24928	25	-23578	24	-4951	2	173	0	0	0	0	0	0	0	-53284	51	57	-543
HIDALGO	-282345	283	-553379	559	-1946206	909	68075	-121	-91530	-299	-275109	127	505419	214	-2575074	1671	2755	-17881
HILL	0	0	-14147	14	0	0	0	0	0	0	0	0	0	0	-14147	14	15	-153
Hood	-112260	113	0	0	0	0	0	0	0	0	0	0	0	0	-112260	113	120	-1204
HOPKINS	0	0	0	0	-6189	3	216	0	0	0	0	0	0	0	-5972	3	6	-27
HOUSTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOWARD	-39003	39	0	0	-13203	6	462	-1	0	0	0	0	0	0	-51744	44	55	-476
HUDSPETH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hunt	-27471	28	-124964	126	-30119	14	1054	-2	0	0	0	0	3475	1	-178026	167	190	-1791
IRION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JACKSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JEFF DAVIS	-35272	35	0	0	0	0	0	0	0	0	0	0	0	0	-35272	35	38	-378
JIM HOGG	0	0	-11789	12	0	0	0	0	0	0	0	0	0	0	-11789	12	13	-127
JIM WELLS	0	0	-11907	12	-6189	3	216	0	0	0	0	0	0	0	-17879	15	19	-155
Johnson	-16279	16	-112939	114	-397947	186	13920	-25	0	0	0	0	0	0	-513246	291	549	-3117
JONES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KARNES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kaufman	-72579	73	-123314	124	-400629	187	14013	-25	0	0	0	0	0	0	-582508	359	623	-3845
KENDALL	-25436	26	0	0	-18567	9	649	-1	0	0	0	0	0	0	-43354	33	46	-353
KENEDY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KERR	-82753	83	0	0	0	0	0	0	0	0	0	0	0	0	-82753	83	89	-888
KIMBLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KINNEY	0	0	-10728	11	0	0	0	0	0	0	0	0	0	0	-10728	11	11	-116
KLEBERG	0	0	-129326	131	-329663	154	11531	-21	0	0	0	0	0	0	-447458	264	479	-2824
KNOX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LA SALLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAMAR	-13566	14	-35367	36	-19598	9	686	-1	0	0	0	0	0	0	-67846	57	73	-612
LAMPASAS	0	0	0	0	-3094	1	108	0	-15332	-50	-46082	21	0	0	-64400	-28	69	295
LAVACA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LEE	0	0	0	0	-24137	11	844	-2	0	0	0	0	0	0	-23292	10	25	-104
LEON	-37307	37	0	0	0	0	0	0	0	0	0	0	0	0	-37307	37	40	-400
LIMESTONE	0	0	-9431	10	0	0	0	0	0	0	0	0	0	0	-9431	10	10	-102
LIVE OAK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LLANO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOVING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MADISON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MARTIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MASON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MATAGORDA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAVERICK	-50873	51	-31123	31	-62714	29	2194	-4	-102211	-334	-307213	142	0	0	-551940	-84	591	901
MCCULLOCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MCLENNAN	-81227	81	0	0	-305526	143	10687	-19	-35774	-117	-107524	50	0	0	-519364	138	556	-1475
MCMULLEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEDINA	0	0	-93251	94	0	0	0	0	0	0	0	0	0	0	-93251	94	100	-1007
MENARD	0	0	-5895	6	0	0	0	0	0	0	0	0	0	0	-5895	6	6	-64
MIDLAND	-326096	327	-128383	130	-387013	181	13537	-24	-4446	-15	-13364	6	52127	22	-793637	627	849	-6707
MILAM	0	0	0	0	-205678	96	7194	-13	0	0	0	0	0	0	-198484	83	212	-890
MILLS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MITCHELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MONTAGUE	0	0	0	0	-205678	96	7194	-13	0	0	0	0	0	0	-198484	83	212	-890
Montgomery	-504999	506	-625999	632	-931431	435	32580	-58	-150454	-492	-452217	209	330140	140	-2302380	1372	2464	-14682
MOTLEY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 58: Calculated ASHRAE Standard 90.1-1989 and 1999 Annual Electricity and Natural Gas Savings (USDOE 2004). A decrease in energy use is negative (i.e., savings); a positive value represents an energy use increase (+). (Part 4)

Counties	Assembly		Education		Retail		Food		Lodging		Office		Warehouse		Total		Total*1.07 (T&D loss) for eGrid	
	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	MWh/yr	Therm/yr
NACOGDOCHES	-8648	9	-74035	75	0	0	0	0	0	0	0	0	13032	6	-69652	89	75	-951
NAVARRO	0	0	-33009	33	-442507	207	15478	-28	-6133	-20	-18433	9	0	0	-484604	201	519	-2149
NOLAN	0	0	0	0	-205678	96	7194	-13	0	0	0	0	0	0	-198484	83	212	-890
Nueces	-290315	291	-382555	386	-212898	99	7447	-13	-36642	-120	-110136	51	0	0	-1025100	694	1097	-7431
PALO PINTO	-8479	9	0	0	-418989	196	14656	-26	0	0	0	0	0	0	-412812	178	442	-1905
Parker	0	0	-16387	17	-1098119	513	38411	-68	0	0	0	0	0	0	-1076095	461	1151	-4931
PECOS	0	0	0	0	0	0	0	0	-20442	-67	-61443	28	0	0	-81885	-38	88	411
PRESIDIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RAINS	0	0	-16505	17	0	0	0	0	0	0	0	0	0	0	-16505	17	18	-178
REAGAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RED RIVER	-1865	2	0	0	0	0	0	0	0	0	0	0	0	0	-1865	2	2	-20
REEVES	-16958	17	0	0	-10315	5	361	-1	0	0	0	0	0	0	-26912	21	29	-227
REFUGIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROBERTSON	0	0	-3773	4	0	0	0	0	0	0	0	0	0	0	-3773	4	4	-41
Rockwall	-32559	33	-281169	284	-312746	146	10939	-19	-20442	-67	-61443	28	62987	27	-634432	431	679	-4614
RUNNELS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rusk	0	0	0	0	-289641	135	10131	-18	0	0	0	0	0	0	-279510	117	299	-1254
San Patricio	-73427	74	-24285	25	-331313	155	11589	-21	0	0	0	0	0	0	-417436	232	447	-2484
SAN SABA	-35442	36	0	0	0	0	0	0	0	0	0	0	0	0	-35442	36	38	-380
SCHLEICHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCURRY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHACKELFORD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smith	-220958	222	-63307	64	-131617	61	4604	-8	-51974	-170	-156218	72	160292	68	-459179	309	491	-3305
SOMERVELL	0	0	-14147	14	0	0	0	0	0	0	0	0	0	0	-14147	14	15	-153
STARR	-32220	32	-90894	92	0	0	0	0	0	0	0	0	0	0	-123113	124	132	-1327
STEPHENS	0	0	-23107	23	0	0	0	0	0	0	0	0	0	0	-23107	23	25	-250
STERLING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STONEWALL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUTTON	0	0	0	0	0	0	0	0	-5059	-17	-15207	7	0	0	-20266	-10	22	102
Tarrant	-1351356	1355	-1285361	1297	-5850582	2731	204644	-364	-490969	-1604	-1475695	682	5950995	2521	-4298325	6618	4599	-70808
TAYLOR	-61387	62	-34188	35	-791562	370	27688	-49	-59282	-194	-178183	82	304077	129	-792838	434	848	-4641
TERRELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
THROCKMORTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TITUS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOM GREEN	-123452	124	-104333	105	-326362	152	11416	-20	-135685	-443	-407825	189	99042	42	-987198	148	1056	-1586
Travis	-866367	869	-501978	507	-2962425	1383	103621	-184	-540030	-1765	-1623157	750	970438	411	-5419898	1970	5799	-21083
UPTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UVALDE	-25436	26	0	0	-487686	228	17059	-30	0	0	0	0	0	0	-496064	223	531	-2384
VAL VERDE	-11701	12	-36782	37	-10315	5	361	-1	-5519	-18	-16589	8	0	0	-80546	43	86	-456
VAN ZANDT	0	0	-19098	19	0	0	0	0	0	0	0	0	0	0	-19098	19	20	-206
Victoria	-8479	9	0	0	-30945	14	1082	-2	-23611	-77	-70966	33	0	0	-132918	-23	142	250
Waller	0	0	0	0	-44766	21	1566	-3	0	0	0	0	0	0	-43201	18	46	-194
WARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WASHINGTON	-2883	3	0	0	-521106	243	18227	-32	0	0	0	0	0	0	-505761	214	541	-2287
WEBB	-46125	46	-860837	869	-68903	32	2410	-4	-150352	-491	-451910	209	0	0	-1575717	661	1686	-7069
WHARTON	-75292	75	0	0	-59001	28	2064	-4	-19727	-64	-59292	27	0	0	-211248	62	226	-667
WICHITA	-188569	189	-103744	105	-213311	100	7461	-13	-115907	-379	-348379	161	0	0	-962449	162	1030	-1737
WILBARGER	-2204	2	0	0	0	0	0	0	0	0	0	0	0	0	-2204	2	2	-24
WILLACY	0	0	0	0	-8252	4	289	-1	0	0	0	0	0	0	-7963	3	9	-36
Williamson	-211971	213	-383145	387	-1951569	911	68263	-122	-83404	-273	-250685	116	284529	121	-2527982	1353	2705	-14473
Wilson	0	0	0	0	-153072	71	5354	-10	-41906	-137	-125957	58	0	0	-315582	-17	338	180
WINKLER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WISE	-50873	51	-391397	395	0	0	0	0	-68788	-225	-206754	96	0	0	-717812	317	768	-3390
YOUNG	-4409	4	0	0	0	0	0	0	0	0	0	0	0	0	-4409	4	5	-47
ZAPATA	0	0	-172120	174	0	0	0	0	0	0	0	0	0	0	-172120	174	184	-1859
ZAVALA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	-16451310	16492	-29329066	29605	-54494173	25440	1906122	-3393	-7304991	-23871	-21956479	10149	47223517	20003	-80406379	74424	86035	-796341

Table 59: Calculated ASHRAE Standard 90.1-1989 and 1999 OSD Electricity and Natural Gas Savings (USDOE 2004). A decrease in energy use is negative (i.e., savings); a positive value represents an energy use increase (+). (Part 1)

Counties	Assembly		Education		Retail		Food		Lodging		Office		Warehouse		Total		Total*1.07 (T&D loss) for eGrid	
	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	MWh/yr	Therm/yr
Non-attainment Counties																		
(square feet in thousands)																		
Brazoria	-1843	-6	-3631	-11	-4608	-1	-466	-4	-353	-2	-896	-1	1074	-1	-10724	-25	11	266
Chambers	0	0	-68	0	0	0	0	0	0	0	0	0	0	0	-68	0	0	2
Collin	-4650	-15	-9525	-28	-14157	-4	-1432	-11	-3366	-15	-5772	-4	4659	-5	-34241	-82	37	875
Dallas	-12677	-42	-23343	-69	-17949	-5	-1815	-14	-6181	-27	-18421	-12	22325	-25	-58062	-193	62	2063
Denton	-4366	-14	-8170	-24	-8126	-2	-822	-6	-977	-4	-1644	-1	3642	-4	-20463	-56	22	602
El Paso	-3102	-10	-3662	-11	-4809	-1	-486	-4	-760	-3	-1406	-1	5055	-6	-9170	-36	10	383
Fort Bend	-2523	-8	-6244	-18	-3313	-1	-335	-3	-525	-2	-2693	-2	3690	-4	-11943	-38	13	409
Galveston	-2425	-8	-1345	-4	-3817	-1	-386	-3	-117	-1	-5540	-3	403	0	-13228	-20	14	218
Hardin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harris	-14539	-48	-31227	-92	-42798	-11	-4328	-33	-8947	-40	-16237	-10	43690	-48	-74385	-282	80	3020
Jefferson	-486	-2	-672	-2	-1749	0	-177	-1	-759	-3	-263	0	52	0	-4053	-9	4	96
Liberty	0	0	-2156	-6	-83	0	-8	0	0	0	-10	0	0	0	-2257	-6	2	69
Montgomery	-2579	-9	-2996	-9	-4044	-1	-409	-3	-1147	-5	-734	0	966	-1	-10945	-28	12	301
Orange	-213	-1	-295	-1	-927	0	-94	-1	-5	0	-31	0	0	0	-1565	-3	2	28
Tarrant	-6903	-23	-6152	-18	-25404	-6	-2569	-20	-3744	-17	-9873	-6	17419	-19	-37226	-109	40	1168
Waller	0	0	0	0	-194	0	-20	0	0	0	0	0	0	0	-214	0	0	2
Total (Non-attainment)	-56306	-186	-99487	-294	-131979	-34	-13346	-103	-26880	-119	-63521	-40	102975	-113	-288544	-888	309	9503
Affected Counties																		
(square feet in thousands)																		
Bastrop	0	0	-435	-1	-263	0	-27	0	-2229	-10	-257	0	0	0	-3211	-12	3	124
Bexar	-4308	-14	-10904	-32	-15542	-4	-1572	-12	-9463	-42	-14028	-9	16411	-18	-39406	-131	42	1404
Caldwell	0	0	-367	-1	-33	0	-3	0	0	0	0	0	0	0	-403	-1	0	12
Comal	-391	-1	-1924	-6	-1363	0	-138	-1	-70	0	-619	0	111	0	-4394	-9	5	98
Ellis	-620	-2	-1419	-4	-782	0	-79	-1	-384	-2	-243	0	708	-1	-2820	-10	3	104
Gregg	-659	-2	-282	-1	-115	0	-12	0	-126	-1	-210	0	435	0	-968	-4	1	46
Guadalupe	-225	-1	-696	-2	-3468	-1	-351	-3	-248	-1	-354	0	3217	-4	-2126	-11	2	120
Harrison	-579	-2	-146	0	-34	0	-3	0	-9	0	0	0	0	0	-772	-2	1	26
Hays	-528	-2	-375	-1	-3623	-1	-366	-3	-24	0	-118	0	1942	-2	-3093	-9	3	95
Henderson	-127	0	-113	0	-21	0	-2	0	0	0	-58	0	0	0	-322	-1	0	9
Hood	-573	-2	0	0	0	0	0	0	0	0	0	0	0	0	-573	-2	1	20
Hunt	-140	0	-598	-2	-131	0	-13	0	0	0	-343	0	10	0	-1215	-3	1	28
Johnson	-83	0	-541	-2	-1728	0	-175	-1	0	0	0	0	0	0	-2526	-4	3	39
Kaufman	-371	-1	-590	-2	-1740	0	-176	-1	0	0	-67	0	0	0	-2943	-5	3	51
Nueces	-1483	-5	-1831	-5	-924	0	-93	-1	-279	-1	-398	0	0	0	-5009	-13	5	136
Parker	0	0	-78	0	-4768	-1	-482	-4	0	0	-37	0	0	0	-5366	-5	6	55
Rockwall	-166	-1	-1346	-4	-1358	0	-137	-1	-156	-1	-346	0	184	0	-3325	-7	4	75
Rusk	0	0	0	0	-1258	0	-127	-1	0	0	0	0	0	0	-1385	-1	1	14
San Patricio	-375	-1	-116	0	-1439	0	-145	-1	0	0	-108	0	0	0	-2183	-3	2	34
Smith	-1129	-4	-303	-1	-571	0	-58	0	-396	-2	-1288	-1	469	-1	-3276	-8	4	89
Travis	-4425	-15	-2403	-7	-12863	-3	-1301	-10	-4118	-18	-4582	-3	2841	-3	-26852	-59	29	634
Upshur	0	0	-433	-1	0	0	0	0	0	0	0	0	0	0	-433	-1	0	14
Victoria	-43	0	0	0	-134	0	-14	0	-180	-1	-233	0	0	0	-604	-1	1	13
Williamson	-1083	-4	-1834	-5	-8474	-2	-857	-7	-636	-3	-1247	-1	833	-1	-13297	-22	14	238
Wilson	0	0	0	0	-665	0	-67	-1	-320	-1	0	0	0	0	-1051	-2	1	22
Total (Affected)	-17310	-57	-26734	-79	-61299	-16	-6199	-48	-18639	-83	-24535	-15	27160	-30	-127556	-327	136	3502

Table 60: Calculated ASHRAE Standard 90.1-1989 and 1999 OSD Electricity and Natural Gas Savings (USDOE 2004). A decrease in energy use is negative (i.e., savings); a positive value represents an energy use increase (+). (Part 2)

ERCOT Counties																		
Counties	Assembly		Education		Retail		Food		Lodging		Office		Warehouse		Total		Total*1.07 (T&D loss) for eGrid	
	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	MWh/yr	Therm/yr
(square feet in thousands)																		
ANDERSON	0	0	0	0	-251	0	-25	0	0	0	0	0	0	0	-276	0	0	3
ANDREWS	0	0	-96	0	0	0	0	0	0	0	0	0	0	0	-96	0	0	3
ANGELINA	-809	-3	-14	0	-1199	0	-121	-1	-244	-1	-471	0	45	0	-2813	-5	3	58
ARANSAS	0	0	0	0	-1431	0	-145	-1	0	0	0	0	0	0	-1576	-1	2	16
ARCHER	-38	0	0	0	0	0	0	0	0	0	0	0	0	0	-38	0	0	1
ATASCOSA	-35	0	-14	0	-28	0	-3	0	0	0	0	0	0	0	-79	0	0	2
AUSTIN	0	0	0	0	0	0	0	0	-122	-1	-237	0	7629	-8	7270	-9	-8	97
BANDERA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bastrop	0	0	-435	-1	-263	0	-27	0	-2229	-10	-4309	-3	0	0	-7262	-14	8	151
BAYLOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BEE	-459	-2	0	0	0	0	0	0	0	0	0	0	0	0	-459	-2	0	16
BELL	-939	-3	-1124	-3	-4571	-1	-462	-4	-1908	-8	-3687	-2	31	0	-12661	-22	14	235
Bexar	-4308	-14	-10904	-32	-15542	-4	-1572	-12	-9463	-42	-18290	-11	16411	-18	-43668	-134	47	1433
BLANCO	0	0	-435	-1	0	0	0	0	0	0	0	0	0	0	-435	-1	0	14
BORDEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BOSQUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazoria	-1843	-6	-3631	-11	-4608	-1	-466	-4	-353	-2	-683	0	1074	-1	-10511	-25	11	265
BRAZOS	-1893	-6	-1083	-3	-1416	0	-143	-1	-1026	-5	-1983	-1	0	0	-7545	-17	8	179
BREWSTER	0	0	0	0	0	0	0	0	0	0	0	0	286	0	286	0	0	3
BRISCOE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BROOKS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BROWN	0	0	-106	0	-940	0	-95	-1	-251	-1	-486	0	0	0	-1878	-3	2	29
BURLESON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BURNET	0	0	0	0	-251	0	-25	0	0	0	0	0	111	0	-165	0	0	4
Caldwell	0	0	-367	-1	-33	0	-3	0	0	0	0	0	0	0	-403	-1	0	12
CALHOUN	0	0	0	0	-1389	0	-140	-1	0	0	0	0	0	0	-1530	-1	2	15
CALLAHAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMERON	-804	-3	-2051	-6	-4585	-1	-464	-4	-933	-4	-1804	-1	1900	-2	-8741	-21	9	223
Chambers	0	0	-68	0	0	0	0	0	0	0	0	0	0	0	-68	0	0	2
CHEROKEE	-593	-2	-45	0	-49	0	-5	0	0	0	0	0	0	0	-693	-2	1	23
CHILDRESS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLAY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COKE	-162	-1	0	0	0	0	0	0	0	0	0	0	0	0	-162	-1	0	6
COLEMAN	0	0	-32	0	0	0	0	0	0	0	0	0	0	0	-32	0	0	1
Collin	-4650	-15	-9525	-28	-14157	-4	-1432	-11	-3366	-15	-6506	-4	4659	-5	-34975	-82	37	880
COLORADO	0	0	-694	-2	0	0	0	0	0	0	0	0	0	0	-694	-2	1	22
Comal	-391	-1	-1924	-6	-1363	0	-138	-1	-70	0	-136	0	111	0	-3911	-9	4	95
COMANCHE	0	0	-91	0	0	0	0	0	-273	-1	-527	0	0	0	-892	-2	1	19
CONCHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COOKE	0	0	-145	0	0	0	0	0	0	0	0	0	0	0	-145	0	0	5
CORYELL	0	0	0	0	-1388	0	-140	-1	0	0	0	0	0	0	-1529	-1	2	15
COTTLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CRANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CROCKETT	-92	0	0	0	0	0	0	0	0	0	0	0	0	0	-92	0	0	3
CROSBY	0	0	0	0	0	0	0	0	-39	0	-75	0	0	0	-114	0	0	2
CULBERSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dallas	-12677	-42	-23343	-69	-17949	-5	-1815	-14	-6181	-27	-11946	-8	22325	-25	-51587	-189	55	2020
DAWSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DE WITT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DELTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Denton	-4366	-14	-8170	-24	-8126	-2	-822	-6	-977	-4	-1888	-1	3642	-4	-20707	-56	22	604
DICKENS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIMMIT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DUVAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EASTLAND	-325	-1	0	0	0	0	0	0	0	0	0	0	0	0	-325	-1	0	11
ECTOR	-327	-1	-649	-2	-236	0	-24	0	0	0	0	0	0	0	-1236	-3	1	35
EDWARDS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ellis	-620	-2	-1419	-4	-782	0	-79	-1	-384	-2	-743	0	708	-1	-3320	-10	4	107
ERATH	0	0	0	0	-133	0	-13	0	0	0	0	0	0	0	-146	0	0	1
FALLS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FANNIN	-208	-1	0	0	0	0	0	0	0	0	0	0	0	0	-208	-1	0	7
FAYETTE	0	0	-86	0	0	0	0	0	-366	-2	-708	0	0	0	-1161	-2	1	25
FISHER	0	0	0	0	0	0	0	0	-43	0	-83	0	0	0	-126	0	0	3
FOARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fort Bend	-2523	-8	-6244	-18	-3313	-1	-335	-3	-525	-2	-1015	-1	3690	-4	-10265	-37	11	398
FRANKLIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 61: Calculated ASHRAE Standard 90.1-1989 and 1999 OSD Electricity and Natural Gas Savings (USDOE 2004). A decrease in energy use is negative (i.e., savings); a positive value represents an energy use increase (+). (Part 3)

Counties	Assembly		Education		Retail		Food		Lodging		Office		Warehouse		Total		Total*1.07 (T&D loss) for eGrid	
	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	MWh/yr	Therm/yr
(square feet in thousands)																		
FREESTONE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galveston	-2425	-8	-1345	-4	-3817	-1	-386	-3	-117	-1	-226	0	403	0	-7913	-17	8	182
GILLESPIE	-191	-1	0	0	-1388	0	-140	-1	-19	0	-38	0	0	0	-1777	-2	2	23
GLASSCOCK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOLIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GONZALES	0	0	-99	0	-58	0	-6	0	0	0	0	0	0	0	-163	0	0	4
GRAYSON	-52	0	-625	-2	-926	0	-94	-1	-108	0	-209	0	782	-1	-1233	-4	1	48
GRIMES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Guadalupe	-225	-1	-696	-2	-3468	-1	-351	-3	-248	-1	-480	0	3217	-4	-2252	-11	2	121
HALL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAMILTON	0	0	0	0	0	0	0	0	-136	-1	-264	0	0	0	-400	-1	0	8
HARDEMAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harris	-14539	-48	-31227	-92	-42798	-11	-4328	-33	-8947	-40	-17292	-11	43690	-48	-75440	-283	81	3027
HASKELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hays	-528	-2	-375	-1	-3623	-1	-366	-3	-24	0	-46	0	1942	-2	-3021	-9	3	95
Henderson	-127	0	-113	0	-21	0	-2	0	0	0	0	0	0	0	-264	-1	0	8
HIDALGO	-1442	-5	-2649	-8	-8451	-2	-855	-7	-698	-3	-1349	-1	1479	-2	-13964	-27	15	288
HILL	0	0	-68	0	0	0	0	0	0	0	0	0	0	0	-68	0	0	2
Hood	-573	-2	0	0	0	0	0	0	0	0	0	0	0	0	-573	-2	1	20
HOPKINS	0	0	0	0	-27	0	-3	0	0	0	0	0	0	0	-30	0	0	0
HOUSTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOWARD	-199	-1	0	0	-57	0	-6	0	0	0	0	0	0	0	-262	-1	0	8
HUDSPETH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hunt	-140	0	-598	-2	-131	0	-13	0	0	0	0	0	10	0	-872	-2	1	25
IRION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JACKSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JEFF DAVIS	-180	-1	0	0	0	0	0	0	0	0	0	0	0	0	-180	-1	0	6
JIM HOGG	0	0	-56	0	0	0	0	0	0	0	0	0	0	0	-56	0	0	2
JIM WELLS	0	0	-57	0	-27	0	-3	0	0	0	0	0	0	0	-87	0	0	2
Johnson	-83	0	-541	-2	-1728	0	-175	-1	0	0	0	0	0	0	-2526	-4	3	39
JONES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KARNES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kaufman	-371	-1	-590	-2	-1740	0	-176	-1	0	0	0	0	0	0	-2876	-5	3	51
KENDALL	-130	0	0	0	-81	0	-8	0	0	0	0	0	0	0	-219	-1	0	5
KENEDY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KERR	-423	-1	0	0	0	0	0	0	0	0	0	0	0	0	-423	-1	0	15
KIMBLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KINNEY	0	0	-51	0	0	0	0	0	0	0	0	0	0	0	-51	0	0	2
KLEBERG	0	0	-619	-2	-1431	0	-145	-1	0	0	0	0	0	0	-2195	-3	2	35
KNOX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LA SALLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAMAR	-69	0	-169	0	-85	0	-9	0	0	0	0	0	0	0	-332	-1	0	9
LAMPASAS	0	0	0	0	-13	0	-1	0	-117	-1	-226	0	0	0	-358	-1	0	7
LAVACA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LEE	0	0	0	0	-105	0	-11	0	0	0	0	0	0	0	-115	0	0	1
LEON	-191	-1	0	0	0	0	0	0	0	0	0	0	0	0	-191	-1	0	7
LIMESTONE	0	0	-45	0	0	0	0	0	0	0	0	0	0	0	-45	0	0	1
LIVE OAK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LLANO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOVING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MADISON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MARTIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MASON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MATAGORDA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAVERICK	-260	-1	-149	0	-272	0	-28	0	-779	-3	-1507	-1	0	0	-2995	-6	3	64
MCCULLOCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MCLENNAN	-415	-1	0	0	-1327	0	-134	-1	-273	-1	-527	0	0	0	-2676	-4	3	46
MCMULLEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEDINA	0	0	-446	-1	0	0	0	0	0	0	0	0	0	0	-446	-1	0	14
MENARD	0	0	-28	0	0	0	0	0	0	0	0	0	0	0	-28	0	0	1
MIDLAND	-1666	-6	-615	-2	-1680	0	-170	-1	-34	0	-66	0	153	0	-4077	-9	4	101
MILAM	0	0	0	0	-893	0	-90	-1	0	0	0	0	0	0	-983	-1	1	10
MILLS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MITCHELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MONTAGUE	0	0	0	0	-893	0	-90	-1	0	0	0	0	0	0	-983	-1	1	10
Montgomery	-2579	-9	-2996	-9	-4044	-1	-409	-3	-1147	-5	-2218	-1	966	-1	-12428	-29	13	311
MOTLEY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 62: Calculated ASHRAE Standard 90.1-1989 and 1999 OSD Electricity and Natural Gas Savings (USDOE 2004). A decrease in energy use is negative (i.e., savings); a positive value represents an energy use increase (+). (Part 4)

Counties	Assembly		Education		Retail		Food		Lodging		Office		Warehouse		Total		Total*1.07 (T&D loss) for eGrid	
	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	MWh/yr	Therm/yr
(square feet in thousands)																		
NACOGDOCHES	-44	0	-354	-1	0	0	0	0	0	0	0	0	38	0	-360	-1	0	13
NAVARRO	0	0	-158	0	-1921	0	-194	-1	-47	0	-90	0	0	0	-2411	-3	3	29
NOLAN	0	0	0	0	-893	0	-90	-1	0	0	0	0	0	0	-983	-1	1	10
Nueces	-1483	-5	-1831	-5	-924	0	-93	-1	-279	-1	-540	0	0	0	-5151	-13	6	137
PALO PINTO	-43	0	0	0	-1819	0	-184	-1	0	0	0	0	0	0	-2047	-2	2	22
Parker	0	0	-78	0	-4768	-1	-482	-4	0	0	0	0	0	0	-5329	-5	6	55
PECOS	0	0	0	0	0	0	0	0	-156	-1	-301	0	0	0	-457	-1	0	9
PRESIDIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RAINS	0	0	-79	0	0	0	0	0	0	0	0	0	0	0	-79	0	0	2
REAGAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RED RIVER	-10	0	0	0	0	0	0	0	0	0	0	0	0	0	-10	0	0	0
REEVES	-87	0	0	0	-45	0	-5	0	0	0	0	0	0	0	-136	0	0	4
REFUGIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROBERTSON	0	0	-18	0	0	0	0	0	0	0	0	0	0	0	-18	0	0	1
Rockwall	-166	-1	-1346	-4	-1358	0	-137	-1	-156	-1	-301	0	184	0	-3280	-7	4	75
RUNNELS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rusk	0	0	0	0	-1258	0	-127	-1	0	0	0	0	0	0	-1385	-1	1	14
San Patricio	-375	-1	-116	0	-1439	0	-145	-1	0	0	0	0	0	0	-2075	-3	2	33
SAN SABA	-181	-1	0	0	0	0	0	0	0	0	0	0	0	0	-181	-1	0	6
SCHLEICHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCURRY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHACKELFORD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smith	-1129	-4	-303	-1	-571	0	-58	0	-396	-2	-766	0	469	-1	-2754	-8	3	85
SOMERVELL	0	0	-68	0	0	0	0	0	0	0	0	0	0	0	-68	0	0	2
STARR	-165	-1	-435	-1	0	0	0	0	0	0	0	0	0	0	-600	-2	1	20
STEPHENS	0	0	-111	0	0	0	0	0	0	0	0	0	0	0	-111	0	0	3
STERLING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STONEWALL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUTTON	0	0	0	0	0	0	0	0	-39	0	-75	0	0	0	-113	0	0	2
Tarrant	-6903	-23	-6152	-18	-25404	-6	-2569	-20	-3744	-17	-7237	-5	17419	-19	-34590	-107	37	1150
TAYLOR	-314	-1	-164	0	-3437	-1	-348	-3	-452	-2	-874	-1	890	-1	-4698	-9	5	92
TERRELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
THROCKMORTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TITUS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOM GREEN	-631	-2	-499	-1	-1417	0	-143	-1	-1035	-5	-2000	-1	290	0	-5435	-11	6	120
Travis	-4425	-15	-2403	-7	-12863	-3	-1301	-10	-4118	-18	-7960	-5	2841	-3	-30230	-61	32	657
UPTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UVALDE	-130	0	0	0	-2118	-1	-214	-2	0	0	0	0	0	0	-2462	-3	3	28
VAL VERDE	-60	0	-176	-1	-45	0	-5	0	-42	0	-81	0	0	0	-409	-1	0	11
VAN ZANDT	0	0	-91	0	0	0	0	0	0	0	0	0	0	0	-91	0	0	3
Victoria	-43	0	0	0	-134	0	-14	0	-180	-1	-348	0	0	0	-719	-1	1	14
Waller	0	0	0	0	-194	0	-20	0	0	0	0	0	0	0	-214	0	0	2
WARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WASHINGTON	-15	0	0	0	-2263	-1	-229	-2	0	0	0	0	0	0	-2506	-2	3	26
WEBB	-236	-1	-4120	-12	-299	0	-30	0	-1147	-5	-2216	-1	0	0	-8048	-20	9	211
WHARTON	-385	-1	0	0	-256	0	-26	0	-150	-1	-291	0	0	0	-1108	-2	1	26
WICHITA	-963	-3	-497	-1	-926	0	-94	-1	-884	-4	-1708	-1	0	0	-5072	-11	5	113
WILBARGER	-11	0	0	0	0	0	0	0	0	0	0	0	0	0	-11	0	0	0
WILLACY	0	0	0	0	-36	0	-4	0	0	0	0	0	0	0	-39	0	0	0
Williamson	-1083	-4	-1834	-5	-8474	-2	-857	-7	-636	-3	-1229	-1	833	-1	-13280	-22	14	238
Wilson	0	0	0	0	-665	0	-67	-1	-320	-1	-618	0	0	0	-1669	-2	2	27
WINKLER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WISE	-260	-1	-1873	-6	0	0	0	0	-525	-2	-1014	-1	0	0	-3672	-9	4	100
YOUNG	-23	0	0	0	0	0	0	0	0	0	0	0	0	0	-23	0	0	1
ZAPATA	0	0	-824	-2	0	0	0	0	0	0	0	0	0	0	-824	-2	1	26
ZAVALA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	-84032	-278	-140384	-414	-236620	-60	-23927	-184	-55707	-247	-107674	-68	138226	-152	-510118	-1403	546	15010

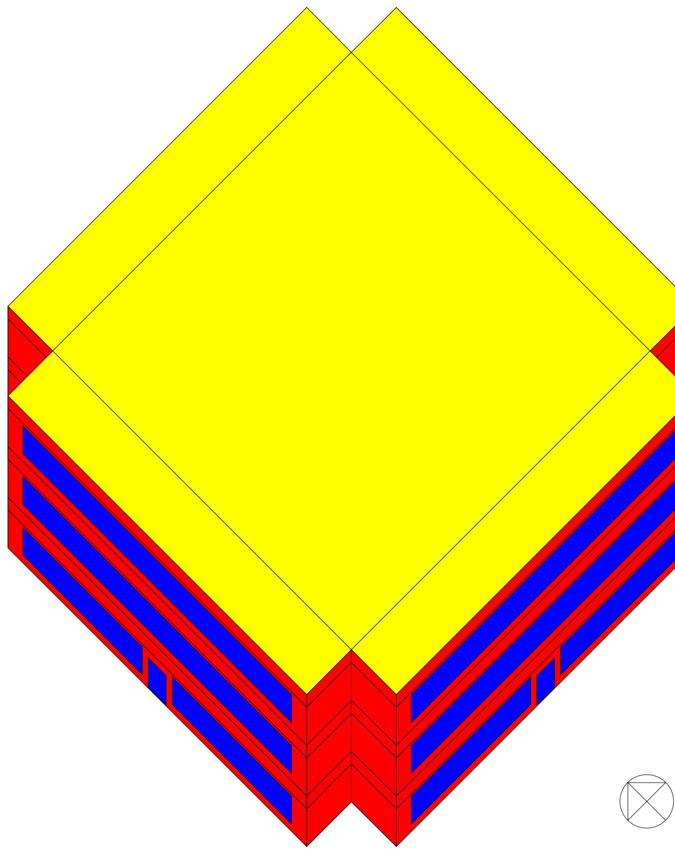


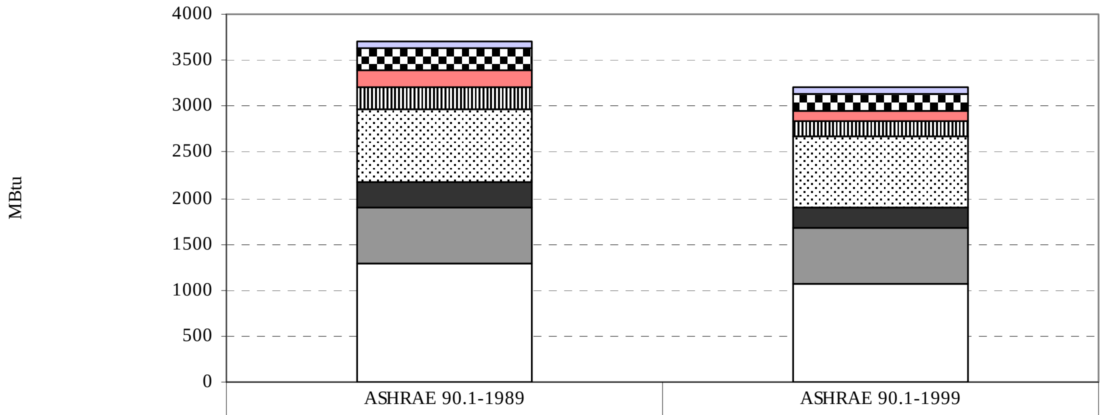
Figure 134: Typical Office Building Used for Annual to OSD calculation (3-story shown).

Table 63: Office/Retail Simulation Input Parameters (LOADS).

NAME	DESCRIPTION	DEFAULT	STATUS	COMMENT
LOADS				
b01	Quick or thermal mode (Q or T)	Quick (Q)	Fixed	Q simulates the building as massless, T will include thermal mass
b02	Location	Bastrop (BAS)	User Defined	41 counties linked to 9 TRY packed weather files according to climate zone
b03	Azimuth of building (degree)	0	User Defined	Orientation of the building
b04	Length of building (ft)	122	User Defined	
b05	Width of building (ft)	122	User Defined	
b06	Floor to ceiling height (ft)	9	User Defined	
b07	Door height (ft)	7	Fixed	
b08	Door width (ft)	6	Fixed	
b09	Run year	2000	User Defined	
b10	Floor to floor height (ft)	13	User Defined	This defines the plenum height in conjunction with b06
b11	Number of floor	6	User Defined	
b12	Perimeter depth (ft)	15	Fixed	Used for thermal zoning
b13	Void			
b14	Underground floor mode	No (N)	User Defined	This allows the user to activate/deactivate underground floors
b15	Front wall: Attached to another building?	No (N)	User Defined	These 4 parameters are used to attach buildings to the different orientations of the model for the retail scenario
b16	Right wall: Attached to another building?	No (N)	User Defined	
b17	Back wall: Attached to another building?	No (N)	User Defined	
b18	Left wall: Attached to another building?	No (N)	User Defined	
b19	Building type	Office (O)	User Defined	Allows the user to switch between Office and Retail
b20	Code compliance	Code (C)	User Defined	Allows user to run user defined model or either of ASHRAE 90.1 1989 or 1999
c01	Roof absorptance	0.45	User Defined	c01 and c03 are used to determine "roof color"
c02	Roof roughness	1	Fixed	This is used to calculate the outside film coefficient for heat transfer calculations, DOE-2 allows values from 1 to 6 increasing in smoothness
c03	Roof outside emissivity	0.89	User Defined	c01 and c03 are used to determine "roof color"
c04	Roof insulation R-value (hr-sq.ft-F/Btu)	R-15	User Defined	
c05	Wall absorptance	0.57	User Defined	c05 and c07 are used to define "wall color"
c06	Wall roughness	2	Fixed	This is used to calculate the outside film coefficient for heat transfer calculations, DOE-2 allows values from 1 to 6 increasing in smoothness
c07	Wall outside emissivity	0.9	User Defined	c05 and c07 are used to define "wall color"
c08	Wall insulation R-value (hr-sq.ft-F/Btu)	R-13	User Defined	
c09	Ground reflectance	0.24	Fixed	This defines the fraction of sunlight reflected from the ground
c10	Void			
c11	U-Factor of glazing (Btu/hr-sq.ft-F)	1.22	User Defined	
c12	Solar Heat Gain Coefficient(SHGC)	0.17	User Defined	
c13	Number of pane of glazing	1	Fixed	
c14	Frame absorptance of glazing	0.7	Fixed	
c15	Frame type - A,B,C,D,E	Aluminum w/o thermal break (A)	User Defined	Allows user to select from 5 different frame types
c16	Void			
c17	Floor weight (lb/sq-ft)	70	User Defined	This corresponds to medium construction, user has a choice of light, medium or heavy construction
c18	Slab-on-grade floor insulation R-value (Exterior insulation, horizontal) (hr-sq.ft-F/Btu)	R-0 (A)	User Defined	User can choose from 9 insulation R-values and insulation depths
c19	Slab-on-grade floor R-value (hr-sq.ft-F/Btu)	0.88	Fixed	
c20	Below-grade wall insulation R-value (hr-sq.ft-F/Btu) (Exterior insulation, vertical, basement wall = 8 ft)	R-0 (A)	User Defined	User can choose from 9 insulation R-values
c21	Below-grade wall R-value (concrete wall) (hr-sq.ft-F/Btu)	0.88	Fixed	
c22	Void			
c23	Floor R-value	1.67	Fixed	
c24	Void			
c25	Ceiling R-value (hr-sq.ft-F/Btu)	1.89	Fixed	
c26	Interior wall R-value (hr-sq.ft-F/Btu)	2.01	Fixed	
c27	Percent window-front (%)	50	User Defined	
c28	Percent window-right (%)	50	User Defined	
c29	Percent window-back (%)	50	User Defined	
c30	Percent window-left (%)	50	User Defined	
sp01	void			
sp02	void			
sp03	Area per person (ft^2/person) for office	275	User Defined	
sp04	Lighting load (W/ft2) for office	1.3	User Defined	
sp05	Equipment load (W/ft2) for office	0.75	User Defined	
sp06	Area per person (ft^2/person) for retail	300	User Defined	
sp07	Lighting load (W/ft2) for retail	1.9	User Defined	
sp08	Equipment load (W/ft2) for retail	0.25	User Defined	
s01	Front Shade (S)	0	User Defined	
s02	Back Shade (N)	0	User Defined	
s03	Left Shade (W)	0	User Defined	
s04	Right Shade (E)	0	User Defined	

Table 64: Office/Retail Simulation Input Parameters (SYSTEMS and PLANT).

NAME	DESCRIPTION	DEFAULT	STATUS	COMMENT
SYSTEM				
sy01	Mode of system	Variable air volume (2)	User Defined	User can choose from Packaged single zone, variable air volume or packaged variable volume system
sy02	Cooling Capacity of cooling system (Btu/hr)	0	Fixed	DOE-2 is autosizing the system
sy03	Heating Capacity of heating system (Btu/hr)	0	Fixed	DOE-2 is autosizing the system
sy04	Seasonal Energy Efficiency Ratio (SEER) for PVAVS and PSZ	10	User Defined	
sy05	ANNUAL FUEL UTILIZATION EFFICIENCY (AFUE) for PSZ	0.8	User Defined	
sy06	**Spare parameter for systems other than VAVS**HEATING SEASONAL PERFORMANCE FACTOR (HSPF)	6.8	User Defined	Unused, since heatpump systems are not included in the office/retail scenario
sy07	**Spare parameter for Pilot light	0	Fixed	Unused
sy08	**Spare parameter for Pilot light	0	Fixed	Unused
sy09	**Spare parameter for Pilot light	0	Fixed	Unused
sy10	Void			
sy11	Exterior lighting (kW)	0	Fixed	
sy12	Void			
sy13	Fan control type	Variable frequency drives (1)	User Defined	User can choose from 4 different type of fan control
sy14	Economizer type	None (1)	User Defined	
sy15	Economizer drybulb limit (F) (use when economizer type(sy14) = dry bulb(2))	65	Fixed	This corresponds to the temperature above which the outside air dampers return to the minimum position
sy16	User input for numbers of fans	Autosized (A)	Fixed	Autosized by DOE-2
sy17	Number of Fans	6	Fixed	equal to the number of floors
sy18	Supply fan total pressure (in W.G)	5.5	Fixed	
sy19	Supply fan efficiency	0.54	Fixed	
sy20	Return fan total pressure (in W.G)	2	Fixed	
sy21	Return fan efficiency	0.51	Fixed	
sy22	Supply motor efficiency	0.5	Fixed	
sy23	Return motor efficiency	0.5	Fixed	
sy24	User input for DHW gallon/hr-person	Autosized (A)	Fixed	The size of DHW depends on the gallons per hour per person requirements of ASHRAE 90.1
sy25	Maximum DHW gallon/h-person (maximum hourly, to be used with occupancy schedule)	0.4	Fixed	
PLANT				
p01	Chiller type	Electric Centrifugal (1)	Fixed	
p02	Number of chillers	1	Fixed	
p03	Chillers size (MBtu/h)	-999	Fixed	Chiller is being autosized by DOE-2
p04	Condenser type	water-cooled (W)	Fixed	
p05	COP	5	User Defined	
p06	Switch for a chiller sizing	Autosized (A)	Fixed	Chiller is being autosized by DOE-2
p07	Cooling tower type	Open tower (O)		
p08	Void			
p09	Gpm/hp	38.2	Fixed	Value from ASHRAE 90.1 1999 for axial fan cooling towers
p10	Cooling tower capacity control	Two-speed fan (1)	Fixed	
p11	Boiler type	Gas fired-hotwater boiler (1)	User Defined	User can choose from gas fired or electric boilers
p12	Number of boilers	1	Fixed	
p13	Boiler size (MBtu/h)	-999	Fixed	Boiler is being autosized by DOE-2
p14	Boiler fuel type	Gas (G)	Fixed	Depends on the value of p10
p15	Boilers efficiency (Et,Ec,AFUE) (%)	80	User Defined	
p16	Switch for a boiler sizing	Autosized (A)	Fixed	Boiler is being autosized by DOE-2
p17	Void			
p18	DHW heater type	Gas water heater (1)	User Defined	User can choose from gas fired or electric water heaters
p19	Number of DHW heater	1	Fixed	
p20	DHW size (MBtu/h)	-999	Fixed	Water heater is being autosized by DOE-2
p21	DHW fuel type	Gas (G)	Fixed	Depends on the value of p18
p22	DHW heater Efficiency (Et,Ec,Energy factor) (%)	54	User Defined	
p23	Switch for a DHW heater sizing	Autosized (A)	Fixed	Water heater is being autosized by DOE-2
p24	DHW Storage Capacity (gal)	75	Fixed	



	ASHRAE 90.1-1989	ASHRAE 90.1-1999
DOMHOT WATER	71.5	71.5
VENT FANS	239.2	177.9
PUMPS & MISC	184.1	111.2
HEAT REJECT	233.9	174.3
SPACE COOL	798.1	774.3
SPACE HEAT	272.1	214.3
MISC EQUIPMT	616.2	616.2
AREA LIGHTS	1289.9	1068.1

Figure 135: Comparison of Annual Energy Use ASHRAE Standard 90.1-1989 vs 90.1-1999.

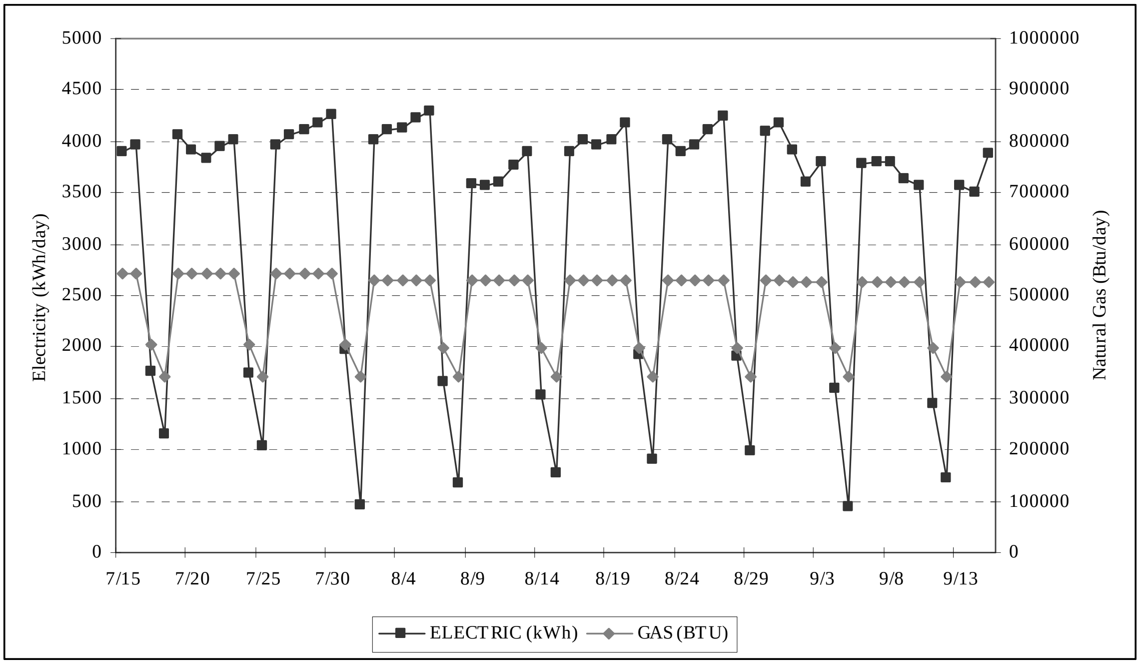


Figure 136: Simulated Electricity and Natural Gas for Building Built to 90.1-1989 Standard for OSD (07/15 – 09/15).

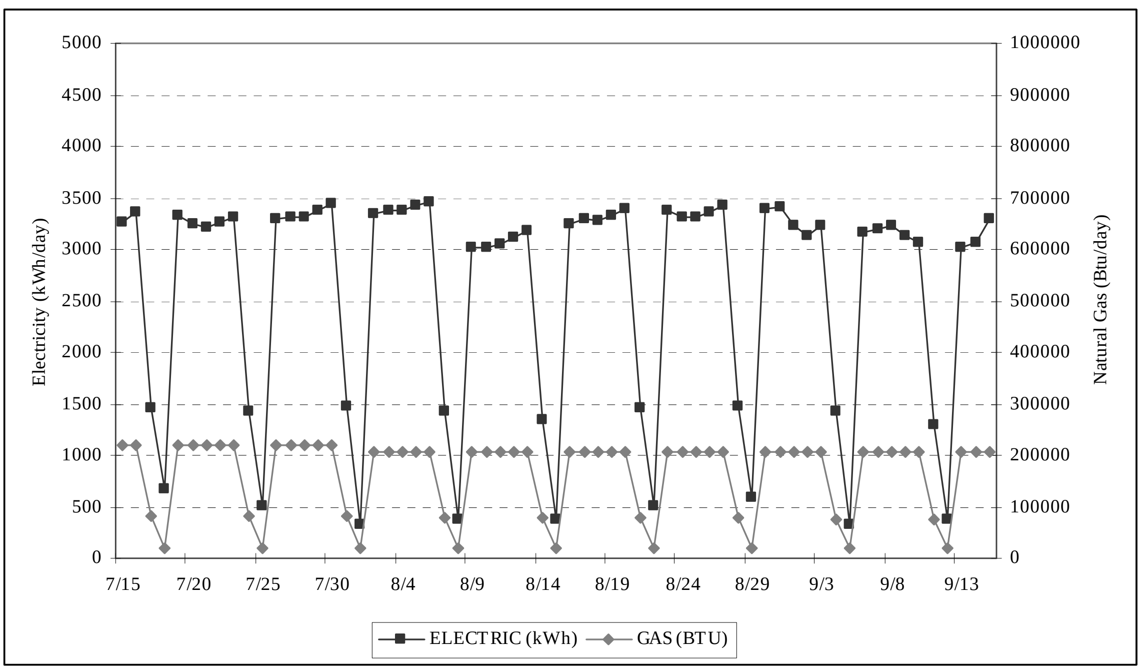


Figure 137: Simulated Electricity and Natural Gas for Building Built to 90.1-1989 Standard for OSD (07/15 – 09/15).

Table 65: Simulated Electricity and Natural Gas for Building Built to 90.1-1989 Standard for Annual and OSD (07/15 – 09/15).

	Electricity (kW)		Gas (Btu)	
	1989	1999	1989	1999
TOTAL (YEAR) (a)	988,405	858,198	331,600,000	278,800,000
OSD (07/15 - 09/15)	199,537	163,841	30,633,205	10,332,355
OSD PER DAY (b)	3167	2601	486241	164006
OSD % (b/a)	0.32%	0.30%	0.15%	0.06%

Table 66: Totalized Annual Electricity Savings from 90.1-1999 by PCA for Commercial Buildings.

PCA	Total Electricity Savings by PCA (MWh)
American Electric Power - West (ERCOT)/PCA	13,175.03
Austin Energy/PCA	287.42
Brownsville Public Utils Board/PCA	0.00
Lower Colorado River Authority/PCA	468.86
Reliant Energy HL&P/PCA	12,950.36
San Antonio Public Service Bd /PCA	6,700.17
South Texas Electric Coop Inc/PCA	0.00
Texas Municipal Power Pool/PCA	0.00
Texas-New Mexico Power Co/PCA	598.75
TXU Electric/PCA	47,880.66
El Paso Electric Co/PCA	23.79
Entergy Electric System/PCA	4,246.63
Total	86,331.66

Table 67: 2006 Annual NOx Reductions from IECC / IRC by PCA for Commercial Buildings by County using 2007 eGRID.

Area	County	American Electric Power - West (ERCOT) /PCA	NOx Reductions (lbs)	Austin Energy/PCA	NOx Reductions (lbs)	Brownsville Public Utils Board/PCA	NOx Reductions (lbs/year)	Lower Colorado River Auhotrity /PCA	NOx Reductions (lbs)	Reliant Energy HL&P/PCA	NOx Reductions (lbs)	San Antonio Public Service Bd/PCA	NOx Reductions (lbs)	South Texas Electric Coop INC/PCA	NOx Reductions (lbs)	Texas Municipal Power Pool/PCA	NOx Reductions (lbs)	Texas-New Mexico Power Co/PCA	NOx Reductions (lbs)	TXU Electric/PCA	NOx Reductions (lbs)	Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
Houston-Galveston Area	Brazoria	0.00883113	116.350405	0.010890729	3.13018213	0.006522185	0	0.003944232	1.849274761	0.0654443	847.5272612	0.014877434	99.6812958	0.006262315	0	0.0048171	0	0.121274957	72.61348905	0.00816387	390.8914665	1532.043375	0.766021687
	Chambers	0.02176222	286.717863	0.026955801	7.7475591	0.016072371	0	0.009076193	4.255422962	0.1649402	2136.035609	0.037472294	251.070639	0.015055623	0	0.0095532	0	0.011518588	6.896765008	0.01581859	757.4045971	3450.128455	1.725064228
	Fort Bend	0.07043123	927.933399	0.087239726	25.0741924	0.052016606	0	0.029374182	13.77224652	0.5338124	6913.063459	0.121275295	812.56476	0.048726002	0	0.030918	0	0.037278747	22.32068322	0.05119528	2451.263463	11165.9922	5.582996101
	Galveston	0.03385674	446.06345	0.041710519	11.9883178	0.025004711	0	0.015351589	7.197676667	0.2495874	3232.246882	0.056747051	380.214737	0.024143087	0	0.0192972	0	0.567751219	339.9415518	0.03283689	1572.251712	5989.904327	2.994952164
	Harris	0.06826733	899.423941	0.084559408	24.3038228	0.050418468	0	0.028471701	13.34911348	0.5174117	6700.669238	0.117549281	787.599843	0.047228963	0	0.0299681	0	0.03613341	21.6349114	0.04962237	2375.951816	10822.93269	5.411466343
	Liberty	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Montgomery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Waller	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beaumont/ Port Arthur Area	Hardin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Jefferson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Orange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dallas/ Fort Worth Area	Collin	0.00203914	26.8656604	0.003716345	1.06814114	0.001505992	0	0.005950953	2.790136853	0.0024815	32.13604059	0.000717051	4.80435989	0.019166247	0	0.0766809	0	0.00086441	0.51756635	0.0040002	191.5321717	259.714077	0.129857038
	Dallas	0.00453947	59.8076544	0.004683963	1.34625112	0.003352602	0	0.00774211	3.629930765	0.0020856	27.00941983	0.00068106	4.56321812	0.007502816	0	0.026717	0	0.007524933	4.505560431	0.04037045	1932.963863	2033.825898	1.016912949
	Denton	0.00047388	6.2433856	0.000872802	0.25085811	0.000349982	0	0.001396994	0.654988235	0.0005854	7.58170338	0.000168971	1.13213072	0.00454374	0	0.0181872	0	0.000186605	0.111730207	0.00084941	40.67008802	56.64488427	0.028322442
	Tarrant	0.01216249	160.241164	0.012266309	3.52554752	0.008982543	0	0.020308652	9.521823096	0.0053165	68.85065737	0.001752506	11.7420839	0.017326428	0	0.0602168	0	0.020603444	12.3363308	0.11064724	5297.862415	5564.080021	2.78204001
	Ellis	0.00327981	43.2116315	0.003307809	0.95072113	0.002422289	0	0.005476558	2.567714199	0.0014337	18.56669766	0.000472592	3.16644357	0.004672353	0	0.0162384	0	0.005556053	3.326691901	0.02983782	1428.654619	1500.444519	0.750222259
	Johnson	0.00028606	3.76882817	0.000526868	0.15143084	0.000211267	0	0.000843297	0.395384535	0.0003534	4.576705512	0.000101999	0.68341224	0.002742835	0	0.0109787	0	0.000112645	0.067446091	0.00051274	24.55055371	34.1937611	0.017096881
	Kaufman	0.00632545	83.3380071	0.006379446	1.83356198	0.004671629	0	0.010562096	4.952096849	0.002765	35.80775656	0.000911441	6.10680707	0.009011105	0	0.0313175	0	0.010715411	6.415862203	0.05754527	2755.305103	2893.759195	1.446879597
	Parker	0.00021749	2.86542977	0.000400576	0.11513245	0.000160626	0	0.000641157	0.300609782	0.0002687	3.479656704	7.75498E-05	0.51959646	0.00208537	0	0.0083471	0	8.56434E-05	0.051279078	0.00038984	18.66571894	25.99742319	0.012998712
	Rockwall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Henderson	0.00081989	10.8021378	0.000826893	0.23766334	0.000605529	0	0.001369042	0.641882789	0.0003584	4.641343525	0.00011814	0.79155446	0.001168005	0	0.0040593	0	0.001388914	0.831613688	0.00745892	357.1381937	375.0843893	0.187542195
	Hood	0.01252711	165.04501	0.012634039	3.6312394	0.009251829	0	0.020917482	9.807276449	0.0054759	70.91472124	0.001805044	12.0940981	0.017845854	0	0.062022	0	0.021221112	12.70615988	0.11396431	5456.686263	5730.884768	2.865442384
	Hunt	0.00618756	81.5212479	0.006240374	1.79359053	0.004569788	0	0.010331844	4.844141691	0.0027047	35.02715147	0.000891572	5.97367936	0.008814664	0	0.0306347	0	0.010481817	6.275997124	0.05629078	2695.23976	2830.675568	1.415337784
El Paso Area	El Paso	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
San Antonio Area	Bexar	0.03341375	440.227069	0.051775843	14.8812646	0.024677545	0	0.090663423	42.50804398	0.0011418	14.78725751	1.143571754	7662.12205	0.046873844	0	0.0046695	0	0.000519582	0.311100384	0.00250387	119.8867099	8294.723491	4.147361745
	Comal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Guadalupe	0.00200047	26.3562088	0.076378745	21.9525601	0.001477434	0	0.133848731	62.75571248	0.0012371	16.02131706	0.003554796	23.8177296	0.001061766	0	0.0018557	0	0.000401718	0.24052921	0.00183516	87.86889725	239.0129545	0.119506477
	Wilson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Austin Area	Bastrop	0.00450233	59.318369	0.171901148	49.4073358	0.003325174	0	0.301245466	141.2405912	0.0027843	36.05823603	0.008000571	53.6051633	0.002389654	0	0.0041765	0	0.000904124	0.541344946	0.0041303	197.7613591	537.9323995	0.2689662
	Caldwell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hays	0.0024586	32.3921099	0.093870431	26.9799706	0.001815785	0	0.164501762	77.12755474	0.0015205	19.69039885	0.004368889	29.2722873	0.001304924	0	0.0022807	0	0.000493717	0.295613404	0.00225544	107.9919726	293.7499074	0.146874954
	Travis	0.00051001	6.71935611	0.299602906	86.1110093	0.000376663	0	0.033939476	15.91270982	0.0003347	4.334599897	0.000906121	6.07116234	0.000271138	0	0.0004717	0	0.000103327	0.061867055	0.00046734	22.3763437	141.5870482	0.070793524
	Williamson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North East Texas Area	Gregg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Harrison	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rusk	0.00068596	9.03760523	0.00069182	0.19884096	0.000506616	0	0.001145408	0.537031037	0.0002999	3.883178626	9.88414E-05	0.6622538	0.000977211	0	0.0033962	0	0.001162035	0.695769335	0.00624051	298.7995594	313.8142384	0.156907119
	Smith	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Upshur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corpus Christi Area	Nueces	0.22756873	2998.22414	0.004556851	1.30971715	0.168069652	0	0.007612767	3.56928767	0.0016809	21.76810609	0.001626796	10.8998052	0.046792036	0	0.0072464	0	0.001609426	0.963645239	0.00828339	396.6143812	3433.349083	1.716674541
	San Patricio	0.05031335	662.879757	0.001007478	0.28956641	0.037158653	0	0.001683113	0.789136646	0.0003716	4.812727867	0.00035967	2.40984659	0.010345288	0	0.0016021	0	0.000355829	0.213053091	0.00183138	87.68778857	759.0818759	0.379540938
Victoria Area	Victoria	0.02183674	287.69958	0.002215582	0.63679628	0.016127403	0	0.003612695	1.693832016	0.0011996	15.53552765	0.000555389	3.72119782	0.52545648	0	0.0324127	0	0.000476855	0.285517561	0.00225485	107.9636595	417.5361109	0.208768055
Other ERCOT counties	Andrews	2.4742E-05	0.3259776	2.49533E-05	0.007172	1.82731E-05	0	4.13138E-05	0.019370186	1.082E-05	0.140062465	3.56511E-06	0.02388685	3.5247E-05	0	0.0001225	0	4.19135E-05	0.025095721	0.00022509	10.77740861	11.31897344	0.005659487
	Angelina	0.00031082	4.0950608	0.000313473	0.09009752	0.000229554	0	0.000519	0.243336005	0.0001359	1.759520601	4.47864E-05	0.30007613	0.000442787	0	0.0015389	0	0.000526534	0.315262468	0.00282766	135.3901098	142.1934633	0.071096732
	Bosque	0.00059539	7.84430261	0.001096604	0.31518267	0.000439723	0	0.001755208	0.822939066	0.0007356	9.525789273	0.000212298	1.42242951	0.005708837	0	0.0228507	0	0.000234455	0.140379853	0.00106721	51.09863427	71.16965726	0.035584829
	Brazos	0.00193973	25.5559318	0.003572622	1.02683276	0.001432574	0	0.005718288	2.681050906	0.0023964	31.03404251	0.000691644	4.63412918	0.018598805	0	0.0744451	0	0.000763829	0.457343134	0.00347685	166.4740992	231.8634294	0.115931715
	Calhoun	0.08269981	1089.5722	0.001655986	0.47595888	0.061077496	0	0.002766524	1.297100034	0.0006108	7.910657184	0.000591187	3.96105302	0.0170045	0	0.0026334	0	0.000584875	0.350194321	0.00301023	144.1319879	1247.699155	0.623849578
	Cameron	0.04837175	637.299068	0.000968599	0.27839197	0.297964476	0	0.001618161	0.758683674	0.0003573	4.627003543	0.00034579	2.31685003	0.009946061	0	0.0015403	0	0.000342098	0.204831321	0.00176071	84.30389576	729.7887241	0.364894362
	Cherokee	0.0035039	46.1639623	0.003533808	1.01567687	0.002587786	0	0.00585073	2.743147095	0.0015316	19.83522261	0.00050488	3.38278321	0.00499158	0	0.0173479	0	0.005935657	3.553980122	0.03187642	1526.264009	1602.958781	0.801479391
	Coke	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coleman	0.00129879	17.1115521	2.6007E-05	0.00747486	0.000959212	0	4.34478E-05	0.020370742	9.593E-06	0.124235569	9.2845E-06	0.06220769	0.000267053	0	4.136E-05	0	9.18536E-06	0.005499744	4.7275E-05	2.263569141	19.59490982	0.009797455
	Crockett	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ector	0.00353575	46.5835702	0.003565928	1.02490888	0.002611307	0	0.005903911	2.768080966	0.0015456	20.01551512	0.00050947	3.41353106	0.005036951	0	0.0175056	0	0.00598961	3.586284071	0.03216616	1540.137006	1617.528896	0.808764448
	Fannin	0.00705631	92.967136	0.007116546	2.04541735	0.005211403	0	0.011782473	5.524277305	0.0030845	39.94509456	0.001016752	6.81240629	0.010052276	0	0.034936	0	0.011953503	7.157170596	0.06419422	3073.661504	3228.113006	1.614056503
	Fayette	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Freestone	0.00367718	48.446913	0.003708565	1.06590523	0.00271576	0	0.006140067	2.878804205	0.0016074	20.81613573	0.000529848	3.55007231	0.005238429	0	0.0182058	0	0.006229194	3.729735434	0.03345281	1601.742486	1682.230052	0.841115026
	Frio	0.00858833	113.15154	0.000871383	0.25045042	0.006342868	0	0.001420864	0.666179983	0.0004718	6.110084971	0.000218433	1.46353799	0.206660746	0	0.0127478	0	0.000187546	0.112293357	0.00088683	42.46184281	164.2159297	0.082107965
	Grimes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hardeman	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Haskell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hidalgo	0.18852746	2483.8543	0.003775086	1.08502448	0.139235931	0	0.006306735	2.956947222	0.0013925	18.03360972	0.001347706	9.02985461	0.03876448	0	0.0060032	0	0.001333316	0.798324028	0.00686231	328.5719451	2844.330009	1.422165005
	Howard	0.00055511	7.31362933	0.000559851	0.16091089	0.000409976	0	0.000926915	0.434589235	0.0002427	3.14243966	7.99868E-05	0.53592502	0.000790802	0	0.0027484	0	0.00094037	0.563047277	0.00505009	241.8018011	253.9523426	0.126976171
	Jack	0.00212145	27.9501421	0.002139557	0.61494533	0.001566784	0	0.003542346	1.66084858	0.0009273	12.00930907	0.000305682	2.04811864	0.00302217	0	0.0105033	0	0.003593766	2.151770442	0.0192997	924.0822034	970.5173376	0.485258669
	Jones	0.04071872	536.47026	0.000815354	0.23434682	0.030072592	0	0.001362147	0.63865028	0.0003008	3.89495281	0.000291082	1.95029493	0.008372468	0	0.0012966	0	0.000287974	0.172424405	0.00148214	70.96594862	614.3268781	0.307163439
	Lamar	0.00095084	12.5273142	0.000958954	0.27561983	0.000702236	0	0.001587687	0.744395928	0.0004156	5.382598317	0.000137007	0.91797121	0.001354543	0	0.0047076	0	0.001610734	0.964428169	0.00865017	414.1756434	434.987971	0.217493986
	Limestone	0.00071976	9.48281498	0.000891528	0.25624029	0.000531572	0	0.000300183	0.140742499	0.0054552	70.64655913	0.001239347	8.30383009	0.000497945	0	0.000316	0	0.000380962	0.228101402	0.00052318	25.05015761	114.10446	0.057052223
	Llano	0.00123817	16.3129752	0.047274044	13.5873702	0.000914447	0	0.082844655	38.84217136	0.0007657	9.916272448	0.002200214	14.7418028	0.000657172	0	0.0011486	0	0.000248641	0.148873727	0.00113586	54.38578623	147.9352519	0.073967626
	McLennan	0.02453432	323.24029	0.024743738	7.11177439	0.018119687	0	0.040966843	19.20752939	0.0107245	138.8863258	0.003535175	23.6862646	0.034951066	0	0.1214699	0	0.041561501	24.88498621	0.22319886	10686.90806	11223.92523	5.611962616
	Milam	0.0022454	29.5832702	0.002264571	0.65087661	0.001658332	0	0.003749326	1.757892036	0.0009815	12.71101353	0.000323543	2.1677903	0.003198756	0	0.011117	0	0.00380375	2.277498484	0.02042738	978.0763673	1027.224708	0.513612354
	Mitchell	0.01494317	196.87665	0.015070721	4.33158354	0.011036196	0	0.024951762	11.69877073	0.006532	84.59178949	0.002153177	14.4266435	0.02128772	0	0.073984	0	0.025313952	15.15675141	0.1359442	6509.097795	6836.179984	3.418089992
	Nolan	0.00056465	7.43932773	0.000569473	0.16367644	0.000417022	0	0.000942846	0.442058464	0.0002468	3.196448361	8.13615E-05	0.5451359	0.000804394	0	0.0027956	0	0.000956532	0.572724298	0.00513689	245.9576172	258.3169884	0.129158494
	Palo Pinto	0.003207	42.2522894	0.005906709	1.69768941	0.002368511	0	0.009454195	4.432651487	0.003962	51.30939304	0.001143513	7.6617268	0.030749889	0	0.1230821	0	0.001262858	0.756137348	0.00574838	275.2359762	383.3458637	0.191672932
	Pecos	4.0968E-05	0.53975027	4.13174E-05	0.01187532	3.02565E-05	0	6.84069E-05	0.032072949	1.791E-05	0.231913949	5.90308E-06	0.03955159	5.83617E-05	0	0.0002028	0	6.93999E-05	0.04155323	0.0003727	17.84511929	18.7418366	0.009370918
	Presidio	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Robertson	0.00073771	9.71931922	0.000835096	0.24002101	0.00054483	0	0.000735917	0.345038755	0.0031497	40.78946759	0.000730875	4.89698674	0.00076086	0	0.0018663	0	0.191632518	114.7401422	0.00339774	162.6858993	333.4168748	0.166708437
	Taylor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Titus	0.00569644	75.0507156	0.005745061	1.65122905	0.004207073	0	0.009511781	4.459650827	0.00249	32.24696447	0.000820806	5.49953445	0.008115023	0	0.0282032	0	0.00964985	5.777856543	0.05182285	2481.312272	2605.998223	1.302999111
	Tom Green	0.00148245	19.531293	2.96846E-05	0.00853187	0.001094854	0	4.95918E-05	0.023251365	1.095E-05	0.141803694	1.05974E-05	0.07100446	0.000304817	0	4.72E-05	0	1.04843E-05	0.006277462	5.396E-05	2.583659964	22.36582179	0.011182911
	Upton	3.1166E-05	0.41061456	3.14322E-05	0.00903414	2.30176E-05	0	5.20405E-05	0.024399468	1.362E-05	0.17642834	4.49076E-06	0.03008884	4.43986E-05	0	0.0001543	0	5.27959E-05	0.031611584	0.00028353	13.57565933	14.25783626	0.007128918
	Ward	0.01855953	244.522289	0.01871795	5.37985952	0.013707039	0	0.030990277	14.52996175	0.0081128	105.0636425	0.002674262	17.9180004	0.026439509	0	0.0918886	0	0.03144012	18.82479992	0.16884373	8084.348706	8490.587258	4.245293629
	Webb	0.02001433	263.6893	0.000400768	0.11518765	0.014781473	0	0.000669531	0.313913478	0.0001478	1.914472163	0.000143074	0.95862146	0.004115289	0	0.0006373	0	0.000141547	0.084751148	0.00072851	34.88163779	301.9578835	0.150978942
	Wharton	0.00014434	1.90167939	0.000178787	0.05138631	0.000106601	0	6.01986E-05	0.028224437	0.001094	14.16742877	0.000248538	1.6652463	9.98576E-05	0	6.336E-05	0	7.6398E-05	0.045743351	0.00010492	5.023547188	22.88325575	0.011441628
	Wichita	0.00020763	2.73557313	0.000209406	0.06018674	0.000153346	0	0.000346701	0.16255276	9.076E-05	1.175390917	2.99181E-05	0.20045617	0.00029579	0	0.001028	0	0.000351734	0.210600911	0.00188893	90.44299064	94.98775126	0.047493876
	Wilbarger	0.02861682	377.027348	0.000573025	0.16469722	0.021134796	0	0.000957307	0.448838713	0.0002114	2.737344152	0.00020457	1.37065291	0.005884109	0	0.0009112	0	0.000202386	0.121178602	0.00104164	49.87434608	431.7444059	0.215872203
	Wise	0.00284449	37.4762	0.002882008	0.8283385	0.002100781	0	0.00476997	2.236426855	0.0012561	16.26663039	0.000413241	2.76878576	0.004181914	0	0.0146143	0	0.004797945	2.872773626	0.02576141	1233.473293	1295.922448	0.647961224
	Young	0.00623586	82.1575748	0.006289085	1.80759068	0.004605458	0	0.010412491	4.881953399	0.0027258	35.30056139	0.000898531	6.02030785	0.008883468	0	0.0308739	0	0.010563634	6.324985404	0.05673017	2716.277877	2852.77085	1.426385425
	Total	**1.12183722**	**14780.2356**	**1.172570094**	**337.016739**	**1.090766584**	**0**	**1.189130767**	**557.5304913**	**1.62936**	**21100.80178**	**1.542362643**	**10334.0877**	**1.359385821**	**0**	**1.2316428**	**0**	**1.221806085**	**731.5574898**	**1.52878695**	**73199.32334**	**121040.5531**	**60.52027655**

		American Electric Power - West (ERCOT) /PCA	NOx Reductions (lbs)	Austin Energy/PCA	NOx Reductions (lbs)	Brownsville Public Utils Board/PCA	NOx Reductions (lbs/year)	Lower Colorado River Auhotrity /PCA	NOx Reductions (lbs)	Reliant Energy HL&P/PCA	NOx Reductions (lbs)	San Antonio Public Service Bd/PCA	NOx Reductions (lbs)	South Texas Electric Coop INC/PCA	NOx Reductions (lbs)	Texas Municipal Power Pool/PCA	NOx Reductions (lbs)	Texas-New Mexico Power Co/PCA	NOx Reductions (lbs)	TXU Electric/PCA
Energy Savings by PCA (MWh)		13,175.03		287.42		0.00		468.86		12,950.36		6,700.17		0.00		0.00		598.75		47,880.66

Table 68: 2006 Totalized OSD Electricity Savings from IECC / IRC by PCA for Commercial Buildings (w/7% T&D).

PCA	Total Electricity Savings by PCA (MWh)
American Electric Power - West (ERCOT)/PCA	70.60
Austin Energy/PCA	1.58
Brownsville Public Utils Board/PCA	0.00
Lower Colorado River Authority/PCA	3.79
Reliant Energy HL&P/PCA	99.03
San Antonio Public Service Bd /PCA	51.11
South Texas Electric Coop Inc/PCA	0.00
Texas Municipal Power Pool/PCA	0.00
Texas-New Mexico Power Co/PCA	3.23
TXU Electric/PCA	285.84
El Paso Electric Co/PCA	0.12
Entergy Electric System/PCA	31.98
Total	547.28

Table 69: 2006 OSD NOx Reductions from Electricity Savings from the IECC / IRC by PCA for Commercial Buildings by County using 2007 eGRID (w/7% T&D).

Area	County	American Electric Power - West (ERCOT) /PCA	NOx Reductions (lbs)	Austin Energy/PCA	NOx Reductions (lbs)	Brownsville Public Utils Board/PCA	NOx Reductions (lbs/year)	Lower Colorado River Auhotrity /PCA	NOx Reductions (lbs)	Reliant Energy HL&P/PCA	NOx Reductions (lbs)	San Antonio Public Service Bd/PCA	NOx Reductions (lbs)	South Texas Electric Coop INC/PCA	NOx Reductions (lbs)	Texas Municipal Power Pool/PCA	NOx Reductions (lbs)	Texas-New Mexico Power Co/PCA	NOx Reductions (lbs)	TXU Electric/PCA	NOx Reductions (lbs)	Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
Houston-Galveston Area	Brazoria	0.00957217	0.67576333	0.011806715	0.018639161	0.007069474	0	0.004263638	0.016171635	0.0710018	7.031337423	0.016140391	0.824986396	0.006781035	0	0.0051797	0	0.126288	0.40742042	0.008772	2.507306187	11.48162455	0.005740812
	Chambers	0.0218814	1.54475373	0.027103415	0.042787932	0.016160386	0	0.009125896	0.034613789	0.1658435	16.42355386	0.037677498	1.925816055	0.01513807	0	0.0096055	0	0.011582	0.03736385	0.015905	4.546375079	24.55526429	0.012277632
	Fort Bend	0.05569551	3.9319179	0.068987309	0.108909681	0.041133619	0	0.023228475	0.088103738	0.4221274	41.80346954	0.095901908	4.901849714	0.038531479	0	0.0244493	0	0.029479	0.09510356	0.040484	11.572054	62.50140812	0.031250704
	Galveston	0.02755599	1.94536088	0.033893644	0.053507608	0.020351324	0	0.012791501	0.048517137	0.2014466	19.94935218	0.045812515	2.341622494	0.019823685	0	0.0167751	0	0.594657	1.91843334	0.028709	8.206359932	34.46315358	0.017231577
	Harris	0.07736057	5.4613991	0.09582276	0.151274581	0.057134232	0	0.032264145	0.122375311	0.5863312	58.06464854	0.1332069	6.808625791	0.053519883	0	0.0339599	0	0.040946	0.132098	0.056232	16.0734804	86.81390171	0.043406951
	Liberty	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Montgomery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Waller	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beaumont/ Port Arthur Area	Hardin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Jefferson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Orange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dallas/ Fort Worth Area	Collin	0.00176365	0.12450774	0.003151138	0.004974674	0.001302533	0	0.005050143	0.019154786	0.0020858	0.2065529	0.00060408	0.030876438	0.015958397	0	0.0637888	0	0.000846	0.00272974	0.004013	1.147142242	1.535938521	0.000767969
	Dallas	0.00504555	0.35619925	0.005305276	0.008375394	0.003726366	0	0.008757286	0.033215684	0.0024131	0.238969082	0.000782263	0.03998395	0.009310387	0	0.033672	0	0.008209	0.0264838	0.044002	12.5776608	13.28088796	0.006640444
	Denton	0.00063576	0.04488239	0.001170951	0.00184857	0.000469535	0	0.001874207	0.007108717	0.0007854	0.077781574	0.000226691	0.011586886	0.006095882	0	0.0243999	0	0.00025	0.00080766	0.00114	0.325734474	0.469750266	0.000234875
	Tarrant	0.01557224	1.09934857	0.015705165	0.024793612	0.011500796	0	0.026002176	0.098624167	0.006807	0.67409882	0.002243821	0.114688766	0.022183886	0	0.0770985	0	0.02638	0.0851038	0.141667	40.49438673	42.59104446	0.021295522
	Ellis	0.00350282	0.24728769	0.003532723	0.00557708	0.002586991	0	0.005848935	0.02218454	0.0015312	0.151631928	0.000504725	0.025798115	0.004990048	0	0.0173426	0	0.005934	0.01914327	0.031867	9.108815731	9.580438356	0.004790219
	Johnson	0.00033718	0.02380351	0.000621017	0.000980394	0.00024902	0	0.000993991	0.003770129	0.0004166	0.041251687	0.000120226	0.006145139	0.003232969	0	0.0129406	0	0.000133	0.00042834	0.000604	0.172754238	0.249133438	0.000124567
	Kaufman	0.00649275	0.45836673	0.006548174	0.010337546	0.004795187	0	0.01084145	0.041120749	0.0028381	0.281061421	0.000935547	0.047818786	0.009249437	0	0.0321458	0	0.010999	0.03548352	0.059067	16.88388935	17.7580781	0.008879039
	Parker	0.00047595	0.0336006	0.000876616	0.001383907	0.000351511	0	0.0014031	0.005321846	0.000588	0.058230136	0.000169709	0.008674367	0.0045636	0	0.0182667	0	0.000187	0.00060464	0.000853	0.243856764	0.351672263	0.000175836
	Rockwall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Henderson	0.00095027	0.06708597	0.000958382	0.00151299	0.000701818	0	0.001586741	0.006018381	0.0004154	0.041135794	0.000136926	0.006998697	0.001353736	0	0.0047048	0	0.00161	0.00519332	0.008645	2.471104695	2.599049854	0.001299525
	Hood	0.01232788	0.87030746	0.012433111	0.019628047	0.00910469	0	0.020584816	0.078076554	0.0053888	0.533655335	0.001776337	0.090794213	0.017562038	0	0.0610356	0	0.020884	0.06737306	0.112152	32.05768188	33.71751654	0.016858758
	Hunt	0.00635121	0.44837439	0.006405424	0.010112189	0.004690653	0	0.010605108	0.040224321	0.0027763	0.274934314	0.000915153	0.046776342	0.0090478	0	0.031445	0	0.010759	0.03470998	0.05778	16.51582245	17.37095398	0.008685477
El Paso Area	El Paso	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
San Antonio Area	Bexar	0.03112811	2.19754128	0.048234164	0.076146867	0.0229895	0	0.084461674	0.320356346	0.0010637	0.105342127	1.065346769	54.45324151	0.043667482	0	0.0043501	0	0.000484	0.00156157	0.002333	0.666751752	57.82094145	0.028910471
	Comal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Guadalupe	0.00200761	0.14173063	0.076651484	0.121009049	0.00148271	0	0.134326688	0.509490338	0.0012416	0.122951305	0.00356749	0.182345694	0.001065557	0	0.0018623	0	0.000403	0.00130062	0.001842	0.526439875	1.605267509	0.000802634
	Wilson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Austin Area	Bastrop	0.00446951	0.31553286	0.170648096	0.269400706	0.003300936	0	0.299049574	1.134271011	0.002764	0.273724721	0.007942252	0.405953595	0.002372235	0	0.0041461	0	0.000898	0.00289555	0.0041	1.17200552	3.573783964	0.001786892
	Caldwell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hays	0.00246935	0.1743281	0.094281013	0.148840638	0.001823727	0	0.165221279	0.626671041	0.0015271	0.151229604	0.004387998	0.22428446	0.001310631	0	0.0022907	0	0.000496	0.00159976	0.002265	0.647518902	1.974472498	0.000987236
	Travis	0.00050761	0.03583552	0.298194277	0.470756783	0.000374892	0	0.033779905	0.128124465	0.0003331	0.032990521	0.000901861	0.046096954	0.000269863	0	0.0004695	0	0.000103	0.00033178	0.000465	0.132956005	0.847092022	0.000423546
	Williamson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North East Texas Area	Gregg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Harrison	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rusk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Smith	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Upshur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corpus Christi Area	Nueces	0.22352453	15.7800879	0.00447587	0.007066018	0.165082827	0	0.007477478	0.028361473	0.001651	0.163500888	0.001597886	0.081672986	0.045960479	0	0.0071176	0	0.001581	0.00509993	0.008136	2.325662037	18.39145122	0.009195726
	San Patricio	0.05533089	3.90617649	0.001107949	0.00174911	0.040864326	0	0.001850962	0.007020551	0.0004087	0.040472736	0.000395538	0.020217194	0.01137698	0	0.0017619	0	0.000391	0.00126243	0.002014	0.57569048	4.55258899	0.002276294
Victoria Area	Victoria	0.02060475	1.45462695	0.002090584	0.003300387	0.015217528	0	0.003408874	0.012929587	0.0011319	0.112096631	0.000524055	0.026786103	0.495811308	0	0.0305841	0	0.00045	0.0014516	0.002128	0.60816696	2.219358216	0.001109679
Other ERCOT counties	Andrews	2.5653E-05	0.00181099	2.58716E-05	4.08433E-05	1.89456E-05	0	4.28342E-05	0.000162467	1.121E-05	0.001110465	3.69632E-06	0.000188931	3.65442E-05	0	0.000127	0	4.35E-05	0.00014019	0.000233	0.066707721	0.070161614	3.50808E-05
	Angelina	0.00032149	0.02269614	0.000324234	0.000511866	0.000237435	0	0.000536817	0.002036104	0.0001405	0.013916822	4.63239E-05	0.002367758	0.000457988	0	0.0015917	0	0.000545	0.00175697	0.002925	0.836009744	0.879295405	0.000439648
	Bosque	0.00093945	0.06632223	0.001730301	0.002731612	0.000693828	0	0.002769496	0.010504476	0.0011606	0.114937019	0.000334979	0.01712182	0.009007821	0	0.0360555	0	0.00037	0.00119347	0.001684	0.481334428	0.694145059	0.000347073
	Brazos	0.00191393	0.13511683	0.003525105	0.005565054	0.00141352	0	0.005642234	0.021400539	0.0023645	0.234158668	0.000682445	0.034881909	0.018351436	0	0.073455	0	0.000754	0.00243143	0.003431	0.980612074	1.414166505	0.000707083
	Calhoun	0.08852525	6.24958787	0.001772635	0.002798444	0.065379841	0	0.0029614	0.011232353	0.0006539	0.064753326	0.000632831	0.032345986	0.01820231	0	0.0028189	0	0.000626	0.00201979	0.003222	0.921061363	7.283799132	0.0036419
	Cameron	0.05467229	3.85968162	0.001094762	0.001728291	0.285623104	0	0.001828931	0.006936986	0.0004038	0.039990992	0.00039083	0.01997655	0.011241561	0	0.0017409	0	0.000387	0.0012474	0.00199	0.568838088	4.498399931	0.0022492
	Cherokee	0.003513	0.24800577	0.003542982	0.005593275	0.002594504	0	0.005865919	0.02224896	0.0015356	0.152072238	0.000506191	0.025873027	0.005004538	0	0.0173929	0	0.005951	0.01919886	0.031959	9.135265956	9.608258081	0.004804129
	Coke	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coleman	0.0013551	0.09566551	2.71346E-05	4.28372E-05	0.001000801	0	4.53316E-05	0.000171939	1.001E-05	0.000991211	9.68705E-06	0.000495136	0.000278632	0	4.315E-05	0	9.58E-06	3.0918E-05	4.93E-05	0.014099138	0.111496685	5.57483E-05
	Crockett	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ector	0.00362926	0.25621393	0.003660242	0.005778394	0.002680373	0	0.006060061	0.022985326	0.0015864	0.157105322	0.000522944	0.026729338	0.005170172	0	0.0179686	0	0.006148	0.01983427	0.033017	9.437612828	9.926259417	0.00496313
	Fannin	0.00762852	0.53854786	0.007693632	0.012145872	0.005633999	0	0.012737922	0.048313916	0.0033346	0.330226909	0.001099201	0.056183627	0.010867422	0	0.0377689	0	0.012923	0.04169057	0.0694	19.83735287	20.86446163	0.010432231
	Fayette	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Freestone	0.00377443	0.26646249	0.003806652	0.006009529	0.002787588	0	0.006302464	0.02390474	0.0016499	0.163389535	0.000543862	0.027798512	0.005376978	0	0.0186873	0	0.006394	0.02062764	0.034338	9.815117342	10.32330979	0.005161655
	Frio	0.01476384	1.04227786	0.001497957	0.002364812	0.010903753	0	0.002442547	0.009264384	0.0008111	0.080320138	0.000375499	0.019192936	0.355261637	0	0.0219143	0	0.000322	0.00104011	0.001525	0.43576737	1.590227613	0.000795114
	Grimes	0.00055442	0.03914051	0.001021149	0.001612079	0.000409467	0	0.001634436	0.006199286	0.0006849	0.067830843	0.00019769	0.010104556	0.005316025	0	0.0212784	0	0.000218	0.00070433	0.000994	0.2840627	0.409654303	0.000204827
	Hardeman	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Haskell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hidalgo	0.239737	16.9246343	0.004800509	0.007578524	0.177056459	0	0.008019827	0.030418561	0.0017708	0.175359781	0.001713782	0.087596814	0.049294041	0	0.0076338	0	0.001695	0.00546983	0.008726	2.494344764	19.72540262	0.009862701
	Howard	0.00058508	0.04130476	0.000590075	0.000931546	0.000432108	0	0.000976955	0.003705511	0.0002558	0.025327264	8.43049E-05	0.00430909	0.000833494	0	0.0028967	0	0.000991	0.00319752	0.005323	1.521456508	1.600232205	0.000800116
	Jack	0.00217756	0.15372836	0.002196145	0.003467036	0.001608224	0	0.003636037	0.013791196	0.0009519	0.094263193	0.000313767	0.016037603	0.003102103	0	0.0107811	0	0.003689	0.01190056	0.01981	5.662567697	5.95575565	0.002977878
	Jones	0.04250012	3.00036735	0.000851025	0.001343506	0.031388236	0	0.00142174	0.005392545	0.0003139	0.031087452	0.000303816	0.015528998	0.008738755	0	0.0013533	0	0.000301	0.00096968	0.001547	0.442192749	3.496882279	0.001748441
	Lamar	0.00107998	0.07624303	0.001089199	0.001719509	0.000797614	0	0.001803327	0.006839873	0.0004721	0.046750718	0.000155616	0.007954	0.001538517	0	0.005347	0	0.00183	0.0059022	0.009825	2.808403768	2.953813094	0.001476907
	Limestone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Llano	0.00124346	0.08778413	0.047475864	0.074949744	0.000918351	0	0.083198331	0.315564587	0.000769	0.076152725	0.002209607	0.112940009	0.000659977	0	0.0011535	0	0.00025	0.00080557	0.001141	0.326062673	0.99425944	0.00049713
	McLennan	0.02303137	1.62593799	0.023227961	0.036669785	0.017009692	0	0.038457253	0.145865273	0.0100675	0.996993049	0.003318614	0.169624836	0.032809997	0	0.1140288	0	0.039015	0.12586864	0.209526	59.89125169	62.99221127	0.031496106
	Milam	0.00165249	0.11666044	0.001666598	0.002631043	0.001220439	0	0.002759294	0.010465779	0.0007223	0.07153388	0.000238109	0.012170519	0.002354105	0	0.0081815	0	0.002799	0.00903103	0.015033	4.297174983	4.519667676	0.002259834
	Mitchell	0.01696145	1.19742216	0.017106233	0.027005466	0.012526789	0	0.028321847	0.107422491	0.0074142	0.734235606	0.002443993	0.124920224	0.024162925	0	0.0839765	0	0.028733	0.09269597	0.154305	44.10691681	46.39061872	0.023195309
	Nolan	0.00060327	0.04258906	0.000608422	0.000960511	0.000445544	0	0.001007331	0.003820727	0.0002637	0.02611477	8.69262E-05	0.004443074	0.00085941	0	0.0029868	0	0.001022	0.00329694	0.005488	1.568763431	1.649988515	0.000824994
	Palo Pinto	0.00307488	0.21707625	0.00566337	0.008940714	0.002270935	0	0.00906471	0.034381717	0.0037988	0.376195064	0.001096403	0.056040642	0.029483083	0	0.1180115	0	0.001211	0.00390629	0.005512	1.575433551	2.271974228	0.001135987
	Pecos	4.2262E-05	0.00298354	4.26225E-05	6.72878E-05	3.12122E-05	0	7.05678E-05	0.000267658	1.847E-05	0.001829449	6.08954E-06	0.000311256	6.02052E-05	0	0.0002092	0	7.16E-05	0.00023096	0.000384	0.10989842	0.115588576	5.77943E-05
	Presidio	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Robertson	0.00035926	0.02536238	0.000406685	0.00064203	0.000265328	0	0.000358385	0.001359327	0.0015339	0.151899519	0.00035593	0.018192715	0.000370532	0	0.0009089	0	0.093323	0.3010726	0.001655	0.472973654	0.971502226	0.000485751
	Taylor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Titus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tom Green	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Upton	3.2238E-05	0.00227589	3.25131E-05	5.13282E-05	2.38092E-05	0	5.38302E-05	0.000204174	1.409E-05	0.001395532	4.6452E-06	0.000237431	4.59255E-05	0	0.0001596	0	5.46E-05	0.00017618	0.000293	0.08383224	0.08817278	4.40864E-05
	Ward	0.01980763	1.39835248	0.0199767	0.031537048	0.014628815	0	0.033074321	0.125448244	0.0086584	0.857442109	0.002854101	0.145882138	0.028217522	0	0.098068	0	0.033554	0.10825057	0.180198	51.50816365	54.17507624	0.027087538
	Webb	0.01418005	1.00106405	0.000283942	0.000448257	0.010472596	0	0.000474359	0.001799207	0.0001047	0.01037224	0.000101367	0.005181206	0.002915661	0	0.0004515	0	0.0001	0.00032353	0.000516	0.147536355	1.166724846	0.000583362
	Wharton	0.00015439	0.01089942	0.000191235	0.000301902	0.000114024	0	6.43902E-05	0.000244227	0.0011702	0.115880738	0.000265844	0.013588106	0.000106811	0	6.777E-05	0	8.17E-05	0.00026363	0.000112	0.032078154	0.173256176	8.66281E-05
	Wichita	0.00021984	0.01552018	0.000221719	0.000350027	0.000162364	0	0.000367089	0.001392338	9.61E-05	0.009516668	3.16774E-05	0.001619132	0.000313184	0	0.0010884	0	0.000372	0.00120146	0.002	0.571684185	0.601283993	0.000300642
	Wilbarger	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Wise	0.00291847	0.20603434	0.002955932	0.004666505	0.002155421	0	0.004892446	0.018556655	0.0012878	0.127526775	0.000423725	0.021657945	0.004280539	0	0.0149528	0	0.004924	0.01588655	0.026441	7.557806377	7.952135146	0.003976068
	Young	0.00549666	0.38804592	0.005543579	0.008751601	0.004059529	0	0.009178198	0.034812167	0.0024027	0.237942092	0.000792019	0.040482618	0.007830425	0	0.0272141	0	0.009311	0.03003978	0.050005	14.29362999	15.03370416	0.007516852
	Total	**1.14303735**	**80.6946346**	**1.154658244**	**1.822849203**	**1.089429227**	**0**	**1.180868675**	**4.478940028**	**1.5393506**	**152.4425952**	**1.443965054**	**73.80561909**	**1.48172714**	**0**	**1.2697054**	**0**	**1.151969**	**3.71638898**	**1.517783**	**433.8456297**	**750.8066569**	**0.375403328**

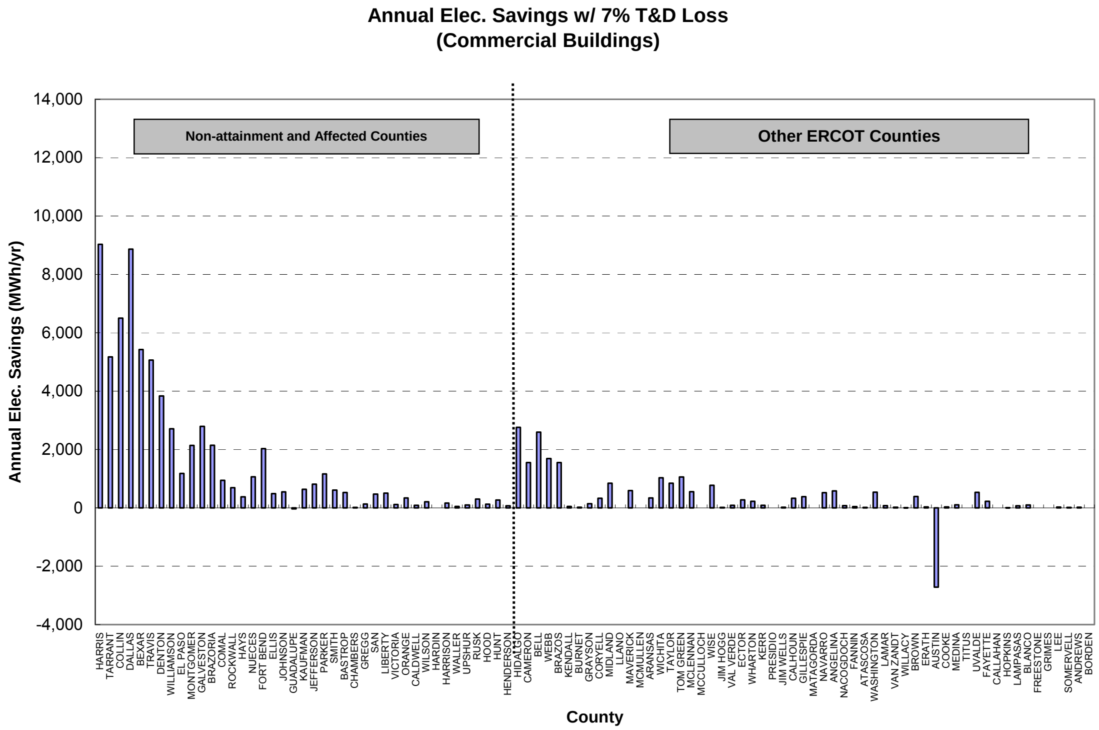
Energy Savings by PCA (MWh)																				
		70.60		1.58		0.00		3.79		99.03		51.11		0.00		0.00		3.23		285.84

Table 70: 2006 Annual and OSD NOx Reductions from IECC / IRC by PCA for Commercial Buildings by County using 2007 eGRID (w/7% T&D) (1).

	Electricity Savings and Resultant NOx Reductions (Office)				Total Natural Gas Savings and Resultant NOx Reductions (Office)				Total Nox Reductions	
County	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	OSD Electricity Savings per County w/ 7% T&D Loss (MWh/County)	OSD Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Total OSD N.G. Savings (Therm/County)	OSD Nox Reductions (Tons)	Annual Nox Reductions (Tons)	OSD Nox Reductions (Tons)
HARRIS	9,030.69	5.41	79.59	0.04	(186,667.16)	(0.86)	3,020.1513	0.0139	4.55	0.0573
TARRANT	5,174.46	2.78	39.83	0.02	(73,466.78)	(0.34)	1,167.8272	0.0054	2.44	0.0267
COLLIN	6,498.20	0.13	36.64	0.00	(42,972.57)	(0.20)	874.8515	0.0040	(0.07)	0.0048
DALLAS	8,867.84	1.02	62.13	0.01	(121,998.11)	(0.56)	2,063.0828	0.0095	0.46	0.0161
BEXAR	5,425.60	4.15	42.16	0.03	(45,316.49)	(0.21)	1,404.3183	0.0065	3.94	0.0354
TRAVIS	5,062.31	0.07	28.73	0.00	(17,676.19)	(0.08)	633.9964	0.0029	(0.01)	0.0033
DENTON	3,837.88	0.03	21.90	0.00	(38,523.72)	(0.18)	602.3581	0.0028	(0.15)	0.0030
WILLIAMSON	2,708.72	0.00	14.23	0.00	(14,490.63)	(0.07)	238.2135	0.0011	(0.07)	0.0011
EL PASO	1,177.56	0.00	9.81	0.00	(25,334.10)	(0.12)	383.3589	0.0018	(0.12)	0.0018
MONTGOMERY	2,139.92	0.00	11.71	0.00	(13,186.57)	(0.06)	301.2280	0.0014	(0.06)	0.0014
GALVESTON	2,794.36	2.99	14.15	0.02	(17,609.56)	(0.08)	217.9650	0.0010	2.91	0.0182
BRAZORIA	2,146.27	0.77	11.47	0.01	(17,604.21)	(0.08)	266.1899	0.0012	0.69	0.0070
COMAL	940.57	0.00	4.70	0.00	(6,994.35)	(0.03)	98.4224	0.0005	(0.03)	0.0005
ROCKWALL	688.54	0.00	3.56	0.00	(4,659.31)	(0.02)	75.2771	0.0003	(0.02)	0.0003
HAYS	375.48	0.15	3.31	0.00	(8,583.97)	(0.04)	95.3167	0.0004	0.11	0.0014
NUECES	1,065.79	1.72	5.36	0.01	(7,287.50)	(0.03)	136.3955	0.0006	1.68	0.0098
FORT BEND	2,024.57	5.58	12.78	0.03	(28,713.92)	(0.13)	409.3869	0.0019	5.45	0.0331
ELLIS	481.31	0.75	3.02	0.00	(4,862.74)	(0.02)	103.5543	0.0005	0.73	0.0053
JOHNSON	549.17	0.02	2.70	0.00	(3,117.09)	(0.01)	39.1167	0.0002	0.00	0.0003
GUADALUPE	(36.23)	0.12	2.27	0.00	(9,701.85)	(0.04)	120.2586	0.0006	0.07	0.0014
KAUFMAN	637.91	1.45	3.15	0.01	(3,912.27)	(0.02)	51.4313	0.0002	1.43	0.0091
JEFFERSON	812.69	0.00	4.34	0.00	(1,146.52)	(0.01)	96.0829	0.0004	(0.01)	0.0004
PARKER	1,159.48	0.01	5.74	0.00	(4,967.78)	(0.02)	55.4462	0.0003	(0.01)	0.0004
SMITH	605.22	0.00	3.51	0.00	(3,831.97)	(0.02)	88.7568	0.0004	(0.02)	0.0004
BASTROP	528.59	0.27	3.44	0.00	8,719.02	0.04	124.0469	0.0006	0.31	0.0024
CHAMBERS	15.26	1.73	0.07	0.01	(154.07)	(0.00)	2.1562	0.0000	1.72	0.0123
GREGG	132.74	0.00	1.04	0.00	(2,444.32)	(0.01)	45.9812	0.0002	(0.01)	0.0002
SAN PATRICIO	470.16	0.38	2.34	0.00	(2,592.76)	(0.01)	33.5615	0.0002	0.37	0.0024
LIBERTY	503.81	0.00	2.42	0.00	(4,956.93)	(0.02)	69.0581	0.0003	(0.02)	0.0003
VICTORIA	117.08	0.21	0.65	0.00	365.90	0.00	13.1182	0.0001	0.21	0.0012
ORANGE	338.53	0.00	1.67	0.00	(2,045.61)	(0.01)	27.5519	0.0001	(0.01)	0.0001
CALDWELL	89.87	0.00	0.43	0.00	(860.69)	(0.00)	11.9492	0.0001	(0.00)	0.0001
WILSON	202.90	0.00	1.13	0.00	802.63	0.00	22.4999	0.0001	0.00	0.0001
HARDIN	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0000	0.00	0.0000
HARRISON	163.41	0.00	0.83	0.00	(1,539.53)	(0.01)	25.9036	0.0001	(0.01)	0.0001
WALLER	46.22	0.00	0.23	0.00	(193.79)	(0.00)	2.1493	0.0000	(0.00)	0.0000
UPSHUR	96.88	0.00	0.46	0.00	(977.89)	(0.00)	13.6855	0.0001	(0.00)	0.0001
RUSK	299.08	0.16	1.48	0.00	(1,253.81)	(0.01)	13.9058	0.0001	0.15	0.0001
HOOD	120.12	2.87	0.61	0.02	(1,204.18)	(0.01)	20.2726	0.0001	2.86	0.0170
HUNT	265.27	1.42	1.30	0.01	(2,136.17)	(0.01)	27.7201	0.0001	1.41	0.0088
HENDERSON	69.67	0.19	0.34	0.00	(601.98)	(0.00)	8.6933	0.0000	0.18	0.0013
HIDALGO	2,755.33	1.42	14.94	0.01	(17,881.28)	(0.08)	287.6217	0.0013	1.34	0.0112
CAMERON	1,547.18	0.36	9.35	0.00	(11,368.82)	(0.05)	222.5916	0.0010	0.31	0.0033
BELL	2,596.04		13.55		(4,084.42)	(0.02)	234.8310	0.0011	(0.02)	0.0011
WEBB	1,686.02	0.15	8.61	0.00	(7,068.65)	(0.03)	211.0172	0.0010	0.12	0.0016
BRAZOS	1,552.17	0.12	8.07	0.00	(5,126.50)	(0.02)	178.7705	0.0008	0.09	0.0015
KENDALL	46.39		0.23		(353.22)	(0.00)	5.4849	0.0000	(0.00)	0.0000
BURNET	18.97		0.18		(422.32)	(0.00)	4.0808	0.0000	(0.00)	0.0000
GRAYSON	145.95		1.32		(3,368.59)	(0.02)	47.5576	0.0002	(0.02)	0.0002
CORYELL	330.18		1.64		(1,384.19)	(0.01)	15.3518	0.0001	(0.01)	0.0001
MIDLAND	849.19		4.36		(6,706.76)	(0.03)	100.7163	0.0005	(0.03)	0.0005
LLANO	0.00	0.07	0.00	0.00	0.00	0.00	0.0000	0.0000	0.07	0.0005
MAVERICK	590.58		3.20		901.07	0.00	63.9862	0.0003	0.00	0.0003
MCMULLEN	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
ARANSAS	340.40		1.69		(1,427.05)	(0.01)	15.8272	0.0001	(0.01)	0.0001
WICHITA	1,029.82	0.05	5.43	0.00	(1,736.93)	(0.01)	113.3687	0.0005	0.04	0.0008
TAYLOR	848.34	0.00	5.03	0.00	(4,640.88)	(0.02)	92.0256	0.0004	(0.02)	0.0004
TOM GREEN	1,056.30	0.01	5.82	0.00	(1,585.54)	(0.01)	119.6439	0.0006	0.00	0.0006
MCLENNAN	555.72	5.61	2.86	0.03	(1,474.83)	(0.01)	45.8163	0.0002	5.61	0.0317
MCCULLOCH	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
WISE	768.06	0.65	3.93	0.00	(3,390.44)	(0.02)	100.0357	0.0005	0.63	0.0044
JIM HOGG	12.61		0.06		(127.33)	(0.00)	1.7820	0.0000	(0.00)	0.0000
VAL VERDE	86.18		0.44		(456.49)	(0.00)	10.7105	0.0000	(0.00)	0.0000
ECTOR	269.71	0.81	1.32	0.00	(2,385.82)	(0.01)	34.6524	0.0002	0.80	0.0051
WHARTON	226.04	0.01	1.19	0.00	(666.54)	(0.00)	25.5166	0.0001	0.01	0.0002
KERR	88.55		0.45		(887.67)	(0.00)	14.9442	0.0001	(0.00)	0.0001
PRESIDIO	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0000	0.00	0.0000
JIM WELLS	19.13		0.09		(155.39)	(0.00)	2.0969	0.0000	(0.00)	0.0000
CALHOUN	330.39	0.62	1.64	0.00	(1,385.08)	(0.01)	15.3617	0.0001	0.62	0.0037
GILLESPIE	381.23		1.90		(1,734.83)	(0.01)	23.2967	0.0001	(0.01)	0.0001
MATAGORDA	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
NAVARRO	518.53		2.58		(2,148.80)	(0.01)	29.0595	0.0001	(0.01)	0.0001
ANGELINA	578.36	0.07	3.01	0.00	(2,352.17)	(0.01)	57.5286	0.0003	0.06	0.0007
NACOGDOCHES	74.53		0.39		(951.47)	(0.00)	13.2008	0.0001	(0.00)	0.0001
FANNIN	43.55	1.61	0.22	0.01	(436.56)	(0.00)	7.3496	0.0000	1.61	0.0105
ATASCOSA	16.89		0.08		(131.00)	(0.00)	1.9596	0.0000	(0.00)	0.0000
WASHINGTON	541.16		2.68		(2,286.70)	(0.01)	25.5391	0.0001	(0.01)	0.0001
LAMAR	72.60	0.22	0.36	0.00	(612.35)	(0.00)	8.7367	0.0000	0.21	0.0015
VAN ZANDT	20.44		0.10		(206.27)	(0.00)	2.8868	0.0000	(0.00)	0.0000
WILLACY	8.52		0.04		(35.72)	(0.00)	0.3962	0.0000	(0.00)	0.0000
BROWN	388.45		2.01		(513.62)	(0.00)	28.9243	0.0001	(0.00)	0.0001
ERATH	31.53		0.16		(132.17)	(0.00)	1.4658	0.0000	(0.00)	0.0000
AUSTIN	(2,720.04)		(7.78)		(11,490.26)	(0.05)	97.0529	0.0004	(0.05)	0.0004
COOKE	32.42		0.16		(327.24)	(0.00)	4.5797	0.0000	(0.00)	0.0000
MEDINA	99.78		0.48		(1,007.18)	(0.00)	14.0954	0.0001	(0.00)	0.0001
TITUS	0.00	1.30	0.00	0.00	0.00	0.00	0.0000	0.0000	1.30	0.0000
UVALDE	530.79		2.63		(2,383.96)	(0.01)	28.0075	0.0001	(0.01)	0.0001
FAYETTE	225.20	0.00	1.24	0.00	770.75	0.00	24.8558	0.0001	0.00	0.0001
CALLAHAN	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
HOPKINS	6.39		0.03		(26.79)	(0.00)	0.2971	0.0000	(0.00)	0.0000
LAMPASAS	68.91		0.38		294.76	0.00	7.2111	0.0000	0.00	0.0000
BLANCO	97.13		0.46		(980.44)	(0.00)	13.7211	0.0001	(0.00)	0.0001
FREESTONE	0.00	0.84	0.00	0.01	0.00	0.00	0.0000	0.0000	0.84	0.0052
GRIMES	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0000	0.00	0.0002
LEE	24.92		0.12		(104.48)	(0.00)	1.1588	0.0000	(0.00)	0.0000
SOMERVELL	15.14		0.07		(152.80)	(0.00)	2.1384	0.0000	(0.00)	0.0000
ANDREWS	21.44	0.01	0.10	0.00	(216.46)	(0.00)	3.0293	0.0000	0.00	0.0000
BORDEN	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000

Table 71: 2006 Annual and OSD NOx Reductions from IECC / IRC by PCA for Commercial Buildings by County using 2007 eGRID (w/7% T&D) (2).

	Electricity Savings and Resultant NOx Reductions (Office)				Total Natural Gas Savings and Resultant NOx Reductions (Office)				Total Nox Reductions	
County	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	OSD Electricity Savings per County w/ 7% T&D Loss (MWh/County)	OSD Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Total OSD N.G. Savings (Therm/County)	OSD Nox Reductions (Tons)	Annual Nox Reductions (Tons)	OSD Nox Reductions (Tons)
CHEROKEE	146.10	0.80	0.74	0.00	(1,397.00)	(0.01)	22.9473	0.0001	0.80	0.0049
DIMMIT	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
FALLS	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
COLORADO	155.16		0.74		(1,566.16)	(0.01)	21.9182	0.0001	(0.01)	0.0001
FRIO	0.00	0.08	0.00	0.00	0.00	0.00	0.0000	0.0000	0.08	0.0008
MILAM	212.38	0.51	1.05	0.00	(890.35)	(0.00)	9.8747	0.0000	0.51	0.0023
JACKSON	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
ANDERSON	59.64		0.30		(250.05)	(0.00)	2.7732	0.0000	(0.00)	0.0000
HILL	15.14		0.07		(152.80)	(0.00)	2.1384	0.0000	(0.00)	0.0000
CULBERSON	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
MASON	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
PECOS	87.62	0.01	0.49	0.00	410.88	0.00	9.4168	0.0000	0.01	0.0001
RAINS	17.66		0.08		(178.26)	(0.00)	2.4948	0.0000	(0.00)	0.0000
LAVACA	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
PALO PINTO	441.71	0.19	2.19	0.00	(1,904.68)	(0.01)	21.6470	0.0001	0.18	0.0012
KIMBLE	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
MADISON	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
ARCHER	7.98		0.04		(80.04)	(0.00)	1.3474	0.0000	(0.00)	0.0000
REFUGIO	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
LIMESTONE	10.09	0.06	0.05	0.00	(101.86)	(0.00)	1.4256	0.0000	0.06	0.0000
CLAY	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
BEE	96.17		0.49		(964.07)	(0.00)	16.2304	0.0001	(0.00)	0.0001
MARTIN	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
GONZALES	36.05		0.17		(282.15)	(0.00)	3.7800	0.0000	(0.00)	0.0000
BURLESON	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
KARNES	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
KLEBERG	478.78		2.35		(2,823.86)	(0.01)	35.3754	0.0002	(0.01)	0.0002
BREWSTER	(104.58)		(0.31)		(442.98)	(0.00)	3.3623	0.0000	(0.00)	0.0000
WINKLER	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
FRANKLIN	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
YOUNG	4.72	1.43	0.02	0.01	(47.29)	(0.00)	0.7962	0.0000	1.43	0.0075
HOUSTON	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
SCURRY	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
BOSQUE	0.00	0.04	0.00	0.00	0.00	0.00	0.0000	0.0000	0.04	0.0003
COMANCHE	173.76		0.95		512.77	0.00	19.3661	0.0001	0.00	0.0001
BRISCOE	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
CONCHO	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
ZAVALA	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
NOLAN	212.38	0.13	1.05	0.00	(890.35)	(0.00)	9.8747	0.0000	0.13	0.0009
BROOKS	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
ROBERTSON	4.04	0.17	0.02	0.00	(40.75)	(0.00)	0.5702	0.0000	0.17	0.0005
LIVE OAK	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
HAMILTON	76.66		0.43		359.52	0.00	8.2397	0.0000	0.00	0.0000
JONES	0.00	0.31	0.00	0.00	0.00	0.00	0.0000	0.0000	0.31	0.0017
REAGAN	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
WARD	0.00	4.25	0.00	0.03	0.00	0.00	0.0000	0.0000	4.25	0.0271
RED RIVER	2.00	0.00	0.01	0.00	(20.01)	(0.00)	0.3369	0.0000	(0.00)	0.0000
HASKELL	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0000	0.00	0.0000
HOWARD	55.37	0.13	0.28	0.00	(475.52)	(0.00)	7.6772	0.0000	0.12	0.0008
SAN SABA	37.92		0.19		(380.17)	(0.00)	6.4003	0.0000	(0.00)	0.0000
JACK	0.00	0.49	0.00	0.00	0.00	0.00	0.0000	0.0000	0.49	0.0030
STEPHENS	24.72		0.12		(249.57)	(0.00)	3.4927	0.0000	(0.00)	0.0000
RUNNELS	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
REEVES	28.80		0.15		(226.55)	(0.00)	3.5576	0.0000	(0.00)	0.0000
DE WITT	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
CHILDRESS	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
CROSBY	21.90		0.12		102.72	0.00	2.3542	0.0000	0.00	0.0000
DAWSON	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
MITCHELL	0.00	3.42	0.00	0.02	0.00	0.00	0.0000	0.0000	3.42	0.0232
WILBARGER	2.36	0.22	0.01	0.00	(23.65)	(0.00)	0.3981	0.0000	0.22	0.0000
COLEMAN	7.06	0.01	0.03	0.00	(71.30)	(0.00)	0.9979	0.0000	0.01	0.0001
UPTON	0.00	0.01	0.00	0.00	0.00	0.00	0.0000	0.0000	0.01	0.0000
COKE	33.93	0.00	0.17	0.00	(340.15)	(0.00)	5.7266	0.0000	(0.00)	0.0000
CROCKETT	19.23	0.00	0.10	0.00	(192.81)	(0.00)	3.2461	0.0000	(0.00)	0.0000
HARDEMAN	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0000	0.00	0.0000
BANDERA	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
BAYLOR	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
COTTLE	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
CRANE	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
DELTA	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
DICKENS	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
DUVAL	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
EASTLAND	68.04		0.35		(682.13)	(0.00)	11.4837	0.0001	(0.00)	0.0001
EDWARDS	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
FISHER	24.09		0.13		112.99	0.00	2.5896	0.0000	0.00	0.0000
FOARD	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
GLASSCOCK	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
GOLIAD	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
HALL	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
HUDSPETH	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
IRION	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
JEFF DAVIS	37.74		0.19		(378.35)	(0.00)	6.3697	0.0000	(0.00)	0.0000
KENEDY	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
KENT	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
KING	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
KINNEY	11.48		0.05		(115.87)	(0.00)	1.6216	0.0000	(0.00)	0.0000
KNOX	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
LA SALLE	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
LEON	39.92		0.20		(400.18)	(0.00)	6.7371	0.0000	(0.00)	0.0000
LOVING	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
MENARD	6.31		0.03		(63.67)	(0.00)	0.8910	0.0000	(0.00)	0.0000
MILLS	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
MONTAGUE	212.38		1.05		(890.35)	(0.00)	9.8747	0.0000	(0.00)	0.0000
MOTLEY	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
REAL	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
SCHLEICHER	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
SHACKELFORD	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
STARR	131.73		0.64		(1,327.32)	(0.01)	19.5574	0.0001	(0.01)	0.0001
STERLING	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
STONEWALL	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
SUTTON	21.69		0.12		101.69	0.00	2.3307	0.0000	0.00	0.0000
TERRELL	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
THROCKMORTON	0.00		0.00		0.00	0.00	0.0000	0.0000	0.00	0.0000
ZAPATA	184.17		0.88		(1,859.02)	(0.01)	26.0167	0.0001	(0.01)	0.0001
TOTAL	**89,557.29**	**60.52**	**567.85**	**0.38**	**(836,157.66)**	**(3.85)**	**15,680.76**	**0.07**	**56.67**	**0.45**



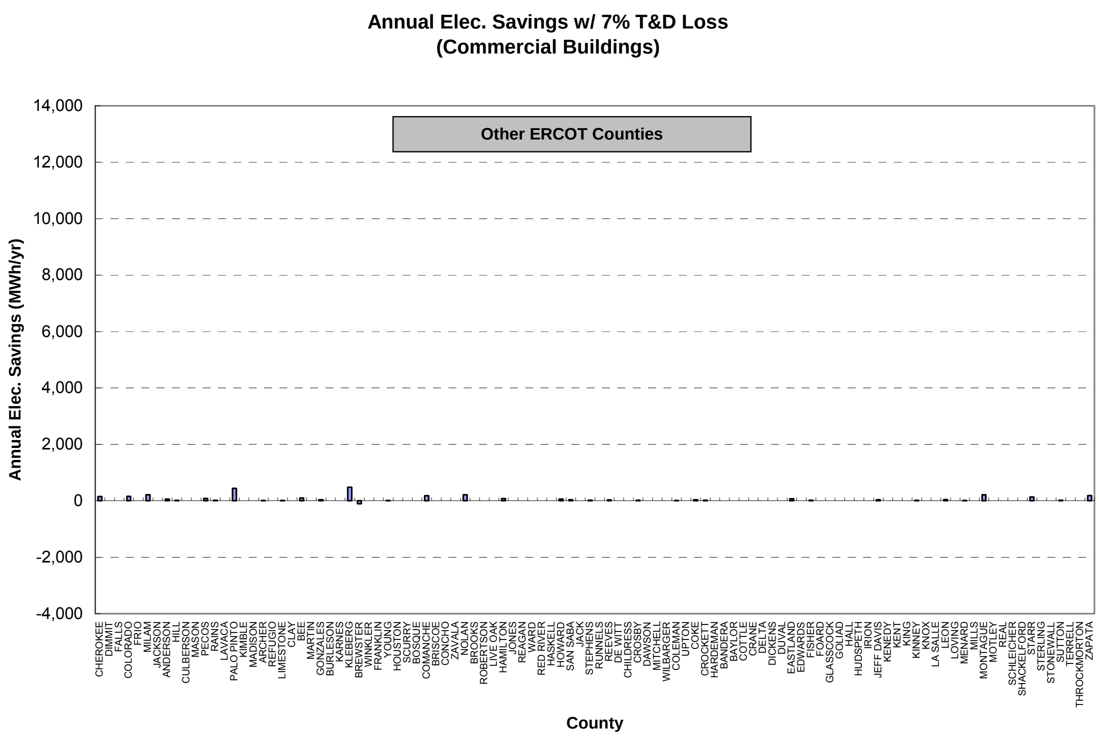
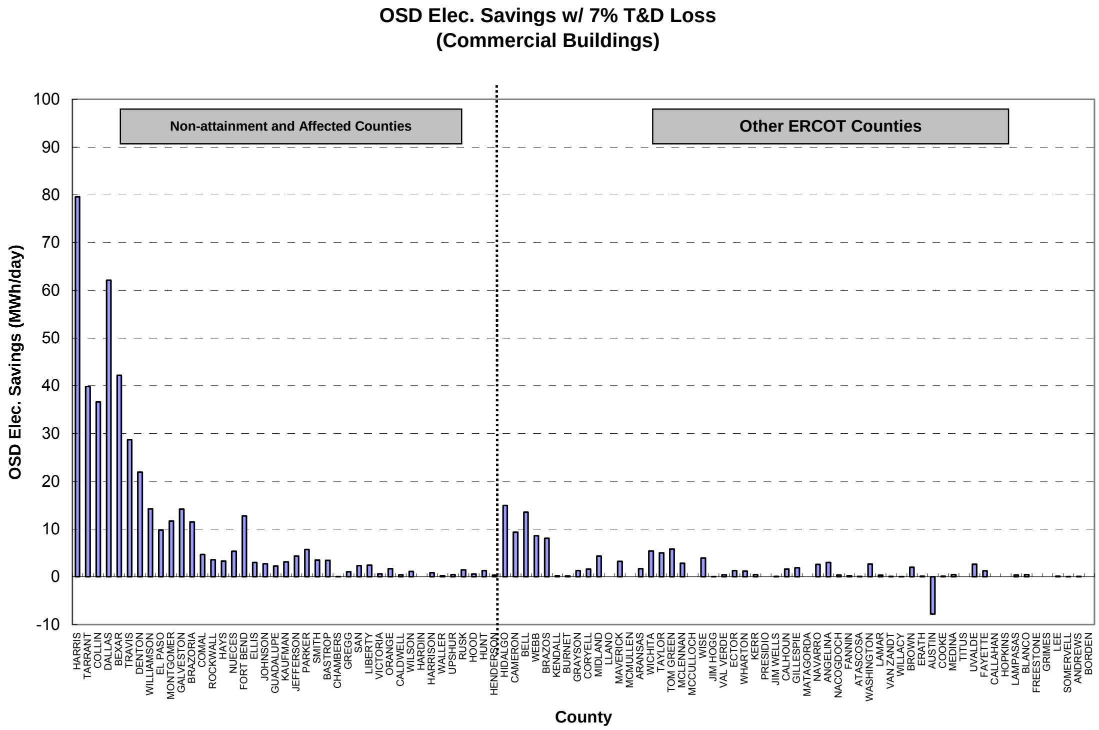


Figure 138: 2006 Annual Electricity Reductions from IECC / IRC by PCA for Commercial Buildings with 7% T&D losses.



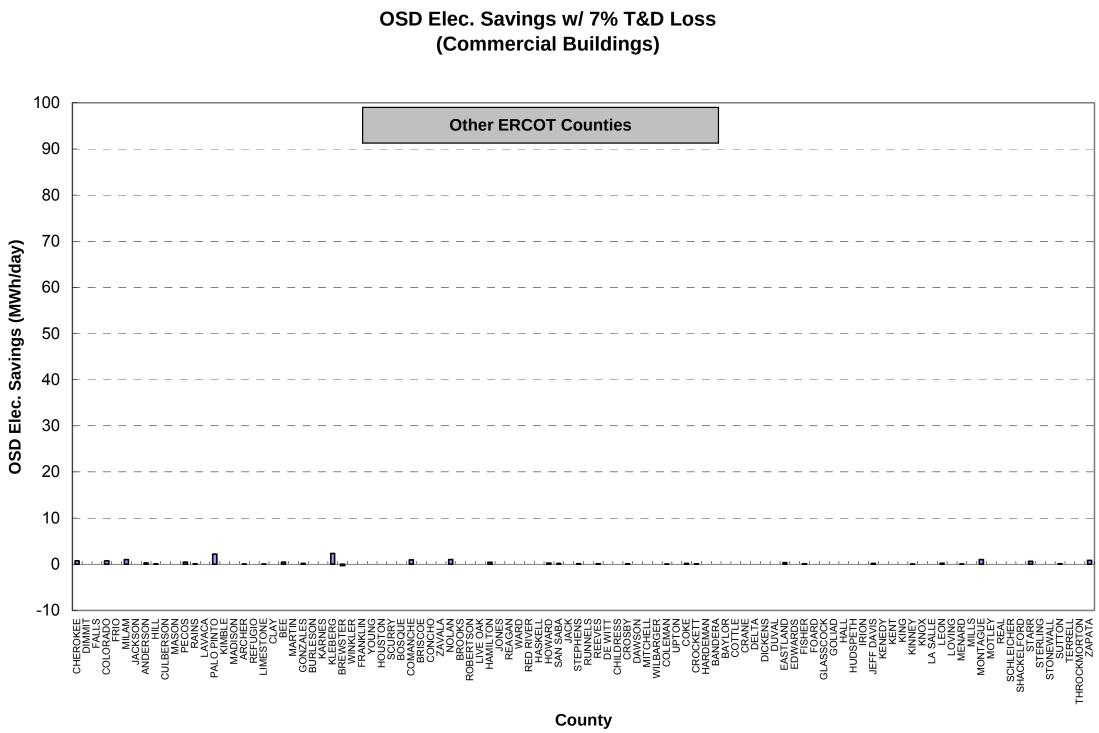
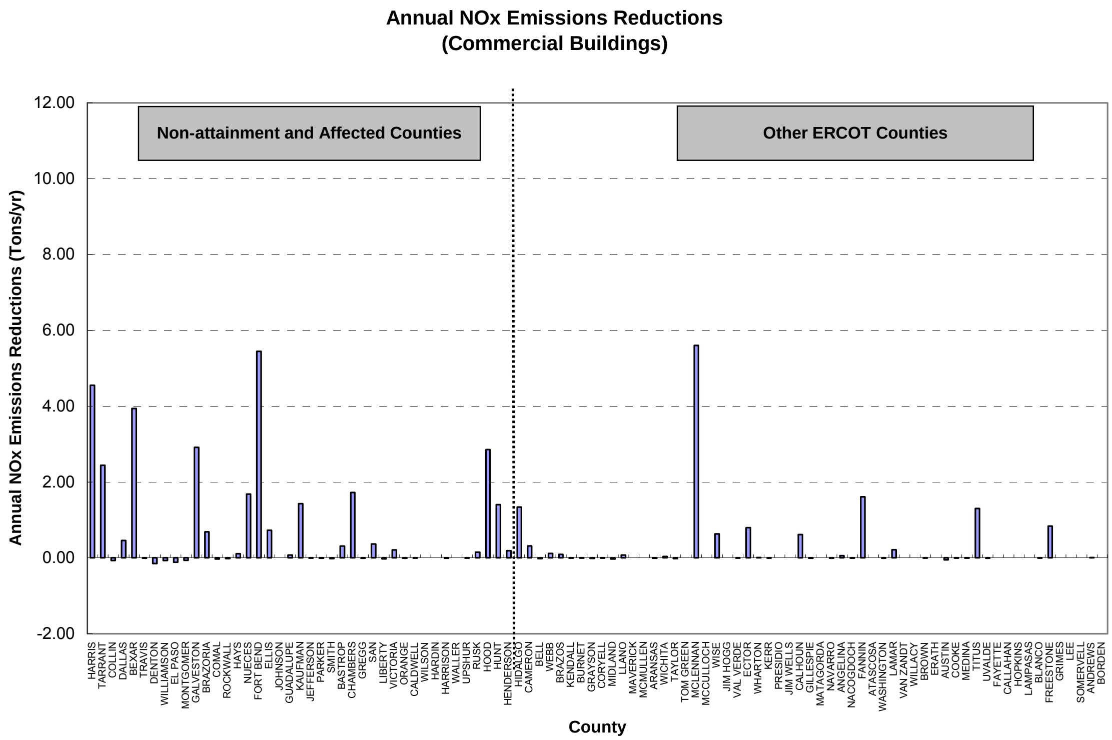


Figure 139: 2006 OSD Electricity Reductions from IECC / IRC by PCA for Commercial Buildings with 7% T&D losses.



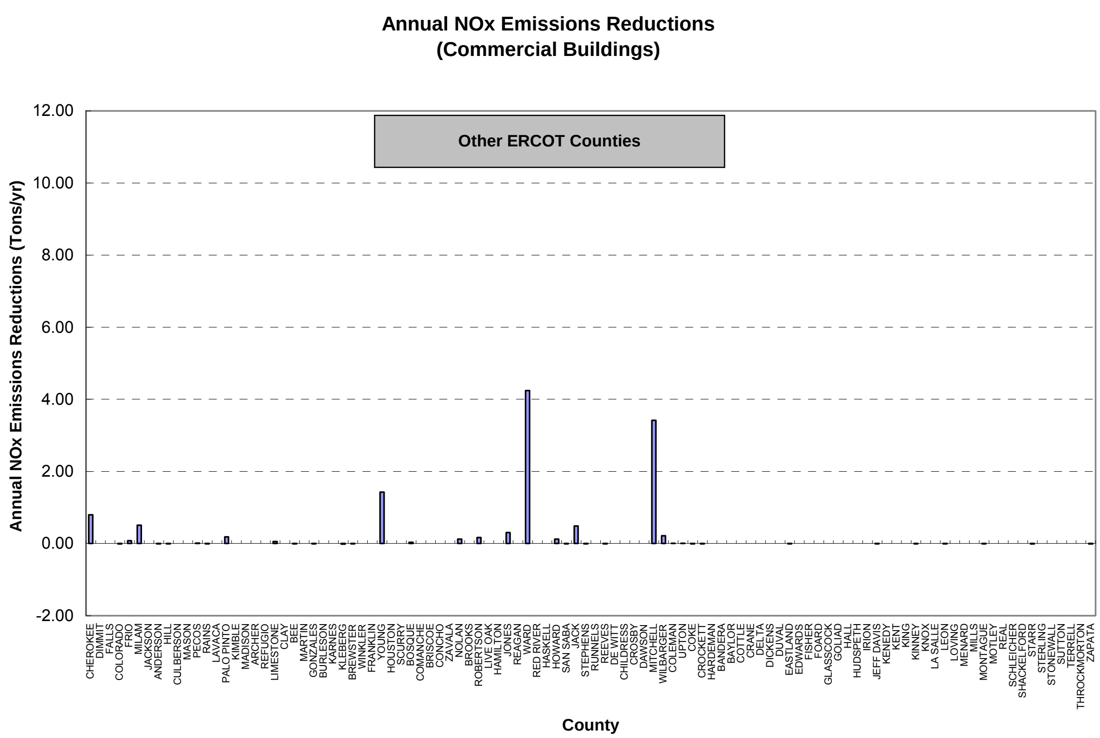
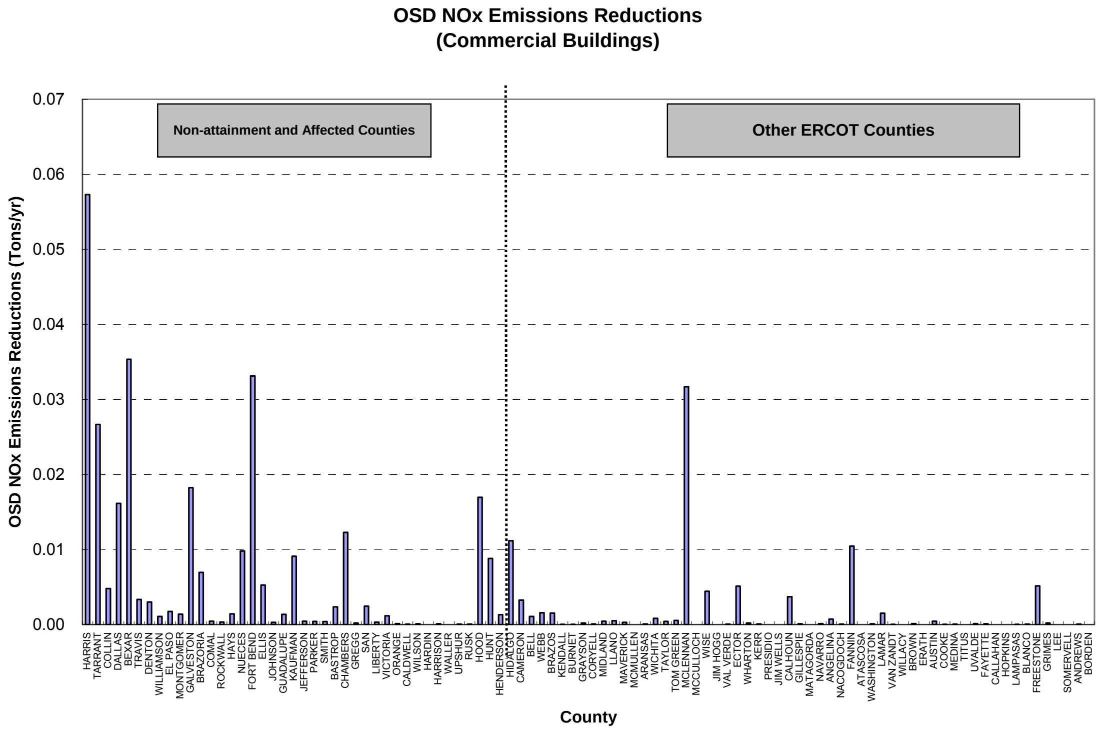


Figure 140: 2006 Annual NOx Reductions from Electricity Savings from the IECC / IRC by PCA for Commercial Buildings by County using 2007 eGRID with 7% T&D losses.



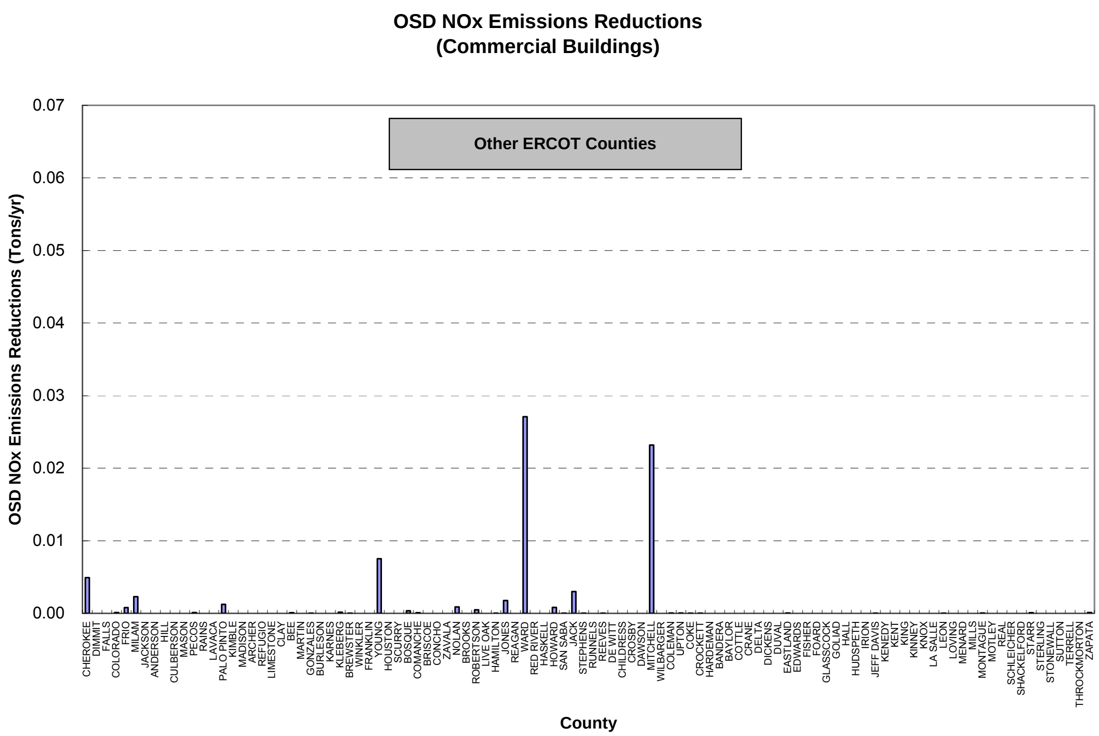


Figure 141: 2006 Annual NOx Reductions from Electricity Savings from the IECC / IRC by PCA for Commercial Buildings by County using 2007 eGRID with 7% T&D losses.

6.1.6 2006 Results for New Residential Construction (Single-family and Multi-family), and Commercial Construction.

6.1.7 2006 Results for New Residential (Single-family and Multi-family), and Commercial Construction using 2007 eGRID.

As shown in Table 68and Table 69, the total annual electricity savings in 2006 were calculated to be 498,582 MWh/yr [79] which includes 393,069 MWh/yr (78.8%) for single-family residential, 15,956 MWh/yr (3.2%) for multi-family residential, and 89,557 MWh/yr (18.0%) for new commercial buildings. Natural gas savings were calculated to be 576,680 MBtu (5,766,808 therms) for new residential and commercial construction.

Using the 2007 eGRID, the total NOx reductions from electricity and natural gas savings from new residential (single-family and multi-family) and commercial construction in 2006 were calculated to be 361.24 tons NOx/year which represents 334.71 tons NOx/year from electricity savings and 26.53 tons NOx/year from natural gas savings. On a peak Ozone Season Day (OSD), the NOx reductions in 2006 are calculated to be 2.22 tons of NOx/day which represents 2.07 tons NOx/day from electricity savings and 0.15 tons NOx/day from natural gas savings.

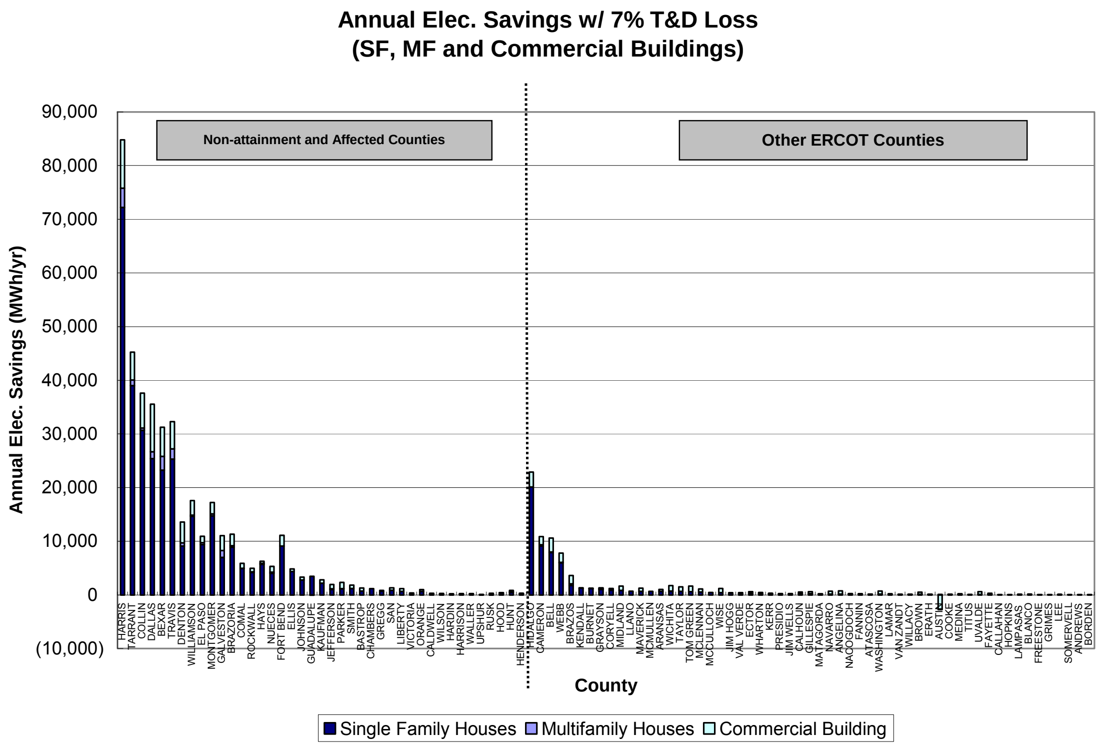
[79] In 2005, it is estimated that there were 128,804 single family residences and 29,972 multi-family residences, which totaled about 350 million sq. ft., and 122 million sq. ft. of commercial building construction.

County	Electricity Savings and Resultant NOx Reductions (Single Family Houses)				Electricity Savings and Resultant NOx Reductions (Multifamily Houses)				Electricity Savings and Resultant NOx Reductions (Commercial Buildings)				Total Electricity Savings and Resultant NOx Reductions (SF, MF and Commecial Buildings)				Total Natural Gas Savings and Resultant NOx Reductions (SF, MF and Commecial Buildings)				Total Nox Reductions	
	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	OSD Electricity Savings per County w/ 7% T&D Loss (MWh/County)	OSD Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	OSD Electricity Savings per County w/ 7% T&D Loss (MWh/County)	OSD Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	OSD Electricity Savings per County w/ 7% T&D Loss (MWh/County)	OSD Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	OSD Electricity Savings per County w/ 7% T&D Loss (MWh/County)	OSD Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Total OSD N.G. Savings (Therm/County)	OSD Nox Reductions (Tons)	Annual Nox Reductions (Tons)	OSD Nox Reductions (Tons)
HARRIS	72,234.29	30.85	447.83	0.22	3,535.56	1.46	20.24	0.01	9,030.69	5.41	79.59	0.04	84,800.54	37.72	547.67	0.27	984,100.79	4.53	6,235.37	0.03	42.24	0.30
TARRANT	39,010.75	10.41	267.94	0.09	1,041.58	0.37	8.14	0.00	5,174.46	2.78	39.83	0.02	45,226.79	13.56	315.91	0.11	623,338.89	2.87	2,869.43	0.01	16.42	0.13
COLLIN	30,665.79	0.54	210.43	0.00	422.61	0.02	3.30	0.00	6,498.20	0.13	36.64	0.00	37,586.59	0.69	250.36	0.00	486,060.35	2.24	2,172.30	0.01	2.93	0.01
DALLAS	25,425.21	3.81	174.69	0.03	1,266.75	0.13	9.90	0.00	8,867.84	1.02	62.13	0.01	35,559.80	4.96	246.72	0.04	351,035.84	1.61	3,215.65	0.01	6.57	0.05
BEXAR	23,262.26	19.69	143.11	0.11	2,562.26	1.51	16.37	0.01	5,425.60	4.15	42.16	0.03	31,250.12	25.35	201.65	0.15	369,297.76	1.70	2,619.33	0.01	27.05	0.16
TRAVIS	25,313.85	0.39	153.50	0.00	1,901.41	0.02	11.58	0.00	5,062.31	0.07	28.73	0.00	32,277.57	0.48	193.81	0.00	381,073.95	1.75	1,697.70	0.01	2.23	0.01
DENTON	9,128.29	0.12	63.71	0.00	595.33	0.00	3.88	0.00	3,837.88	0.03	21.90	0.00	13,561.50	0.15	89.48	0.00	191,012.54	0.88	1,021.38	0.00	1.03	0.01
WILLIAMSON	14,663.92	0.00	88.82	0.00	219.90	0.00	1.34	0.00	2,708.72	0.00	14.23	0.00	17,592.54	0.00	104.38	0.00	197,676.11	0.91	800.61	0.00	0.91	0.00
EL PASO	9,382.60	0.00	52.36	0.00	380.56	0.00	2.07	0.00	1,177.56	0.00	9.81	0.00	10,940.73	0.00	64.25	0.00	201,089.30	0.93	845.73	0.00	0.93	0.00
MONTGOMERY	14,747.16	0.00	91.34	0.00	336.28	0.00	1.92	0.00	2,139.92	0.00	11.71	0.00	17,223.36	0.00	104.97	0.00	213,512.57	0.98	930.57	0.00	0.98	0.00
GALVESTON	7,016.66	16.17	43.07	0.08	1,228.22	0.75	7.04	0.00	2,794.36	2.99	14.15	0.02	11,039.24	19.92	64.26	0.10	102,937.06	0.47	582.88	0.00	20.40	0.11
BRAZORIA	8,883.57	4.18	54.58	0.03	272.61	0.20	1.56	0.00	2,146.27	0.77	11.47	0.01	11,302.45	5.14	67.62	0.04	108,942.81	0.50	651.61	0.00	5.64	0.04
COMAL	4,937.34	0.00	30.36	0.00	7.85	0.00	0.05	0.00	940.57	0.00	4.70	0.00	5,885.76	0.00	35.12	0.00	68,185.56	0.31	319.17	0.00	0.31	0.00
ROCKWALL	4,178.06	0.00	29.18	0.00	100.36	0.00	0.65	0.00	688.54	0.00	3.56	0.00	4,966.96	0.00	33.39	0.00	97,293.42	0.45	258.23	0.00	0.45	0.00
HAYS	5,683.45	0.94	34.52	0.01	209.49	0.04	1.28	0.00	375.48	0.15	3.31	0.00	6,268.42	1.13	39.10	0.01	75,819.40	0.35	322.10	0.00	1.48	0.01
NUECES	4,039.39	6.21	21.05	0.03	216.57	0.10	1.07	0.00	1,065.79	1.72	5.36	0.01	5,321.75	8.03	27.48	0.04	48,689.23	0.22	290.98	0.00	8.26	0.04
FORT BEND	9,114.82	31.82	56.53	0.16	0.00	1.51	0.00	0.01	2,024.57	5.58	12.78	0.03	11,139.39	38.91	69.31	0.19	109,669.66	0.50	788.44	0.00	39.42	0.20
ELLIS	4,368.83	2.81	30.01	0.02	7.17	0.10	0.06	0.00	481.31	0.75	3.02	0.00	4,857.30	3.66	33.09	0.03	70,807.12	0.33	286.73	0.00	3.98	0.03
JOHNSON	2,766.52	0.07	19.01	0.00	1.96	0.00	0.02	0.00	549.17	0.02	2.70	0.00	3,317.65	0.09	21.73	0.00	45,216.17	0.21	154.81	0.00	0.30	0.00
GUADALUPE	3,460.86	0.77	21.27	0.00	0.68	0.03	0.00	0.00	(36.23)	0.12	2.27	0.00	3,425.31	0.92	23.55	0.01	42,933.85	0.20	274.81	0.00	1.11	0.01
KAUFMAN	2,169.92	5.41	15.16	0.04	1.64	0.19	0.01	0.00	637.91	1.45	3.15	0.01	2,809.47	7.05	18.32	0.05	48,510.32	0.22	143.77	0.00	7.27	0.05
JEFFERSON	969.04	0.00	5.85	0.00	156.76	0.00	0.89	0.00	812.69	0.00	4.34	0.00	1,938.49	0.00	11.08	0.00	16,192.52	0.07	144.76	0.00	0.07	0.00
PARKER	1,143.59	0.05	7.99	0.00	24.99	0.00	0.16	0.00	1,159.48	0.01	5.74	0.00	2,328.05	0.07	13.89	0.00	22,853.21	0.11	105.32	0.00	0.18	0.00
SMITH	1,181.53	0.00	8.37	0.00	45.99	0.00	0.35	0.00	605.22	0.00	3.51	0.00	1,832.74	0.00	12.22	0.00	23,675.06	0.11	147.94	0.00	0.11	0.00
BASTROP	739.17	1.72	4.43	0.01	0.00	0.07	0.00	0.00	528.59	0.27	3.44	0.00	1,267.76	2.06	7.87	0.01	17,454.68	0.08	148.93	0.00	2.14	0.01
CHAMBERS	1,174.87	9.83	7.09	0.06	0.00	0.47	0.00	0.00	15.26	1.73	0.07	0.01	1,190.13	12.02	7.16	0.08	16,867.57	0.08	49.99	0.00	12.10	0.08
GREGG	701.44	0.00	4.97	0.00	4.05	0.00	0.03	0.00	132.74	0.00	1.04	0.00	838.23	0.00	6.03	0.00	15,896.52	0.07	79.24	0.00	0.07	0.00
SAN PATRICIO	866.45	1.37	4.51	0.01	2.79	0.02	0.01	0.00	470.16	0.38	2.34	0.00	1,339.40	1.78	6.86	0.01	8,598.03	0.04	64.42	0.00	1.82	0.01
LIBERTY	658.16	0.00	3.96	0.00	0.00	0.00	0.00	0.00	503.81	0.00	2.42	0.00	1,161.97	0.00	6.38	0.00	4,359.89	0.02	95.61	0.00	0.02	0.00
VICTORIA	243.58	0.79	1.52	0.00	0.00	0.02	0.00	0.00	117.08	0.21	0.65	0.00	360.66	1.01	2.17	0.01	4,270.11	0.02	24.50	0.00	1.03	0.01
ORANGE	643.14	0.00	3.88	0.00	0.00	0.00	0.00	0.00	338.53	0.00	1.67	0.00	981.67	0.00	5.55	0.00	7,353.95	0.03	53.74	0.00	0.03	0.00
CALDWELL	222.51	0.00	1.33	0.00	0.00	0.00	0.00	0.00	89.87	0.00	0.43	0.00	312.38	0.00	1.77	0.00	1,933.21	0.01	20.43	0.00	0.01	0.00
WILSON	81.20	0.00	0.50	0.00	2.73	0.00	0.02	0.00	202.90	0.00	1.13	0.00	286.83	0.00	1.64	0.00	2,088.35	0.01	26.32	0.00	0.01	0.00
HARDIN	224.12	0.00	1.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	224.12	0.00	1.35	0.00	3,226.54	0.01	9.07	0.00	0.01	0.00
HARRISON	78.58	0.00	0.56	0.00	0.00	0.00	0.00	0.00	163.41	0.00	0.83	0.00	241.99	0.00	1.38	0.00	506.51	0.00	29.60	0.00	0.00	0.00
WALLER	150.04	0.00	0.93	0.00	59.76	0.00	0.34	0.00	46.22	0.00	0.23	0.00	256.03	0.00	1.50	0.00	3,295.87	0.02	11.90	0.00	0.02	0.00
UPSHUR	13.77	0.00	0.10	0.00	0.00	0.00	0.00	0.00	96.88	0.00	0.46	0.00	110.65	0.00	0.56	0.00	(623.00)	(0.00)	14.33	0.00	(0.00)	0.00
RUSK	37.73	0.59	0.26	0.00	0.00	0.02	0.00	0.00	299.08	0.16	1.48	0.00	336.80	0.76	1.74	0.00	(467.48)	(0.00)	15.94	0.00	0.76	0.00
HOOD	316.71	10.72	2.18	0.07	4.56	0.38	0.04	0.00	120.12	2.87	0.61	0.02	441.39	13.96	2.83	0.09	4,426.63	0.02	33.82	0.00	13.98	0.09
HUNT	477.86	5.30	3.28	0.04	97.73	0.19	0.64	0.00	265.27	1.42	1.30	0.01	840.87	6.90	5.22	0.05	8,206.67	0.04	53.17	0.00	6.93	0.05
HENDERSON	249.15	0.70	1.77	0.01	11.71	0.02	0.09	0.00	69.67	0.19	0.34	0.00	330.53	0.91	2.21	0.01	5,970.13	0.03	21.10	0.00	0.94	0.01
HIDALGO	20,115.23	5.15	100.41	0.04	0.00	0.09	0.00	0.00	2,755.33	1.42	14.94	0.01	22,870.56	6.65	115.35	0.05	189,158.06	0.87	913.33	0.00	7.52	0.05
CAMERON	9,128.14	1.32	45.56	0.01	203.54	0.02	0.66	0.00	1,547.18	0.36	9.35	0.00	10,878.86	1.71	55.58	0.01	87,762.12	0.40	521.16	0.00	2.11	0.01
BELL	7,902.40		53.11		112.67		0.63		2,596.04	0.00	13.55	0.00	10,611.11	0.00	67.29	0.00	125,194.97	0.58	556.89	0.00	0.58	0.00
WEBB	5,945.12	0.55	29.26	0.00	134.77	0.01	0.66	0.00	1,686.02	0.15	8.61	0.00	7,765.91	0.71	38.54	0.00	62,542.24	0.29	408.14	0.00	0.99	0.00
BRAZOS	1,755.52	0.49	10.88	0.00	321.06	0.02	1.84	0.00	1,552.17	0.12	8.07	0.00	3,628.75	0.62	20.79	0.00	28,218.92	0.13	270.98	0.00	0.75	0.01
KENDALL	1,264.91		7.85		0.00		0.00		46.39	0.00	0.23	0.00	1,311.29	0.00	8.08	0.00	21,985.61	0.10	61.19	0.00	0.10	0.00
BURNET	1,162.96		7.05		50.61		0.31		18.97	0.00	0.18	0.00	1,232.54	0.00	7.54	0.00	17,136.25	0.08	50.77	0.00	0.08	0.00
GRAYSON	1,026.07		7.05		131.81		0.86		145.95	0.00	1.32	0.00	1,303.84	0.00	9.22	0.00	17,204.22	0.08	97.76	0.00	0.08	0.00
CORYELL	858.45		5.77		36.59		0.20		330.18	0.00	1.64	0.00	1,225.22	0.00	7.61	0.00	13,621.66	0.06	53.48	0.00	0.06	0.00
MIDLAND	820.78		4.81		0.00		0.00		849.19	0.00	4.36	0.00	1,669.97	0.00	9.17	0.00	17,418.00	0.08	140.08	0.00	0.08	0.00
LLANO	676.83	0.47	4.10	0.00	26.89	0.02	0.16	0.00	0.00	0.07	0.00	0.00	703.71	0.57	4.27	0.00	10,165.69	0.05	27.02	0.00	0.61	0.00
MAVERICK	671.43		3.31		0.00		0.00		590.58	0.00	3.20	0.00	1,262.00	0.00	6.51	0.00	8,491.31	0.04	85.48	0.00	0.04	0.00
MCMULLEN	671.43		3.31		0.00		0.00		0.00	0.00	0.00	0.00	671.43	0.00	3.31	0.00	7,590.24	0.03	21.50	0.00	0.03	0.00
ARANSAS	665.86		3.47		0.00		0.00		340.40	0.00	1.69	0.00	1,006.26	0.00	5.16	0.00	7,163.65	0.03	39.51	0.00	0.03	0.00
WICHITA	659.44	0.18	4.30	0.00	51.70	0.01	0.23	0.00	1,029.82	0.05	5.43	0.00	1,740.97	0.23	9.96	0.00	23,077.02	0.11	145.32	0.00	0.34	0.00
TAYLOR	637.44	0.00	3.96	0.00	4.65	0.00	0.02	0.00	848.34	0.00	5.03	0.00	1,490.43	0.00	9.00	0.00	14,107.83	0.06	120.39	0.00	0.06	0.00
TOM GREEN	613.65	0.04	3.79	0.00	0.00	0.00	0.00	0.00	1,056.30	0.01	5.82	0.00	1,670.15	0.05	9.61	0.00	9,854.61	0.05	146.89	0.00	0.10	0.00
MCLENNAN	552.42	21.00	3.71	0.13	0.00	0.74	0.00	0.00	555.72	5.61	2.86	0.03	1,108.14	27.35	6.58	0.17	7,251.26	0.03	67.31	0.00	27.38	0.17
MCCULLOCH	484.26		2.99		0.00		0.00		0.00	0.00	0.00	0.00	484.26	0.00	2.99	0.00	9,025.00	0.04	21.50	0.00	0.04	0.00
WISE	420.01	2.42	2.88	0.02	6.57	0.09	0.05	0.00	768.06	0.65	3.93	0.00	1,194.64	3.16	6.86	0.02	3,873.63	0.02	117.86	0.00	3.18	0.02
JIM HOGG	368.98		5.86		0.00		0.00		12.61	0.00	0.06	0.00	381.59	0.00	5.92	0.00	38,328.16	0.18	72.95	0.00	0.18	0.00
VAL VERDE	334.32		2.06		2.73		0.02		86.18	0.00	0.44	0.00	423.23	0.00	2.51	0.00	4,694.81	0.02	25.83	0.00	0.02	0.00
ECTOR	313.58	3.03	1.84	0.02	22.68	0.11	0.10	0.00	269.71	0.81	1.32	0.00	605.97	3.94	3.26	0.03	7,609.25	0.04	52.17	0.00	3.98	0.03
WHARTON	241.60	0.07	1.51	0.00	0.00	0.00	0.00	0.00	226.04	0.01	1.19	0.00	467.64	0.08	2.70	0.00	3,205.93	0.01	36.80	0.00	0.09	0.00
KERR	236.35		1.43		0.00		0.00		88.55	0.00	0.45	0.00	324.90	0.00	1.89	0.00	2,467.89	0.01	23.83	0.00	0.01	0.00
PRESIDIO	229.62	0.00	1.42	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	229.96	0.00	1.42	0.00	4,292.98	0.02	10.24	0.00	0.02	0.00
JIM WELLS	228.89		1.19		0.00		0.00		19.13	0.00	0.09	0.00	248.02	0.00	1.29	0.00	2,797.66	0.01	10.24	0.00	0.01	0.00
CALHOUN	227.74	2.26	1.42	0.01	1.06	0.04	0.01	0.00	330.39	0.62	1.64	0.00	559.19	2.92	3.07	0.02	2,289.46	0.01	26.07	0.00	2.93	0.02
GILLESPIE	214.87		1.30		25.30		0.15		381.23	0.00	1.90	0.00	621.40	0.00	3.36	0.00	1,839.53	0.01	32.87	0.00	0.01	0.00
MATAGORDA	192.09		1.20		0.00		0.00		0.00	0.00	0.00	0.00	192.09	0.00	1.20	0.00	3,078.93	0.01	8.97	0.00	0.01	0.00
NAVARRO	178.95		1.20		0.00		0.00		518.53	0.00	2.58	0.00	697.48	0.00	3.78	0.00	677.96	0.00	36.02	0.00	0.00	0.00
ANGELINA	178.35	0.27	1.24	0.00	0.00	0.01	0.00	0.00	578.36	0.07	3.01	0.00	756.71	0.35	4.25	0.00	1,365.03	0.01	67.15	0.00	0.35	0.00
NACOGDOCHES	173.20		1.21		0.55		0.00		74.53	0.00	0.39	0.00	248.28	0.00	1.60	0.00	2,673.96	0.01	22.59	0.00	0.01	0.00
FANNIN	172.22	6.04	1.18	0.04	5.75	0.21	0.04	0.00	43.55	1.61	0.22	0.01	221.52	7.87	1.44	0.06	2,673.36	0.01	14.84	0.00	7.88	0.06
ATASCOSA	144.13		0.89		1.08		0.00		16.89	0.00	0.08	0.00	162.10	0.00	0.97	0.00	1,998.29	0.01	8.51	0.00	0.01	0.00
WASHINGTON	142.40		0.88		29.72		0.17		541.16	0.00	2.68	0.00	713.28	0.00	3.73	0.00	494.64	0.00	33.24	0.00	0.00	0.00
LAMAR	116.10	0.81	0.83	0.01	0.66	0.03	0.01	0.00	72.60	0.22	0.36	0.00	189.35	1.06	1.19	0.01	2,324.95	0.01	14.15	0.00	1.07	0.01
VAN ZANDT	114.77		0.79		2.63		0.02		20.44	0.00	0.10	0.00	137.83	0.00	0.91	0.00	1,798.01	0.01	7.82	0.00	0.01	0.00
WILLACY	107.07		0.53		0.00		0.00		8.52	0.00	0.04	0.00	115.60	0.00	0.58	0.00	1,066.37	0.00	3.73	0.00	0.00	0.00
BROWN	106.33		0.71		15.58		0.09		388.45	0.00	2.01	0.00	510.36	0.00	2.81	0.00	1,781.50	0.01	35.07	0.00	0.01	0.00
ERATH	103.93		0.65		4.65		0.02		31.53	0.00	0.16	0.00	140.11	0.00	0.82	0.00	3,057.36	0.01	6.52	0.00	0.01	0.00
AUSTIN	102.35		0.63		1.17		0.01		(2,720.04)	0.00	(7.78)	0.00	(2,616.51)	0.00	(7.14)	0.00	(9,911.20)	(0.05)	101.38	0.00	(0.05)	0.00
COOKE	101.88		0.70		1.64		0.01		32.42	0.00	0.16	0.00	135.94	0.00	0.87	0.00	1,475.59	0.01	8.91	0.00	0.01	0.00
MEDINA	97.13		0.60		0.00		0.00		99.78	0.00	0.48	0.00	196.91	0.00	1.08	0.00	470.70	0.00	18.43	0.00	0.00	0.00
TITUS	92.08	4.88	0.65	0.00	0.00	0.17	0.00	0.00	0.00	1.30	0.00	0.00	92.08	6.35	0.65	0.00	2,317.48	0.01	4.26	0.00	6.36	0.00
UVALDE	79.06		0.49		1.36		0.01		530.79	0.00	2.63	0.00	611.22	0.00	3.13	0.00	(1,148.71)	(0.01)	31.63	0.00	(0.01)	0.00
FAYETTE	75.65	0.00	0.47	0.00	0.00	0.00	0.00	0.00	225.20	0.00	1.24	0.00	300.85	0.00	1.71	0.00	1,919.84	0.01	28.00	0.00	0.01	0.00
CALLAHAN	71.60		0.44		0.00		0.00		0.00	0.00	0.00	0.00	71.60	0.00	0.44	0.00	2,088.03	0.01	3.13	0.00	0.01	0.00
HOPKINS	70.82		0.49		0.00		0.00		6.39	0.00	0.03	0.00	77.21	0.00	0.52	0.00	1,172.24	0.01	3.22	0.00	0.01	0.00
LAMPASAS	70.02		0.47		0.00		0.00		68.91	0.00	0.38	0.00	138.93	0.00	0.85	0.00	1,400.89	0.01	9.94	0.00	0.01	0.00
BLANCO	67.15		0.41		0.00		0.00		97.13	0.00	0.46	0.00	164.28	0.00	0.87	0.00	(27.16)	(0.00)	16.24	0.00	(0.00)	0.00
FREESTONE	64.84	3.15	0.44	0.02	2.90	0.11	0.02	0.00	0.00	0.84	0.00	0.01	67.74	4.10	0.45	0.03	1,138.69	0.01	2.90	0.00	4.10	0.03
GRIMES	62.30	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	62.30	0.00	0.39	0.00	946.31	0.00	2.59	0.00	0.00	0.00
LEE	61.30		0.37		0.00		0.00		24.92	0.00	0.12	0.00	86.22	0.00	0.49	0.00	651.71	0.00	3.48	0.00	0.00	0.00
SOMERVELL	58.00		0.40		0.00		0.00		15.14	0.00	0.07	0.00	73.14	0.00	0.47	0.00	859.16	0.00	4.56	0.00	0.00	0.00
ANDREWS	50.51	0.02	0.30	0.00	0.00	0.00	0.00	0.00	21.44	0.01	0.10	0.00	71.95	0.03	0.40	0.00	1,268.14	0.01	5.45	0.00	0.03	0.00
BORDEN	48.88		0.27		0.00		0.00		0.00	0.00	0.00	0.00	48.88	0.00	0.27	0.00	2,244.01	0.01	2.31	0.00	0.01	0.00

Table 72: 2006 Annual and OSD NOx Reductions from Electricity and Natural Gas Savings Due to the IECC / IRC for Single-family and Multi-family Residences and for Commercial Buildings by County (using 2007 eGRID) (Part 1).

County	Electricity Savings and Resultant NOx Reductions (Single Family Houses)				Electricity Savings and Resultant NOx Reductions (Multifamily Houses)				Electricity Savings and Resultant NOx Reductions (Commercial Buildings)				Total Electricity Savings and Resultant NOx Reductions (SF, MF and Commecial Buildings)				Total Natural Gas Savings and Resultant NOx Reductions (SF, MF and Commecial Buildings)				Total Nox Reductions	
	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	OSD Electricity Savings per County w/ 7% T&D Loss (MWh/County)	OSD Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	OSD Electricity Savings per County w/ 7% T&D Loss (MWh/County)	OSD Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	OSD Electricity Savings per County w/ 7% T&D Loss (MWh/County)	OSD Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	OSD Electricity Savings per County w/ 7% T&D Loss (MWh/County)	OSD Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Total OSD N.G. Savings (Therm/County)	OSD Nox Reductions (Tons)	Annual Nox Reductions (Tons)	OSD Nox Reductions (Tons)
CHEROKEE	48.02	3.00	0.33	0.02	1.10	0.11	0.01	0.00	146.10	0.80	0.74	0.00	195.22	3.91	1.08	0.03	(365.30)	(0.00)	25.63	0.00	3.90	0.03
DIMMIT	47.28		0.23		0.00		0.00		0.00	0.00	0.00	0.00	47.28	0.00	0.23	0.00	534.52	0.00	1.51	0.00	0.00	0.00
FALLS	46.68		0.31		0.00		0.00		0.00	0.00	0.00	0.00	46.68	0.00	0.31	0.00	737.42	0.00	1.82	0.00	0.00	0.00
COLORADO	44.50		0.28		0.00		0.00		155.16	0.00	0.74	0.00	199.66	0.00	1.02	0.00	(890.23)	(0.00)	23.77	0.00	(0.00)	0.00
FRIO	42.79	0.31	0.26	0.00	0.00	0.01	0.00	0.00	0.00	0.08	0.00	0.00	42.79	0.40	0.26	0.00	622.52	0.00	1.92	0.00	0.40	0.00
MILAM	40.75	1.92	0.24	0.01	0.00	0.07	0.00	0.00	212.38	0.51	1.05	0.00	253.13	2.50	1.29	0.01	(377.18)	(0.00)	11.39	0.00	2.50	0.01
JACKSON	39.61		0.25		0.00		0.00		0.00	0.00	0.00	0.00	39.61	0.00	0.25	0.00	634.83	0.00	1.85	0.00	0.00	0.00
ANDERSON	39.44		0.28		0.00		0.00		59.64	0.00	0.30	0.00	99.09	0.00	0.57	0.00	572.03	0.00	4.90	0.00	0.00	0.00
HILL	38.90		0.26		0.00		0.00		15.14	0.00	0.07	0.00	54.04	0.00	0.33	0.00	461.72	0.00	3.65	0.00	0.00	0.00
CULBERSON	38.73		0.22		0.00		0.00		0.00	0.00	0.00	0.00	38.73	0.00	0.22	0.00	901.79	0.00	1.82	0.00	0.00	0.00
MASON	37.60		0.23		0.00		0.00		0.00	0.00	0.00	0.00	37.60	0.00	0.23	0.00	533.84	0.00	1.41	0.00	0.00	0.00
PECOS	36.38	0.04	0.22	0.00	0.00	0.00	0.00	0.00	87.62	0.01	0.49	0.00	123.99	0.05	0.71	0.00	1,088.81	0.01	11.03	0.00	0.05	0.00
RAINS	34.19		0.23		0.00		0.00		17.66	0.00	0.08	0.00	51.85	0.00	0.32	0.00	400.58	0.00	3.91	0.00	0.00	0.00
LAVACA	31.88		0.20		0.95		0.00		0.00	0.00	0.00	0.00	32.83	0.00	0.20	0.00	605.37	0.00	1.57	0.00	0.00	0.00
PALO PINTO	30.02	0.81	0.19	0.00	0.42	0.03	0.00	0.00	441.71	0.19	2.19	0.00	472.16	1.03	2.38	0.01	(1,014.65)	(0.00)	23.01	0.00	1.03	0.01
KIMBLE	29.56		0.18		0.00		0.00		0.00	0.00	0.00	0.00	29.56	0.00	0.18	0.00	550.82	0.00	1.31	0.00	0.00	0.00
MADISON	26.70		0.17		0.00		0.00		0.00	0.00	0.00	0.00	26.70	0.00	0.17	0.00	405.56	0.00	1.11	0.00	0.00	0.00
ARCHER	25.36		0.17		1.27		0.01		7.98	0.00	0.04	0.00	34.62	0.00	0.21	0.00	850.65	0.00	2.50	0.00	0.00	0.00
REFUGIO	23.76		0.15		0.00		0.00		0.00	0.00	0.00	0.00	23.76	0.00	0.15	0.00	380.90	0.00	1.11	0.00	0.00	0.00
LIMESTONE	23.34	0.33	0.16	0.00	0.36	0.02	0.00	0.00	10.09	0.06	0.05	0.00	33.80	0.40	0.21	0.00	281.16	0.00	2.38	0.00	0.40	0.00
CLAY	22.83		0.15		0.00		0.00		0.00	0.00	0.00	0.00	22.83	0.00	0.15	0.00	799.80	0.00	0.91	0.00	0.00	0.00
BEE	21.78		0.14		0.00		0.00		96.17	0.00	0.49	0.00	117.95	0.00	0.63	0.00	(614.91)	(0.00)	17.25	0.00	(0.00)	0.00
MARTIN	21.05		0.12		0.00		0.00		0.00	0.00	0.00	0.00	21.05	0.00	0.12	0.00	618.58	0.00	1.01	0.00	0.00	0.00
GONZALES	20.33		0.13		0.00		0.00		36.05	0.00	0.17	0.00	56.38	0.00	0.30	0.00	27.18	0.00	4.69	0.00	0.00	0.00
BURLESON	20.02		0.12		0.00		0.00		0.00	0.00	0.00	0.00	20.02	0.00	0.12	0.00	304.17	0.00	0.83	0.00	0.00	0.00
KARNES	19.19		0.11		0.00		0.00		0.00	0.00	0.00	0.00	19.19	0.00	0.11	0.00	269.22	0.00	0.81	0.00	0.00	0.00
KLEBERG	18.30		0.09		0.00		0.00		478.78	0.00	2.35	0.00	497.08	0.00	2.44	0.00	(2,605.65)	(0.01)	36.02	0.00	(0.01)	0.00
BREWSTER	15.91		0.10		0.00		0.00		(104.58)	0.00	(0.31)	0.00	(88.67)	0.00	(0.21)	0.00	(146.38)	(0.00)	4.07	0.00	(0.00)	0.00
WINKLER	14.73		0.09		0.00		0.00		0.00	0.00	0.00	0.00	14.73	0.00	0.09	0.00	433.01	0.00	0.71	0.00	0.00	0.00
FRANKLIN	14.65		0.10		0.00		0.00		0.00	0.00	0.00	0.00	14.65	0.00	0.10	0.00	248.08	0.00	0.61	0.00	0.00	0.00
YOUNG	13.86	5.34	0.09	0.03	0.00	0.19	0.00	0.00	4.72	1.43	0.02	0.01	18.58	6.95	0.11	0.04	356.84	0.00	1.40	0.00	6.95	0.04
HOUSTON	13.72		0.10		0.00		0.00		0.00	0.00	0.00	0.00	13.72	0.00	0.10	0.00	285.94	0.00	0.74	0.00	0.00	0.00
SCURRY	13.69		0.08		0.00		0.00		0.00	0.00	0.00	0.00	13.69	0.00	0.08	0.00	628.32	0.00	0.65	0.00	0.00	0.00
BOSQUE	12.97	0.15	0.09	0.00	0.00	0.01	0.00	0.00	0.00	0.04	0.00	0.00	12.97	0.19	0.09	0.00	204.84	0.00	0.50	0.00	0.19	0.00
COMANCHE	12.97		0.09		0.00		0.00		173.76	0.00	0.95	0.00	186.73	0.00	1.04	0.00	717.60	0.00	19.87	0.00	0.00	0.00
BRISCOE	12.09		0.06		0.00		0.00		0.00	0.00	0.00	0.00	12.09	0.00	0.06	0.00	1,262.23	0.01	0.71	0.00	0.01	0.00
CONCHO	11.37		0.07		0.00		0.00		0.00	0.00	0.00	0.00	11.37	0.00	0.07	0.00	211.85	0.00	0.50	0.00	0.00	0.00
ZAVALA	9.46		0.05		0.00		0.00		0.00	0.00	0.00	0.00	9.46	0.00	0.05	0.00	106.90	0.00	0.30	0.00	0.00	0.00
NOLAN	9.24	0.48	0.06	0.00	0.00	0.02	0.00	0.00	212.38	0.13	1.05	0.00	221.62	0.63	1.11	0.00	(620.92)	(0.00)	10.28	0.00	0.63	0.00
BROOKS	8.92		0.04		0.00		0.00		0.00	0.00	0.00	0.00	8.92	0.00	0.04	0.00	91.84	0.00	0.28	0.00	0.00	0.00
ROBERTSON	8.90	0.64	0.06	0.00	0.00	0.03	0.00	0.00	4.04	0.17	0.02	0.00	12.94	0.83	0.07	0.00	94.44	0.00	0.94	0.00	0.83	0.00
LIVE OAK	7.80		0.04		0.00		0.00		0.00	0.00	0.00	0.00	7.80	0.00	0.04	0.00	100.67	0.00	0.28	0.00	0.00	0.00
HAMILTON	7.78		0.05		0.00		0.00		76.66	0.00	0.43	0.00	84.44	0.00	0.48	0.00	482.42	0.00	8.54	0.00	0.00	0.00
JONES	6.93	1.11	0.04	0.01	2.96	0.02	0.01	0.00	0.00	0.31	0.00	0.00	9.89	1.44	0.06	0.01	302.94	0.00	0.63	0.00	1.44	0.01
REAGAN	6.48		0.04		0.00		0.00		0.00	0.00	0.00	0.00	6.48	0.00	0.04	0.00	103.55	0.00	0.30	0.00	0.00	0.00
WARD	6.31	15.88	0.04	0.11	0.00	0.56	0.00	0.00	0.00	4.25	0.00	0.03	6.31	20.69	0.04	0.14	185.58	0.00	0.30	0.00	20.69	0.14
RED RIVER	6.01	0.00	0.04	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.01	0.00	8.00	0.00	0.05	0.00	131.13	0.00	0.61	0.00	0.00	0.00
HASKELL	4.62	0.00	0.03	0.00	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.47	0.00	0.03	0.00	163.53	0.00	0.30	0.00	0.00	0.00
HOWARD	4.21	0.48	0.02	0.00	13.69	0.02	0.06	0.00	55.37	0.13	0.28	0.00	73.27	0.62	0.37	0.00	118.03	0.00	9.38	0.00	0.62	0.00
SAN SABA	2.69		0.02		0.00		0.00		37.92	0.00	0.19	0.00	40.61	0.00	0.21	0.00	(342.04)	(0.00)	6.50	0.00	(0.00)	0.00
JACK	2.31	1.82	0.01	0.01	0.00	0.06	0.00	0.00	0.00	0.49	0.00	0.00	2.31	2.36	0.01	0.02	67.36	0.00	0.10	0.00	2.37	0.02
STEPHENS	2.31		0.01		0.00		0.00		24.72	0.00	0.12	0.00	27.03	0.00	0.13	0.00	(182.21)	(0.00)	3.59	0.00	(0.00)	0.00
RUNNELS	2.27		0.01		0.00		0.00		0.00	0.00	0.00	0.00	2.27	0.00	0.01	0.00	42.37	0.00	0.10	0.00	0.00	0.00
REEVES	2.10		0.01		0.00		0.00		28.80	0.00	0.15	0.00	30.90	0.00	0.16	0.00	(164.69)	(0.00)	3.66	0.00	(0.00)	0.00
DE WITT	1.98		0.01		0.00		0.00		0.00	0.00	0.00	0.00	1.98	0.00	0.01	0.00	31.74	0.00	0.09	0.00	0.00	0.00
CHILDRESS	1.96		0.01		0.00		0.00		0.00	0.00	0.00	0.00	1.96	0.00	0.01	0.00	89.76	0.00	0.09	0.00	0.00	0.00
CROSBY	1.96		0.01		0.00		0.00		21.90	0.00	0.12	0.00	23.86	0.00	0.13	0.00	192.48	0.00	2.45	0.00	0.00	0.00
DAWSON	1.96		0.01		0.00		0.00		0.00	0.00	0.00	0.00	1.96	0.00	0.01	0.00	89.76	0.00	0.09	0.00	0.00	0.00
MITCHELL	0.00	12.79	0.00	0.10	0.00	0.45	0.00	0.00	0.00	3.42	0.00	0.02	0.00	16.66	0.00	0.12	0.00	0.00	0.00	0.00	16.66	0.12
WILBARGER	0.00	0.78	0.00	0.00	0.00	0.01	0.00	0.00	2.36	0.22	0.01	0.00	2.36	1.01	0.01	0.00	(23.65)	(0.00)	0.40	0.00	1.01	0.00
COLEMAN	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	7.06	0.01	0.03	0.00	7.06	0.05	0.03	0.00	(71.30)	(0.00)	1.00	0.00	0.05	0.00
UPTON	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00
COKE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.93	0.00	0.17	0.00	33.93	0.00	0.17	0.00	(340.15)	(0.00)	5.73	0.00	(0.00)	0.00
CROCKETT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.10	0.00	19.23	0.00	0.10	0.00	(192.81)	(0.00)	3.25	0.00	(0.00)	0.00
HARDEMAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BANDERA	0.00		0.00		13.72		0.05		0.00	0.00	0.00	0.00	13.72	0.00	0.05	0.00	425.76	0.00	1.22	0.00	0.00	0.00
BAYLOR	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COTTLE	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CRANE	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DELTA	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DICKENS	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DUVAL	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EASTLAND	0.00		0.00		0.00		0.00		68.04	0.00	0.35	0.00	68.04	0.00	0.35	0.00	(682.13)	(0.00)	11.48	0.00	(0.00)	0.00
EDWARDS	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FISHER	0.00		0.00		0.00		0.00		24.09	0.00	0.13	0.00	24.09	0.00	0.13	0.00	112.99	0.00	2.59	0.00	0.00	0.00
FOARD	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GLASSCOCK	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GOLIAD	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HALL	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HUDSPETH	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IRION	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JEFF DAVIS	0.00		0.00		0.00		0.00		37.74	0.00	0.19	0.00	37.74	0.00	0.19	0.00	(378.35)	(0.00)	6.37	0.00	(0.00)	0.00
KENEDY	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
KENT	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
KING	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
KINNEY	0.00		0.00		0.00		0.00		11.48	0.00	0.05	0.00	11.48	0.00	0.05	0.00	(115.67)	(0.00)	1.62	0.00	(0.00)	0.00
KNOX	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LA SALLE	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LEON	0.00		0.00		0.00		0.00		39.92	0.00	0.20	0.00	39.92	0.00	0.20	0.00	(400.16)	(0.00)	6.74	0.00	(0.00)	0.00
LOVING	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MENARD	0.00		0.00		0.00		0.00		6.31	0.00	0.03	0.00	6.31	0.00	0.03	0.00	(63.67)	(0.00)	0.89	0.00	(0.00)	0.00
MILLS	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MONTAGUE	0.00		0.00		0.00		0.00		212.38	0.00	1.05	0.00	212.38	0.00	1.05	0.00	(890.35)	(0.00)	9.87	0.00	(0.00)	0.00
MOTLEY	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
REAL	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SCHLEICHER	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SHACKELFORD	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STARR	0.00		0.00		0.00		0.00		131.73	0.00	0.64	0.00	131.73	0.00	0.64	0.00	(1,327.32)	(0.01)	19.56	0.00	(0.01)	0.00
STERLING	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STONEWALL	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUTTON	0.00		0.00		0.00		0.00		21.69	0.00	0.12	0.00	21.69	0.00	0.12	0.00	101.69	0.00	2.33	0.00	0.00	0.00
TERRELL	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
THROCKMORTON	0.00		0.00		0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZAPATA	0.00		0.00		0.00		0.00		184.17	0.00	0.88	0.00	184.17	0.00	0.88	0.00	(1,859.02)	(0.01)	26.02	0.00	(0.01)	0.00
TOTAL	393,068.92	263.32	2,464.64	1.63	15,955.87	10.88	99.50	0.07	89,557.29	60.52	567.85	0.38	498,582.08	334.71	3,131.99	2.07	5,766,807.90	26.53	32,661.11	0.15	361.24	2.22

Table 73: 2006 Annual and OSD NOx Reductions from Electricity and Natural Gas Savings Due to the IECC / IRC for Single-family and Multi-family Residences and for Commercial Buildings by County (using 2007 eGRID) (Part 2).



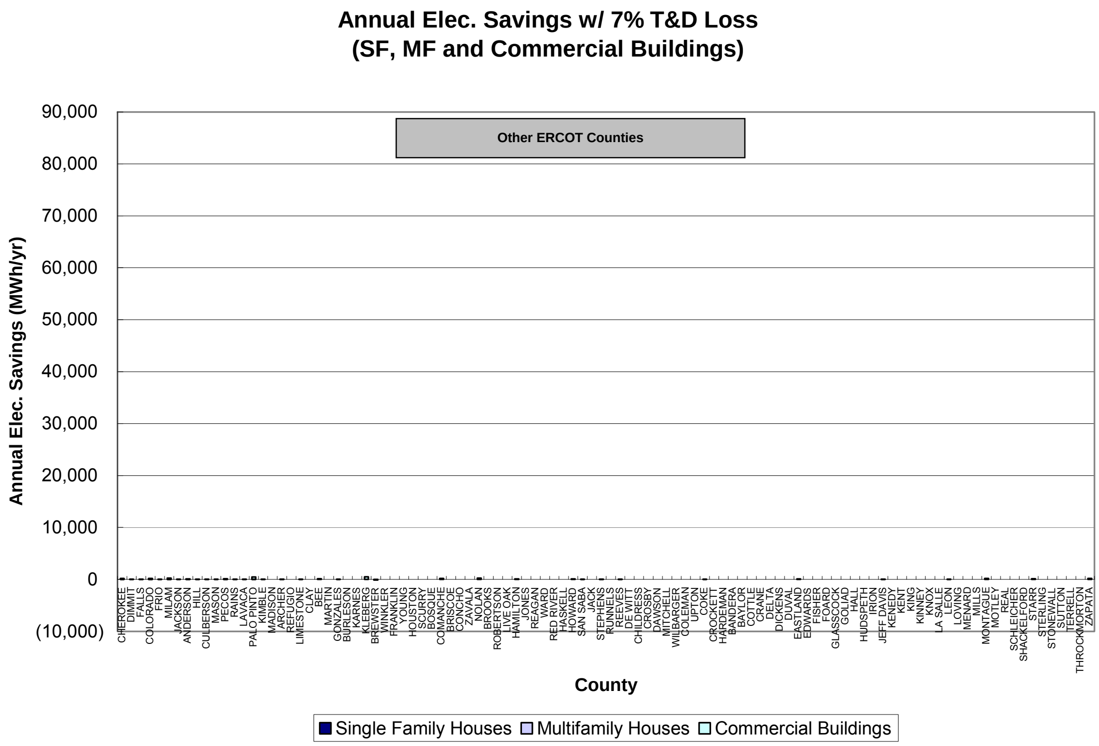
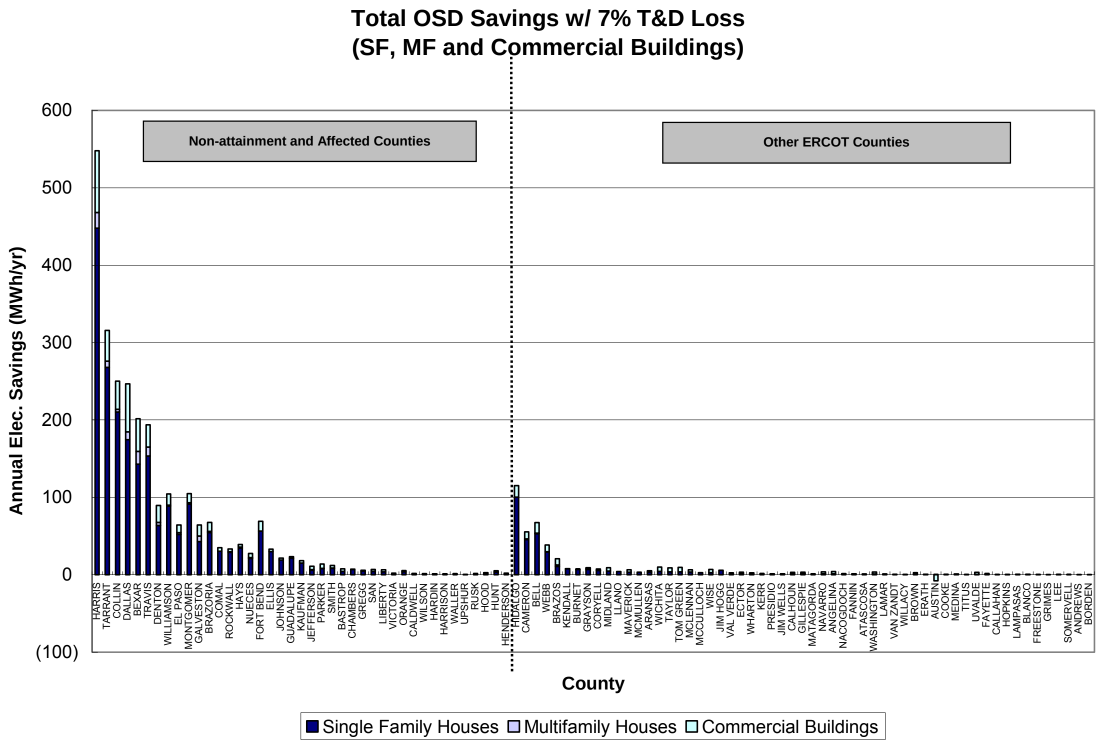


Figure 142: 2006 Annual Electricity Reductions from IECC / IRC by PCA for Single-family and Multi-family Residences and for Commercial Buildings by County.



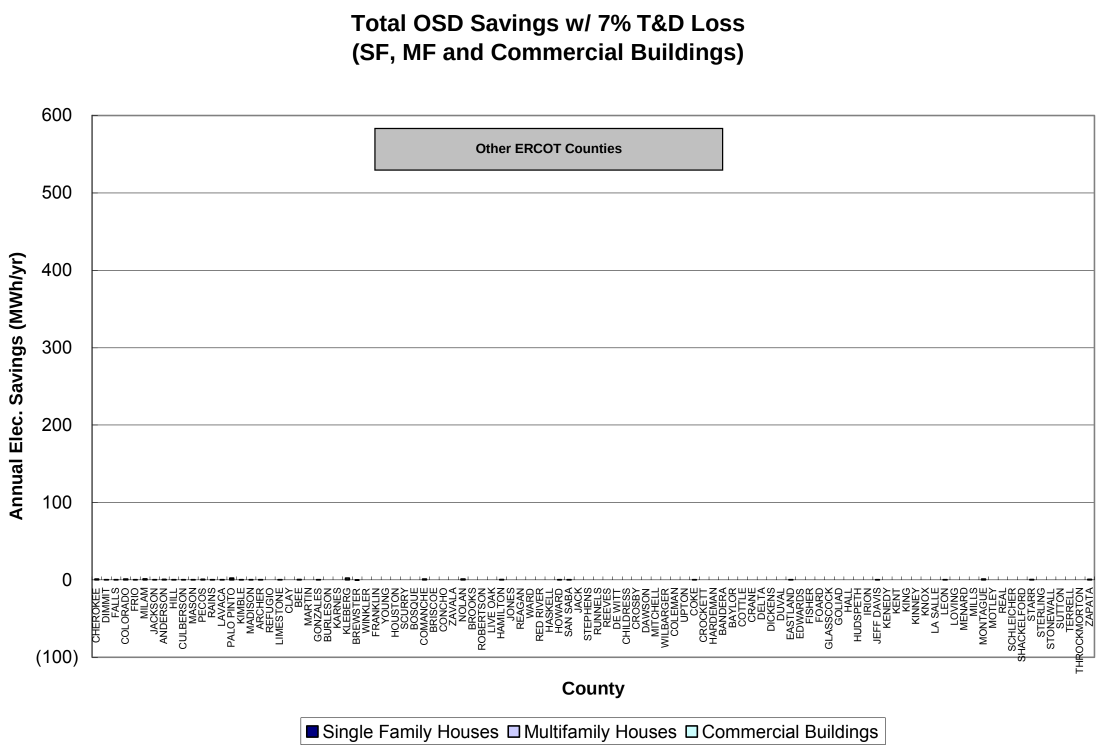
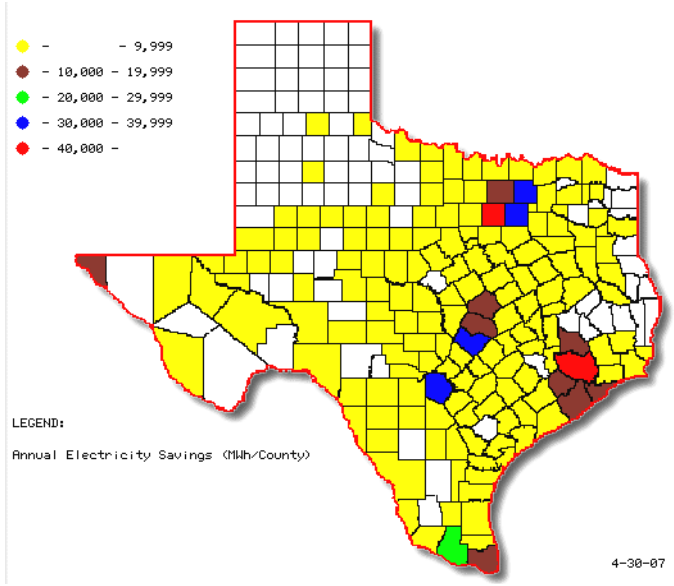


Figure 143: 2006 OSD Electricity Reductions from IECC / IRC by PCA for Single-family and Multi-family Residences and for Commercial Buildings by County.



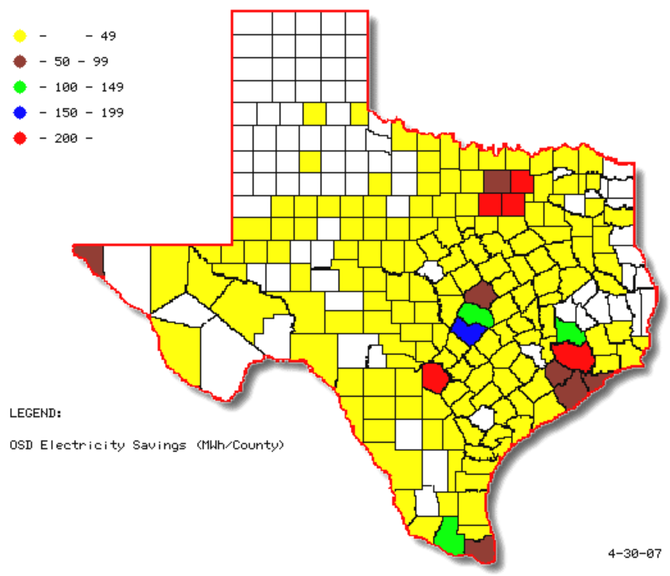
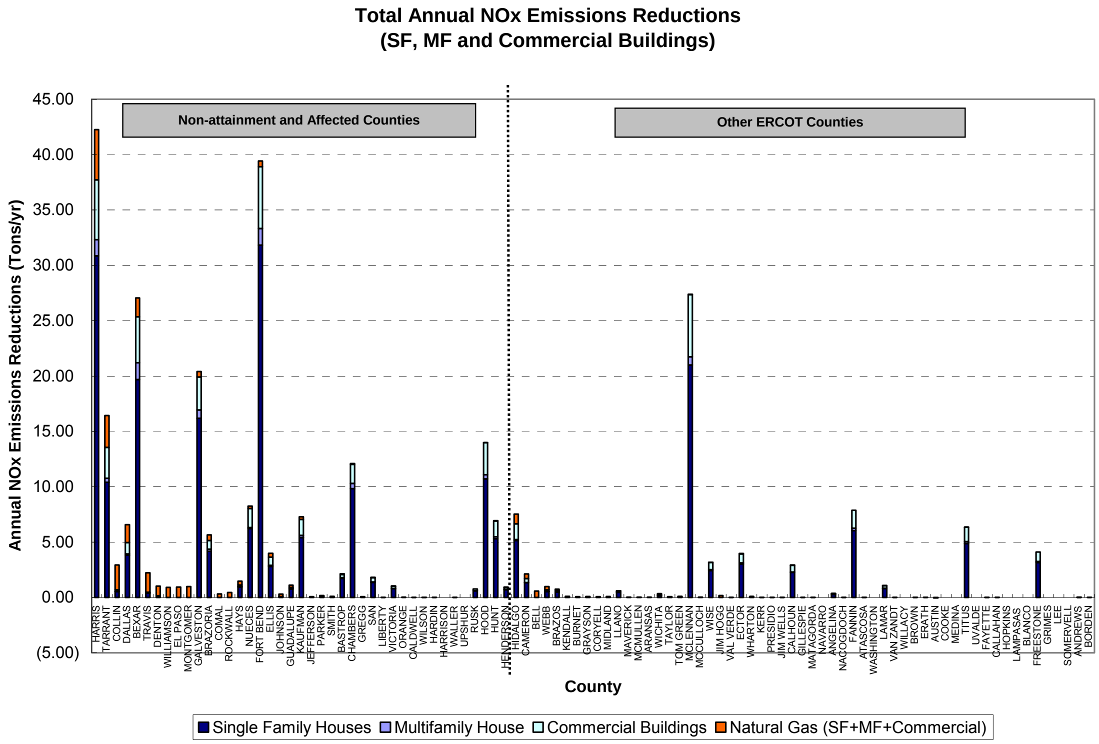


Figure 144: 2005 Annual and OSD Electricity Reductions from IECC / IRC by PCA for Single-family and Multi-family Residences and for Commercial Buildings by County.



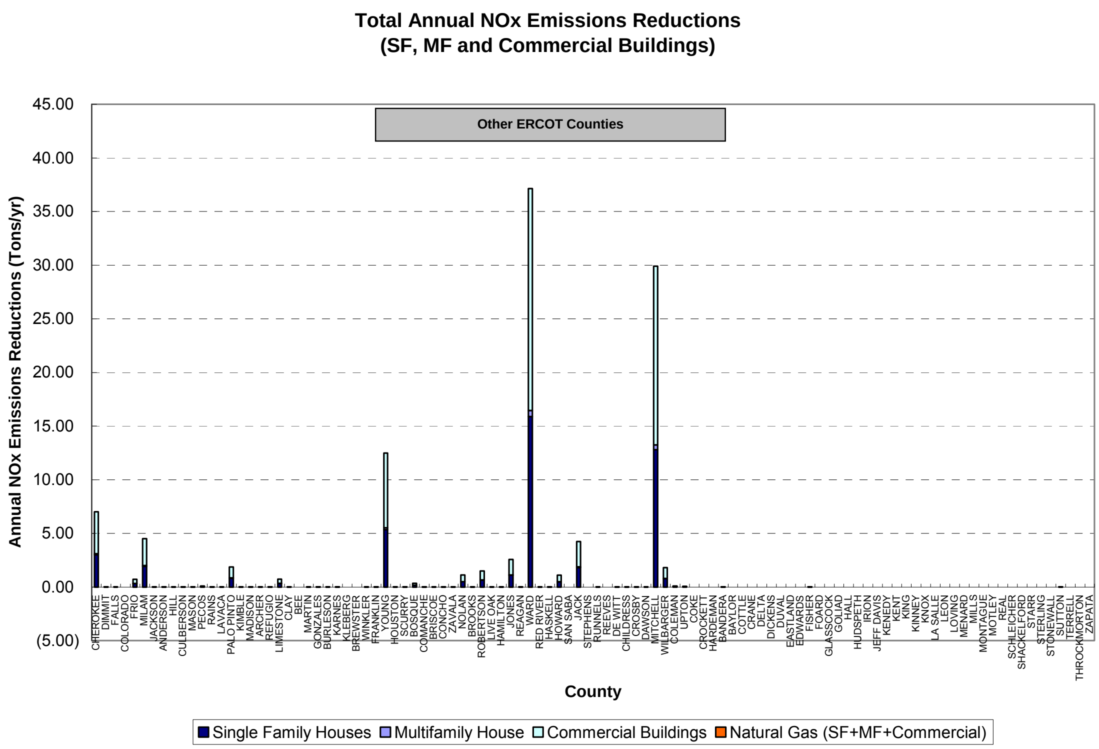
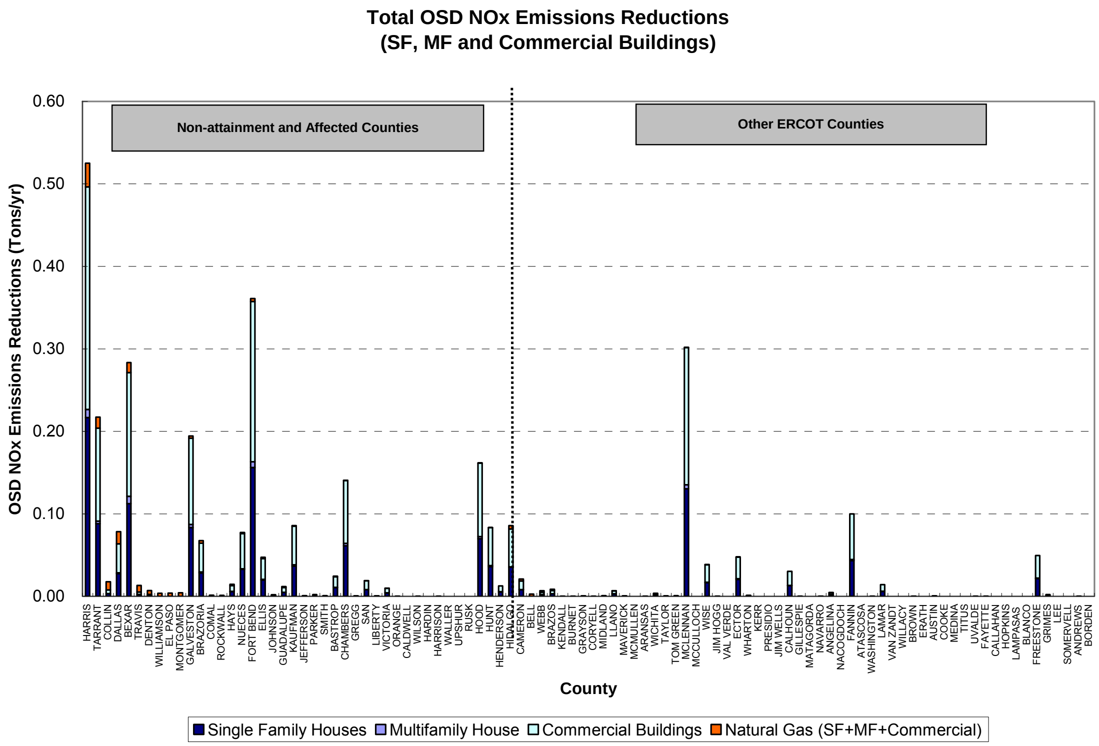


Figure 145: 2006 Annual NOx Reductions from Electricity and Natural Gas Savings Due to the IECC / IRC for Single-family and Multi-family Residences and for Commercial Buildings by County (using 1999 eGRID).



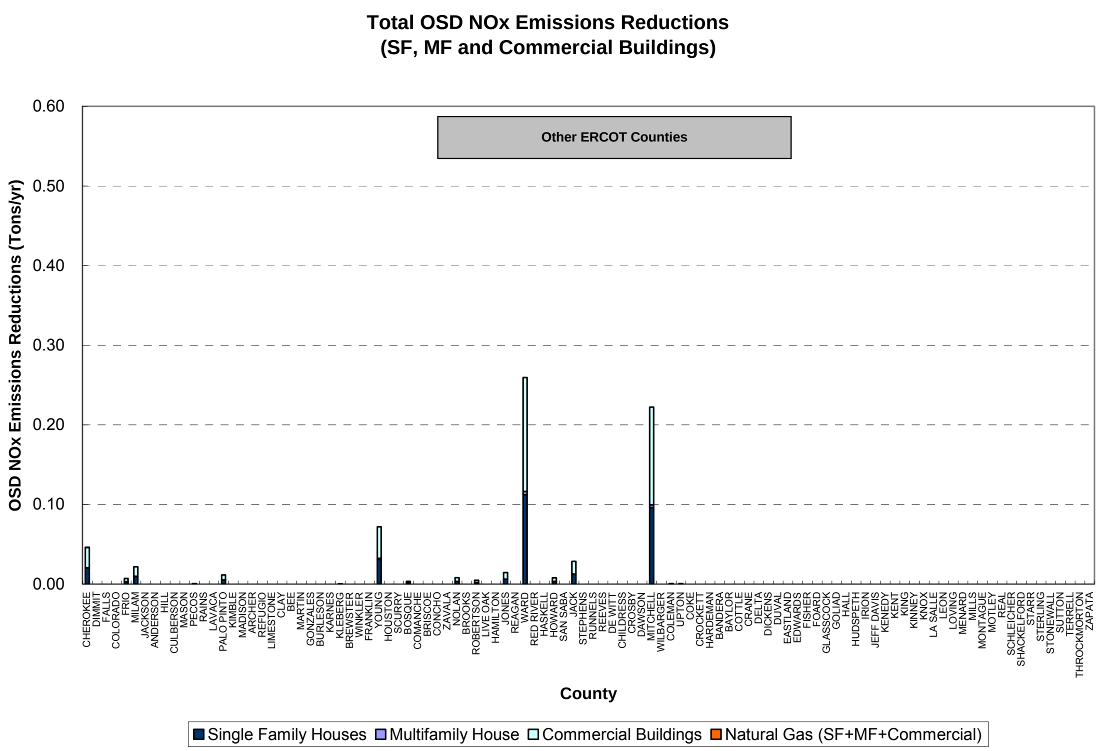
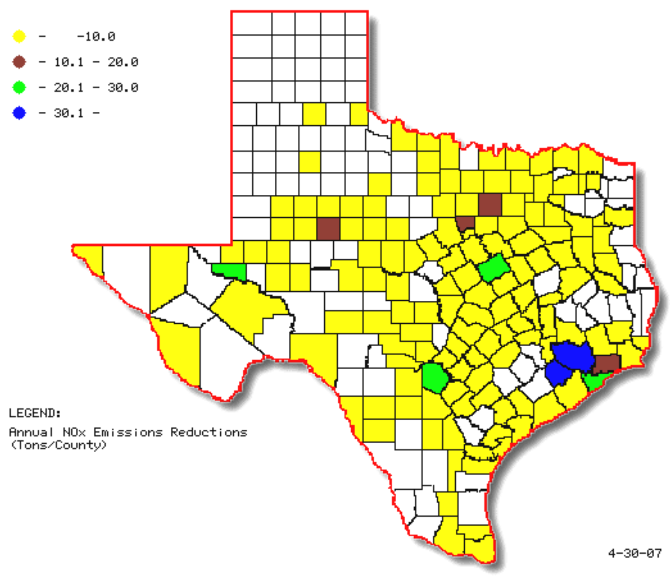


Figure 146: 2007 OSD NOx Reductions from Electricity and Natural Gas Savings Due to the IECC / IRC for Single-family and Multi-family Residences and for Commercial Buildings by County (using 2007 eGRID).



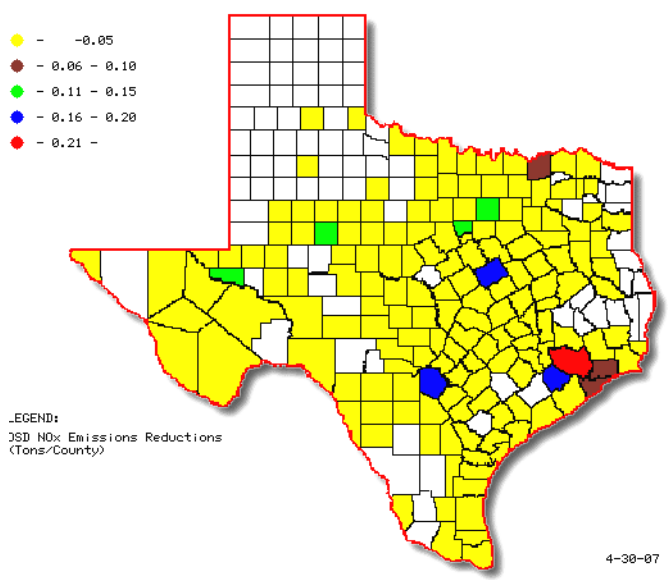


Figure 147: 2006 Annual and OSD NOx Reductions from Electricity and Natural Gas Savings Due to the IECC / IRC for Single-family and Multi-family Residences and for Commercial Buildings by County (using 2007 eGRID).

7 COMPARISON OF 2006 EMISSIONS REDUCTIONS VS 2005 EMISSIONS REDUCTIONS

The 2006 emissions reductions calculations were performed using the 25% 2007 annual eGRID and the 25% 2007 Ozone Season Day (OSD) eGRID. The most significant change in 2006 emission calculations is the expanded target counties. While only the 41 non-attainment and affected counties have been targeted to calculate the emission reductions in 2005, in 2006, all the counties in ERCOT region have been targeted as well as 41 non-attainment and affected counties. Not surprisingly, the resultant NOx emission reductions in 2006 calculations are increased about 35% in annual and 76% in OSD calculation. There are several changed affecting the calculations as well as the increased number of target counties, including:

- Changes to the target counties (from 41 non-attainment and affected counties to all the counties in ERCOT region and 41 non-attainment and affected counties)
- Changes to the code-compliant simulations for both single and multifamily;
- Change to the number of building permits for the 41 counties for 2006.

If all the ERCOT counties are targeted then these changes resulted in a 35% increase in the total annual 2006 NOx reductions from new single-family, multi-family and commercial construction when compared to 2005, which includes a 46% increase from single-family residential electricity savings, a 58% increase from multi-family residential electricity savings, a 28% increase from commercial electricity savings, and a 16% decrease in natural gas savings from single-family, multi-family residential, and commercial buildings. For OSD reductions, the increase in total NOx reductions was 76% from new single-family, multi-family and commercial construction when compared to 2005, which includes a 85% increase from single-family residential electricity savings, a 133% increase from multi-family residential electricity savings, a 31% increase from commercial electricity savings, and a 150% increase in natural gas savings from single-family, multi-family residential, and commercial buildings.

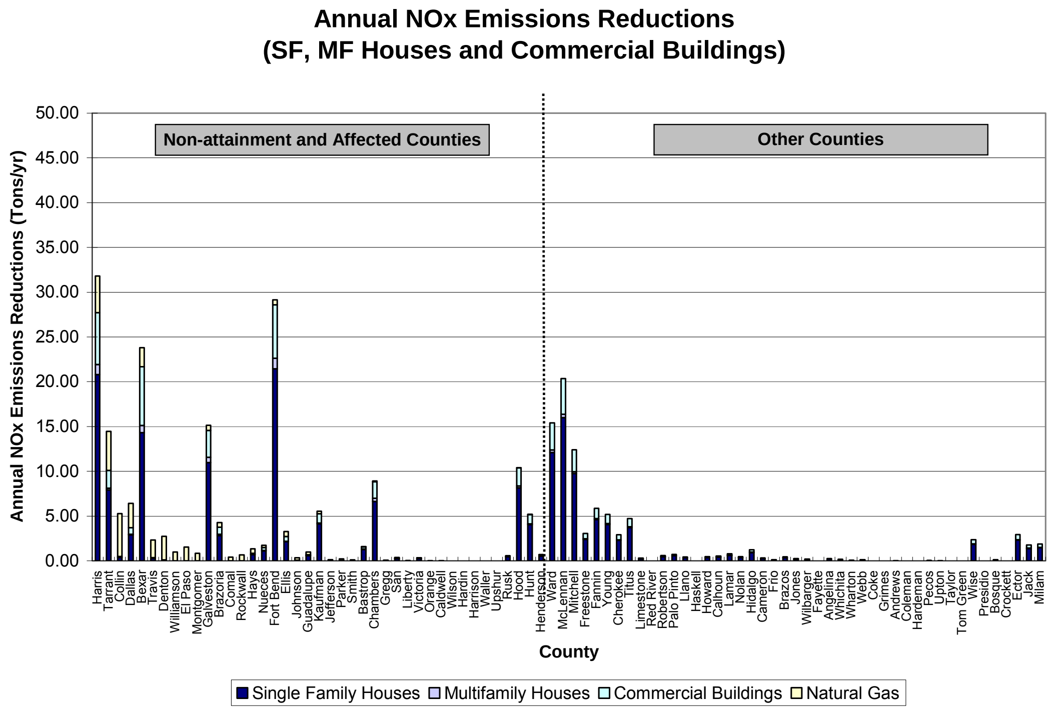


Figure 148: 2005 Annual NOx Reductions from Electricity and Natural Gas Savings Due to the IECC / IRC for Single-family, Multi-family Residences, and Commercial Buildings by County (using 2007 eGRID).

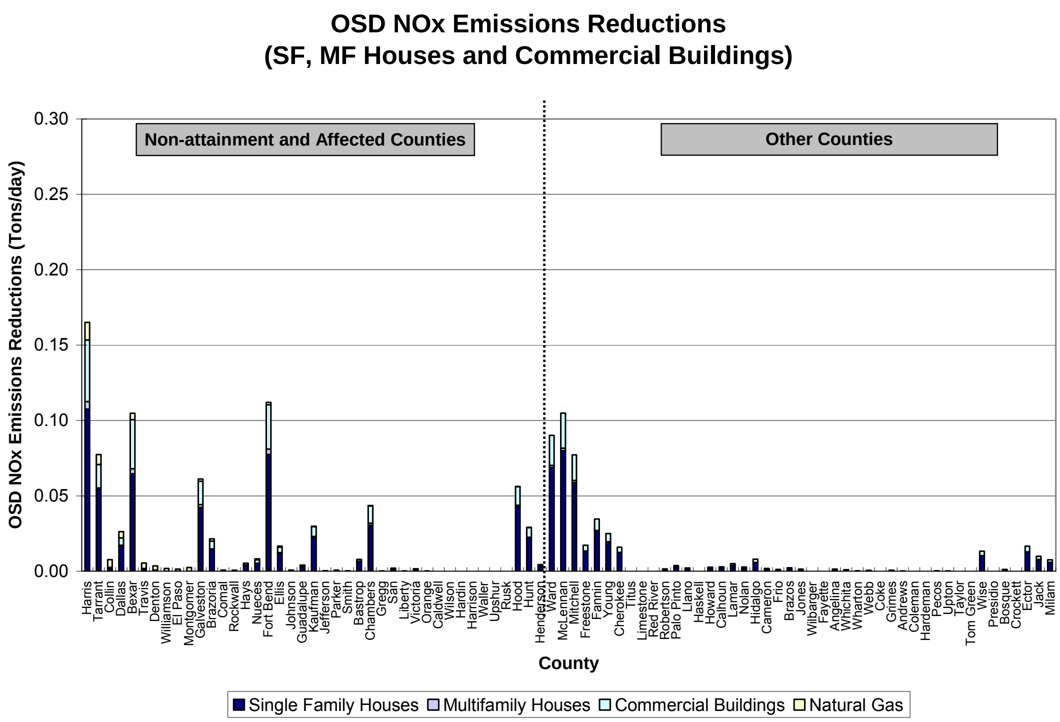
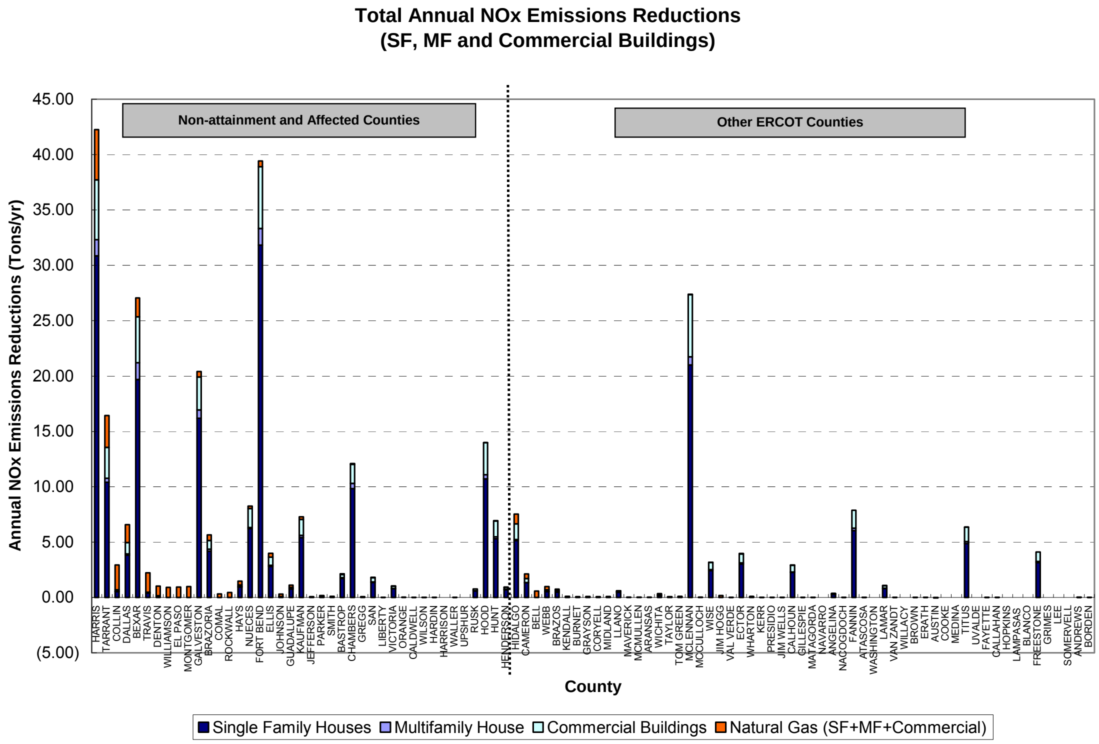


Figure 149: 2005 OSD NOx Reductions from Electricity and Natural Gas Savings Due to the IECC / IRC for Single-family, Multi-family Residences, and Commercial Buildings by County (Using 2007 eGRID).



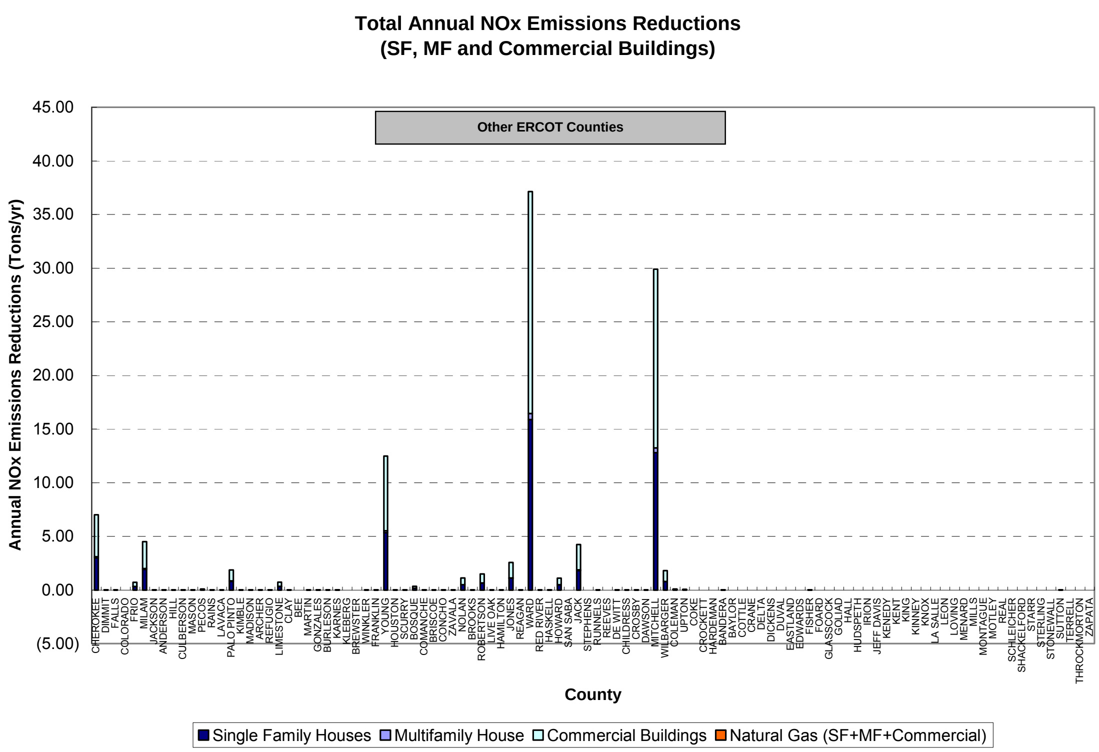
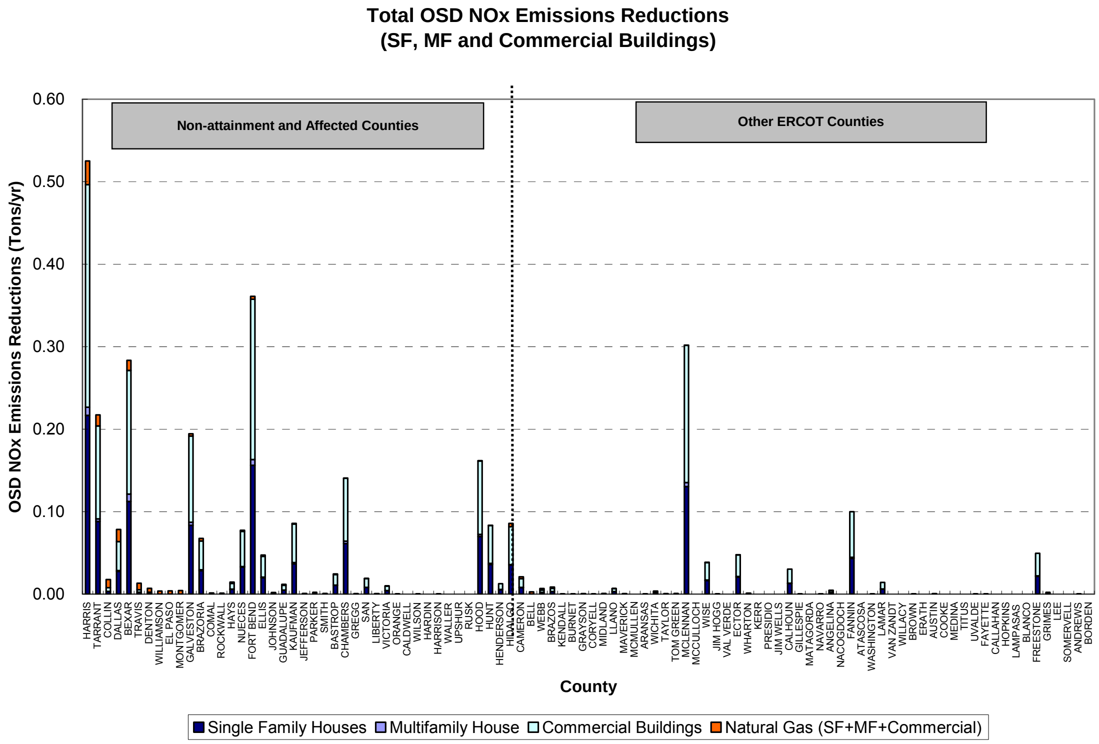


Figure 150: 2006 Annual NOx Reductions from Electricity and Natural Gas Savings Due to the IECC / IRC for Single-family and Multi-family Residences and for Commercial Buildings by County



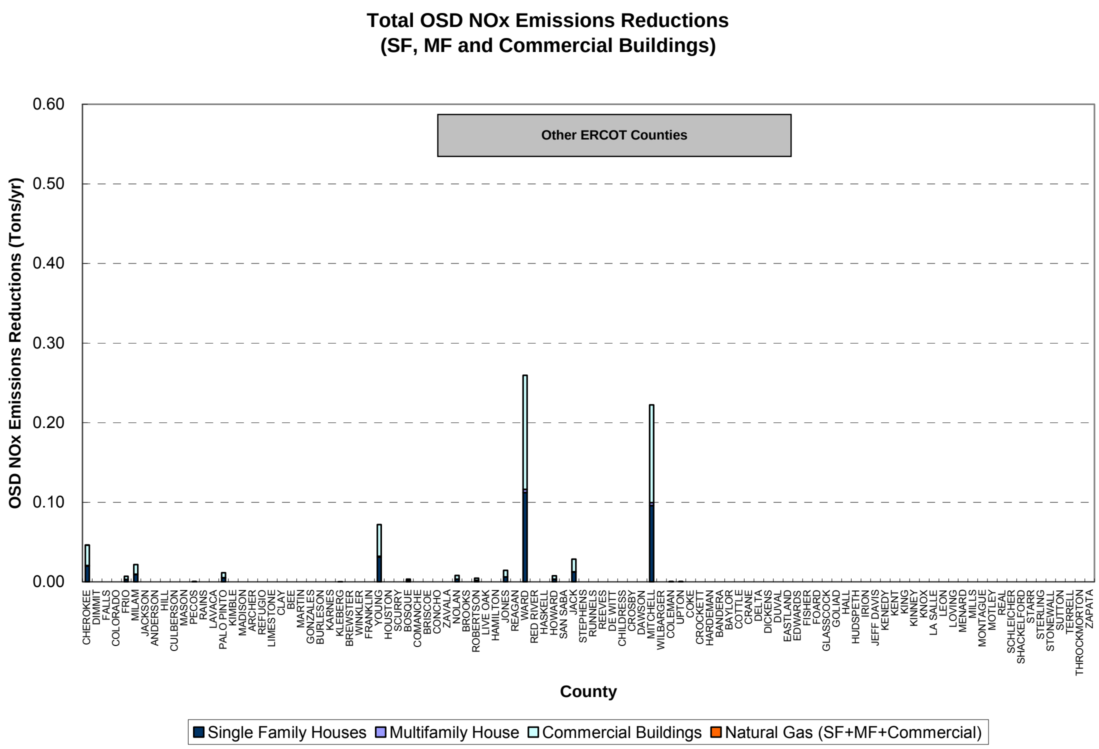


Figure 151: 2006 OSD NOx Reductions from Electricity and Natural Gas Savings Due to the IECC / IRC for Single-family and Multi-family Residences and for Commercial Buildings by County

Table 74: Comparison of 2006 Emissions Reductions vs. 2005 Emissions Reductions from Implementation of the IECC / IRC to Single-family, Multi-family Residential, and Commercial Construction.

ITEM	2006 (2007 eGRID)	2005 (2007 eGRID)	% Diff.
Annual (tons-NOx/yr)			
Total-Electricity and N.G.	361.24	268.2	35%
Single-Family Electricity	263.32	180.01	46%
Multi-Family Electricity	10.88	6.89	58%
Commercial Electricity	60.52	49.53	22%
N.G. (SF+MF+Commercial)	26.53	31.77	-16%
OSD (tons-NOx/yr)			
Total-Electricity and N.G.	2.22	1.26	76%
Single-Family Electricity	1.63	0.88	85%
Multi-Family Electricity	0.07	0.03	133%
Commercial Electricity	0.38	0.29	31%
N.G. (SF+MF+Commercial)	0.15	0.06	150%

7.1.1 Changes in the target counties

In the 2005 annual report, the new single and multifamily houses and commercial buildings in the 41 non-attainment and affected counties were targeted to calculate the annual and OSD energy savings and NOx emissions reductions. In this year's report, the target counties have been expanded to all ERCOT counties as well as the 41 non-attainment and affected counties. There are 194 counties in ERCOT region. Of these counties, 31 counties have been assigned to non-attainment and affected counties.

7.1.2 Changes to the Code-compliant Simulations.

In both the single-family and multi-family code-compliant simulations, new features were added and corrections were made to the DOE-2 input file to improve the accuracy of the simulations. As shown in Table 75, for the single-family simulations, these changes include:

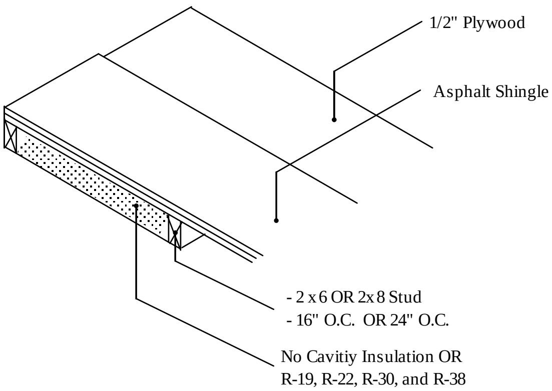
- Addition of an unconditioned, vented attic space with the ducts inside the attic;
- Replacing quick construction mode (that uses pre-calculated weighting factors) by delayed construction mode (that takes into account the thermal mass effect of the materials in the construction assembly);
- Replacing heating and cooling system autosizing by specified heating and cooling system sizes based on 500 sq. ft. per ton for the cooling system and 1.3 times the cooling system size for heating system;
- Using SEER 13 air conditioner and SEER 13/7.7 HSPF heat pump, instead of SEER 10 air conditioner and SEER 10/6.8 HSPF heat pump, for code-compliant houses;
- Eliminating additional heat gain from two occupants, considering no additional heat gain other than 0.88 kW specified in 2000/2001 IECC.
- Correcting the building envelope requirement for West Texas;
- Correcting first floor roof height specification;
- Correcting intermediate floor construction specifications;
- Correcting the crawlspace underground wall area specification;
- Modifying crawlspace height to simulate infiltration;

Next section presents the detailed description regarding the changes in single family input file.

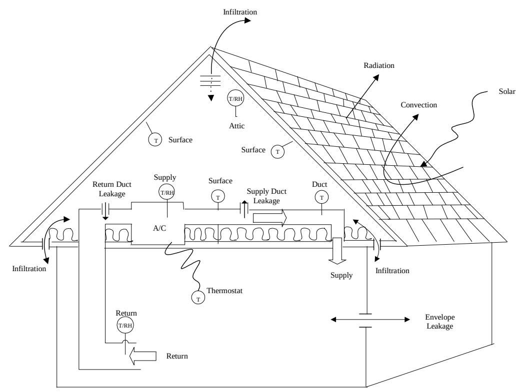
7.1.2.1 Changes in single family input file

A. Roof Configuration

The 2005 simulation model assumed flat roof for all the configurations, with ducts in the conditioned area. For 2006, the simulation model incorporated an unconditioned attic with ducts in the attic. The simulation assumes attic with insulation on the ceiling.



Flat roof configuration
(2005 Simulation Model)

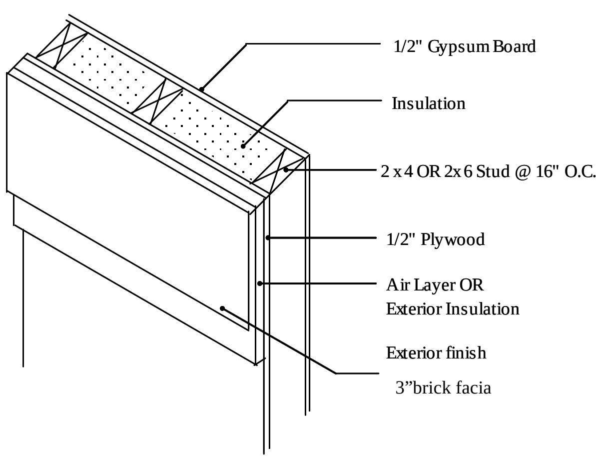


Attic configuration with ducts in unconditioned attic (2006 Simulation Model)

The high attic temperature during summer and low attic temperature during winter nights has resulted in up to 10% increase in the electricity use and up to 6% increase in the natural gas use in 2006 simulation results for Harris. This impact was larger in one-story configurations.

B. Construction Mode

For 2005, the building was modeled in quick construction mode that uses pre-calculated weighting factors and does not take into account the thermal mass effect of the materials in the construction assembly. For 2006, the model is simulated in delayed construction mode by specifying layers of the construction assemblies.



2005 code:

```
WALL-CON1 = CONSTRUCTION
           ABSORPTANCE = P-WALLABSORPTANCE[]        $BRICK (DOE2.1E BDL SUMMARY)
           ROUGHNESS = P-WALLROUGHNESS[]            $BRICK (DOE2.1E BDL SUMMARY)
           U = P-WALLUVALUE[] ..                    $IECC 2001(RESIDENTIAL BUILDING)(BTU/HR.FT^2.F)
```

2006 code:

```
WALL_1       = CONSTRUCTION
               ABSORPTANCE = P-WALLABSORPTANCE[]
               ROUGHNESS = P-WALLROUGHNESS[]
               LAYERS = WA_1   ..

WALL_2       = CONSTRUCTION
               ABSORPTANCE = P-WALLABSORPTANCE[]
               ROUGHNESS = P-WALLROUGHNESS[]
               LAYERS = WA_2   ..

WA_1  = LAYERS                                         $ WA_1 = Insulated part, WA_2 = Stud part
        MATERIAL = (EXF[],AL21,PW03,CAVINS[],GP01)  ..  $ EXF[] = exterior finish
WA_2  = LAYERS                                         $ AL21 = Air layer
        MATERIAL = (EXF[],AL21,PW03,STUD[],GP01)  ..    $ PW03 = Plywood 1/2"
                                                       $ CAVINS[] = Cavity Insulation
                                                       $ GP01[] = Gypsum/plaster board
```

The relatively stable indoor temperature due to the effect of thermal mass has resulted in up to 12% decrease in electricity use and up to 12% decrease in natural gas use.

C. Heating and Cooling System Sizing

For 2005, the heating and cooling systems were auto-sized by the DOE-2.1e simulation program. In 2006, the systems are sized based on 500 sq. ft. per ton for the cooling system and 1.3 times the cooling system size for heating system.

This change has resulted in a less than 1% increase in electricity use and up to 2% increase in natural gas use.

D. Cooling System Efficiency

For 2005 simulations, the pre-code and code compliant houses were simulated with SEER 10 cooling system and 6.8 HSPF heat pump. For 2006 simulations, the code compliant houses are simulated with SEER 13 cooling system and 7.7 HSPF heat pump.

This has resulted in up to 6% decrease in electricity use in code compliant house configurations.

E. Number of Occupants

For 2005, the internal heat gain from two occupants was considered in the simulation. Considering no such requirement in the 2000/2001 IECC and assuming that the occupant heat gain in included in the constant internal heat gain (Section 402.1.3.6, 2000/2001 IECC), no additional occupant heat gain was assumed for 2006 simulations.

This reduced internal heat gain has decreased the electricity use by up to 3% and increased the natural gas use by 5%.

F. Building Envelope

The window area in two-story configuration is lower than in one story configuration. This requires different building envelope requirements for the two scenarios. For 2005, the houses in West Texas counties were simulated with same building envelope characteristics that follow the prescriptive table applicable to one-story configuration. For 2006, this is corrected. This change resulted in a very small decrease in the electricity use and up to 8% increase in the natural gas use, in simulations for West Texas.

G. First floor roof position in one-story configuration:

For 2005, the height of the first-floor roof in the one-story configuration was fixed to 8 feet. For 2006, this is simulated using a parameter to be able to input different roof heights in East and West Texas, obtained from NAHB housing survey data.

This change has a very small effect (~0.05%) on the electricity use in one-story configurations.

2005 code:

```
##ELSEIF #[SECONDFLOOR[] EQS "NO"]              $SECOND STOREY DEACTIVATED
  TOP-A1 = ROOF
              HEIGHT = P-BUILDINGWIDTH[]        $(FT)
              WIDTH = P-BUILDINGLEN[]           $(FT)
              X = 0   Y = 0
              Z = 8                             $COORDINATES
```

2006 code:

```
##ELSEIF #[#[SECONDFLOOR[] EQS NO] AND #[ATTIC[] EQS NO]]  $ FLAT ROOF ON FIRST FLOOR ACTIVATED
TOP1_1 = ROOF
       ##IF #[THERMALMASS[] EQS ON]
             WIDTH = P-THERMALWALL1[]
             CONSTRUCTION = CEIL_1
       ##ELSEIF #[THERMALMASS[] EQS OFF]
             WIDTH = P-BUILDINGLEN[]
             CONSTRUCTION = CLNG-CON1
       ##ENDIF
              HEIGHT = P-BUILDINGWIDTH[]
              X = 0
              Y = 0
              Z = P-ROOFHEIGHT[]                   $ COORDINATES
```

H. Intermediate floor construction in two-story configuration:

For 2005, the intermediate floor construction between the first and the second floor used the insulation R-value for an exposed floor adopted from 2001 IECC prescriptive tables (Table 502.2.4). This is applicable only to the intermediate floor between the first floor and the unconditioned, vented crawl space. For 2006, overall R-value of the layered construction without any insulation was used for the intermediate floor. The intermediate floor construction between the crawl space and the first floor still uses the same insulated floor specification.

This change has resulted in up to 2% increase in electricity use and a very small impact on gas use in all the two-story configurations.

2005 code:

```
##SET1 P-FLOORUVALUE #[1 / c26]                          $ FLOOR U-VALUE

SFLOOR-CON1 = CONSTRUCTION
$           LAYERS = CLNG-LAY1
            U = P-FLOORUVALUE[]  ..                   $IECC 2001(RESIDENTIAL BUILDING)(BTU/HR.FT^2.F)


##IF #[SECONDFLOOR[] EQS "YES"]                $SECOND STOREY ACTIVATED
   FLOOR1_1 = INTERIOR-WALL
              HEIGHT = P-BUILDINGWIDTH[]      $(FT)
              WIDTH = P-BUILDINGLEN[]         $(FT)
              X = 0   Y = 0
              Z = P-ROOFHEIGHT[]               $JAYA.M, 11/04/2003 ADJUST ROOF Z-VALUE.
              NEXT-TO = RM-2
$             INT-WALL-TYPE = STANDARD         PLACED IN SET-DEFAULT
              TILT = 0                         $(DEGREES)
              CONSTRUCTION = SFLOOR-CON1

##IF #[CRAWLSPACE[] EQS "ON"]                       $ CRAWLSPACE ACTIVATED
FLOOR1-R_1 = INTERIOR-WALL
       ##IF #[THERMALMASS[] EQS ON]
             WIDTH = P-FLOORWDT_A[]                 $ (FT)
             CONSTRUCTION = IW-1
       ##ELSEIF #[THERMALMASS[] EQS OFF]
             WIDTH = P-BUILDINGLEN[]                $ (FT)
             CONSTRUCTION = SFLOOR-CON1
       ##ENDIF
```

2006 code:

```
IFLOOR-CON1  = CONSTRUCTION
               U = 0.28  ..                        $ CP02,PW03,STUD-10IN/AL33,GP01

IFL_1        = LAYERS
               MATERIAL = (INTFLOOR_FIN[], PW03, GP01)  ..        $ Choice of floor interior finish

IFLOOR_1     = CONSTRUCTION                         $ FLOOR IN BETWEEN FIRST AND SECOND STORY
               LAYERS = IFL_1    ..

##IF #[SECONDFLOOR[] EQS YES]                       $CEILING ON FIRST FLOOR ACTIVATED
CEIL1_1 = INTERIOR-WALL
     ##IF #[THERMALMASS[] EQS ON]
             CONSTRUCTION = IFLOOR_1
             WIDTH = INTFLRWDT_A[]         $(FT)
     ##ELSEIF #[THERMALMASS[] EQS OFF]
             CONSTRUCTION = IFLOOR-CON1
             WIDTH = P-BUILDINGLEN[]         $(FT)
     ##ENDIF

##SET1 P-FLOORUVALUE #[1 / c26]                     $ FLOOR U-VALUE (ABOVE VENTED CRAWLSPACE)

FLOOR-CON1   = CONSTRUCTION
               U = P-FLOORUVALUE[]  ..              $ (BTU/HR.FT^2.F) 2001 IECC

FLOOR-1     = INTERIOR-WALL
             HEIGHT = P-BUILDINGWIDTH[]             $ (FT) , TURNED ON BY M.MALHOTRA
##IF #[THERMALMASS[] EQS ON]
     ##IF #[CRAWLSPACETYPE[] EQS "VENTED"]              $ INSULATED FLOOR
             CONSTRUCTION = FLOOR_1
             WIDTH = P-THERMALWALL1[]                $ (FT)
     ##ELSEIF #[CRAWLSPACETYPE[] EQS "UNVENTED"]         $ UNINSULATED FLOOR (INSULATED CRAWLSPACE WALLS)
             CONSTRUCTION = IFLOOR_1
             WIDTH = P-THERMALWALL1[]               $ (FT)
     ##ENDIF
##ELSEIF #[THERMALMASS[] EQS OFF]
     ##IF #[CRAWLSPACETYPE[] EQS "VENTED"]              $ INSULATED FLOOR
             CONSTRUCTION = FLOOR-CON1
             WIDTH = P-BUILDINGLEN[]                $ (FT)
     ##ELSEIF #[CRAWLSPACETYPE[] EQS "UNVENTED"]         $ UNINSULATED FLOOR (INSULATED CRAWLSPACE WALLS)
             CONSTRUCTION = IFLOOR-CON1
```

I. Underground Wall Area of the Crawlspace

The underground construction was simulated using the Winklemann's method that uses the effective heat transfer surface area that is in contact with the ground. In 2005 simulation model, the underground wall area of the crawlspace used 4 ft. height of crawlspace wall below ground.

This has resulted in very small impact on electricity and gas use.

J. Crawlspace Wall Height

For 2005, the crawlspace height was assumed to be 1.5 ft. above ground and 1 ft. below ground. It was found that with this dimensions, the infiltration effect in the vented crawlspace was not seen. For 2006, crawlspace height of 2 ft. above ground and 3 ft. below ground was assumed.

This has resulted in less than 1% decrease in electricity use and a 1.5% increase in gas use in crawlspace configurations.

The cumulative impact of all changes is up to ±10% for Harris and ±15% for Tarrant .

Table 76 and

Table 77 show the actual impact of these changes on a house located in Harris and Tarrant counties as well as the total impact on the previously mentioned counties. For Harris County (Table 76, Step 2), the above changes resulted in a 25.8% increase in the annual MWh savings for the entire county from 49,541 MWh/year to 62,345 MWh/year. Annual natural gas savings went down by 4.0% from 986,455 to 946,982 therms/year. The OSD MWh savings went up by 78.5%. By the changes in the simulation input, the total annual NOx emissions savings increased by 22.13% from 32.68 to 39.91 tons/year, while the OSD emissions savings increased by 71.9% from 0.128 to 0.22 tons/OSD.

For Tarrant County (

Table 77, Step 2), the above changes resulted in a 5.9% increase in the annual MWh savings for the entire county from 33,607 MWh/year to 35,584 MWh/year. Annual natural gas savings went down by 39.7 % from 1,016,947 to 613,524 therms /year. The OSD MWh savings went up by 37.3%. The total annual NOx emissions savings increased by 6.6% from 54.6 to 58.3 tons/year, while the peak emissions savings increased by 4.7% from 0.311 to 0.326 tons/OSD.

The “Per House” columns show the differences for one configuration of the single family house as an example. Note 1 of Table 76 and

Table 77 provide the house configuration used. Figure 152 and Figure 153 show the percentage change in savings for each of the above mentioned steps.

Table 78 shows the changes made to the Multi-family model, they are:

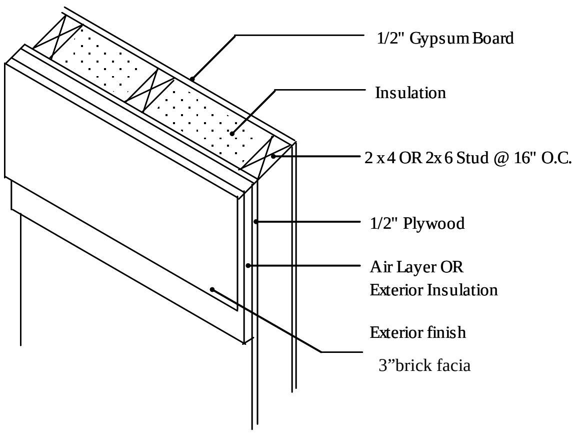
- Replacing quick construction mode (that uses pre-calculated weighting factors) by delayed construction mode (that takes into account the thermal mass effect of the materials in the construction assembly);
- Replacing heating and cooling system autosizing by specified heating and cooling system sizes based on 500 sq. ft. per ton for the cooling system and 1.3 times the cooling system size for heating system;
- Using SEER 13 air conditioner and SEER 13/7.7 HSPF heat pump, instead of SEER 10 air conditioner and SEER 10/6.8 HSPF heat pump, for code-compliant houses;
- Eliminating additional heat gain from two occupants, considering no additional heat gain other than 0.88 kW specified in 2000/2001 IECC;
- Correcting wall emissivity from 1 to 0.9;
- Correcting geographical location for Harris county;
- Correcting intermediate floor construction specifications;

Next section presents the detailed description regarding the changes in multifamily input file.

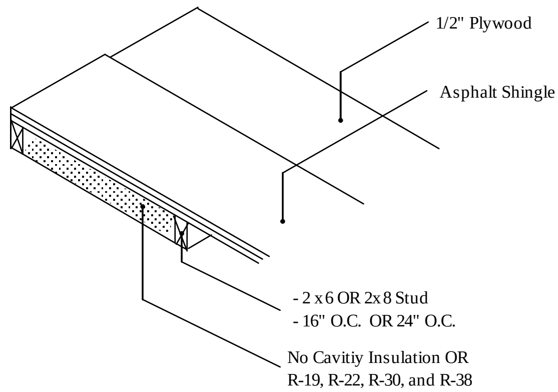
7.1.2.2 Changes in multifamily input file

A. Construction Mode

For 2005, the building was modeled in quick construction mode that uses pre-calculated weighting factors and does not take into account the thermal mass effect of the materials in the construction assembly. For 2006, the model is simulated in delayed construction mode by specifying layers of the construction assemblies.



Layering of Wall Assembly (2006)



Layering of Roof Assembly (2006)

The relatively stable indoor temperature due to the effect of thermal mass has resulted in up to 8% decrease in electricity use. However, it increased gas use by up to 2%.

B. Heating and Cooling System Sizing

For 2005, the heating and cooling systems were auto-sized by the DOE-2.1E simulation program. In 2006, the systems were sized based on 500 sq. ft. per ton for the cooling system and 1.3 times the cooling system size for heating system.

This change has resulted in a very small impact on electricity use (up to 0.3%) and gas use (up to 0.6%).

C. Cooling System Efficiency

For 2005 simulations, the pre-code and code compliant houses were simulated with SEER 10 cooling system and 6.8 HSPF heat pump. For 2006 simulations, the code compliant houses are simulated with SEER 13 cooling system and 7.7 HSPF heat pump.

This has resulted in 4% decrease in electricity use for code compliant house configurations.

D. Number of Occupants

For 2005, the internal heat gain from two occupants was considered in the simulation. Considering no such requirement in the 2000/2001 IECC and assuming that the occupant heat gain in included in the constant internal heat gain (Section 402.1.3.6, 2000/2001 IECC), no additional occupant heat gain was assumed for 2006 simulations.

Due to reduced internal heat gain, this change has decreased the electricity use by up to 7% and increased the natural gas use by up to 3%.

E. Wall Emissivity

For 2005, wall emissivity was specified as 1. For 2006, 0.9 wall emissivity is used. This change has resulted in a very small decrease in electricity use (~0.2%) and a very small increase in natural gas use (~0.3%).

F. Harris County Location:

For 2005, the Harris County geographical location was based on Houston. For 2006, the county details for Harris are modified to be consistent with the values used in all input files. This change has a very small effect (+/- 0.02%) on the electricity and natural gas use.

2005 code:

```
##ELSEIF #[b02 EQS "HAR"]                    $ HAR: HARRIS
     ##SET1 P-LATITUDE #[29.17 * 1]
     ##SET1 P-LONGITUDE #[95.44 * 1]
     ##SET1 P-TIME-ZONE #[6 * 1]
     ##SET1 P-ALTITUDE #[108 * 1]
     ##SET1 P-AIRCHANGE #[0.57 * 0.81]
```

2006 code:

```
##ELSEIF #[b02 EQS "HAR"]                  $ HAR: HARRIS (WEATHER FILE: HOUSTON)
     ##SET1 P-HDD #[1500 * 1]              $ HEATING DEGREE DAYS
     ##SET1 P-LATITUDE #[29.47 * 1]        $ LATITUDE
     ##SET1 P-LONGITUDE #[95.03 * 1]       $ LONGTITUDE
     ##SET1 P-TIME-ZONE #[6 * 1]           $ TIME ZONE
     ##SET1 P-ALTITUDE #[68.00 * 1]        $ ALTITUDE(ft)
     ##SET1 P-AIRCHANGE #[0.57 * 0.81]     $ NORMALIZED LEAKAGE x WEATHER FACTOR
```

G. Construction specification for Interior Wall and Roof:

For 2005, the intermediate floor construction between the floors used the insulation R-value for an exposed floor adopted from 2001 IECC prescriptive tables (Table 502.2.4). For 2006, overall R-value of the layered construction without any insulation was used for the intermediate floor.

Also, for 2005, the roof construction of a unit in the 3 floor, 6-unit configuration was mistakenly specified as layered construction, even in quick mode. For 2006 this is corrected. This change has a small impact on the energy use of the 3 floor, 6-unit configuration simulated in quick mode, only. Since, 2006 annual report uses delayed construction mode, the effect of this change is not seen at all.

These changes have a combined effect of up to 0.3% decrease in the electricity use and up to 0.6% decrease in the gas use.

2005 code:

```
$***********UNIT - 9 SPACE CONDITION DETAILS***************************************************
.
.
##elseif #[THERMALMASS[] EQS OFF]
.
.
ROOF-9_1 =   ROOF
             HEIGHT = P-UNITWDT[]                $ (FT)
             WIDTH = P-UNITLEN[]                 $ (FT)
             X = 0   Y = 0  Z = P-UNITCEILHT[]   $ JAYA.M, 11/04/2003 ADJUST ROOF Z-VALUE.
             AZIMUTH = 180                       $ (DEGREES)
             TILT = 0                            $ (DEGREES)
             CONSTRUCTION = CEIL-1
```

2006 code:

```
$***********UNIT - 9 SPACE CONDITION DETAILS***************************************************
.
.
##elseif #[THERMALMASS[] EQS OFF]
.
.
ROOF-9_1 =   ROOF
             HEIGHT = P-UNITWDT[]                $ (FT)
             WIDTH = P-UNITLEN[]                 $ (FT)
             X = 0   Y = 0  Z = P-UNITCEILHT[]   $ JAYA.M, 11/04/2003 ADJUST ROOF Z-VALUE.
             AZIMUTH = 180                       $ (DEGREES)
             TILT = 0                            $ (DEGREES)
             CONSTRUCTION = CLNG-CON1
```

Table 79 and Table 80 show the impact of these changes on house configuration in Harris and Tarrant counties as well as the total impact on the previously mentioned counties. For Harris County (Table 79, Step 2), the above changes resulted in a 14.4% increase in the annual MWh savings for the entire county from 2,862 MWh/year to 3,275 MWh/year. Annual natural gas savings also increased by 0.5% from 67,776 to 68,141 therms/year. The OSD MWh savings went up by 87.5%. By the changes in the simulation input, the total annual NOx emissions savings increased by 12.55% from 1.94 to 2.18 tons/year, while the OSD emissions savings increased by 72.21% from 0.0063 to 0.0109 tons/OSD.

For Tarrant County (Table 80, Step 2), the above changes resulted in a 94.7% increase in the annual MWh savings for the entire county from 433 MWh/year to 843 MWh/year. Annual natural gas savings went down by 12.6% from 17,399 to 19,591 therms/year. The OSD MWh savings went up by 115.8%. The total annual NOx emissions savings increased by 78.64% from 0.41 to 0.73, while the OSD savings increased by 103.3% from 0.0026 to 0.0053.

The “Per House” columns show the differences for one configuration of the multifamily house as an example. Note 1 of Table 79 and Table 80 provide the house configuration used. Figure 154 and Figure 155 show the percentage change in savings for each of the above previously mentioned steps.

7.1.3 Change to the Number of Building Permits for the 41 Counties for 2006:

The number of building permits issued for Single- and Multi-family housing in 2005 from actual construction data was used to update the calculations for 2006.

For single-family housing in Harris County (Table 76, Step 3), the annual MWh savings increased by 45.8%, from 49,541 to 72,234 MWh/year. The annual natural gas savings went up by 11.2%, from 986,455 to 1,097,208 therms. The OSD MWh savings increased by 106.8%, from 216.56 to 447.83 MWh/OSD. The OSD gas savings went up by 15.9%, from 2,592 to 3,004 therms/OSD. The annual NOx emissions reduction increased by 41.50%, from 39.91 to 46.24 tons/year, while the OSD day NOx emissions reduction increased by 99.40%, from 0.128 to 0.26 tons/OSD.

For single-family housing in Tarrant County (

Table 77, Step 3), the annual MWh savings increased by 16.1% from 33,607 to 39,011 MWh/year. The annual natural gas savings went down by 33.9% from 1,016,947 to 672,603. The OSD MWh savings increased by 50.6%, from 178 to 267.9 MWh/OSD. The OSD gas savings went up by 9.6%, from 1,484 to 1,627 therms/OSD. The annual NOx emissions reduction increased by 8.38%, from 30.37 to 32.91 tons/year, while the OSD NOx emissions reduction increased by 48.61%, from 0.14 to 0.21 tons/OSD.

For multi-family housing in Harris County (Table 79, Step 3), the annual MWh savings increased by 23.5%, from 2,862 to 3,535 MWh/year. The annual natural gas savings increased by 8.5%, from 67,776 to 73,560 therms. The OSD MWh savings increased by 100.1%, from 10 to 20.24 MWh/OSD. The OSD gas savings went up by 8.0%, from 196 to 212 therms/OSD. The annual NOx emissions reduction increased by 21.4%, from 1.94 to 2.35 tons/year, while the OSD NOx emissions reduction increased by 73.35%, from 0.0063 to 0.0110 tons/OSD.

For multi-family housing in Tarrant County (Table 80, Step 3), the annual MWh savings increased by 140.5%, from 433 to 1,041 MWh/year. The annual natural gas savings increased by 39.1%, from 17,399 to 24,203. The OSD MWh savings increased by 166.6%, from 3 to 8.14 MWh/OSD. The OSD gas savings went up by 23.5%, from 60 to 75 therms/OSD. The annual NOx emissions reduction increased by 120.7%, from 0.41 to 0.91 tons/year, while the OSD NOx emissions reduction increased by 148.22%, from 0.0026 to 0.0064 tons/OSD.

7.1.4 Use of 1999, 2000 and 2002 TRY weather files

The 2000 and 2002 TRY weather files as well as 1999 TRY weather file has been used for the simulation in the 2006 annual report, while only the 1999 TRY weather file was used in the 2005 annual report.

<u>Use of 2000 TRY weather file</u>

For single-family housing in Harris County (Table 76, Step 4), the annual MWh savings increased by 18.0%, from 49,541 to 72,249 MWh/year. The annual natural gas savings went up by 29.7%, from 986,455 to 1,279,137 therms. The OSD MWh savings increased by 98.7%, from 216.56 to 430.38 MWh/OSD. The OSD gas savings went up by 15.9%, from 2,592 to 3,004 therms/OSD. The annual NOx emissions reduction increased by 44.09%, from 39.91 to 47.08 tons/year, while the OSD day NOx emissions reduction increased by 92.00%, from 0.128 to 0.246 tons/OSD.

For single-family housing in Tarrant County (

Table 77, Step 4), the annual MWh savings increased by 18.0% from 33,607 to 39,649 MWh/year. The annual natural gas savings went down by 20.9% from 1,016,947 to 804,022. The OSD MWh savings increased by 57.0%, from 178 to 279.30 MWh/OSD. The OSD gas savings went up by 9.6%, from 1,484 to 1,627 therms/OSD. The annual NOx emissions reduction increased by 11.53%, from 30.37 to 33.87 tons/year, while the OSD NOx emissions reduction increased by 54.68%, from 0.14 to 0.22 tons/OSD.

For multi-family housing in Harris County (Table 79, Step 4), the annual MWh savings increased by 19.2%, from 2,862 to 3,412 MWh/year. The annual natural gas savings increased by 4.5%, from 67,776 to 70,844 therms. The OSD MWh savings increased by 94.2%, from 10 to 19.64 MWh/OSD. The OSD gas savings went up by 8.0%, from 196 to 212 therms/OSD. The annual NOx emissions reduction increased by 17.22%, from 1.94 to 2.27 tons/year, while the OSD NOx emissions reduction increased by 73.35%, from 0.0063 to 0.0110 tons/OSD.

For multi-family housing in Tarrant County (Table 80, Step 4), the annual MWh savings increased by 141.0%, from 433 to 1,043 MWh/year. The annual natural gas savings increased by 34.5%, from 17,399 to 23,097. The OSD MWh savings increased by 185.9%, from 3 to 8.73 MWh/OSD. The OSD gas savings went up by 23.5%, from 60 to 75 therms/OSD. The annual NOx emissions reduction increased by 120.13%, from 0.41 to 0.90 tons/year, while the OSD NOx emissions reduction increased by 167.48%, from 0.0026 to 0.0069 tons/OSD.

Use of 2002 TRY weather file

For single-family housing in Harris County (Table 76, Step 5), the annual MWh savings increased by 29.8%, from 49,541 to 64,329 MWh/year. The annual natural gas savings went up by 24.0%, from 986,455 to 1,223,425 therms. The OSD MWh savings increased by 75.2%, from 216.56 to 379.38 MWh/OSD. The OSD gas savings went up by 15.9%, from 2,592 to 3,004 therms/OSD. The annual NOx emissions reduction increased by 29.49%, from 39.91 to 42.31 tons/year, while the OSD day NOx emissions reduction increased by 70.50%, from 0.128 to 0.218 tons/OSD.

For single-family housing in Tarrant County (

Table 77, Step 5), the annual MWh savings increased by 0.7% from 33,607 to 33,827 MWh/year. The annual natural gas savings went down by 17.7% from 1,016,947 to 837,302. The OSD MWh savings increased by 30.8%, from 178 to 232.75 MWh/OSD. The OSD gas savings went up by 9.6%, from 1,484 to 1,627 therms/OSD. The annual NOx emissions reduction decreased by 2.17%, from 30.37 to 29.71 tons/year, while the OSD NOx emissions reduction increased by 29.79%, from 0.14 to 0.18 tons/OSD.

For multi-family housing in Harris County (Table 79, Step 5), the annual MWh savings increased by 2.1%, from 2,862 to 2,921 MWh/year. The annual natural gas savings increased by 3.2%, from 67,776 to 69,965 therms. The OSD MWh savings increased by 81.8%, from 10 to 18.39 MWh/OSD. The OSD gas savings went up by 8.0%, from 196 to 212 therms/OSD. The annual NOx emissions reduction increased by 2.58%, from 1.94 to 1.99 tons/year, while the OSD NOx emissions reduction increased by 73.35%, from 0.0063 to 0.0110 tons/OSD.

For multi-family housing in Tarrant County (Table 80, Step 5), the annual MWh savings increased by 86.4%, from 433 to 807 MWh/year. The annual natural gas savings increased by 32.7%, from 17,399 to 23,399. The OSD MWh savings increased by 131.2%, from 3 to 7.06 MWh/OSD. The OSD gas savings went up by 23.5%, from 60 to 75 therms/OSD. The annual NOx emissions reduction increased by 75.96%, from 0.41 to 0.72 tons/year, while the OSD NOx emissions reduction increased by 117.40%, from 0.0026 to 0.0056 tons/OSD.

Table 75: Description of Steps for Comparison of 2005 vs. 2006 Energy and NOx Reductions for Single-Family Residence.

Comparison between 2005 and 2006 simulation and eGRID results for SF

1. 2005 Original			
Simulations	2005 input file	2005 building permit #	1999 TRY
2. 2005 vs. 2006 w/2006 input file			
Simulations	2006 input file	2005 building permit #	1999 TRY
3. 2005 vs. 2006 w/ 2006 building permit #			
Simulations	2006 input file	2006 building permit #	1999 TRY
3. 2005 vs. 2006 w/1999,2000 and 2002 TRY			
Simulations	2006 input file	2006 building permit #	1999, 2000, and 2002 TRY

*** The changes from 2004 to 2005 input files**

Changes	2005	2006
Roof configuration and duct location	Flat roof Ducts in the conditioned space	Unconditioned, vented attic Ducts in the attic
Construction mode	Quick (uses precalculated weighting factors)	Delayed mode (considers thermal mass of construction materials)
Heating and cooling system size	Autosizing	Cooling system : 500 sq. ft./ton Heating system: 1.3 x cooling system size
Heating and cooling system efficiency	SEER 10 air conditioner SEER 10/6.8 HSPF heat pump	SEER 13 air conditioner SEER 13/7.7 HSPF heat pump
No. of occupants	Two (simulates heat gain from occupants in addition to 0.88 kW from lights and equipment)	None (considering no additional internal heat gain other than 0.88 kW)
Building envelope specifications	Used same insulation values for one and two story for West Texas	Corrected, based on different wall-to-window ratio in one and two story house
First floor roof height	Fixed to 8 ft.	Corrected, to position first floor roof accurately on the walls
Intermediate floor construction	Included insulation required for exposed floor	No insulation specified
Crawlspace underground wall area	Assumes 4 ft. crawlspace underground wall height	Uses a variable defined for crawlspace underground wall height
Crawlspace height	1.5 ft. above ground and 1 ft. below ground (output showed no crawlspace infiltration)	2 ft. above ground, 3 ft. below ground (this simulated crawlspace infiltration)

Table 76: Comparison of 2005 vs. 2006 Energy and NOx Emissions Reductions for Single-family House (Harris County).

Single Family Houses
Harris County

Energy Savings

			Per House[1]						County Total[2]			
Step	**County**	**No. of Building Permits (Single Family Residences)**	**Annual Elec.Savings per House (kWh/yr)**	**Annual NG Savings per House (Therms/yr)**	**Ozone Season Period**	**OSD Elec. Savings per House (kWh/day)**	**OSD NG Savings per House (Therm/day)**	**Total Annual Elec.Savings per County (MWh/yr) w/ 7% T&D Loss**	**Total Annual NG Savings per County (Therms/yr)**	**Total OSD Elec. Savings per County (MWh/day) w/ 7% T&D Loss**	**Total OSD NG Savings per County (Therm/day)**
1 (Original_2005)	Harris	28,020	1,717	46	7/15 - 9/15	7.38	0.12	49,541	986,455	216.56	2,592
2 (2006 Input)	Harris	28,020	2,211	38	7/15 - 9/15	13.92	0.12	62,345	946,982	386.52	2,592
3 (2006 Permit #)	Harris	32,465	2,211	38	7/15 - 9/15	13.92	0.12	72,234	1,097,208	447.83	3,004
4 (2000 TRY)	Harris	32,465	2,152	41	7/15 - 9/15	13.07	0.12	72,249	1,279,137	430.38	3,004
5 (2002 TRY)	Harris	32,465	1,935	37	7/15 - 9/15	11.71	0.12	64,329	1,223,425	379.38	3,004

NOx Emissions Reductions

Step	**County**	**Total Annual NOx Reductions from Elec. (Tons/yr) *(Total Value)***	**2005 vs. % Diff**	**Total Annual NOx Reductions from NG (Tons/yr) *(For the County Only)***	**2005 vs. % Diff**	**Total Annual NOx Reductions (Tons/yr)**	**2005 vs. % Diff**	**Total Peak-day NOx Reductions from Elec. (Tons/day) *(Total Value)***	**2005 vs. % Diff**	**Total Peak-day NOx Reductions from NG (Tons/day) *(For the County Only)***	**2005 vs. % Diff**	**Total Peak-day NOx Reductions (Tons/day)**	**2005 vs. % Diff**
1 (Original_2005)	Harris	28.14	0.00%	4.54	0.00%	32.68	0.00%	0.116	0.00%	0.012	0.00%	0.128	0.00%
2 (2006 Input)	Harris	35.55	26.35%	4.36	-4.00%	39.91	22.13%	0.21	79.31%	0.01	0.00%	0.22	71.92%
3 (2006 Permit #)	Harris	41.19	46.39%	5.05	11.23%	46.24	41.50%	0.24	107.99%	0.01	15.86%	0.26	99.40%
4 (2000 TRY)	Harris	41.20	46.41%	5.88	29.67%	47.08	44.09%	0.232	99.83%	0.014	15.86%	0.246	92.00%
5 (2002 TRY)	Harris	36.69	30.37%	5.63	24.02%	42.31	29.49%	0.204	76.12%	0.014	15.86%	0.218	70.50%

1. "Per House" shows the simulation results only from one house type (i.e., Slab-on-grade, 1-story, and fuel option 1)
2. "County Total" shows the combined simulation results from all house type considering no. of building permit, percentage of house type, etc.

Table 77: Comparison of 2005 vs. 2006 Energy and NOx Emissions Reductions for Single-family House (Tarrant County).

Single Family Houses
Tarrant County

Energy Savings

			Per House[1]						County Total[2]			
Step	**County**	**No. of Building Permits (Single Family Residences)**	**Annual Elec.Savings per House (kWh/yr)**	**Annual NG Savings per House (Therms/yr)**	**Ozone Season Period**	**OSD Elec. Savings per House (kWh/day)**	**OSD NG Savings per House (Therm/day)**	**Total Annual Elec.Savings per County (MWh/yr) w/ 7% T&D Loss**	**Total Annual NG Savings per County (Therms/yr)**	**Total OSD Elec. Savings per County (MWh/day) w/ 7% T&D Loss**	**Total OSD NG Savings per County (Therm/day)**
1 (Original_2005)	Tarrant	14,705	2,226	93	7/15 - 9/15	12.27	0.12	33,607	1,016,947	178	1,484
2 (2006 Input)	Tarrant	14,705	2,416	67	7/15 - 9/15	17.29	0.12	35,584	613,524	244.41	1,484
3 (2006 Permit #)	Tarrant	16,121	2,416	67	7/15 - 9/15	17.29	0.12	39,011	672,603	267.94	1,627
4 (2000 TRY)	Tarrant	16,121	2,449	86	7/15 - 9/15	17.93	0.12	39,649	804,022	279.30	1,627
5 (2002 TRY)	Tarrant	16,121	2,084	90	7/15 - 9/15	15.01	0.12	33,827	837,302	232.75	1,627

NOx Emissions Reductions

Step	**County**	**Total Annual NOx Reductions from Elec. (Tons/yr) *(Total Value)***	**2005 vs. % Diff**	**Total Annual NOx Reductions from NG (Tons/yr) *(For the County Only)***	**2005 vs. % Diff**	**Total Annual NOx Reductions (Tons/yr)**	**2005 vs. % Diff**	**Total Peak-day NOx Reductions from Elec. (Tons/day) *(Total Value)***	**2005 vs. % Diff**	**Total Peak-day NOx Reductions from NG (Tons/day) *(For the County Only)***	**2005 vs. % Diff**	**Total Peak-day NOx Reductions (Tons/day)**	**2005 vs. % Diff**
1 (Original_2005)	Tarrant	25.69	0.00%	4.68	0.00%	30.37	0.00%	0.135	0.00%	0.007	0.00%	0.14	0.00%
2 (2006 Input)	Tarrant	27.20	5.88%	2.82	-39.67%	30.02	-1.13%	0.185	37.33%	0.007	0.00%	0.19	35.53%
3 (2006 Permit #)	Tarrant	29.82	16.08%	3.09	-33.86%	32.91	8.38%	0.203	50.58%	0.007	9.63%	0.21	48.61%
4 (2000 TRY)	Tarrant	30.17	17.44%	3.70	-20.94%	33.87	11.53%	0.212	56.95%	0.007	9.63%	0.22	54.68%
5 (2002 TRY)	Tarrant	25.86	0.65%	3.85	-17.67%	29.71	-2.17%	0.177	30.81%	0.007	9.63%	0.18	29.79%

1. "Per House" shows the simulation results only from one house type (i.e., Slab-on-grade, 1-story, and fuel option 1)
2. "County Total" shows the combined simulation results from all house type considering no. of building permit, percentage of house type, etc.

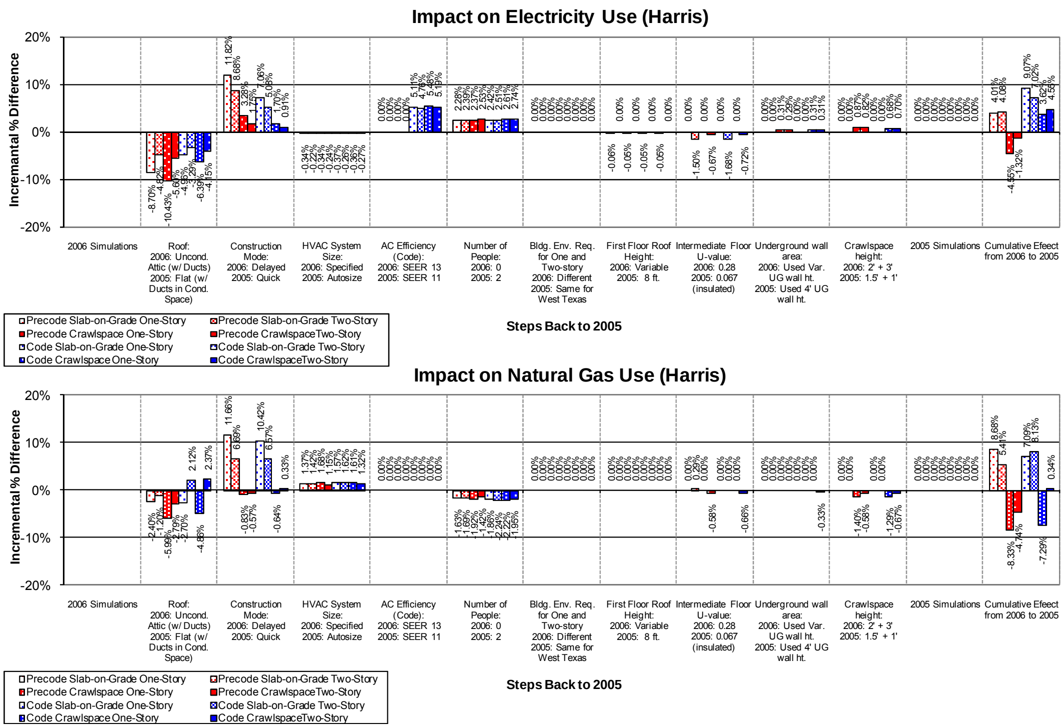


Figure 152: Impact of Changes in the Simulation Input for Single-family Residences on the Annual Electricity and Natural Gas Consumption (Harris County).

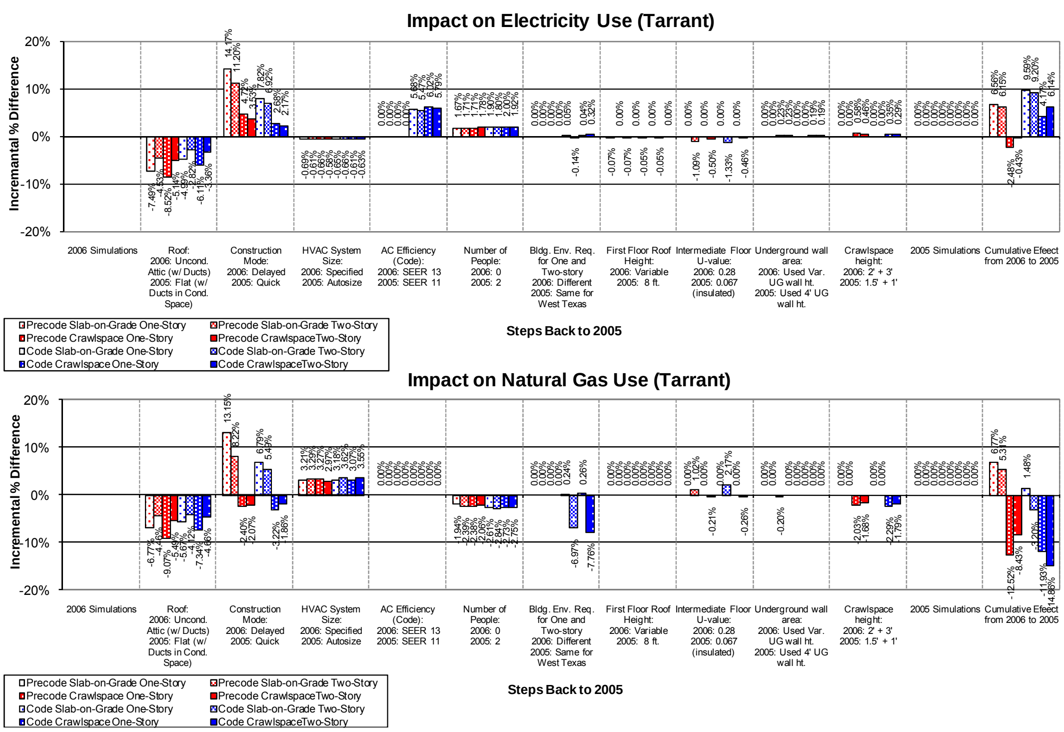


Figure 153: Impact of Changes in the Simulation Input for Single-family Residences on the Annual Electricity and Natural Gas Consumption (Tarrant County).

Table 78: Description of Steps for Comparison of 2005 vs 2006 Energy and NOx Reductions for Multi-Family.

Comparison between 2005 and 2006 simulation and eGRID results for SF

1. 2005 Original			
Simulations	2005 input file	2005 building permit #	1999 TRY
2. 2005 vs. 2006 w/2006 input file			
Simulations	2006 input file	2005 building permit #	1999 TRY
3. 2005 vs. 2006 w/ 2006 building permit #			
Simulations	2006 input file	2006 building permit #	1999 TRY
3. 2005 vs. 2006 w/1999,2000 and 2002 TRY			
Simulations	2006 input file	2006 building permit #	1999, 2000, and 2002 TRY

*** The changes from 2004 to 2005 input files**

Changes	2005	2006
Construction mode	Quick (uses precalculated weighting factors)	Delayed mode (considers thermal mass of construction materials)
Heating and cooling system size	Autosizing	Cooling system : 500 sq. ft./ton Heating system: 1.3 x cooling system size
Heating and cooling system efficiency	SEER 10 air conditioner SEER 10/6.8 HSPF heat pump	SEER 13 air conditioner SEER 13/7.7 HSPF heat pump
No. of occupants	Two (simulates heat gain from occupants in addition to 0.88 kW from lights and equipment)	None (considering no additional internal heat gain other than 0.88 kW)
Wall emissivity	1	Corrected to 0.9
Geographical loaction of Harris county	Used information for Houston	Corrected, uses information for Harris county
Intermediate floor construction	Included insulation required for exposed floor	No insulation specified

*** For detailed explanation for the difference between 2004 and 2005 input, see the documents attached.**

Table 79: Comparison of 2005 vs 2006 Energy and NOx Emissions Reductions for Multi-family House (Harris County).

Multi-Family Houses
Harris County

Energy Savings

			Per House[1]					County Total[2]			
Step	County	No. of Building Permits (Single Family Residences)	Annual Elec.Savings per House (kWh/yr)	Annual NG Savings per House (Therms/yr)	Peak date	Peak-day Elec. Savings per House (kWh/day)	Peak-day NG Savings per House (Therm/day)	Total Annual Elec.Savings per County (MWh/yr) w/ 7% T&D Loss	Total Annual NG Savings per County (Therms/yr)	Total Peak-day Elec. Savings per County (MWh/day) w/ 7% T&D Loss	Total Peak-day NG Savings per County (Therm/day)
1 (Original_2005)	Harris	8,375	417	41	7/15 - 9/15	1.49	0.12	2,862	67,776	10	196
2 (2006 Input)	Harris	8,375	445	41	7/15 - 9/15	2.61	0.12	3,275	68,141	18.75	196
3 (2006 Permit #)	Harris	9,041	445	41	7/15 - 9/15	2.61	0.12	3,535	73,560	20.24	212
4 (2000 TRY)	Harris	9,041	438	39	7/15 - 9/15	2.68	0.12	3,412	70,844	19.64	212
5 (2002 TRY)	Harris	9,041	385	37	7/15 - 9/15	2.27	0.12	2,921	69,965	18.39	212

NOx Emissions Reductions

Step	County	Total Annual NOx Reductions from Elec. (Tons/yr) *(Total Value)*	2005 vs. % Diff	Total Annual NOx Reductions from NG (Tons/yr) *(For the County Only)*	2005 vs. % Diff	Total Annual NOx Reductions (Tons/yr)	2005 vs. % Diff	Total Peak-day NOx Reductions from Elec. (Tons/day) *(Total Value)*	2005 vs. % Diff	Total Peak-day NOx Reductions from NG (Tons/day) *(For the County Only)*	2005 vs. % Diff	Total Peak-day NOx Reductions (Tons/day)	2005 vs. % Diff
1 (Original_2005)	Harris	1.63	0.00%	0.31	0.00%	1.94	0.00%	0.01	0.00%	0.001	0.00%	0.0063	0.00%
2 (2006 Input)	Harris	1.87	14.85%	0.31	0.54%	2.18	12.55%	0.01	84.21%	0.001	0.00%	0.0109	72.21%
3 (2006 Permit #)	Harris	2.02	23.91%	0.34	8.53%	2.35	21.44%	0.01	84.21%	0.001	7.95%	0.0110	73.35%
4 (2000 TRY)	Harris	1.95	19.65%	0.33	4.53%	2.27	17.22%	0.01	84.21%	0.001	7.95%	0.0110	73.35%
5 (2002 TRY)	Harris	1.67	2.45%	0.32	3.23%	1.99	2.58%	0.01	84.21%	0.001	7.95%	0.0110	73.35%

1. "Per House" shows the simulation results only from one house type (i.e., Slab-on-grade, 1-story, and fuel option 1)
2. "County Total" shows the combined simulation results from all house type considering no. of building permit, percentage of house type, etc.

Table 80: Comparison of 2005 vs 2006 Energy and NOx Emissions Reductions for Multi-family House (Tarrant County).

Multi-Family Houses
Tarrant County

Energy Savings

			Per House[1]					County Total[2]			
Step	County	No. of Building Permits (Single Family Residences)	Annual Elec.Savings per House (kWh/yr)	Annual NG Savings per House (Therms/yr)	Peak date	Peak-day Elec. Savings per House (kWh/day)	Peak-day NG Savings per House (Therm/day)	Total Annual Elec.Savings per County (MWh/yr) w/ 7% T&D Loss	Total Annual NG Savings per County (Therms/yr)	Total Peak-day Elec. Savings per County (MWh/day) w/ 7% T&D Loss	Total Peak-day NG Savings per County (Therm/day)
1 (Original_2005)	Tarrant	2,583	341	34	7/15 - 9/15	1.52	0.12	433	17,399	3	60
2 (2006 Input)	Tarrant	2,583	414	35	7/15 - 9/15	2.98	0.12	843	19,591	6.59	60
3 (2006 Permit #)	Tarrant	3,191	414	35	7/15 - 9/15	2.98	0.12	1,041	24,203	8.14	75
4 (2000 TRY)	Tarrant	3,191	403	34	7/15 - 9/15	3.10	0.12	1,043	23,399	8.73	75
5 (2002 TRY)	Tarrant	3,191	328	33	7/15 - 9/15	2.46	0.12	807	23,097	7.06	75

NOx Emissions Reductions

Step	County	Total Annual NOx Reductions from Elec. (Tons/yr) *(Total Value)*	2005 vs. % Diff	Total Annual NOx Reductions from NG (Tons/yr) *(For the County Only)*	2005 vs. % Diff	Total Annual NOx Reductions (Tons/yr)	2005 vs. % Diff	Total Peak-day NOx Reductions from Elec. (Tons/day) *(Total Value)*	2005 vs. % Diff	Total Peak-day NOx Reductions from NG (Tons/day) *(For the County Only)*	2005 vs. % Diff	Total Peak-day NOx Reductions (Tons/day)	2005 vs. % Diff
1 (Original_2005)	Tarrant	0.33	0.00%	0.08	0.00%	0.41	0.00%	0.00	0.00%	0.00	0.00%	0.0026	0.00%
2 (2006 Input)	Tarrant	0.64	94.61%	0.09	12.60%	0.73	78.64%	0.01	115.72%	0.000	0.00%	0.0053	103.32%
3 (2006 Permit #)	Tarrant	0.80	140.45%	0.11	39.11%	0.91	120.72%	0.01	163.17%	0.000	23.54%	0.0064	148.22%
4 (2000 TRY)	Tarrant	0.80	140.85%	0.11	34.49%	0.90	120.13%	0.01	184.75%	0.000	23.54%	0.0069	167.48%
5 (2002 TRY)	Tarrant	0.62	86.41%	0.11	32.75%	0.72	75.96%	0.01	128.66%	0.000	23.54%	0.0056	117.40%

1. "Per House" shows the simulation results only from one house type (i.e., Slab-on-grade, 1-story, and fuel option 1)
2. "County Total" shows the combined simulation results from all house type considering no. of building permit, percentage of house type, etc.

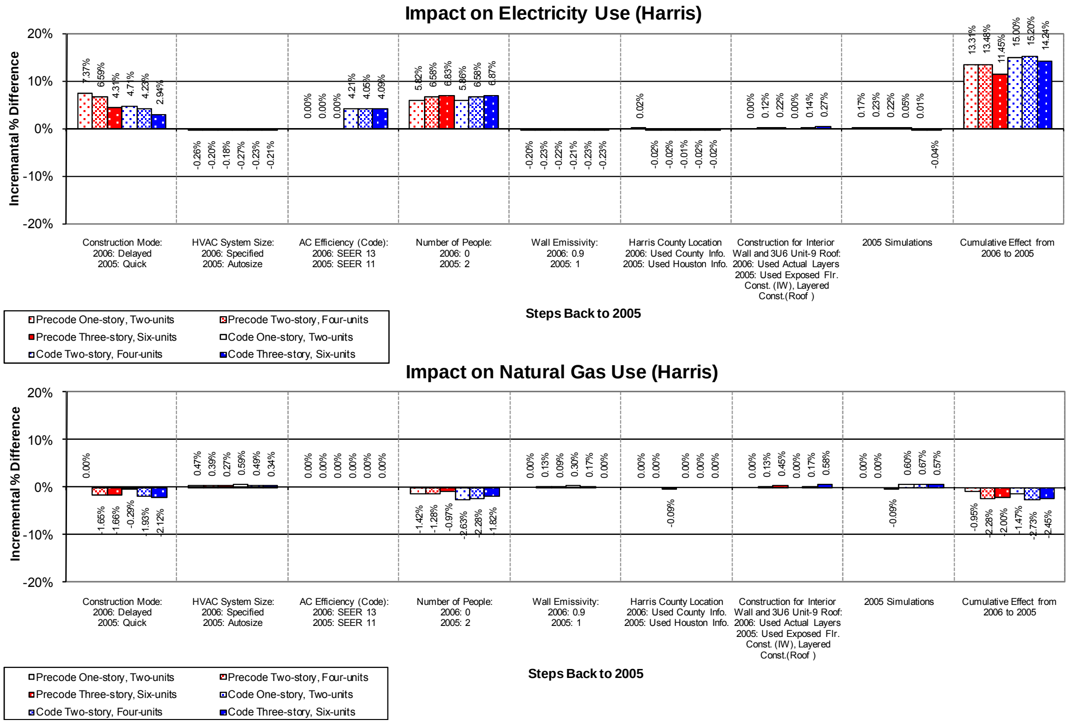


Figure 154: Impact of Changes in the Simulation Input for Multi-family Residences on the Annual Electricity and Natural Gas Consumption (Harris County).

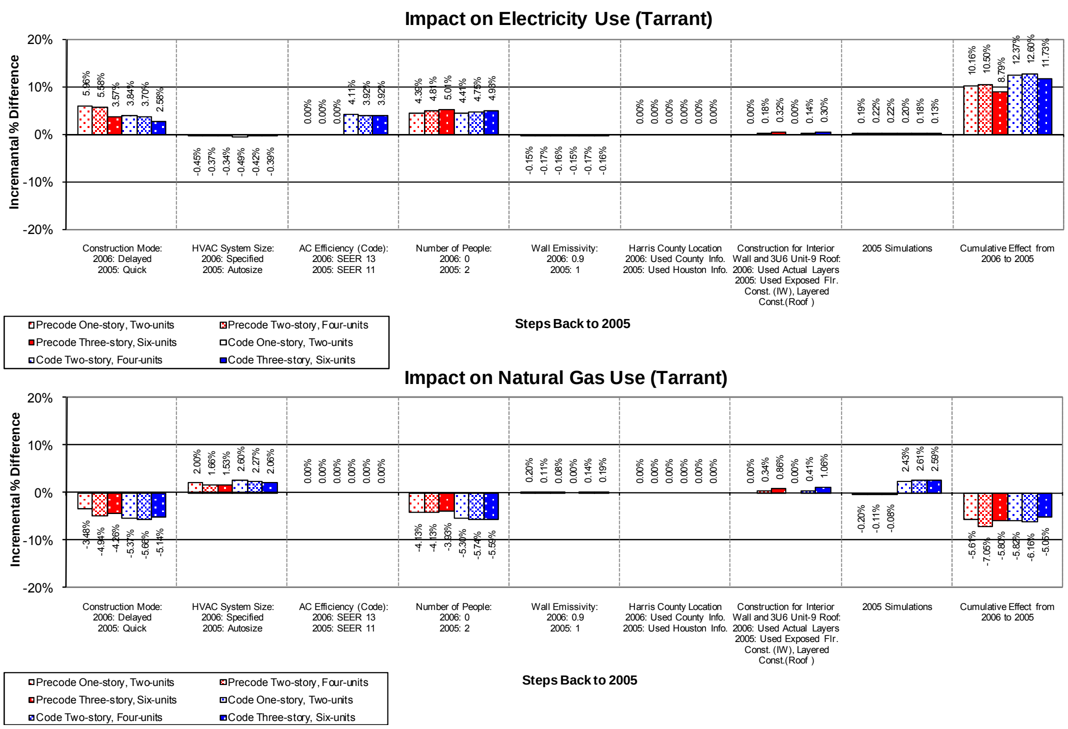


Figure 155: Impact of Changes in the Simulation Input for Multi-family Residences on the Annual Electricity and Natural Gas Consumption (Tarrant County).

8 CALCULATION OF INTEGRATED NOx EMISSIONS REDUCTIONS FROM MULTIPLE STATE AGENCIES PARTICIPATING IN THE TEXAS EMISSIONS REDUCTION PLAN (TERP).

8.1 Background

In January 2005, the Laboratory was asked by the Texas Commission on Environmental Quality (TCEQ) to develop a method by which the NOx emissions savings from the energy-efficiency programs from multiple Texas State Agencies working under Senate Bill 5 and Senate Bill 7 could be reported in a uniform format to allow the TCEQ to consider the combined savings for Texas' State Implementation Plan (SIP) planning purposes. This required that the analysis should include the cumulative savings estimates from all projects projected through 2020 for both the annual and Ozone Season Day[80] (OSD) NOx reductions. The NOx emissions reduction from all these programs were calculated using estimated emissions factors for 2007 from the US Environmental Protection Agency (US EPA) eGRID database, which had been specially prepared for this purpose. The different programs included in the 2006 cumulative analysis are:

- ESL Single-family new construction
- ESL Multi-family new construction
- ESL Commercial new construction
- Federal Buildings
- Furnace Pilot Light Program
- PUC Senate Bill 7 and Senate Bill 5 Program
- SECO Senate Bill 5 Program
- Electricity generated by wind farms in Texas (ERCOT[81])
- SEER13 upgrades to Single Family and Multifamily residences

The Laboratory's single- and multi-family programs include the energy savings attained by constructing new residences in Texas according to the IECC 2000/2001 building code (IECC 2000). The baseline for comparison for the code programs is the published data on residential construction characteristics by the National Association of Home Builders (NAHB) for 1999 (NAHB 1999). Annual electricity (MWh) and natural gas (MBtu) savings are from the Laboratory's Annual Reports to the TCEQ (Haberl et al., 2002, 2003, 2004, 2006).

The Texas Public Utility Commission's (PUC) Senate Bill and Senate Bill 7 programs include their incentive and rebates programs managed by the different Utilities for Texas (PUC 2007). These include the Residential Energy Efficiency Programs (REEP) as well as the Commercial & Industrial Standard Offer Programs (C&I SOP). The energy efficiency measures include high efficiency HVAC equipment, variable speed drives, increased insulation levels, infiltration reduction, duct sealing, Energy Star Homes, etc. Annual electricity savings according to the utilities (or Power Control Authorities – PCAs) were reported for the different programs completed in the years 2001 through 2006. The PUC also reported the savings from the Senate Bill 5 grant program which was conducted in 2002 and 2003.

The Texas State Energy Conservation Office (SECO) funds energy-efficiency programs directed towards school districts, government agencies, city and county governments, private industries and residential energy consumers. For the 2006 reporting year SECO submitted annual energy savings values for 149 projects which included projects funded by SECO and by Energy Service projects.

Finally, the integrated savings include MWh and NOx emissions savings from the currently installed green power generation (wind) capacity in west Texas, as reported to the Electric Reliability council of Texas (ERCOT). For projections through 2013, annual growth factors were chosen to comply with the Legislative

[80] An ozone season day (OSD) represents the daily average emissions during the period that runs from mid-July to mid -September.
[81] ERCOT is the Electric Reliability Council of Texas.

requirements: 3,700 MW in 2009, and 7,000 MW in 2015. Actual measured electricity production for 2001 through 2006 were also included.

8.2 Description of the Analysis Method

Annual and Ozone Season Day (OSD) NOx emissions reduction were calculated for 2005 and cumulatively from 2006 to 2020 using several factors to discount the potential savings. These factors include an annual degradation factor, a transmission and distribution factor, a discount factor and growth factors as shown in Table 81, and are described as follows:

Annual degradation factor: This factor was used to account for an assumed decrease in the performance of the measures installed as the equipment wears down and degrades. An annual degradation factor of 5% was used for all the programs[82]. This value was taken from a study by Kats et al. (1996).

Transmission and distribution loss: This factor adjusts the reported savings to account for the loss in energy resulting from the transmission and distribution of the power from the electricity producers to the electricity consumers. For this calculation, the energy savings reported at the consumer level are increased by 7% to give credit for the actual power produced that is lost in the transmission and distribution system on its way to the customer. In the case of electricity generated by wind, the T&D losses were assumed to cancel out since wind energy is displacing power produced by conventional power plants, therefore, there is no net increase or decrease in T&D losses.

Initial discount factor: This factor was used to discount the reported savings for any inaccuracies in the assumptions and methods employed in the calculation procedures. For the Laboratory's single- and multi-family program, the discount factor was assumed to be 20%. For PUC's Senate Bill 5 and Senate Bill 2007 programs and electricity from wind, the discount factor was taken as 25%. For the savings in the SECO program, the discount factor was 60%.

Growth factor: The growth factors shown in Table 81 were used to account for several different factors. First, in the case of wind energy, the factor accounted for the increased number of wind turbines which are being installed every year in the western portion of the state. Three different scenarios were possible for wind energy projections:

- No annual growth;
- 17% growth factor, on the basis that the installed wind power generation capacity will grow to 3,700 MW until 2009 from current installed level of 2000 MW. For this growth scenario, the 17% growth will achieve 3,700 MW by 2009; after that, the wind power generation will be fixed at the production level achieved in 2009; and
- 22.7% growth factor, on the basis that the installed wind power generation capacity will grow to 7,000 MW by 2015.

In the growth factors used for 2006 and beyond a 17.0% growth factor was assumed for the wind energy portion of savings.

Also, included in Table 81 are growth factors for single-family (3.25%) and multi-family residential (1.54%) construction. These values represent the average growth rate for these housing types from recent U.S. Census data for Texas.

Figure 156 shows the overall information flow that was used to calculate the NOx emissions savings from the annual and Ozone Season Day (OSD) electricity savings (MWh) from all programs. For the Laboratory's single-family and multi-family code-implementation programs, the annual and ozone season

[82] A degradation of 5% per year would accumulate as a 5%, 10%, 15%...etc, degradation in performance. Although the assumption of this high level of degradation may not actually occur, it was chosen as a conservative estimate. Improvements in this assumption will be made annually as measured data confirm a reduced degradation rate.

savings were calculated from DOE-2 hourly simulation models[83]. The base case is taken as the average characteristics of single- and multi-family residences for Texas published by the National Association of Home Builders for 1999 (NAHB 1999). The OSD consumption is the average daily consumption for the period between July 15 and September 15, 1999.The annual electricity savings from PUC programs were calculated using deemed savings tables and spreadsheets created for the utilities incentive programs by Frontier Associates in Austin, Texas. (PUC 2007)

The SECO electricity savings were submitted as annual savings by project[84]. A description of the measures completed for the project was also submitted for information purposes (SECO 2007). The electricity production from wind farms in Texas was from the actual on-site metered data measured at 15-minute intervals.

Integration of the programs into a uniform format allowed for NOx emissions to be evaluated using different criteria as shown in Table 81. These include evaluation by program across, evaluation across an individual county by program or for the total programs, evaluation by SIP area, evaluation for all ERCOT counties except Houston/Galveston, and evaluation within a 200 km radius of Dallas/Ft.Worth.

8.3 Calculation Procedure

ESL Single-family and Multi-family. The calculation of the annual and OSD electricity savings reported for the years 2002 through 2004 included the savings from code-compliant new housing in all 41 non-attainment and affected counties as reported in the Laboratory's annual report submitted by the Laboratory to the Texas Commission of Environmental Quality (TCEQ). The savings for 2001 were also incorporated since some of the programs were reporting savings from September to December 2001. In 2005 and 2006 the annual and OSD electricity savings were calculated for new residential construction in all the counties in ERCOT region, which includes the 41 non-attainment and affected counties. These savings were then tabulated by county and program. Using the calculated values for 2002 through 2006, savings were then projected to 2020 by incorporating the different adjustment factors mentioned above.

In these calculations it was assumed that the same amount of electricity savings from the code-complaint construction would be achieved for each year after 2006 through 2020[85]. The projected energy savings through 2020, according to county, were then divided into the different Power Control Authorities (PCA) in eGRID. To determine which PCA was to be used, or in counties with multiple PCA, the allocation to each PCA by county was obtained from PUC's listing published in the Laboratory's 2005 annual report[86].

For the 2006 annual and OSD NOx emissions calculations the US EPA's 2007 eGRID were used[87]. An example of the eGRID spreadsheet[88] is given in Table 82. The total electricity savings for each PCA were used to calculate the NOx emissions reduction for each of the different counties using the emissions factors contained in eGRID. Similar calculations were performed for each year for which the analysis was required. The cumulative NOx emissions reduction for the electricity savings from residential new construction for 2006 through 2020 is provided in Table 83. NOx emissions reduction is provided in Table 84.

[83] These values are based on a performance analysis as defined by Chapter 4 of IECC 2000/2001. This analysis is discussed in the Laboratory's annual reports to the TCEQ.
[84] The reporting requirements to the SECO did not require energy savings by project type, although for selected sites, energy savings by project type was available. Therefore annual total usage was used.
[85] This would include the appropriate discount and degradation factors for each year.
[86] Haberl et al., 2005, pp. 197.
[87] This required two separate versions of the 2007 eGRID, which were specially prepared for Texas by Mr. Art Diem at the US EPA. One of the versions contains estimates of annual SOx, NOx and CO2 data for 2007, using a 25% capacity factor. The second version contains estimates of SOx, NOx and CO2 data for 2007 for an average day in the ozone season period, which runs from Mid July to Mid September.
[88] To use this spreadsheet electricity savings for each PCA is entered in the bottom row of the spreadsheet (MWh). The spreadsheet then allocates the MWh of electricity savings according to the counties (blue columns) where the PCA owned and operated a power plant. Totals for all PCAs are then listed on the far right columns (white columns). Similar spreadsheets for the 2007 eGRID exist for SOx and CO2.

ESL-Commercial Buildings. The annual and OSD electricity savings for 2002 through 2006 for commercial buildings were obtained from the annual reports for 2005 and 2006 submitted by the Laboratory to TCEQ[89]. These savings were also tabulated by county and program. Using the calculated values for 2002 through 2006, savings were then projected to 2020 by incorporating the different adjustment factors mentioned above[90].

In the projected 2006 cumulative electricity savings was assumed that the same amount of electricity savings from 2006 would be achieved for each year after 2006 through 2020. Similarly to the single family calculations, the projected energy saving numbers through 2020, by county, were allocated into the appropriate Power Control Authorities (PCA).

Federal Buildings. Energy savings achieved from Energy Savings Performance Contracts (ESPCs) were also reported in 2006. This includes savings (estimated) from energy conservation measures implemented in Federal Buildings in Texas. The 2006 savings include projects implemented in 14 Federal buildings reported by the regional office of the Department of Energy. Annual kWh savings reported for each of the projects were divided by 365 to obtain the average Ozone Season Day savings[91].

In the calculation for 2006, it was assumed that the electricity savings from 2005 would also be achieved for each year from 2006 through 2020 after the appropriate degradation factors were applied. Similarly to the single family calculations, the projected energy saving numbers through 2020, by county, were proportioned into the PUC's Power Control Authorities (PCA) and the cumulative NOx emission reduction values calculated.

Furnace Pilot Light Program. For the furnace pilot light program savings, the N.G. energy savings achieved by retrofitting existing furnaces in single-family and multi-family residences for the entire residential stock for Texas have been projected until 2020. Pilot light removal saves at least 500 Btu/hr of natural gas for each hour of operation for the entire life of the furnace when the furnace is replaced with a code-compliant replacement. The energy savings for the Ozone season day are calculated by dividing the annual number by 365. It is also being assumed that of the total furnaces that were retrofitted, 75% are operational during the Ozone Season Period. Cumulative NOx emissions reduction for the N.G. savings from the removal of furnace pilot lights were also calculated by county for 2006 through 2020 by SIP area[92].

PUC-Senate Bill 7. For the PUC Senate Bill 7 program savings, the annual electricity savings for 2001 through 2006 were obtained from the Public Utilities Commission[93]. Using these values savings were projected through 2020 by incorporating the different adjustment factors mentioned above. Similar savings were assumed for each year after 2007 until 2020. The 2007 annual and OSD eGRID was also used to calculate the NOx emissions savings for the PUC-Senate Bill 7 program. The total electricity savings for each PCA were used to calculate the NOx emissions reduction for each county using the emissions factors contained in the US EPA's eGRID spreadsheet. The cumulative NOx emissions reduction for each county by SIP area for the different programs was then calculated.

PUC-Senate Bill 5 Grants Program. To calculate the annual electricity savings from the PUC's Senate Bill 5 program, electricity savings were also obtained from the Public Utilities Commission[94]. The annual and

[89] These savings include new construction in office, assembly, education, retail, food, lodging and warehouse construction as defined by Dodge building type (Dodge 1995, 1999, 2003), using energy savings from the Pacific Northwest National Laboratory (USDOE 2005), and data from CBECS (2005).

[90] This also includes the appropriate discount and degradation factors for each year.

[91] This method yields suitable OSD values for lighting retrofits and/or retrofits that are not weather dependent. In the case of retrofits to cooling systems, weather normalization would increase the OSD savings substantially. Retrofits to heating systems would be reduced by weather normalization.

[92] These use the NOx/MBtu values provided in the US EPA AP 42 guideline.

[93] In a similar fashion to the previous programs, to obtain the Ozone Season Day (OSD) savings, the annual electricity savings were divided by 365.

[94] In a similar fashion as the PUC's Senate Bill 7 program, the annual electricity savings numbers were then divided by 365 to get average electricity savings per day for OSD calculations. The preferred approach would be to weather-normalize the savings and then calculate savings for the OSD period. However, only annual values were obtained for the 2005 report to the TCEQ. Dividing the

average day electricity savings were then proportioned according to the PCA and program. Using the actual reported numbers for 2002 and 2003, savings through 2020 were projected incorporating the different adjustment factors mentioned above[95]. The 2007 annual and OSD eGRID were used to calculate the NOx emissions savings for PUC-Senate Bill 5 Grants Program. The total electricity savings for each PCA were used to calculate the NOx emissions reduction for each of the different counties.

SECO Savings. The annual electricity savings from energy conservation projects reported by political subdivisions for 35 counties through 2006 were obtained from the State Energy Conservation Office[96]. These submittals included information gathered from SECO's website[97] and paper submittals[98]. The annual and average day electricity values where then summarized according to county and program. Using the actual reported numbers for 2004, savings through 2020 were projected using the different adjustment factors mentioned above. In a similar fashion as the previous programs it was assumed that the same amount of electricity savings will be achieved for each year after 2007 until 2020. The 2007 annual and OSD eGRID were then used to calculate the NOx emissions savings for the SECO program.

Electricity Generated by Wind Farms. The measured electricity production from all the wind farms in Texas for 2001 through 2006 was obtained from the Energy Reliability Council of Texas (ERCOT). To obtain the annual production, the 15-minute data were summed for the 12 months, while for the OSD period the data were converted to average daily electricity production during the months of July, August and September. Using the reported numbers for 2006, savings through 2020 were projected incorporating the different adjustment factors mentioned above. The 2007 annual and OSD eGRID were then used to calculate the NOx emissions reduction for the electricity generated by Texas' wind farms[99]. The total electricity savings for each PCA were used to calculate the NOx emissions reduction for each of the different counties

SEER 13 Single-Family and Multi-family. In January of 2006 Federal Regulations mandated that the minimum efficiency for residential air conditioners be increased to SEER 13 from the previous SEER 10. Although the electricity savings from new construction reflected this change in values, the annual and OSD electricity savings from the replacement of the air conditioning units by air conditioners with an efficiency of SEER 13 in existing residences needed to be calculated.

In the 2006 report to the TCEQ, the annual and OSD electricity savings for all the counties in ERCOT region as well as the 41 non-attainment and affected counties was calculated for the retrofit. Using the numbers for 2006, the savings through 2020 were projected by incorporating the appropriate adjustment factors[100]. In this analysis it was assumed that an equal number of existing houses had their air conditioners replaced as reported for 2006 by the air conditioner manufacturers. This replacement rate continued until all the existing air conditioner stock was replaced with SEER 13 air conditioners. The total electricity savings for each PCA were used to calculate the NOx emissions reduction for each of the different county using the emissions factors contained in the 2007 eGRID. Cumulative NOx emissions reduction for each county by SIP area was also calculated.

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annual values by 365 is probably a reasonable approach for lighting projects. However, this undercounts potential savings from electric loads associated with the cooling season.

[95] Since the savings for the PUC's Senate Bill 5 were only reported for two years these savings actually reduced due to the imposed degradation factor.

[96] In a similar fashion as the PUC's Senate Bill 5 and 7 programs, these annual electricity savings numbers were divided by 365 to get average electricity savings per day for the OSD calculations.

[97] This web site was developed for SECO by the Laboratory, at the request of the TCEQ.

[98] In these submittals, there were several municipalities whose electricity or natural consumption increased in 2004 as compared to 2001, which caused the reported savings from these municipalities to be negative. Since no additional information was reported from these projects that might have indicated what the cause of this was, it was assumed that the energy conservation projects were working as designed, but that other factors had changed the energy consumption. Therefore, in the final values of electricity savings from the political subdivisions that reported to SECO for the calculation of annual and OSD NOx reductions, the negative savings were omitted.

[99] This credited the electricity generated by the wind farm to the utility that either owned the wind farm or was associated with the wind farm owner.

[100] Additional details about this calculation are contained in the Laboratory's 2006 Annual Report to the TCEQ, available at the Senate Bill 5 web site "eslsb5.tamu.edu".

8.4 Results

The total cumulative annual and OSD electricity savings for all the different programs in the integrated format was calculated using the adjustment factors shown in Table 81 for 2001 through 2020 as shown in Table 83. NOx emissions reduction from the electricity and natural gas savings for the annual and OSD for all the programs in the integrated format is shown in Table 84. In Table 83 and Table 84 annual values are shown for 2005, and cumulative annual values are shown 2006 through 2020. The OSD NOx emissions reduction is also shown in Figure 157 as stacked bar charts and in Figure 158 for the individual components.

In 2006 (Table 83) the cumulative annual electricity savings[101] from code-compliant residential and commercial construction is calculated to be 1,428,464 MWh/year (17.0% of the total electricity savings), savings from retrofits to Federal buildings is 109,073 MWh/year (1.3%), savings from furnace pilot light retrofits is 2,548,904 MBtu/year, savings from the PUC's Senate Bill 5 and Senate Bill 7 programs is 1,376,334 MWh/year (16.3%), savings from SECO's Senate Bill 5 program is 293,763 MWh/year (3.5%), electricity savings from green power purchases (wind) is 4,782,508 MWh/year (56.9%), and savings from residential air conditioner retrofits[102] is 405,879 MWh/year (4.8%). The total savings from all programs is 8,396,023 MWh/year.

In 2006 the cumulative OSD electricity savings from code-compliant residential and commercial construction is calculated to be 7,703 MWh/day (29.9%), savings from retrofits to Federal buildings is 299 MWh/day (1.2%), savings from furnace pilot light retrofits is 5,819 MBtu/day, savings from the PUC's Senate Bill 5 and Senate Bill 7 programs is 3,770 MWh/day (14.6%), savings from SECO's Senate Bill 5 program is 804 MWh/day (3.1%), electricity savings from green power purchases (wind) are 10,305 MWh/day (40.0%), and savings from residential air conditioner retrofits are 2,879 MWh/day (11.1%). The total savings from all programs is 25,760 MWh/day, which would be a 1,073 MW average hourly load reduction during the OSD period.

By 2013 the cumulative annual electricity savings from code-compliant residential and commercial construction is calculated to be 3,024,261 MWh/year (16.8% of the total electricity savings), savings from retrofits to Federal buildings will be 402,732 MWh/year (2.2%), savings from furnace pilot light retrofits will remain at 2,548,904 MBtu/year, savings from the PUC's Senate Bill 5 and Senate Bill 7 programs will be 2,544,432 MWh/year (14.2%), savings from SECO's Senate Bill 5 program will be 407,940 MWh/year (2.3%), electricity savings from green power purchases (wind) will be 9,273,739 MWh/year (51.7%), and savings from residential air conditioner retrofits[103] will be 2,286,232 MWh/year (12.7%). The total savings from all programs will be 17,939,336 MWh/year.

By 2013 the cumulative OSD electricity savings from code-compliant residential and commercial construction is calculated to be 15,544 MWh/day (25.5%), savings from retrofits to Federal buildings will be 1103 MWh/day (1.8%), savings from furnace pilot light retrofits will remain at 5,819 MBtu/day, savings from the PUC's Senate Bill 5 and Senate Bill 7 programs will be 6,971 MWh/day (11.4%), savings from SECO's Senate Bill 5 program will be 1,117 MWh/day (1.8%), electricity savings from green power purchases (wind) will be 20,088 MWh/day (32.9%), and savings from residential air conditioner retrofits will be 16,216 MWh/day (26.6%). The total savings from all programs will be 61,039 MWh/day, which would be a 2,543 MW average hourly load reduction during the OSD period.

In 2006 (Table 84) the cumulative NOx emissions reduction[104] from code-compliant residential and commercial construction is calculated to be 1,010 tons-NOx/year (17.0% of the total NOx savings), savings from retrofits to Federal buildings is 84 tons-NOx/year (1.5%), savings from furnace pilot light retrofits is 117 tons-NOx/year (2.0%), savings from the PUC's Senate Bill 5 and Senate Bill 7 programs is 1,045 tons-

[101] This includes the savings from 2001 through 2006.
[102] This assumes air conditioners in existing homes are replaced with the more efficient SEER 13 units, versus an average of SEER 11, which is slightly more efficient than the previous minimum standard of SEER 10.
[103] This assumes air conditioners in existing homes are replaced with the more efficient SEER 13 units, versus an average of SEER 11, which is slightly more efficient than the previous minimum standard of SEER 10.
[104] These NOx emissions reduction were calculated with the US EPA's 2007 eGRID for annual (25% capacity factor) and Ozone Season Day OSD.

NOx/year (18.2%), savings from SECO's Senate Bill 5 program is 224 tons-NOx/year (3.9%), electricity savings from green power purchases (wind) is 2,978 tons-NOx/year (51.9%), and savings from residential air conditioner retrofits is 280 tons-NOx/year (4.9%). The total NOx emissions reduction from all programs is 5,738 tons-NOx/year.

In 2006 the cumulative OSD NOx emissions reduction from code-compliant residential and commercial construction is calculated to be 5.35 tons-NOx/day (30.5%), savings from retrofits to Federal buildings is 0.22 tons-NOx/day (1.3%), savings from furnace pilot light retrofits is 0.32 tons-NOx/day (1.8%), savings from the PUC's Senate Bill 5 and Senate Bill 7 programs is 2.63 tons-NOx/day (15.0%), savings from SECO's Senate Bill 5 program is 0.62 tons-NOx/day (3.4%), electricity savings from green power purchases (wind) are 6.44 tons-NOx/day (36.7%), and savings from residential air conditioner retrofits are 1.96 tons-NOx/day (11.2%). The total NOx emissions reduction from all programs is 17.52 tons-NOx/day.

By 2013 the cumulative NOx emissions reduction from code-compliant residential and commercial construction is calculated to be 2,121 tons-NOx/year (17.8% of the total NOx savings), savings from retrofits to Federal buildings will be 308 tons-NOx/year (2.6%), savings from furnace pilot light retrofits will be 117 tons-NOx/year (0.9%), savings from the PUC's Senate Bill 5 and Senate Bill 7 programs will be 1,784 tons-NOx/year (15.0%), savings from SECO's Senate Bill 5 program will be 311 tons-NOx/year (2.6%), electricity savings from green power purchases (wind) will be 5,652 tons-NOx/year (47.6%), and savings from residential air conditioner retrofits will be 1,574 tons-NOx/year (13.3%). The total NOx emissions reduction from all programs will be 11,868 tons-NOx/year.

By 2013 the cumulative OSD NOx emissions reduction from code-compliant residential and commercial construction is calculated to be 10.75 tons-NOx/day (26.3%), savings from retrofits to Federal buildings will be 0.81 tons-NOx/day (1.9%), savings from furnace pilot light retrofits will be 0.32 tons-NOx/day (0.8 %), savings from the PUC's Senate Bill 5 and Senate Bill 7 programs will be 4.78 tons-NOx/day (11.7%), savings from SECO's Senate Bill 5 program will be 0.84 tons-NOx/day (2.0%), electricity savings from green power purchases (wind) will be 12.32 tons-NOx/day (30.1%), and savings from residential air conditioner retrofits will be 11.03 tons-NOx/day (26.9%). The total NOx emissions reduction from all programs will be 40.86 tons-NOx/day.

Table 81: Final Adjustment Factors used for the Calculation of the Annual and OSD NOx Savings for the Different Programs.

	ESL-Single Family[16]	ESL-Multifamily[16]	ESL-Commercial[16]	Federal Buildings[15]	Furnace Pilot Light Program[15]	PUC (SB7)[15]	PUC (SB5 Grant Program)[15]	SECO[15]	Wind-ERCOT[8]	SEER13 Single Family	SEER13 Multifamily
Annual Degradation Factor [11]	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
T&D Loss [9]	7.00%	7.00%	7.00%	7.00%	0.00%	7.00%	7.00%	7.00%	0.00%	7.00%	7.00%
Initial Discount Factor [12]	20.00%	20.00%	20.00%	20.00%	20.00%	25.00%	25.00%	60.00%	25.00%	20.00%	20.00%
Growth Factor	3.25%	1.54%	3.25%	0.00%	0.00%	0.00%	0.00%	0.00%	According to SB 20, section 39.904	N.A.	N.A.

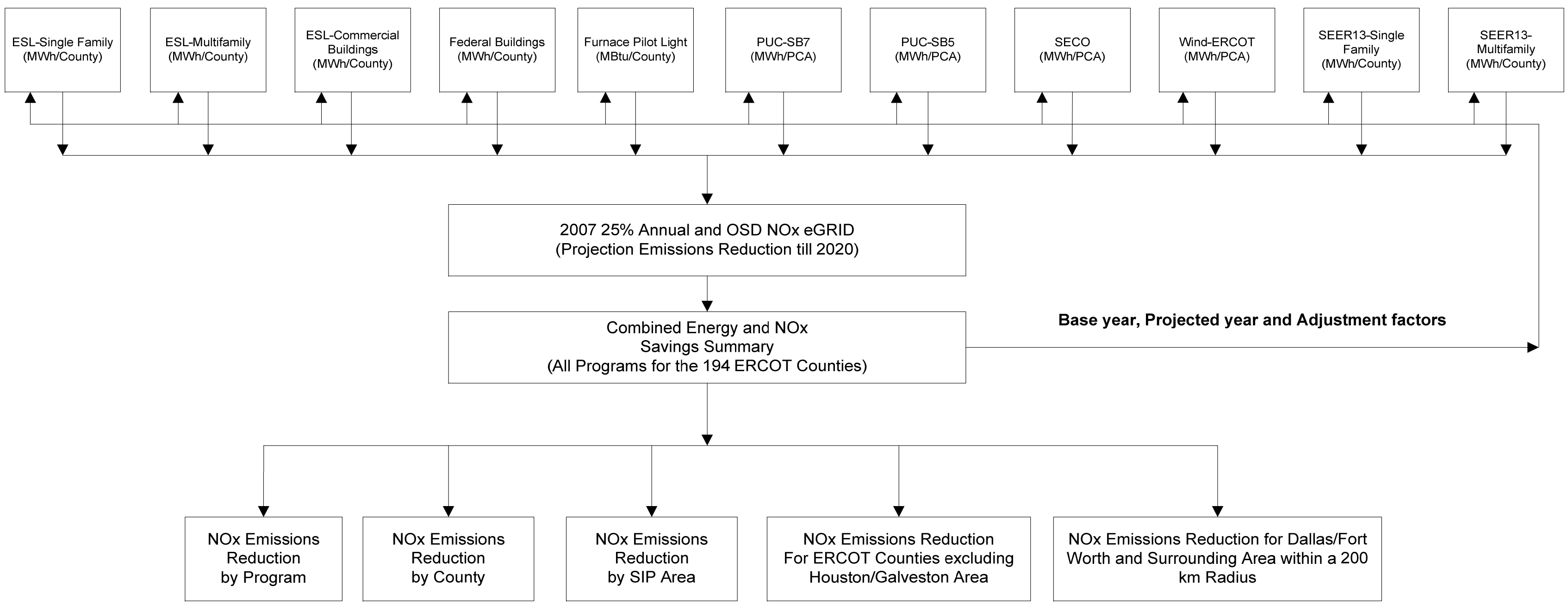

Figure 156: Process Flow Diagram of the NOx Emissions Reduction Calculations.

Table 82: Example of NOx Emissions Reduction Calculations using eGRID.

Area	County	American Electric Power - West (ERCOT) /PCA	NOx Reductions (lbs)	Austin Energy/PCA	NOx Reductions (lbs)	Brownsville Public Utils Board/PCA	NOx Reductions (lbs)	Lower Colorado River Auhotrity /PCA	NOx Reductions (lbs)	Reliant Energy HL&P/PCA	NOx Reductions (lbs)	San Antonio Public Service Bd/PCA	NOx Reductions (lbs)	South Texas Electric Coop INC/PCA	NOx Reductions (lbs)	Texas Municipal Power Pool/PCA	NOx Reductions (lbs)	Texas-New Mexico Power Co/PCA	NOx Reductions (lbs)	TXU Electric/PCA	NOx Reductions (lbs)	Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
Houston-Galveston Area	Brazoria	0.008831132	226.0465792	0.010890729	8.193488679	0.006522185	0	0.003944232	14.32402746	0.065444292	3035.079423	0.014877434	272.3666894	0.006262315	0	0.004817148	0	0.121274957	139.7235344	0.00816387	940.7285451	4636.462287	2.318231144
	Chambers	0.021762222	557.0379581	0.026955801	20.27982242	0.016072371	0	0.009076193	32.96145962	0.164940225	7649.355979	0.037472294	686.0191605	0.015055623	0	0.009553214	0	0.011518588	13.2708178	0.015818592	1822.787617	10781.71281	5.390856407
	Fort Bend	0.070431234	1802.797078	0.087239726	65.63359654	0.052016606	0	0.029374182	106.6764342	0.533812376	24756.36787	0.121275295	2220.231709	0.048726002	0	0.030918012	0	0.037278747	42.94966114	0.051195276	5899.267979	34893.92432	17.44696216
	Galveston	0.033856739	866.6159501	0.041710519	31.3803294	0.025004711	0	0.015351589	55.75143316	0.249587379	11574.99759	0.056747051	1038.889275	0.024143087	0	0.019297151	0	0.567751219	654.118618	0.032836887	3783.817742	18005.57093	9.002785467
	Harris	0.068267332	1747.408655	0.084559408	63.61709594	0.050418468	0	0.028471701	103.3989497	0.517411736	23995.76304	0.117549281	2152.01819	0.047228963	0	0.029968099	0	0.03613341	41.63009278	0.049622373	5718.021208	33821.85723	16.91092861
	Liberty	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Montgomery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Waller	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beaumont/ Port Arthur Area	Hardin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Jefferson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Orange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dallas/ Fort Worth Area	Collin	0.002039135	52.19483875	0.003716345	2.795940278	0.001505992	0	0.005950953	21.61171382	0.002481478	115.0823578	0.000717051	13.12731328	0.019166247	0	0.07668094	0	0.00086441	0.995905867	0.004000199	460.945804	666.7538738	0.333376937
	Dallas	0.004539471	116.1948312	0.004683963	3.523914222	0.003352602	0	0.00774211	28.1165509	0.002085611	96.72341896	0.00068106	12.46842352	0.007502816	0	0.026717045	0	0.007524933	8.669640256	0.040370454	4651.916039	4917.612818	2.458806409
	Denton	0.00047388	12.12970385	0.000872802	0.656640103	0.000349982	0	0.001396994	5.073377767	0.000585443	27.15083393	0.000168971	3.093405773	0.00454374	0	0.018187155	0	0.000186605	0.214992277	0.000849405	97.87758499	146.1965387	0.073098269
	Tarrant	0.012162492	311.3179263	0.012266309	9.228387517	0.008982543	0	0.020308652	73.75369976	0.005316504	246.5610524	0.001752506	32.08377752	0.017326428	0	0.060216761	0	0.020603444	23.73767965	0.110647237	12749.95959	13446.64211	6.723321056
	Ellis	0.003279814	83.95193355	0.003307809	2.488584531	0.002422289	0	0.005476558	19.88888265	0.001433682	66.48919108	0.000472592	8.651911537	0.004672353	0	0.016238427	0	0.005556053	6.401250735	0.029837824	3438.233618	3626.105373	1.813052686
	Johnson	0.000286058	7.322112154	0.000526868	0.396381687	0.000211267	0	0.000843297	3.062551359	0.000353404	16.38963767	0.000101999	1.867338584	0.002742835	0	0.010978701	0	0.000112645	0.129780379	0.000512745	59.08393672	88.25173856	0.044125869
	Kaufman	0.006325453	161.9098051	0.006379446	4.799487271	0.004671629	0	0.010562096	38.3577242	0.002765	128.2311379	0.000911441	16.68608752	0.009011105	0	0.031317452	0	0.010715411	12.34546025	0.057545265	6630.9817	6993.311403	3.496655701
	Parker	0.000217489	5.566981877	0.000400576	0.301367914	0.000160626	0	0.000641157	2.328449436	0.000268692	12.46099677	7.75498E-05	1.419732426	0.00208537	0	0.008347076	0	8.56434E-05	0.098671668	0.000389838	44.92135575	67.09755584	0.033548778
	Rockwall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Henderson	0.000819895	20.98648722	0.000826893	0.622101782	0.000605529	0	0.001369042	4.971866208	0.000358395	16.62111282	0.00011814	2.162823693	0.001168005	0	0.004059317	0	0.001388914	1.600198603	0.007458924	859.4971295	906.4617199	0.45323086
	Hood	0.01252711	320.6508812	0.012634039	9.505044007	0.009251829	0	0.020917482	75.96475123	0.005475887	253.9526704	0.001805044	33.04561243	0.017845854	0	0.062021991	0	0.021221112	24.4493081	0.113964315	13132.18878	13849.75705	6.924878523
	Hunt	0.006187558	158.3801895	0.006240374	4.694858985	0.004569788	0	0.010331844	37.5215301	0.002704724	125.4357135	0.000891572	16.32233268	0.008814664	0	0.030634735	0	0.010481817	12.0763306	0.056290785	6486.427041	6840.857996	3.420428998
El Paso Area	El Paso	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
San Antonio Area	Bexar	0.033413751	855.276978	0.051775843	38.95283667	0.024677545	0	0.090663423	329.2568536	0.001141841	52.95463998	1.143571754	20935.7914	0.046873844	0	0.004669544	0	0.000519582	0.598622181	0.002503865	288.5221599	22501.3535	11.25067675
	Comal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Guadalupe	0.002000467	51.20507169	0.076378745	57.46248772	0.001477434	0	0.133848731	486.0903138	0.001237133	57.37392999	0.003554796	65.07897116	0.001061766	0	0.001855699	0	0.000401718	0.462828487	0.001835165	211.4673431	929.140946	0.464570473
	Wilson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Austin Area	Bastrop	0.004502334	115.2442433	0.171901148	129.3274415	0.003325174	0	0.301245466	1094.014881	0.002784342	129.1281298	0.008000571	146.4694129	0.002389654	0	0.004176513	0	0.000904124	1.041660856	0.004130298	475.937112	2091.162881	1.04558144
	Caldwell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hays	0.002458599	62.93167289	0.093870431	70.62211537	0.001815785	0	0.164501762	597.4110691	0.001520452	70.51327681	0.004368889	79.98286869	0.001304924	0	0.002280677	0	0.000493717	0.568821994	0.00225544	259.8960069	1141.925832	0.570962916
	Travis	0.000510007	13.05442349	0.299602906	225.4020851	0.000376663	0	0.033939476	123.2559365	0.000334709	15.52263338	0.000906121	16.58869273	0.000271138	0	0.000471744	0	0.000103327	0.119045148	0.000467336	53.85143207	447.7942484	0.223897124
	Williamson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North East Texas Area	Gregg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Harrison	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rusk	0.000685965	17.55833805	0.00069182	0.520481264	0.000506616	0	0.001145408	4.159710327	0.000299851	13.90604891	9.88414E-05	1.809525774	0.000977211	0	0.003396227	0	0.001162035	1.338805667	0.006240507	719.0980079	758.3909179	0.379195459
	Smith	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Upshur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corpus Christi Area	Nueces	0.22756873	5824.975938	0.004556851	3.428283791	0.168069652	0	0.007612767	27.64682441	0.001680888	77.95375313	0.001626796	29.78235622	0.046792036	0	0.007246366	0	0.001609426	1.854254911	0.008283395	954.5014455	6920.142856	3.460071428
	San Patricio	0.050313351	1287.848557	0.001007478	0.757961986	0.037158653	0	0.001683113	6.112458369	0.000371629	17.2348572	0.00035967	6.584604794	0.010345288	0	0.001602105	0	0.000355829	0.409958691	0.001831382	211.0314828	1529.979881	0.76498994
Victoria Area	Victoria	0.021836736	558.9452467	0.002215582	1.666862472	0.016127403	0	0.003612695	13.12000619	0.001199621	55.63426979	0.000555389	10.16770824	0.52545648	0	0.032412721	0	0.000476855	0.549395481	0.002254849	259.8278678	899.9113567	0.449955678
Other ERCOT counties	Andrews	2.47421E-05	0.633312124	2.49533E-05	0.018773251	1.82731E-05	0	4.13138E-05	0.150036693	1.08153E-05	0.501577618	3.56511E-06	0.065267829	3.5247E-05	0	0.000122499	0	4.19135E-05	0.048289414	0.000225089	25.93716362	27.35442055	0.01367721
	Angelina	0.00031082	7.955919749	0.000313473	0.235837079	0.000229554	0	0.000519	1.884820844	0.000135867	6.301018286	4.47864E-05	0.81992053	0.000442787	0	0.001538876	0	0.000526534	0.606630902	0.002827658	325.8330045	343.6371519	0.171818576
	Bosque	0.000595392	15.23997933	0.001096604	0.825014503	0.000439723	0	0.001755208	6.374283599	0.000735562	34.11279889	0.000212298	3.88661097	0.005708837	0	0.02285067	0	0.000234455	0.270120186	0.001067208	122.9751683	183.6839758	0.091841988
	Brazos	0.001939725	49.65028649	0.003572622	2.687812467	0.001432574	0	0.005718288	20.7667609	0.002396384	111.1359931	0.000691644	12.66217912	0.018598805	0	0.074445136	0	0.000763829	0.880023807	0.003476855	400.6404605	598.4235164	0.299211758
	Calhoun	0.082699809	2116.830355	0.001655986	1.245858399	0.061077496	0	0.002766524	10.04701783	0.000610844	28.32885022	0.000591187	10.8230826	0.0170045	0	0.002633372	0	0.000584875	0.673847089	0.003010234	346.8714129	2514.820424	1.257410212
	Cameron	0.048371747	1238.150172	0.000968599	0.728712051	0.297964476	0	0.001618161	5.876577133	0.000357288	16.56975992	0.00034579	6.330503314	0.009946061	0	0.001540279	0	0.000342098	0.394138287	0.001760709	202.8877272	1470.93759	0.735468795
	Cherokee	0.003503899	89.68774747	0.003533808	2.658611083	0.002587786	0	0.00585073	21.24774271	0.001531635	71.03190513	0.00050488	9.243032581	0.00499158	0	0.017347879	0	0.005935657	6.838600793	0.031876422	3673.14266	3873.8503	1.93692515
	Coke	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coleman	0.001298787	33.24447222	2.6007E-05	0.019566001	0.000959212	0	4.34478E-05	0.157786761	9.59321E-06	0.444899929	9.2845E-06	0.16997473	0.000267053	0	4.13567E-05	0	9.18536E-06	0.010582658	4.72752E-05	5.447558433	39.49484073	0.01974742
	Crockett	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ector	0.003535748	90.50296541	0.003565928	2.682776563	0.002611307	0	0.005903911	21.44087434	0.001545556	71.67755054	0.00050947	9.327047245	0.005036951	0	0.017505563	0	0.00598961	6.900760344	0.032166163	3706.529738	3909.061712	1.954530856
	Fannin	0.007056315	180.6173605	0.007116546	5.354034748	0.005211403	0	0.011782473	42.78969328	0.003084477	143.0473568	0.001016752	18.61404924	0.010052276	0	0.034935966	0	0.011953503	13.77189259	0.064194222	7397.14566	7801.340048	3.900670024
	Fayette	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Freestone	0.003677178	94.12308402	0.003708565	2.790087625	0.00271576	0	0.006140067	22.29850932	0.001607379	74.54465257	0.000529848	9.700129134	0.005238429	0	0.018205785	0	0.006229194	7.176790757	0.033452809	3854.790927	4065.42418	2.03271209
	Frio	0.008588335	219.8317964	0.000871383	0.655572927	0.006342868	0	0.001420864	5.160066298	0.000471808	21.88082203	0.000218433	3.998934744	0.206660746	0	0.012747844	0	0.000187546	0.216075897	0.000886827	102.189664	353.9329323	0.176966466
	Grimes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hardeman	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Haskell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hidalgo	0.188527456	4825.653746	0.003775086	2.840133709	0.139235931	0	0.006306735	22.9037859	0.001392518	64.58015017	0.001347706	24.6729498	0.03876448	0	0.006003193	0	0.001333316	1.536142338	0.006862311	790.7489276	5732.935836	2.866467918
	Howard	0.000555113	14.20898268	0.000559851	0.421196428	0.000409976	0	0.000926915	3.366221326	0.000242653	11.25338899	7.99868E-05	1.464348181	0.000790802	0	0.002748377	0	0.00094037	1.083420679	0.005050094	581.9258697	613.723428	0.306861714
	Jack	0.002121449	54.30177924	0.002139557	1.609665938	0.001566784	0	0.003542346	12.86452461	0.000927334	43.00653033	0.000305682	5.596228347	0.00302217	0	0.010503338	0	0.003593766	4.140456206	0.019299698	2223.917843	2345.437027	1.172718514
	Jones	0.040718722	1042.259088	0.000815354	0.613420549	0.030072592	0	0.001362147	4.946827986	0.00030076	13.94821343	0.000291082	5.32893728	0.008372468	0	0.001296587	0	0.000287974	0.331780603	0.001482142	170.7883116	1238.216579	0.61910829
	Lamar	0.000950838	24.33817497	0.000958954	0.721455757	0.000702236	0	0.001587687	5.765907769	0.000415633	19.27561996	0.000137007	2.508241656	0.001354543	0	0.004707619	0	0.001610734	1.855761432	0.008650166	996.7647898	1051.229951	0.525614976
	Limestone	0.000719757	18.42329542	0.000891528	0.670728366	0.000531572	0	0.000300183	1.090156782	0.00545518	252.9923553	0.001239347	22.68917849	0.000497945	0	0.00031596	0	0.000380962	0.438914787	0.000523179	60.28629516	356.5909243	0.178295462
	Llano	0.001238174	31.69299001	0.047274044	35.56597012	0.000914447	0	0.082844655	300.8619059	0.000765714	35.51115798	0.002200214	40.28013466	0.000657172	0	0.001148571	0	0.000248641	0.286464175	0.001135861	130.8861051	575.0847279	0.287542364
	McLennan	0.024534317	627.9940467	0.024743738	18.61560781	0.018119687	0	0.040966843	148.7767984	0.010724513	497.3657473	0.003535175	64.71975936	0.034951066	0	0.121469933	0	0.041561501	47.88391622	0.22319886	25719.36288	27124.71876	13.56235938
	Milam	0.002245405	57.4746346	0.002264571	1.703718789	0.001658332	0	0.003749326	13.61619935	0.000981518	45.51940379	0.000323543	5.923216216	0.003198756	0	0.011117048	0	0.00380375	4.382383245	0.02042738	2353.86146	2482.481016	1.241240508
	Mitchell	0.014943169	382.493668	0.015070721	11.3382478	0.011036196	0	0.024951762	90.61580067	0.006532002	302.9316123	0.002153177	39.41900132	0.02128772	0	0.07398395	0	0.025313952	29.16475857	0.135944204	15664.94698	16520.91007	8.260455036
	Nolan	0.000564654	14.45319062	0.000569473	0.428435476	0.000417022	0	0.000942846	3.424076134	0.000246823	11.44679952	8.13615E-05	1.489515743	0.000804394	0	0.002795613	0	0.000956532	1.102041289	0.005136889	591.9273539	624.2714127	0.312135706
	Palo Pinto	0.003206998	82.08811543	0.005906709	4.443830552	0.002368511	0	0.009454195	34.33422818	0.003962005	183.7440401	0.001143513	20.93471146	0.030749889	0	0.123082087	0	0.001262858	1.454966345	0.005748375	662.3893373	989.3892293	0.494694615
	Pecos	4.09677E-05	1.048631523	4.13174E-05	0.031084551	3.02565E-05	0	6.84069E-05	0.248429171	1.79079E-05	0.830506919	5.90308E-06	0.108069782	5.83617E-05	0	0.000202832	0	6.93999E-05	0.079957102	0.0003727	42.94648142	45.29316047	0.02264658
	Presidio	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Robertson	0.000737708	18.88277792	0.000835096	0.628273174	0.00054483	0	0.000735917	2.67258533	0.003149678	146.0711407	0.000730875	13.38040458	0.00076086	0	0.001866305	0	0.191632518	220.7840225	0.003397737	391.5236901	793.9428943	0.396971447
	Taylor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Titus	0.005696437	145.8091831	0.005745061	4.322217039	0.004207073	0	0.009511781	34.54335843	0.002490043	115.4795873	0.000820806	15.02679093	0.008115023	0	0.028203184	0	0.00964985	11.11780398	0.051822854	5971.584145	6297.883086	3.148941543
	Tom Green	0.001482448	37.94556586	2.96846E-05	0.022332825	0.001094854	0	4.95918E-05	0.180099353	1.09498E-05	0.507813132	1.05974E-05	0.19401082	0.000304817	0	4.72049E-05	0	1.04843E-05	0.012079149	5.39604E-05	6.217896494	45.07979763	0.022539899
	Upton	3.11661E-05	0.797745539	3.14322E-05	0.023647546	2.30176E-05	0	5.20405E-05	0.188992281	1.36234E-05	0.631807433	4.49076E-06	0.082213995	4.43986E-05	0	0.000154304	0	5.27959E-05	0.060827297	0.000283531	32.67149923	34.45673333	0.017228367
	Ward	0.018559529	475.0600294	0.01871795	14.08218954	0.013707039	0	0.030990277	112.54551	0.008112796	376.2433542	0.002674262	48.95869786	0.026439509	0	0.091888626	0	0.03144012	36.22285079	0.16884373	19455.98267	20519.0953	10.25954765
	Webb	0.020014327	512.2978652	0.000400768	0.301512399	0.014781473	0	0.000669531	2.431496589	0.000147832	6.855915242	0.000143074	2.619313398	0.004115289	0	0.000637307	0	0.000141547	0.163078928	0.000728512	83.94696529	608.6161471	0.304308074
	Wharton	0.00014434	3.694599265	0.000178787	0.134507561	0.000106601	0	6.01986E-05	0.218619544	0.001093979	50.7349716	0.000248538	4.550077512	9.98576E-05	0	6.33625E-05	0	7.6398E-05	0.088019771	0.000104918	12.08978615	71.5105814	0.035755291
	Wichita	0.000207633	5.314695266	0.000209406	0.157543345	0.000153346	0	0.000346701	1.259093698	9.07612E-05	4.209191786	2.99181E-05	0.547721432	0.00029579	0	0.001027996	0	0.000351734	0.405240184	0.001888925	217.6622165	229.5557022	0.114777851
	Wilbarger	0.028616818	732.4920115	0.000573025	0.431107444	0.021134796	0	0.000957307	3.476594279	0.000211372	9.802701684	0.00020457	3.745137877	0.005884109	0	0.000911232	0	0.000202386	0.233172965	0.001041639	120.0287677	870.2094935	0.435104747
	Wise	0.002844488	72.80908734	0.002882008	2.16823872	0.002100781	0	0.00476997	17.32281236	0.001256075	58.25242144	0.000413241	7.565361234	0.004181914	0	0.014614274	0	0.004797945	5.527817073	0.025761411	2968.505674	3132.151412	1.566075706
	Young	0.006235856	159.6164509	0.006289085	4.731505443	0.004605458	0	0.010412491	37.81441029	0.002725836	126.4148216	0.000898531	16.44973921	0.008883468	0	0.030873859	0	0.010563634	12.17059429	0.056730171	6537.057865	6894.255386	3.447127693
	Total	**1.121837219**	**28715.17018**	**1.172570094**	**882.1668247**	**1.090766584**	**0**	**1.189130767**	**4318.494059**	**1.629360006**	**75564.06999**	**1.542362643**	**28236.60382**	**1.359385821**	**0**	**1.231642808**	**0**	**1.221806085**	**1407.669558**	**1.528786947**	**176163.2035**	**315287.3779**	**157.643689**
Energy Savings by PCA (MWh)		25,597		752		0		3,632		46,377		18,307		0		0		1,152		115,231			

Table 83: Annual and OSD Electricity Savings for the Different Programs.

Program	2005	Cumulative 2006	Cumulative 2007	Cumulative 2008	Cumulative 2009	Cumulative 2010	Cumulative 2011	Cumulative 2012	Cumulative 2013	Cumulative 2014	Cumulative 2015	Cumulative 2016	Cumulative 2017	Cumulative 2018	Cumulative 2019	Cumulative 2020
	Annual (MWh)	Annual (MWh)	Annual (MWh)	Annual (MWh)	Annual (MWh)	Annual (MWh)	Annual (MWh)	Annual (MWh)	Annual (MWh)	Annual (MWh)	Annual (MWh)	Annual (MWh)	Annual (MWh)	Annual (MWh)	Annual (MWh)	Annual (MWh)
ESL-Single Family	225,389	924,435	1,130,412	1,331,385	1,526,961	1,716,750	1,900,358	2,077,395	2,247,468	2,410,186	2,565,156	2,711,987	2,855,381	2,984,366	3,104,035	3,213,997
ESL-Multifamily	9,228	70,641	76,713	82,429	87,780	92,759	97,358	101,570	105,387	108,801	111,806	114,393	116,653	118,374	119,655	120,487
ESL-Commercial	56,084	433,388	471,614	508,595	544,233	578,430	611,090	642,115	671,406	698,868	724,402	747,910	770,563	789,631	806,381	820,715
Federal Buildings	52,276	109,073	159,415	206,960	251,708	293,659	332,813	369,171	402,732	433,496	461,464	486,635	509,009	528,586	545,366	559,350
Furnace Pilot Light Program (MBtu)	2,209,050	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904
PUC (SB7)	336,358	1,362,701	1,573,304	1,769,598	1,951,584	2,119,261	2,272,629	2,411,689	2,536,441	2,646,884	2,743,018	2,824,843	2,892,360	2,945,569	2,984,469	3,009,060
PUC (SB5 grant program)	0	13,633	12,827	12,021	11,215	10,409	9,603	8,797	7,991	7,186	6,380	5,574	4,768	3,962	3,156	2,350
SECO	87,550	293,764	297,494	335,753	353,938	370,249	384,686	397,250	407,941	416,757	423,700	428,770	431,966	433,289	432,738	430,313
Wind-ERCOT	2,912,683	4,782,508	5,023,145	4,820,640	5,705,725	6,533,348	7,303,511	8,016,212	9,273,739	9,269,232	9,383,227	9,461,078	9,954,593	9,960,154	10,138,098	10,268,312
SEER13-Single Family	0	374,246	624,639	913,010	1,185,311	1,441,594	1,681,860	1,906,108	2,114,339	2,306,551	2,482,746	2,642,923	2,787,083	2,915,224	2,803,568	2,590,509
SEER13-Multifamily	0	31,634	52,532	76,375	98,620	119,281	138,371	155,904	171,894	186,354	199,298	210,738	220,690	229,165	219,722	202,900
	OSD (MWh)	OSD (MWh)	OSD (MWh)	OSD (MWh)	OSD (MWh)	OSD (MWh)	OSD (MWh)	OSD (MWh)	OSD (MWh)	OSD (MWh)	OSD (MWh)	OSD (MWh)	OSD (MWh)	OSD (MWh)	OSD (MWh)	OSD (MWh)
ESL-Single Family	776	4,693	5,676	6,634	7,566	8,469	9,344	10,186	10,994	11,768	12,503	13,200	13,879	14,489	15,054	15,573
ESL-Multifamily	36	329	352	374	393	412	428	444	457	469	479	487	494	499	502	503
ESL-Commercial	412	2,681	2,909	3,128	3,340	3,543	3,736	3,920	4,093	4,255	4,406	4,544	4,677	4,788	4,885	4,968
Federal Buildings	0	299	437	567	690	805	912	1,011	1,103	1,188	1,264	1,333	1,395	1,448	1,494	1,532
Furnace Pilot Light Program (MBtu)	5,819	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983
PUC (SB7)	828	3,733	4,310	4,848	5,347	5,806	6,226	6,607	6,949	7,252	7,515	7,739	7,924	8,070	8,177	8,244
PUC (SB5 grant program)	0	37	35	33	31	29	26	24	22	20	17	15	13	11	9	6
SECO	316	805	815	920	970	1,014	1,054	1,088	1,118	1,142	1,161	1,175	1,183	1,187	1,186	1,179
Wind-ERCOT	4,377	10,305	10,003	10,435	12,351	14,142	15,809	17,352	20,088	20,064	20,311	20,479	21,548	21,560	21,945	22,227
SEER13-Single Family	0	2,666	4,449	6,503	8,442	10,268	11,979	13,576	15,059	16,428	17,683	18,824	19,851	20,764	19,969	18,451
SEER13-Multifamily	0	213	354	514	664	803	931	1,049	1,157	1,254	1,341	1,418	1,485	1,542	1,479	1,365
Total Ann (MWh)	3,679,568	8,396,023	9,422,095	10,056,765	11,717,073	13,275,739	14,732,280	16,086,212	17,939,338	18,484,315	19,101,196	19,634,850	20,543,066	20,908,319	21,157,187	21,217,993
Total OSD (MWh)	6,744	25,762	29,340	33,955	39,792	45,290	50,446	55,258	61,042	63,839	66,681	69,215	72,450	74,359	74,699	74,049
Total OSD (Mbtu)	5,819	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983

Table 84: Annual and OSD NOx Emissions Reduction Values for the Different Programs.

Program	2005	Cum. 2006	Cum. 2007	Cum. 2008	Cum. 2009	Cum. 2010	Cum. 2011	Cum. 2012	Cum. 2013	Cum. 2014	Cum. 2015	Cum. 2016	Cum. 2017	Cum. 2018	Cum. 2019	Cum. 2020
	Annual (Tons)	Annual (Tons)	Annual (Tons)	Annual (Tons)	Annual (Tons)	Annual (Tons)	Annual (Tons)	Annual (Tons)	Annual (Tons)	Annual (Tons)	Annual (Tons)	Annual (Tons)	Annual (Tons)	Annual (Tons)	Annual (Tons)	Annual (Tons)
ESL-Single Family	158	656	800	940	1,076	1,208	1,336	1,459	1,578	1,691	1,799	1,901	2,000	2,090	2,173	2,250
ESL-Multifamily	6	50	54	58	62	65	68	71	73	75	77	79	80	81	82	83
ESL-Commercial	39	304	331	357	381	405	428	450	470	490	508	524	540	553	565	575
Federal Buildings	40	84	122	158	193	225	255	283	308	332	353	373	390	405	418	428
Furnace Pilot Light Program	102	117	117	117	117	117	117	117	117	117	117	117	0	0	0	0
PUC (SB7)	237	1,039	1,118	1,253	1,378	1,494	1,599	1,695	1,781	1,856	1,922	1,978	2,023	2,059	2,085	2,298
PUC (SB5 grant program)	0	6	5	5	5	4	4	4	3	3	3	2	2	2	1	1
SECO	67	224	227	256	270	282	293	303	311	318	323	327	329	330	330	328
Wind-ERCOT	1,848	2,978	3,128	2,947	3,488	3,994	4,464	4,900	5,652	5,666	5,736	5,783	6,085	6,088	6,197	6,277
SEER13-Single Family	0	258	430	629	816	993	1,158	1,313	1,456	1,589	1,710	1,820	1,920	2,008	1,931	1,784
SEER13-Multifamily	0	22	36	53	68	82	95	107	118	128	137	145	152	158	151	140
	OSD (Tons)	OSD (Tons)	OSD (Tons)	OSD (Tons)	OSD (Tons)	OSD (Tons)	OSD (Tons)	OSD (Tons)	OSD (Tons)	OSD (Tons)	OSD (Tons)	OSD (Tons)	OSD (Tons)	OSD (Tons)	OSD (Tons)	OSD (Tons)
ESL-Single Family	0.76	3.29	3.97	4.63	5.27	5.90	6.50	7.09	7.64	8.18	8.69	9.17	9.64	10.06	10.45	10.81
ESL-Multifamily	0.03	0.23	0.24	0.26	0.27	0.28	0.29	0.30	0.31	0.32	0.33	0.33	0.34	0.34	0.34	0.34
ESL-Commercial	0.23	1.83	1.99	2.14	2.29	2.43	2.56	2.68	2.80	2.91	3.02	3.11	3.20	3.28	3.35	3.40
Federal Buildings	0.11	0.22	0.32	0.42	0.51	0.59	0.67	0.74	0.81	0.87	0.93	0.98	1.02	1.06	1.10	1.12
Furnace Pilot Light Program	0.28	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.00	0.00	0.00	0.00
PUC (SB7)	0.64	2.61	3.00	3.36	3.69	4.00	4.28	4.54	4.77	4.97	5.14	5.29	5.41	5.51	5.57	5.62
PUC (SB5 grant program)	0.00	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
SECO	0.18	0.61	0.62	0.69	0.73	0.77	0.80	0.82	0.84	0.86	0.88	0.89	0.89	0.90	0.89	0.89
Wind-ERCOT	4.38	6.44	6.15	6.42	7.60	8.70	9.72	10.67	12.32	12.34	12.49	12.60	13.25	13.26	13.50	13.67
SEER13-Single Family	0.00	1.81	3.03	4.42	5.74	6.98	8.15	9.23	10.24	11.17	12.03	12.80	13.50	14.12	13.58	12.55
SEER13-Multifamily	0.00	0.15	0.24	0.35	0.45	0.55	0.63	0.71	0.79	0.85	0.91	0.97	1.01	1.05	1.01	0.93
Total Annual	2,498	5,738	6,368	6,772	7,854	8,870	9,819	10,702	11,868	12,265	12,684	13,049	13,521	13,774	13,933	14,163
Total OSD	6.60	17.52	19.89	23.02	26.89	30.52	33.94	37.12	40.86	42.81	44.74	46.46	48.27	49.58	49.79	49.33

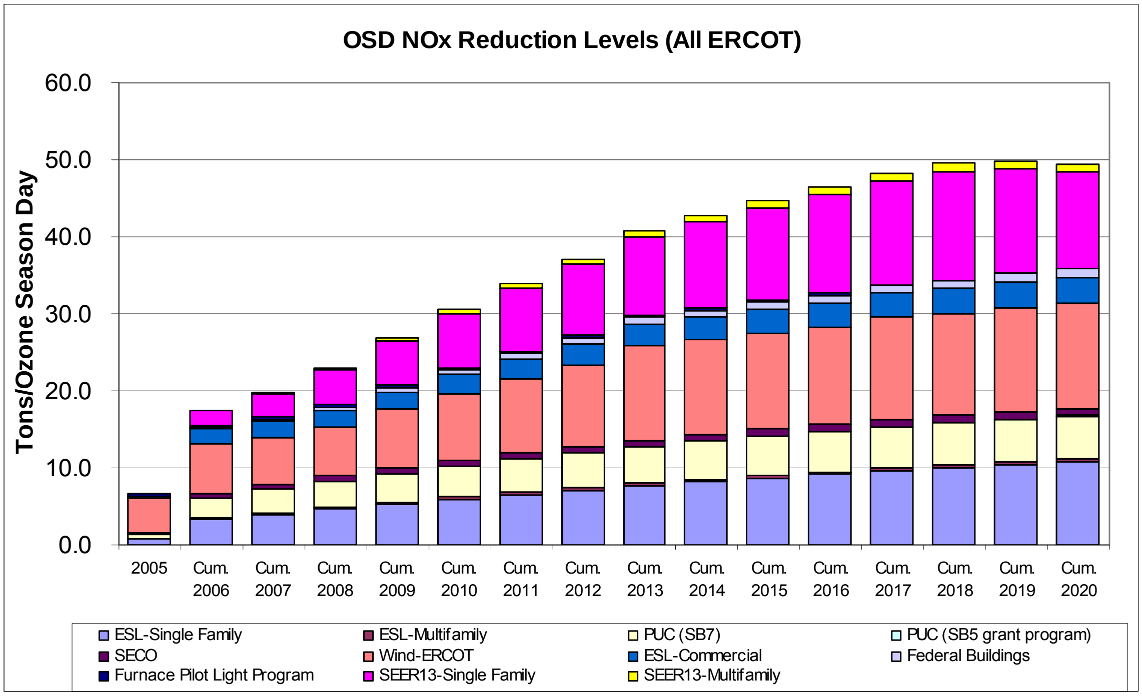

Figure 157: Cumulative OSD NOx Emissions Reduction Projections through 2020.

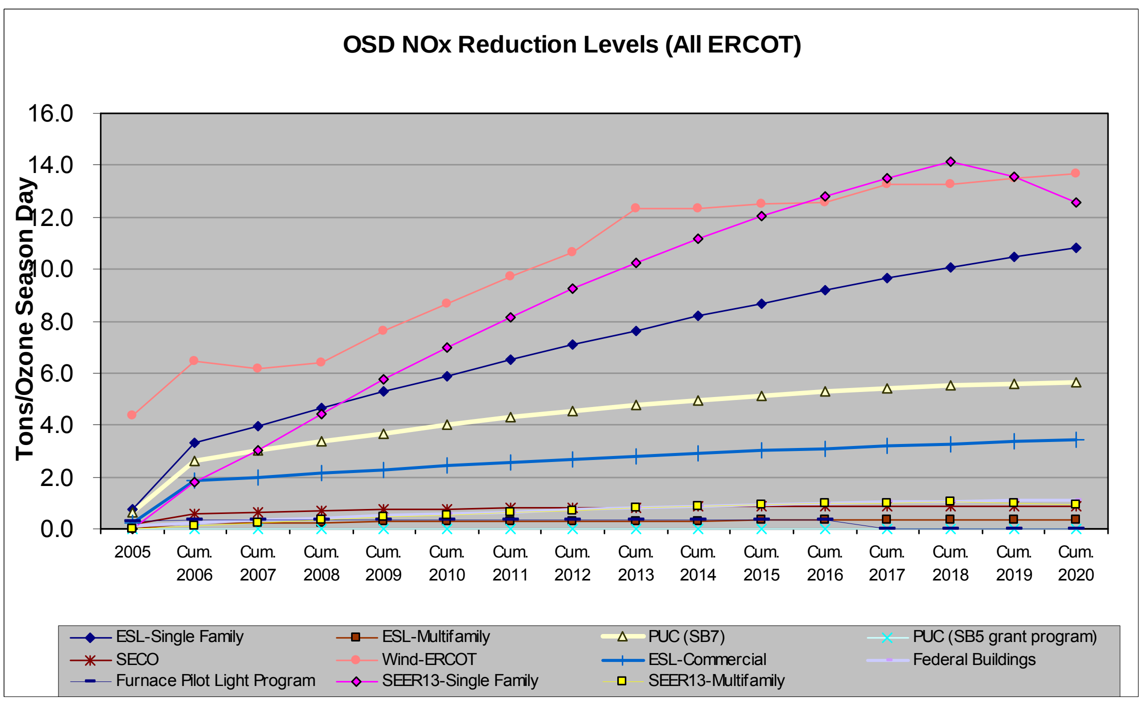

Figure 158: Cumulative OSD NOx Emissions Reduction Projections through 2020.

8.5 Weather Data.

In order to calculate the NOx emissions from energy efficiency and renewable energy (EE/RE) projects in non-attainment and affected counties in Texas (Figure 159) several weather data sets needed to be assembled from the many different weather sources (Figure 160 and Table 85), including hourly weather data sets needed for the DOE-2 simulations and daily average weather data for analysis that used monthly utility billing data.

In the archive the counties were grouped according to the nearest TMY2 weather station as shown in Table 86. Next, for each group, weather files were determined for F-CHART, PV F-CHART, ASHRAE 90.1-1989, and ASHRAE 90.1-1999 analysis. Finally, as shown in Table 87, weather files were assigned for NOAA data (temperature, humidity, wind speed) and NREL (solar radiation). In some instances, where solar radiation data were not available from the NREL database, TCEQ solar data were used. For NREL solar sources, solar data included global horizontal, direct normal beam, and diffuse solar radiation. For TCEQ solar sources, only global horizontal solar radiation data were available which required synthesis of direct normal beam and diffuse radiation using an iterative kt procedure (Erbs 1982). Synthetic beam and diffuse solar data were also used to fill missing NREL data.

In 2005, at the request of the TCEQ, the 9 weather stations assembled for calculating emissions from the non-attainment and affected counties were expanded to include all counties in ERCOT (**Error! Reference source not found.**). To accomplish this, 8 additional weather stations were added to the original 9 stations for a total of 17 weather stations (Table 88). Assignment of weather stations was then performed as shown in Table 89, with additional details provided in Table 90. Figure 161 shows an updated map of Texas showing the available weather files, 2000/2001 IECC weather zones, and ERCOT county outline. Figure 162 shows the clustering of the counties around their chosen TMY2 and NOAA weather stations. Figure 163 shows the 2000/2001 and 2006 IECC weather zones and available weather files. During the period from January 2006 to June 2007, the Laboratory maintained and added additional years of weather data to the archive.

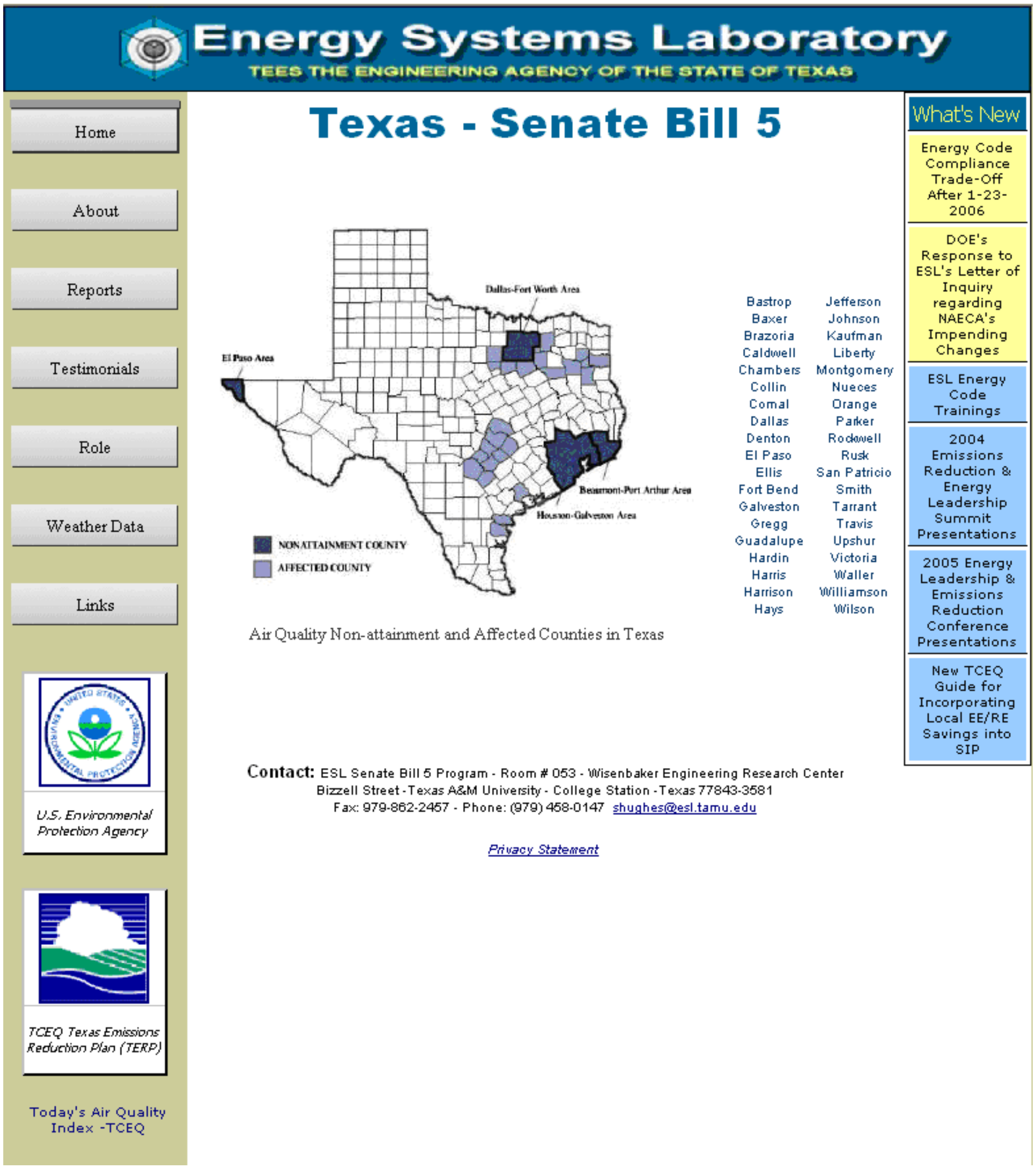

Figure 159: Main Screen of the Senate Bill 5 Web Page Showing the New Weather Data Button.

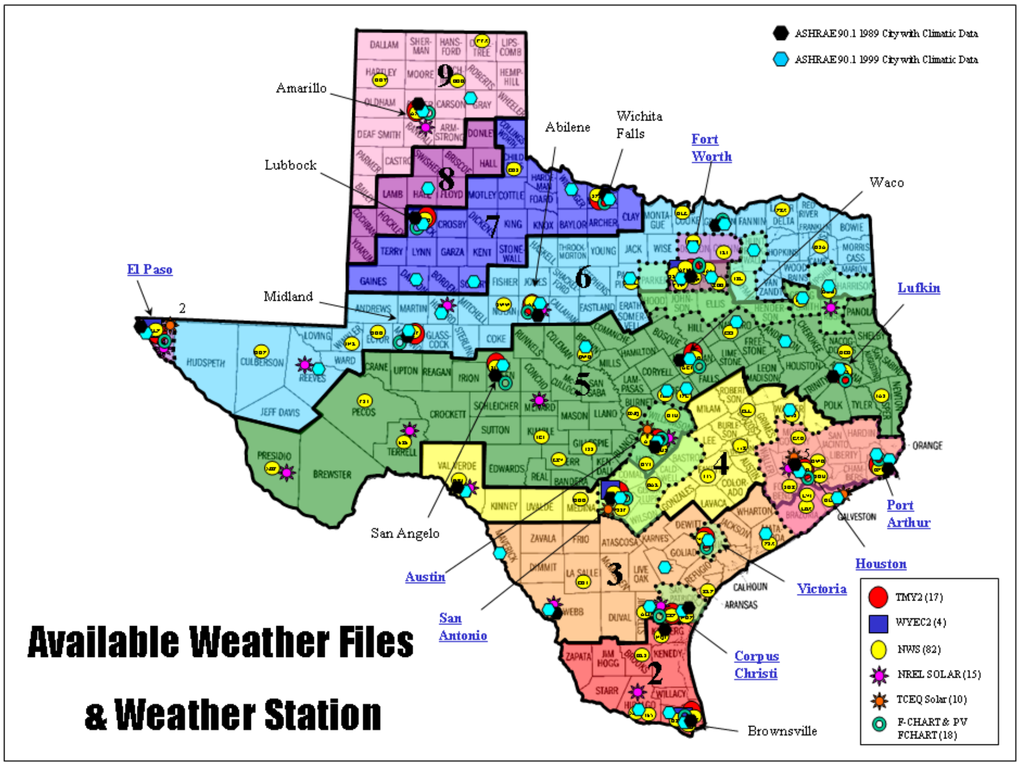

Figure 160: Available Weather Stations in Texas for 41 Non-attainment and Affected Counties.

Table 85: List of Available Weather Files in Texas (Listed by Symbol).

List of Available Weather Files and Weather Stations of Texas

Texas Weather Stations (NOAA)

1	Abilene Regional Airport (ABI)
2	Alice International Airport (ALI)
3	Amarillo International Airport (AMA)
4	Angleton / Lake Jackson Brazoria (LBX)
5	Arlington Municipal Airport (GKY)
6	Austin - Bergstrom International (AUS)
7	Austin Camp Mabry (ATT)
8	Borger Hutchinson County Airport (BGD)
9	BRENHAM: BRENHAM MUNICIPAL AIRPORT (11R)
10	Brownsville S Padre Isl International (BRO)
11	BROWNWOOD: BROWNWOOD REGIONAL AIRPORT (BWD)
12	Burnet Municipal Airport (BMQ)
13	Childress Municipal Airport (CDS)
14	College Station (CLL)
15	Conroe Montgomery County Airport (CXO)
16	Corpus Christi International Airport (CRP)
17	CORPUS CHRISTI: CORPUS CHRISTI NAS/TRUAX FIELD ARPT (NGP)
18	Corsicana Campbell Field (CRS)
19	Cotulla La Salle Co Airport (COT)
20	Dalhart Municipal Airport (DHT)
21	Dallas - Fort Worth International Airport (DFW)
22	Dallas Love Field (DAL)
23	Dallas Redbird Airport (RBD)
24	Del Rio International Airport (DRT)
25	Denton Municipal Airport (DTO)
26	Dryden Terrell County Airport (6R6)
27	El Paso International Airport (ELP)
28	FALFURRIAS: BROOKS COUNTY AIRPORT (BKS)
29	Fort Stockton Pecos County Airport (FST)
30	Fort Worth Alliance Airport (AFW)
31	Fort Worth Meacham (FTW)
32	FREDERICKSBURG: GILLESPIE COUNTY AIRPORT (T82)
33	GAINESVILLE: GAINESVILLE MUNICIPAL AIRPORT (GLE)
34	Galveston Scholes Field (GLS)
35	GEORGETOWN: GEORGETOWN MUNICIPAL AIRPORT (GTU)
36	Harlingen Rio Grande Valley I (HRL)
37	Hondo Municipal Airport (HDO)
38	Houston Bush Intercontinental (IAH)
39	Houston Clover Field (LVJ)
40	Houston Hooks Memorial Airport (DWH)
41	Houston Sugarland Mem (SGR)
42	Houston William P Hobby Airport (HOU)
43	Huntsville Municipal Airport (UTS)
44	JASPER: JASPER COUNTY-BELL FIELD AIRPORT (JAS)
45	Junction Kimble County Airport (JCT)
46	KERRVILLE: KERRVILLE MUNI/LOUIS SCHREINER FLD AIRPORT (ERV)
47	KILLEEN: KILLEEN MUNICIPAL AIRPORT (ILE)
48	KINGSVILLE: KINGSVILLE NAS AIRPORT (NQI)
49	LA GRANGE: FAYETTE REGIONAL AIR CENTER AIRPORT (3T5)
50	Longview E Tx Rgnl Airport (GGG)
51	Lubbock International Airport (LBB)
52	Lufkin Angelina Cty Airport (LFK)
53	MARFA: MARFA MUNICIPAL AIRPORT (MRF)
54	McAllen Miller International Airport (MFE)
55	McKinney Municipal Airport (TKI)
56	Midland International Airport (MAF)
57	Mineral Wells Airport (MWL)
58	MOUNT PLEASANT: MOUNT PLEASANT REGIONAL AIRPORT (OSA)
59	NACOGDOCHES: A L MANGHAM JR REGIONAL AIRPORT (OCH)
60	New Braunfels Municipal Airport (BAZ)
61	Odessa Schlemeyer Field (ODO)
62	Palacios Municipal Airport (PSX)
63	PARIS: COX FIELD AIRPORT (PRX)
64	PERRYTON: PERRYTON OCHILTREE COUNTY AIRPORT (PYX)
65	Pine Springs Guadalupe Mounta (GDP)
66	Port Arthur Se Tx Rgnl Airport (BPT)
67	Port Isabel Cameron County Airport (PIL)
68	Rockport Aransas Co Airport (RKP)
69	San Angelo Mathis Field (SJT)
70	San Antonio International Airport (SAT)
71	San Antonio Stinson Municipal Airport (SSF)
72	SAN MARCOS: SAN MARCOS MUNICIPAL AIRPORT (HYI)
73	SWEETWATER: AVENGER FIELD AIRPORT (SWW)
74	TEMPLE: DRAUGHON-MILLER CNTRL TEXAS REGIONAL ARPT (TPL)
75	Terrell Municipal Airport (TRL)
76	Tyler Pounds Field (TYR)
77	Victoria Regional Airport (VCT)
78	WACO: MC GREGOR EXECUTIVE AIRPORT (PWG)
79	Waco Regional Airport (ACT)
80	WESLACO: MID VALLEY AIRPORT (T65)
81	Wichita Falls Municipal Airport (SPS)
82	Wink Winkler Co Airport (INK)

Texas TMY2 Weather Files

1	Abilene
2	Amarillo
3	Austin
4	Brownsville
5	Corpus Christi
6	El Paso
7	Fort Worth
8	Houston
9	Lubbock
10	Lufkin
11	Midland
12	Port Arthur
13	San Angelo
14	San Antonio
15	Victoria
16	Waco
17	Wichita Falls

Texas WYEC2 Weather Files

1	El Paso
2	Brownsville
3	Fort Worth
4	San Antonio

NREL Solar Stations

1	Abilene
2	Austin
3	Big Spring
4	Canyon
5	Clear Lake
6	Corpus Christi
7	Del Rio
8	Edinburg
9	El Paso
10	Laredo
11	Menard
12	Overton
13	Pecos
14	Presidio
15	Sanderson

TCEQ Solar Stations

1	Bexar
2	Travis
3	El Paso (2)
4	Galveston
5	Harris (5)

FCHART and PV FCHART (New Weather File)

1	ABILENE
2	AMARILLO
3	AUSTIN
4	BROWNSVILLE
5	CORPUS CHRISTI
6	EL PASO
7	FORT WORTH
8	HOUSTON
9	LUBBOCK
10	LUFKIN
11	MIDLAND-ODESSA
12	PORT ARTHUR
13	SAN ANGELO
14	SAN ANTONIO
15	SHERMAN
16	VICTORIA
17	WACO
18	WICHITA FALLS

Table 86: Assignment of Weather Stations for 41 Non-attainment and Affected Counties (NOAA, TMY2, F-CHART, PV F-CHART, NAHB, Climate Zone, HDD, CDD, 90.1-1989, 90.1-1999).

Area	No.	County	NOAA Weather Station		Solar Station		TMY2		FCHART		PV-FCHART		DOE Include File	Weather File	DOE TRY weather file name	East or West Texas	Climate Zone	HDD		CDD		AHSRAE 90.1-1989		AHSRAE 90.1-1999		County
			WBAN No.	Weather Station	Source	File	WBAN No.	File										1989	1999	1989	1999	Nearest City	Table 8A (10, 12, 16)	Nearest City	Table B (5, 6, 8, 10)	
	ID	County	WBAN No.	Weather Station	x	x	x	TMY2File	Fchart	FchartID	PVFChart	PVFChartID	DOE_INC	x	DOE_WF	PRECODE	CZ									County
Austin	22	Bastrop	13958	Austin Camp Mabry (ATT)	NREL	Austin	13958	Austin	Austin	14	Austin	18	BAS	Austin	ATT	West	4					Austin	12	Austin	6	Bastrop
	26	Caldwell	13958	Austin Camp Mabry (ATT)	NREL	Austin	13958	Austin	Austin	14	Austin	18	CAL	Austin	ATT	West	4					Austin	12	Austin	6	Caldwell
	8	Hays	13958	Austin Camp Mabry (ATT)	NREL	Austin	13958	Austin	Austin	14	Austin	18	HAY	Austin	ATT	West	5					Austin	12	Austin	6	Hays
	40	Travis	13958	Austin Camp Mabry (ATT)	NREL	Austin	13958	Austin	Austin	14	Austin	18	TRA	Austin	ATT	West	5	1735	1688	6873	7171	Austin	12	Austin	6	Travis
	41	Williamson	13958	Austin Camp Mabry (ATT)	NREL	Austin	13958	Austin	Austin	14	Austin	18	WLL	Austin	ATT	West	5					Austin	12	Kileen/Robert-gray or **Austin**	6	Williamson
Corpus	38	Nueces	12924	Corpus Christi International Airport (CRP)	NREL	Corpus Christi	12924	Corpus Christi	Corpus Christi	52	Corpus Christi	58	NUE	Corpus Christi	CRP	East	3	889	1016	8200	8023	Corpus Christi	16	Corpus Christi or Alice	5	Nueces
	15	San Patricio	12924	Corpus Christi International Airport (CRP)	NREL	Corpus Christi	12924	Corpus Christi	Corpus Christi	52	Corpus Christi	58	SAP	Corpus Christi	CRP	East	3					Corpus Christi	16	Corpus Christi or Alice	5	San Patricio
El Paso	30	El Paso	23044	El Paso International Airport (ELP)	TCEQ	C12-El Paso UTEP	23044	El Paso	El Paso	68	El Paso	70	ELP	El Paso	ELP	West	6	2605	2708	5617	5488	El Paso	12	El Paso	10	El Paso
Dallas-Ft. Worth	27	Collin	03927	Dallas - Fort Worth International Airpor (DFW)	NREL	Overton	03927	Fort Worth	Fort Worth	78	Fort Worth	83	COL	Fort Worth	DFW	West	6					Sherman or Fort Worth	12	**Denton,** Greenville or Sherman	8	Collin
	4	Dallas	03927	Dallas - Fort Worth International Airpor (DFW)	NREL	Overton	03927	Fort Worth	Fort Worth	78	Fort Worth	83	DAL	Fort Worth	DFW	West	5		2259		6587	Fort Worth	12	Dallas	8	Dallas
	29	Denton	03927	Dallas - Fort Worth International Airpor (DFW)	NREL	Overton	03927	Fort Worth	Fort Worth	78	Fort Worth	83	DEN	Fort Worth	DFW	West	6					Shermanor Fort Worth	12	Denton	8	Denton
	31	Ellis	03927	Dallas - Fort Worth International Airpor (DFW)	NREL	Overton	03927	Fort Worth	Fort Worth	78	Fort Worth	83	ELL	Fort Worth	DFW	West	5					Fort Worth	12	Fort Worth, Dallas or Corsicana	8	Ellis
	23	Hood	03927	Dallas - Fort Worth International Airpor (DFW)	NREL	Overton	03927	Fort Worth	Fort Worth	78	Fort Worth	83	HOD	Fort Worth	DFW	West	5					Fort Worth	12	Mineral Wells or Fort Worth	8	Hood
	24	Hunt	03927	Dallas - Fort Worth International Airpor (DFW)	NREL	Overton	03927	Fort Worth	Fort Worth	78	Fort Worth	83	HNT	Fort Worth	DFW	West	6					Shermanor Fort Worth	12	Greenville	10	Hunt
	36	Johnson	03927	Dallas - Fort Worth International Airpor (DFW)	NREL	Overton	03927	Fort Worth	Fort Worth	78	Fort Worth	83	JOH	Fort Worth	DFW	West	5					Fort Worth	12	Mineral Wells or Fort Worth	8	Johnson
	10	Kaufman	03927	Dallas - Fort Worth International Airpor (DFW)	NREL	Overton	03927	Fort Worth	Fort Worth	78	Fort Worth	83	KAU	Fort Worth	DFW	West	6					Fort Worth	12	Greenville, **Dallas** or Corsicana	8	Kaufman
	39	Parker	03927	Dallas - Fort Worth International Airpor (DFW)	NREL	Overton	03927	Fort Worth	Fort Worth	78	Fort Worth	83	PAR	Fort Worth	DFW	West	6					Fort Worth	12	Mineral Wells or Fort Worth	8	Parker
	13	Rockwall	03927	Dallas - Fort Worth International Airpor (DFW)	NREL	Overton	03927	Fort Worth	Fort Worth	78	Fort Worth	83	ROC	Fort Worth	DFW	West	6					Shermanor Fort Worth	12	**Dallas** or Greeenville	8	Rockwall
	17	Tarrant	03927	Dallas - Fort Worth International Airpor (DFW)	NREL	Overton	03927	Fort Worth	Fort Worth	78	Fort Worth	83	TAR	Fort Worth	DFW	West	5	2354		6174		Fort worth	12	Fort worth	8	Tarrant
Houston/Galveston	2	Brazoria	12960	Houston Bush Intercontinental (IAH)	NREL	Clear Lake	12960	Houston	Houston	96	Houston	102	BRA	Houston	IAH	East	3					Houston	10	Houston, Galveston or Bay City	5	Brazoria
	5	Fort Bend	12960	Houston Bush Intercontinental (IAH)	NREL	Clear Lake	12960	Houston	Houston	96	Houston	102	FOB	Houston	IAH	East	4					Houston	10	Houston or Bay City	5	Fort Bend
	32	Galveston	12960	Houston Bush Intercontinental (IAH)	NREL	Clear Lake	12960	Houston	Houston	96	Houston	102	GAL	Houston	IAH	East	3		1263		7378	Houston	10	Galveston	5	Galveston
	34	Harris	12960	Houston Bush Intercontinental (IAH)	NREL	Clear Lake	12960	Houston	Houston	96	Houston	102	HAR	Houston	IAH	East	4	1346	1371	7125	7357	Houston	10	Houston	5	Harris
	37	Montgomery	12960	Houston Bush Intercontinental (IAH)	NREL	Clear Lake	12960	Houston	Houston	96	Houston	102	MOG	Houston	IAH	East	4					Houston	10	Huntsville or **Houston**	5	Montgomery
	20	Waller	12960	Houston Bush Intercontinental (IAH)	NREL	Clear Lake	12960	Houston	Houston	96	Houston	102	WAL	Houston	IAH	East	4					Houston	10	Houston	5	Waller
Tyler/Longview	33	Gregg	03901	Longview E Tx Rgnl Airport (GGG)	NREL	Overton	93987	Lufkin	Lufkin	125	Lufkin	131	GRE	Lufkin	GGG	East	6					Lufkin	12	Longview	8	Gregg
	35	Harrison	03901	Longview E Tx Rgnl Airport (GGG)	NREL	Overton	93987	Lufkin	Lufkin	125	Lufkin	131	HAN	Lufkin	GGG	East	6					Lufkin	12	Longview	8	Harrison
	9	Henderson	03901	Longview E Tx Rgnl Airport (GGG)	NREL	Overton	93987	Lufkin	Lufkin	125	Lufkin	131	HDS	Lufkin	GGG	East	5					Lufkin, Waco or Fort Worth	12	Tyler, Palestine or Corsicana	8	Henderson
	14	Rusk	03901	Longview E Tx Rgnl Airport (GGG)	NREL	Overton	93987	Lufkin	Lufkin	125	Lufkin	131	RUS	Lufkin	GGG	East	5					Lufkin	12	Tyler or Longview	8	Rusk
	16	Smith	03901	Longview E Tx Rgnl Airport (GGG)	NREL	Overton	93987	Lufkin	Lufkin	125	Lufkin	131	SMI	Lufkin	GGG	East	5		1296		6562	Lufkin	12	Tyler	8	Smith
	18	Upshur	03901	Longview E Tx Rgnl Airport (GGG)	NREL	Overton	93987	Lufkin	Lufkin	125	Lufkin	131	UPS	Lufkin	GGG	East	6					Lufkin	12	Tyler or Longview	8	Upshur
Beaumont Pt. Arthur	3	Chambers	12917	Port Arthur Se Tx Rgnl Airport (BPT)	TCEQ	C34-Galveston Airport	12917	Port Arthur	Port Arthur	166	Port Arthur	172	CHA	Port Arthur	BPT	East	4					Houston or Port Arthur	10	Beaumont or **Houston**	5	Chambers
	7	Hardin	12917	Port Arthur Se Tx Rgnl Airport (BPT)	TCEQ	C34-Galveston Airport	12917	Port Arthur	Port Arthur	166	Port Arthur	172	HAD	Port Arthur	BPT	East	4					Port Arthur	10	Beaumont	6	Hardin
	25	Jefferson	12917	Port Arthur Se Tx Rgnl Airport (BPT)	TCEQ	C34-Galveston Airport	12917	Port Arthur	Port Arthur	166	Port Arthur	172	JEF	Port Arthur	BPT	East	4	1416	1677	6888	6703	Port Arthur	10	Beaumont	6	Jefferson
	11	Liberty	12917	Port Arthur Se Tx Rgnl Airport (BPT)	TCEQ	C34-Galveston Airport	12917	Port Arthur	Port Arthur	166	Port Arthur	172	LIB	Port Arthur	BPT	East	4					Houston or Port Arthur	10	Beaumont, Galveston or **Houston**	5	Liberty
	12	Orange	12917	Port Arthur Se Tx Rgnl Airport (BPT)	TCEQ	C34-Galveston Airport	12917	Port Arthur	Port Arthur	166	Port Arthur	172	ORA	Port Arthur	BPT	East	4					Port Arthur	10	Beaumont	6	Orange
San Antonio	1	Bexar	12921	San Antonio International Airport (SAT)	TCEQ	C58-Camp Bullis	12921	San Antonio	San Antonio	187	San Antonio	194	BEX	San Antonio	SAT	West	4	1579	1644	7170	7142	San Antonio	12	San Antonio	6	Bexar
	28	Comal	12921	San Antonio International Airport (SAT)	TCEQ	C58-Camp Bullis	12921	San Antonio	San Antonio	187	San Antonio	194	COM	San Antonio	SAT	West	4					San Antonio	12	San Antonio	6	Comal
	6	Guadalupe	12921	San Antonio International Airport (SAT)	TCEQ	C58-Camp Bullis	12921	San Antonio	San Antonio	187	San Antonio	194	GUA	San Antonio	SAT	West	4					San Antonio	12	San Antonio	6	Guadalupe
	21	Wilson	12921	San Antonio International Airport (SAT)	TCEQ	C58-Camp Bullis	12921	San Antonio	San Antonio	187	San Antonio	194	WIL	San Antonio	SAT	West	4					San Antonio	12	San Antonio	6	Wilson
Victoria	19	Victoria	12912	Victoria Regional Airport (VCT)	TCEQ	C58-Camp Bullis	12912	Victoria	Victoria	347	Victoria	225	VIC	Victoria	VCT	East	3	Hou	1296	Hou	7507			Victoria	5	Victoria

Table 87: Availability of Weather Data for 41 Non-attainment and Affected County (NOAA, NREL, TCEQ, ESL).

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Table 88: Main NOAA Weather Stations used in eCALC.

ABI	Abilene Regional Airport
AMA	Amarillo International Airport
BRO	Brownsville S. Padre Island International
LBB	Lubbock International Airport
MAF	Midland International Airport
SJT	San Angelo Mathis Field
ACT	Waco Regional Airport
SPS	Wichita Falls Municipal Airport
ATT	Austin Camp Mabry
BPT	Port Arthur Se TX Rgnl Airport
CRP	Corpus Christi International Airport
DFW	Dallas - Fort Worth International Airport
ELP	El Paso International Airport
GGG	Longview E TX Rgnl Airport
IAH	Houston Bush Intercontinental
SAT	San Antonio International Airport
VCT	Victoria Regional Airport

Table 89: Summary of Weather Data Assignments for ERCOT Counties.

ERCOT COUNTY	ASSIGNED WEATHER STATION
ANDERSON	GGG
ANDREWS	MAF
ANGELINA	GGG
ARANSAS	CRP
ARCHER	SPS
ATASCOSA	SAT
AUSTIN	IAH
BANDERA	SAT
BASTROP	ATT
BAYLOR	SPS
BEE	VCT
BELL	ACT
BEXAR	SAT
BLANCO	ATT
BORDEN	LBB
BOSQUE	ACT
BRAZORIA	IAH
BRAZOS	IAH
BREWSTER	SJT
BRISCOE	AMA
BROOKS	BRO
BROWN	ACT
BURLESON	IAH
BURNET	ATT
CALDWELL	ATT
CALHOUN	VCT
CALLAHAN	ABI
CAMERON	BRO
CHAMBERS	BPT
CHEROKEE	GGG
CHILDRESS	LBB
CLAY	SPS
COKE	SJT
COLEMAN	ABI
COLLIN	DFW
COLORADO	IAH
COMAL	SAT
COMANCHE	ACT
CONCHO	SJT
COOKE	SPS
CORYELL	ACT
COTTLE	SPS
CRANE	MAF
CROCKETT	SJT
CROSBY	LBB
CULBERSON	ELP
DALLAS	DFW
DAWSON	LBB
DE WITT	VCT
DELTA	DFW
DENTON	DFW
DICKENS	LBB
DIMMIT	CRP
DUVAL	CRP
EASTLAND	ABI
ECTOR	MAF
EDWARDS	SJT
ELLIS	DFW
ERATH	ABI
FALLS	ACT
FANNIN	SPS
FAYETTE	IAH
FISHER	ABI
FOARD	SPS
FORT BEND	IAH
FRANKLIN	DFW
FREESTONE	ACT
FRIO	SAT
GALVESTON	IAH
GILLESPIE	ATT
GLASSCOCK	MAF
GOLIAD	VCT
GONZALES	SAT
GRAYSON	SPS
GRIMES	IAH
GUADALUPE	SAT
HALL	AMA
HAMILTON	ACT
HARDEMAN	SPS
HARRIS	IAH
HASKELL	ABI
HAYS	ATT
HENDERSON	DFW
HIDALGO	BRO
HILL	ACT
HOOD	DFW
HOPKINS	DFW
HOUSTON	GGG
HOWARD	MAF
HUDSPETH	ELP
HUNT	SPS
IRION	SJT
JACK	ABI
JACKSON	VCT
JEFF DAVIS	MAF
JIM HOGG	BRO
JIM WELLS	CRP
JOHNSON	DFW
JONES	ABI
KARNES	VCT
KAUFMAN	DFW
KENDALL	SAT
KENEDY	BRO
KENT	LBB
KERR	ATT
KIMBLE	SJT
KING	LBB
KINNEY	SAT
KLEBERG	CRP
KNOX	SPS
LA SALLE	CRP
LAMAR	DFW
LAMPASAS	ACT
LAVACA	VCT
LEE	ATT
LEON	ACT
LIMESTONE	ACT
LIVE OAK	CRP
LLANO	ATT
LOVING	MAF
MADISON	IAH
MARTIN	MAF
MASON	ATT
MATAGORDA	VCT
MAVERICK	CRP
MCCULLOCH	SJT
MCLENNAN	ACT
MCMULLEN	CRP
MEDINA	SAT
MENARD	SJT
MIDLAND	MAF
MILAM	IAH
MILLS	ACT
MITCHELL	ABI
MONTAGUE	SPS
MONTGOMERY	IAH
MOTLEY	LBB
NACOGDOCHES	GGG
NAVARRO	ACT
NOLAN	ABI
NUECES	CRP
PALO PINTO	ABI
PARKER	DFW
PECOS	SJT
PRESIDIO	SJT
RAINS	DFW
REAGAN	MAF
REAL	ATT
RED RIVER	DFW
REEVES	MAF
REFUGIO	VCT
ROBERTSON	IAH
ROCKWALL	DFW
RUNNELS	SJT
RUSK	GGG
SAN PATRICIO	CRP
SAN SABA	ATT
SCHLEICHER	SJT
SCURRY	LBB
SHACKELFORD	ABI
SMITH	DFW
SOMERVELL	DFW
STARR	BRO
STEPHENS	ABI
STERLING	SJT
STONEWALL	LBB
SUTTON	SJT
TARRANT	DFW
TAYLOR	ABI
TERRELL	SJT
THROCKMORTON	ABI
TITUS	DFW
TOM GREEN	SJT
TRAVIS	ATT
UPTON	MAF
UVALDE	SAT
VAL VERDE	SAT
VAN ZANDT	DFW
VICTORIA	VCT
WALLER	IAH
WARD	MAF
WASHINGTON	IAH
WEBB	CRP
WHARTON	VCT
WICHITA	SPS
WILBARGER	SPS
WILLACY	BRO
WILLIAMSON	ATT
WILSON	SAT
WINKLER	MAF
WISE	DFW
YOUNG	ABI
ZAPATA	BRO
ZAVALA	CRP

Table 90: Assignment of NWS Weather Stations for all ERCOT Counties.

No.	The City TMY2 Weather File is Available	County with TMY2 Weather Station					Adjacent Counties						Nearest Counties						
		County Name	Weather Zone	HDD	Table	Weather Station Assigned	No.	County Name	Weather Zone	HDD	Table	Weather Station Assigned	No.	County Name	Nearest Cities with TMY2 Files	Weather Zone	HDD	Table	Weather Station Assigned
1	Abilene	TAYLOR	6B	2584	B-8	ABI	1	CALLAHAN	6B			ABI	1	EASTLAND	Abilene (6B)	6B			ABI
							2	COLEMAN	5B			ABI	2	ERATH	Abilene (6B), Fort Worth (5B)	6B			ABI
							3	FISHER	6B			ABI	3	HASKELL	Abilene (6B), Wichita Falls (7B)	6B			ABI
							4	JONES	6B			ABI	4	JACK	Fort Worth (5B), Abilene (6B)	6B			ABI
							5	NOLAN	6B			ABI	5	MITCHELL	Abilene (6B), Midland (6B)	6B			ABI
							6	SHACKELFORD	6B			ABI	6	PALO PINTO	Fort Worth (5B), Abilene (6B)	6B	2625	B-8	ABI
													7	STEPHENS	Abilene (6B)	6B			ABI
													8	THROCKMORTON	Abilene (6B), Wichita Falls (7B)	6B			ABI
													9	YOUNG	Wichita Falls (7B), Abilene (6B), Fort Worth (5B)	6B			ABI
2	Amarillo	POTTER	9B	4258	B-13	AMA							10	BRISCOE	Amarillo (9B), Lubbock (7B)	8			AMA
													11	HALL	Amarillo (9B), Lubbock (7B)	8			AMA
3	Austin	TRAVIS	5B	1688	B-6	ATT	7	BASTROP	4B			ATT	12	GILLESPIE	San Antonio (4B), Austin (5B)	5A			ATT
							8	BLANCO	5A			ATT	13	KERR	San Antonio (4B), Austin (5B)	5A			ATT
							9	BURNET	5A			ATT	14	LEE	Austin (5B), Houston (4B)	4B			ATT
							10	CALDWELL	4B			ATT	15	LLANO	Austin (5B), San Antonio (4B)	5B			ATT
							11	HAYS	5B			ATT	16	MASON	Austin (5B), San Antonio (4B)	5B			ATT
							12	WILLIAMSON	5B			ATT	17	REAL	San Antonio (4B), Austin (5B), San Angelo (5B)	5A			ATT
													18	SAN SABA	Austin (5B), San Angelo (5B), Waco (5B)	5B			ATT
4	Brownsville	CAMERON	2B	635	B-3	BRO	13	HIDALGO	2B	778	B-3	BRO	19	BROOKS	Brownsville (2B), Corpus Christie (3B)	2B			BRO
							14	WILLACY	2B			BRO	20	JIM HOGG	Brownsville (2B), Corpus Christie (3B)	2B			BRO
													21	KENEDY	Brownsville (2B), Corpus Christie (3B)	2B			BRO
													22	STARR	Brownsville (2B)	2B			BRO
													23	ZAPATA	Brownsville (2B), Corpus Christie (3B)	2B			BRO
5	Corpus Christi	NUECES	3B	1016	B-5	CRP	15	ARANSAS	3B			CRP	24	DIMMIT	Corpus Christi (3B), San Anotonio (4B)	3C			CRP
							16	JIM WELLS	3C	1062	B-5	CRP	25	DUVAL	Corpus Christi (3B)	3C			CRP
							17	KLEBERG	2B			CRP	26	LA SALLE	Corpus Christi (3B)	3C			CRP
							18	SAN PATRICIO	3C			CRP	27	LIVE OAK	Corpus Christi (3B), Victoria (3B)	3C			CRP
													28	MAVERICK	San Anotonio (4B), Corpus Christi (3B)	3C	1441	B-5	CRP
													29	MCMULLEN	Corpus Christi (3B), Victoria (3B)	3C			CRP
													30	WEBB	Corpus Christi (3B)	3C	1025	B-5	CRP
													31	ZAVALA	San Anotonio (4B), Corpus Christi (3B)	3C			CRP
6	El Paso	EL PASO	6B	2708	B-10	ELP	19	HUDSPETH	6B			ELP	32	CULBERSON	El Paso (6B)	6B			ELP
7	Fort Worth	TARRANT	5B	2304	B-8	DFW	20	COLLIN	6B			DFW	33	DELTA	Fort Worth (5B)	6B			DFW
							21	DALLAS	5B	2259	B-8	DFW	34	FRANKLIN	Fort Worth (5B)	6B			DFW
							22	DENTON	6B	2665	B-8	DFW	35	HENDERSON	Fort Worth (5B), Lufkin (5A), Waco (5B)	5B			DFW
							23	ELLIS	5B			DFW	36	HOOD	Fort Worth (5B), Waco (5B)	5B			DFW
							24	JOHNSON	5B			DFW	37	HOPKINS	Fort Worth (5B)	6B			DFW
							25	PARKER	6B			DFW	38	KAUFMAN	Fort Worth (5B)	6B			DFW
							26	WISE	6B			DFW	39	LAMAR	Fort Worth (5B)	6B			DFW
													40	RAINS	Fort Worth (5B)	6B			DFW
													41	RED RIVER	Fort Worth (5B)	6B			DFW
													42	ROCKWALL	Fort Worth (5B)	6B			DFW
													43	SMITH	Fort Worth (5B), Lufkin (5A)	5B	2194	B-8	DFW
													44	SOMERVELL	Fort Worth (5B), Waco (5B)	5B			DFW
													45	TITUS	Fort Worth (5B)	6B			DFW
													46	VAN ZANDT	Fort Worth (5B)	6B			DFW
8	Houston	HARRIS	4B	1371	B-5	IAH	27	BRAZORIA	3B			IAH	47	AUSTIN	Houston (4B)	4B			IAH
							28	FORT BEND	4B			IAH	48	BRAZOS	Houston (4B), Austin (5B), Waco (5B)	4B			IAH
							29	GALVESTON	3B	1263	B-5	IAH	49	BURLESON	Austin (5B), Waco (5B), Houston (4B)	4B			IAH
							30	MONTGOMERY	4B			IAH	50	COLORADO	Houston (4B), Victoria (3B)	4B			IAH
							31	WALLER	4B			IAH	51	FAYETTE	Houston (4B), San Antonio (4B)	4B			IAH
													52	GRIMES	Houston (4B)	4B			IAH
													53	MADISON	Houston (4B), Waco (5B), Lufkin (5A)	4B			IAH
													54	MILAM	Austin (5B), Waco (5B), Houston (4B)	4B			IAH
													55	ROBERTSON	Waco (5B), Houston (4B)	4B			IAH
													56	WASHINGTON	Houston (4B), Austin (5B)	4B			IAH
9	Lubbock	LUBBOCK	7B	3431	B-11	LBB	32	CROSBY	7B			LBB	57	BORDEN	Lubbock (7B), Abilene (6B), Midland (6B)	7B			LBB
													58	CHILDRESS	Lubbock (7B), Wichita Falls (7B)	7B			LBB
													59	DAWSON	Lubbock (7B), Midland (6B)	7B	3159	B-11	LBB
													60	DICKENS	Lubbock (7B)	7B			LBB
													61	KENT	Lubbock (7B), Abilene (6B)	7B			LBB
													62	KING	Lubbock (7B), Abilene (6B), Wichita Falls (7B)	7B			LBB
													63	MOTLEY	Lubbock (7B)	7B			LBB
													64	SCURRY	Lubbock (7B), Midland (6B), Abilene (6B)	7B	3185	B-11	LBB
													65	STONEWALL	Abilene (6B), Lubbock (7B), Wichita Falls (7B)	7B			LBB
10	Lufkin	ANGELINA	5A	1951	B-8	GGG	33	CHEROKEE	5A			GGG	66	ANDERSON	Lufkin (5A)	5A	2005	B-8	GGG
							34	HOUSTON	5A			GGG	67	RUSK	Lufkin (5A)	5B			GGG
							35	NACOGDOCHES	5A			GGG	67						
11	Midland	MIDLAND	6B	2751	B-10	MAF	36	ANDREWS	6B			MAF	68	HOWARD	Midland (6B)	6B	2772	B-10	MAF
							37	CRANE	5B			MAF	69	JEFF DAVIS	Midland (6B), El Paso (6B)	6B			MAF
							38	ECTOR	6B			MAF	70	LOVING	Midland (6B)	6B			MAF
							39	GLASSCOCK	6B			MAF	71	REEVES	Midland (6B)	6B	2505	B-8	MAF
							40	MARTIN	6B			MAF	72	WARD	Midland (6B)	6B			MAF
							41	REAGAN	5B			MAF	73	WINKLER	Midland (6B)	6B			MAF
							42	UPTON	5B			MAF	73						
12	Port Arthur	JEFFERSON	4B	1677	B-6	BPT	43	CHAMBERS	4B			BPT	73						
13	San Angelo	TOM GREEN	5B	2414	B-8	SJT	44	COKE	6B			SJT	74	BREWSTER	El Paso (6B), San Angelo (5B)	5A			SJT
							45	CONCHO	5B			SJT	75	CROCKETT	San Angelo (5B)	5B			SJT
							46	IRION	5B			SJT	76	EDWARDS	San Angelo (5B)	5A			SJT
							47	MENARD	5B			SJT	77	KIMBLE	San Angelo (5B), Austin (5B)	5A			SJT
							48	RUNNELS	5B			SJT	78	MCCULLOCH	San Angelo (5B)	5B			SJT
							49	SCHLEICHER	5B			SJT	79	PECOS	San Angelo (5B)	5A			SJT
							50	STERLING	6B			SJT	80	PRESIDIO	El Paso (6B), San Angelo (5B)	5A			SJT
													81	SUTTON	San Angelo (5B)	5A			SJT
													82	TERRELL	San Angelo (5B)	5A			SJT
14	San Antonio	BEXAR	4B	1644	B-6	SAT	51	ATASCOSA	3C			SAT	83	FRIO	San Antonio (4B), Corpus Christi (3B)	3C			SAT
							52	BANDERA	5A			SAT	84	GONZALES	San Antonio (4B), Victoria (3B)	4B			SAT
							53	COMAL	4B			SAT	85	KINNEY	San Antonio (4B)	4B			SAT
							54	GUADALUPE	4B			SAT	86	UVALDE	San Antonio (4B)	4B			SAT
							55	KENDALL	5A			SAT	87	VAL VERDE	San Anotonio (4B), San Angelo (5B)	4B	1565	B-5	SAT
							56	MEDINA	4B			SAT	87						SAT
							57	WILSON	4B			SAT	87						
15	Victoria	VICTORIA	3B	1296	B-5	VCT	58	CALHOUN	3B			VCT	88	BEE	Corpus Christi (3B), Victoria (3B)	3B	1372	B-5	VCT
							59	DE WITT	3C			VCT	89	KARNES	Victoria (3B), San Antonio (4B), Corpus Christi (3B)	3C			VCT
							60	GOLIAD	3B			VCT	90	MATAGORDA	Victoria (3B)	3B	1370	B-5	VCT
							61	JACKSON	3B			VCT	91	WHARTON	Victoria (3B), Houston (4B)	3B			VCT
							62	LAVACA	4B			VCT	91						
							63	REFUGIO	3B			VCT	91						
16	Waco	MCLENNAN	5B	2179	B-8	ACT	64	BELL	5B	2127	B-8	ACT	92	BROWN	Abilene (6B), Waco (5B), San Angelo (5B)	5B	2199	B-8	ACT
							65	BOSQUE	5B			ACT	93	COMANCHE	Waco (5B), Abilene (6B)	5B			ACT
							66	CORYELL	5B			ACT	94	FREESTONE	Waco (5B)	5B			ACT
							67	FALLS	5B			ACT	95	HAMILTON	Waco (5B)	5B			ACT
							68	HILL	5B			ACT	96	LAMPASAS	Waco (5B), Austin (5B)	5B			ACT
							69	LIMESTONE	5B			ACT	97	LEON	Waco (5B), Lufkin (5A)	5B			ACT
													98	MILLS	Waco (5B), Austin (5B)	5B			ACT
													99	NAVARRO	Waco (5B), Fort Worth (5B)	5B	2396	B-8	ACT
17	Wichita Falls	WICHITA	7B	3042	B-10	SPS	70	ARCHER	7B			SPS	100	COOKE	Fort Worth (5B), Wichita Falls (7B)	6B			SPS
							71	BAYLOR	7B			SPS	101	COTTLE	Witchita Falls (7B), Lubbock (7B)	7B			SPS
							72	CLAY	7B			SPS	102	FANNIN	Fort Worth (5B), Wichita Falls (7B)	6B			SPS
							73	WILBARGER	7B	3186	B-10	SPS	103	FOARD	Witchita Falls (7B)	7B			SPS
													104	GRAYSON	Fort Worth (5B), Wichita Falls (7B)	6B	2890	B-10	SPS
													105	HARDEMAN	Witchita Falls (7B)	7B			SPS
													106	HUNT	Fort Worth (5B), Wichita Falls (7B)	6B	2953	B-10	SPS
													107	KNOX	Wichita Falls (7B)	7B			SPS
													108	MONTAGUE	Wichita Falls (7B), Fort Worth (5B)	6B			SPS

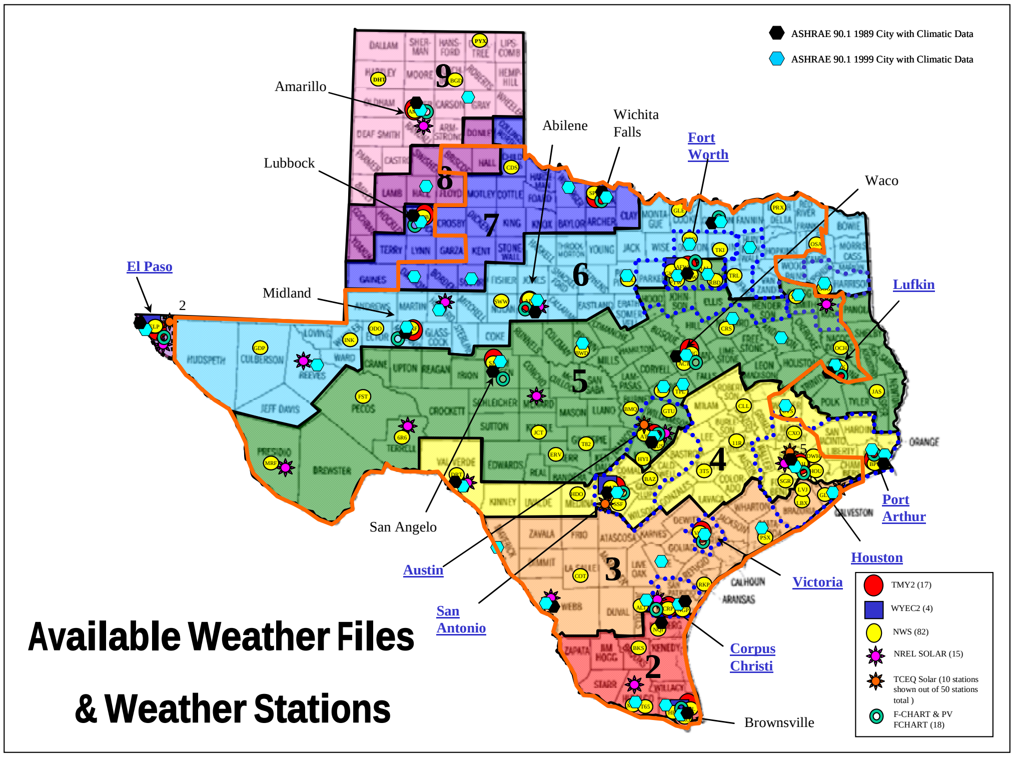

Figure 161: Available Weather Stations in Texas for all ERCOT Counties.

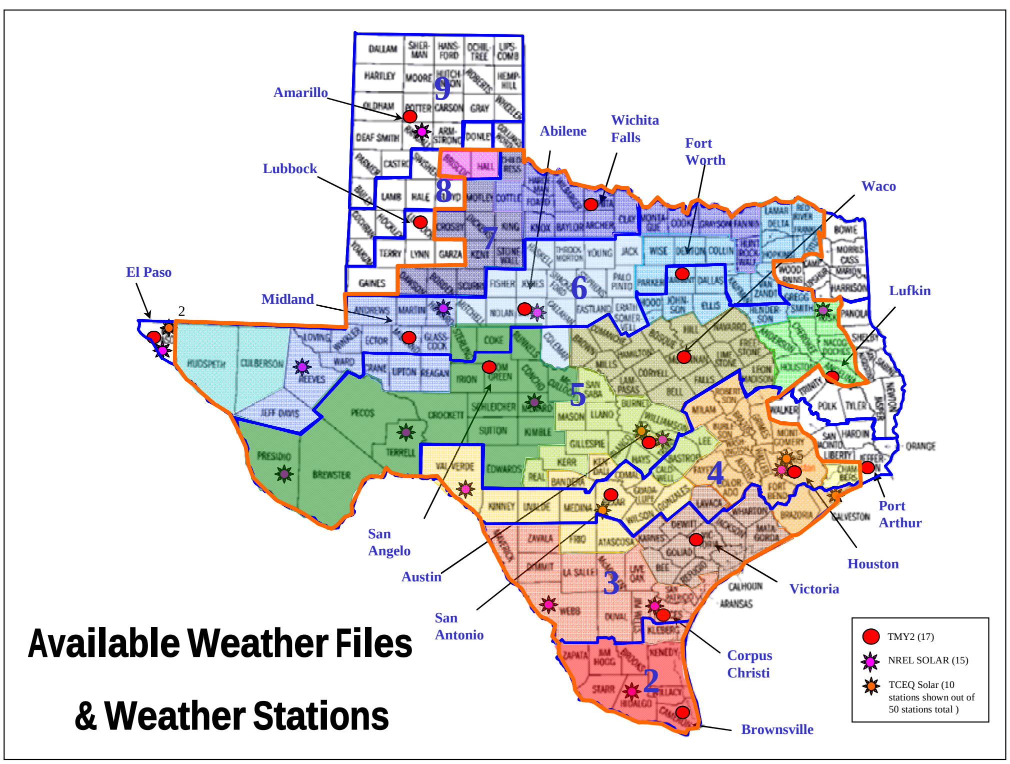

Figure 162: Grouping of Weather Stations in Texas for all ERCOT Counties.

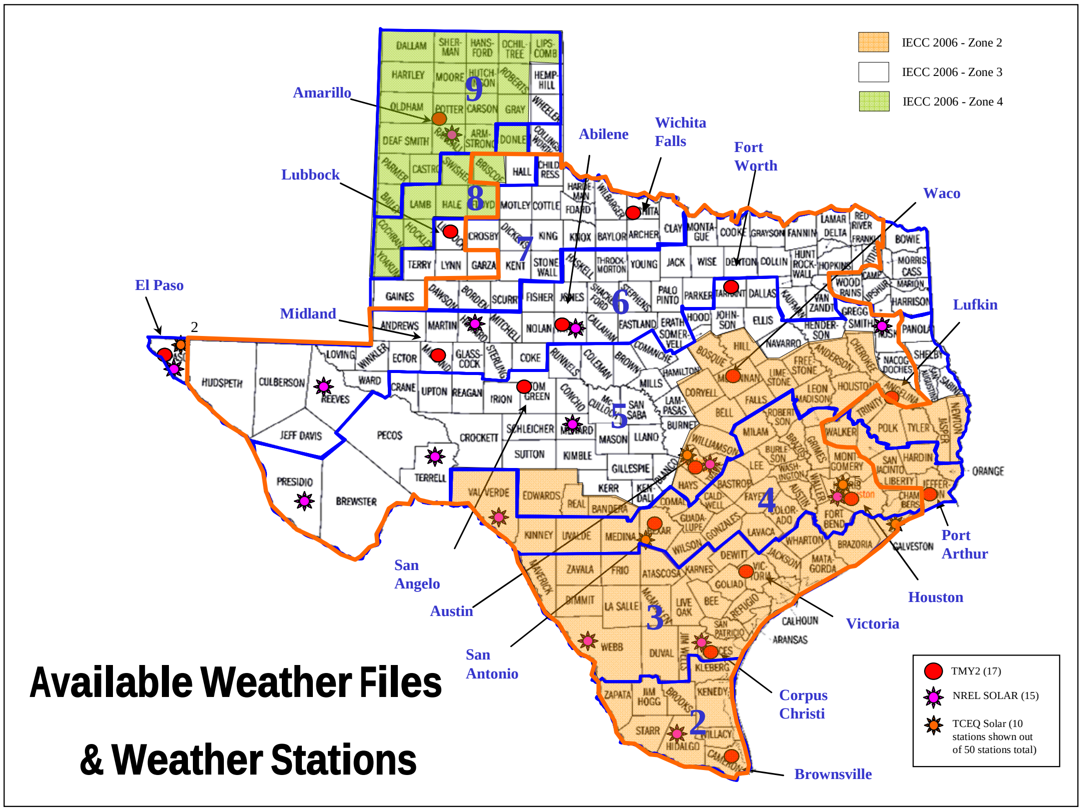

Figure 163: Available Weather Stations in Texas for all ERCOT Counties Showing 2000/2001 and 2006 Climate Zones.

Table 91: List of Available Weather Files in Texas (Listed by Symbol).

List of Available Weather Files and Weather Stations of Texas

Texas Weather Stations (NOAA)

1	Abilene Regional Airport (ABI)
2	Alice International Airport (ALI)
3	Amarillo International Airport (AMA)
4	Angleton / Lake Jackson Brazori (LBX)
5	Arlington Municipal Airport (GKY)
6	Austin - Bergstrom International (AUS)
7	Austin Camp Mabry (ATT)
8	Borger Hutchinson County Airport (BGD)
9	BRENHAM: BRENHAM MUNICIPAL AIRPORT (11R)
10	Brownsville S Padre Isl International (BRO)
11	BROWNWOOD: BROWNWOOD REGIONAL AIRPORT (BWD)
12	Burnet Municipal Airport (BMQ)
13	Childress Municipal Airport (CDS)
14	College Station (CLL)
15	Conroe Montgomery County Airport (CXO)
16	Corpus Christi International Airport (CRP)
17	CORPUS CHRISTI: CORPUS CHRISTI NAS/TRUAX FIELD ARPT (NGP)
18	Corsicana Campbell Field (CRS)
19	Cotulla La Salle Co Airport (COT)
20	Dalhart Municipal Airport (DHT)
21	Dallas - Fort Worth International Airport (DFW)
22	Dallas Love Field (DAL)
23	Dallas Redbird Airport (RBD)
24	Del Rio International Airport (DRT)
25	Denton Municipal Airport (DTO)
26	Dryden Terrell County Airport (6R6)
27	El Paso International Airport (ELP)
28	FALFURRIAS : BROOKS COUNTY AIRPORT (BKS)
29	Fort Stockton Pecos County Airport (FST)
30	Fort Worth Alliance Airport (AFW)
31	Fort Worth Meacham (FTW)
32	FREDERICKSBURG: GILLESPIE COUNTY AIRPORT (T82)
33	GAINESVILLE : GAINESVILLE MUNICIPAL AIRPORT (GLE)
34	Galveston Scholes Field (GLS)
35	GEORGETOWN : GEORGETOWN MUNICIPAL AIRPORT (GTU)
36	Harlingen Rio Grande Valley I (HRL)
37	Hondo Municipal Airport (HDO)
38	Houston Bush Intercontinental (IAH)
39	Houston Clover Field (LVJ)
40	Houston Hooks Memorial Airport (DWH)
41	Houston Sugarland Mem (SGR)
42	Houston William P Hobby Airport (HOU)
43	Huntsville Municipal Airport (UTS)
44	JASPER : JASPER COUNTY-BELL FIELD AIRPORT (JAS)
45	Junction Kimble County Airport (JCT)
46	KERRVILLE : KERRVILLE MUNI/LOUIS SCHREINER FLD AIRPORT (ERV)
47	KILLEEN : KILLEEN MUNICIPAL AIRPORT (ILE)
48	KINGSVILLE : KINGSVILLE NAS AIRPORT (NQI)
49	LA GRANGE : FAYETTE REGIONAL AIR CENTER AIRPORT (3T5)
50	Longview E Tx Rgnl Airport (GGG)
51	Lubbock International Airport (LBB)
52	Lufkin Angelina Cty Airport (LFK)
53	MARFA : MARFA MUNICIPAL AIRPORT (MRF)
54	McAllen Miller International Airport (MFE)
55	McKinney Municipal Airport (TKI)
56	Midland International Airport (MAF)
57	Mineral Wells Airport (MWL)
58	MOUNT PLEASANT : MOUNT PLEASANT REGIONAL AIRPORT (OSA)
59	NACOGDOCHES : A L MANGHAM JR REGIONAL AIRPORT (OCH)
60	New Braunfels Municipal Airport (BAZ)
61	Odessa Schlemeyer Field (ODO)
62	Palacios Municipal Airport (PSX)
63	PARIS : COX FIELD AIRPORT (PRX)
64	PERRYTON : PERRYTON OCHILTREE COUNTY AIRPORT (PYX)
65	Pine Springs Guadalupe Mounta (GDP)
66	Port Arthur Se Tx Rgnl Airport (BPT)
67	Port Isabel Cameron County Airport (PIL)
68	Rockport Aransas Co Airport (RKP)
69	San Angelo Mathis Field (SJT)
70	San Antonio International Airport (SAT)
71	San Antonio Stinson Municipal Airport (SSF)
72	SAN MARCOS : SAN MARCOS MUNICIPAL AIRPORT (HYI)
73	SWEETWATER : AVENGER FIELD AIRPORT (SWW)
74	TEMPLE: DRAUGHON-MILLER CNTRL TEXAS REGIONAL ARPT (TPL)
75	Terrell Municipal Airport (TRL)
76	Tyler Pounds Field (TYR)
77	Victoria Regional Airport (VCT)
78	WACO : MC GREGOR EXECUTIVE AIRPORT (PWG)
79	Waco Regional Airport (ACT)
80	WESLACO : MID VALLEY AIRPORT (T65)
81	Wichita Falls Municipal Airport (SPS)
82	Wink Winkler Co Airport (INK)

Texas TMY2 Weather Files

1	Abilene
2	Amarillo
3	Austin
4	Brownsville
5	Corpus Christi
6	El Paso
7	Fort Worth
8	Houston
9	Lubbock
10	Lufkin
11	Midland
12	Port Arthur
13	San Angelo
14	San Antonio
15	Victoria
16	Waco
17	Wichita Falls

Texas WYEC2 Weather Files

1	El Paso
2	Brownsville
3	Fort Worth
4	San Antonio

NREL Solar Stations

1	Abilene
2	Austin
3	Big Spring
4	Canyon
5	Clear Lake
6	Corpus Christi
7	Del Rio
8	Edinburg
9	El Paso
10	Laredo
11	Menard
12	Overton
13	Pecos
14	Presidio
15	Sanderson

TCEQ Solar Stations

1	Bexar
2	Travis
3	El Paso (2)
4	Galveston
5	Harris (5)

FCHART and PV FCHART (New Weather File)

1	ABILENE
2	AMARILLO
3	AUSTIN
4	BROWNSVILLE
5	CORPUS CHRISTI
6	EL PASO
7	FORT WORTH
8	HOUSTON
9	LUBBOCK
10	LUFKIN
11	MIDLAND-ODESSA
12	PORT ARTHUR
13	SAN ANGELO
14	SAN ANTONIO
15	SHERMAN
16	VICTORIA
17	WACO
18	WICHITA FALLS

9 PLANNED VERIFICATION TO THE EMISSIONS CALCULATOR (eCALC)

As part of the analysis effort, verification and validation efforts are planned for each of the major analysis areas in the emissions calculator, including: on-site inspections, and calibrated simulations.

9.1 On-site Inspections

On-site inspection work continued in 2006, including residential and commercial buildings to determine if specific energy-conserving features are being installed properly.

9.2 Calibrated Simulations

Calibrated simulations are planned for two commercial sites and one residential site to help confirm the accuracy of the code-compliant DOE-2 simulations. For each site, existing data loggers, installed from previous projects were restarted and the data from the sensors checked for accuracy. These sites include a standard office building, a K-12 school and a residence in College Station, Texas.

9.2.1 Standard Office building

The calibrated simulation of a standard office building using the Texas A&M University Systems Building in College Station, Texas, continues. Figure 164 to Figure 168 show the related information from this site. This building is currently being monitored as part of the campus energy conservation program and includes the channels shown in Figure 167. The goal with this site is to develop a calibrated simulation of the actual building (Figure 165), and a representative building (Figure 166), and then compare/contrast the savings differences between the calibrated model vs the representative model.

Figure 164: Standard Office Building (Texas A&M University Systems Building, College Station, Texas).

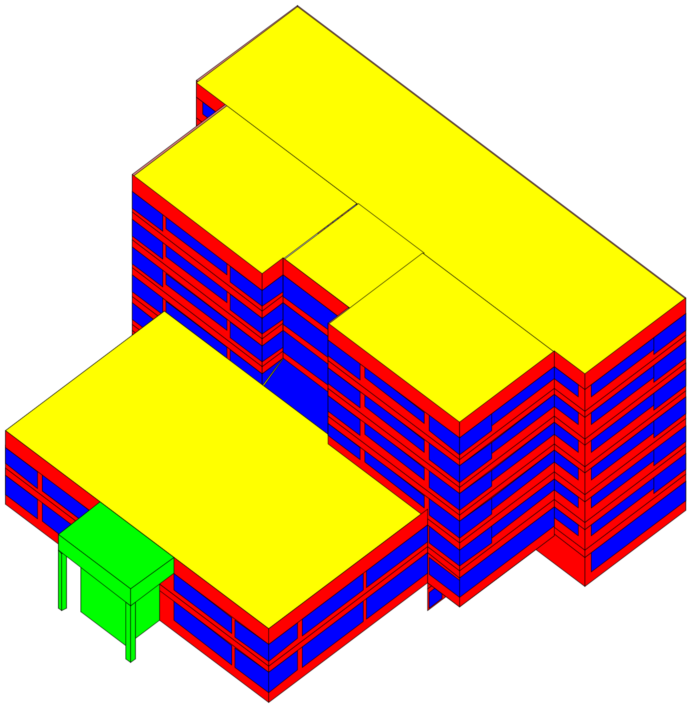

Figure 165: Computer Simulation (DOE-2.1E) of Case Study Office Building

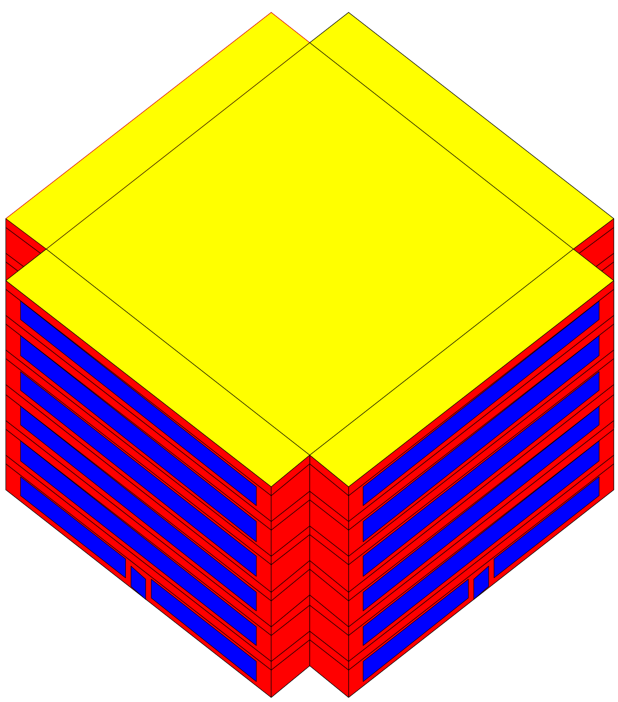

Figure 166: Computer Simulation (DOE-2.1E) of Base Case Office Building

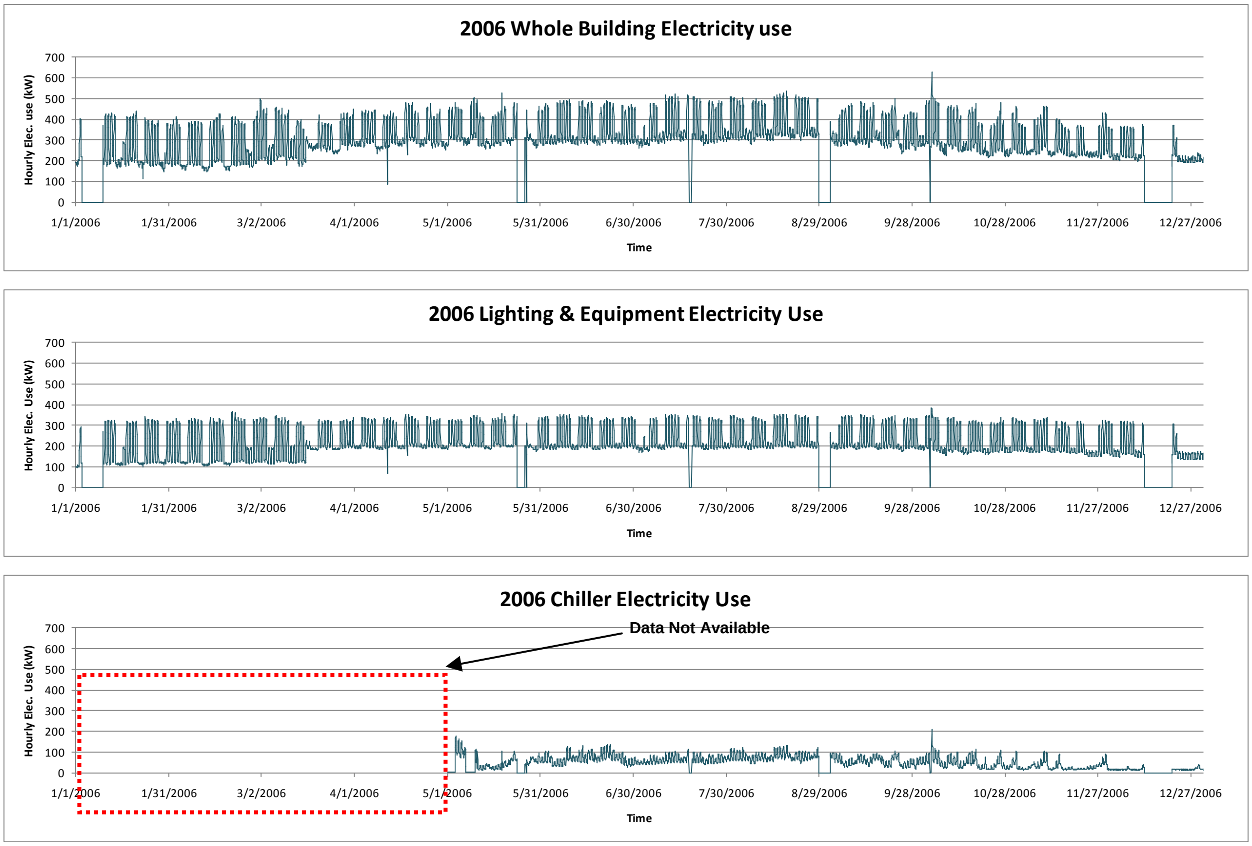

Figure 167: 2006 Time Series Plots from the Data logger Installed in the Case Study Office Building

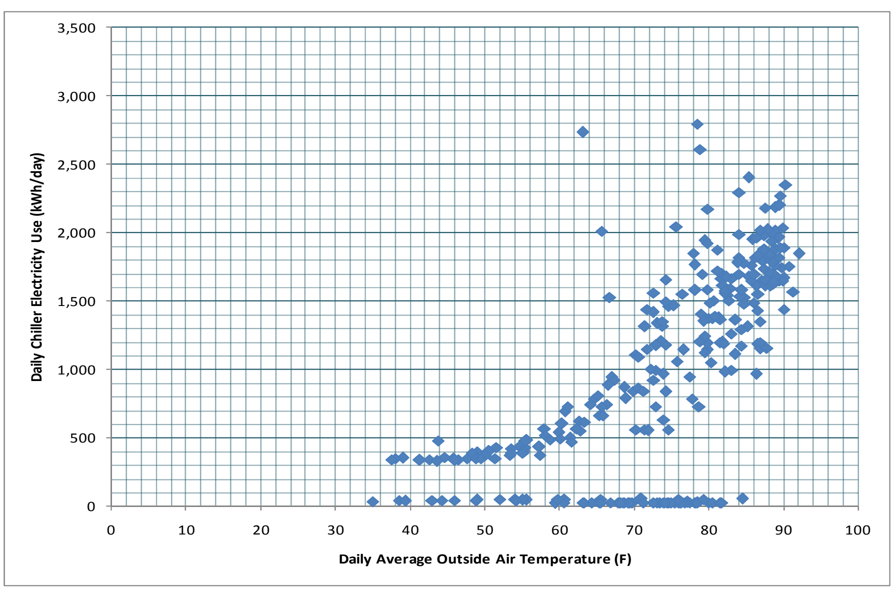

Figure 168: Scatter Plot: Outside Temperature (F) vs. Daily Whole Building Cooling Use (kWh/day)

9.2.2 K-12 Elementary School.

To expand the capabilities of the emissions calculator, which currently covers office and retail type buildings, K-12 schools were identified as the next largest category of buildings that needed to be included in the emissions reductions calculations. To begin to prepare for this new model, in cooperation with the College Station Independent School District (CSISD), the Laboratory collected representative characteristic shaping data for the school (Figure 169) and then developed a calibrated simulation of the school (Figure 170). Next, a representative shaping model was developed that could be used for an automated school generation (Figure 171 and Figure 172). Finally, actual measured data were gathered from the school to allow for the calibration of the simulation and comparison against the representative model (Figure 173 and Figure 174).

Figure 169: Photo of Case Study Elementary School

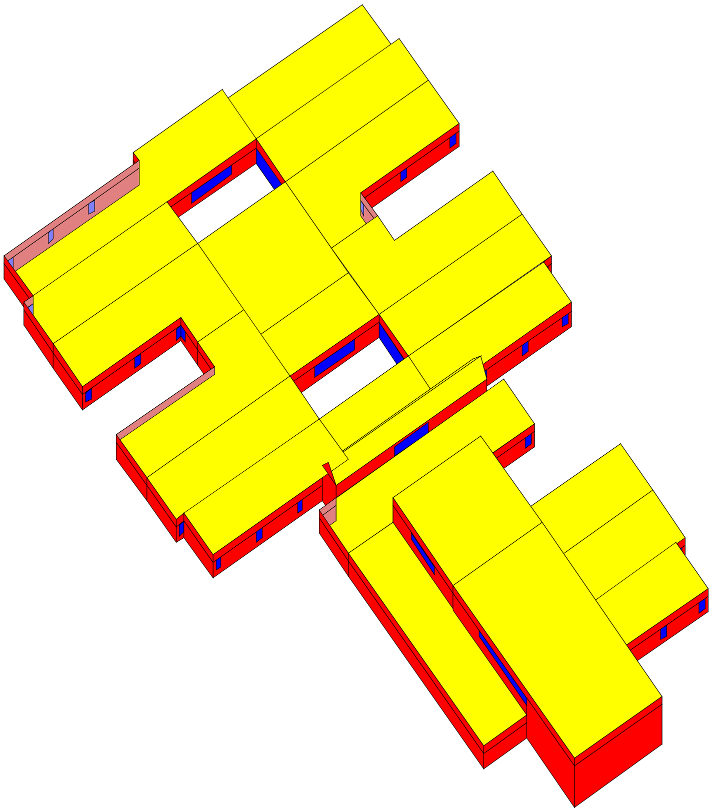

Figure 170: Computer Simulation (DOE-2.1E) of Case Study Elementary School

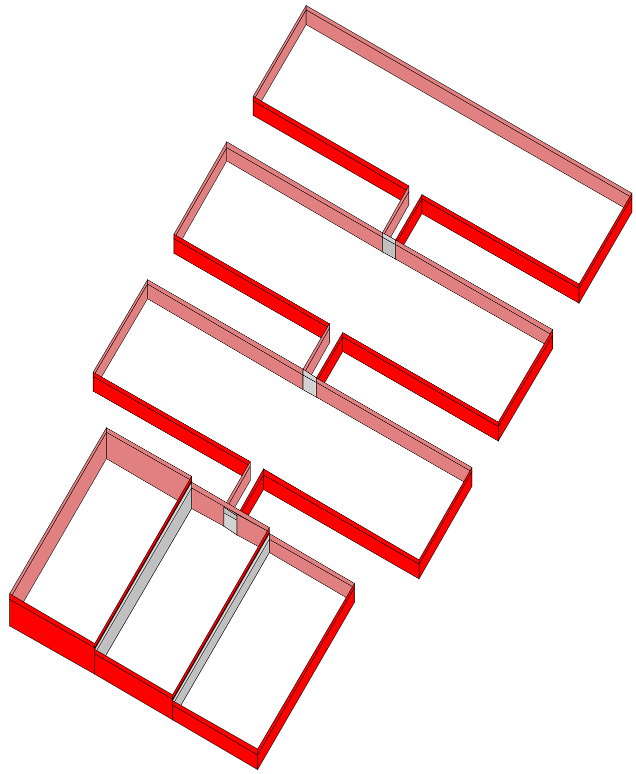

Figure 171: Computer Simulation (DOE-2.1E) of Base Case School Building

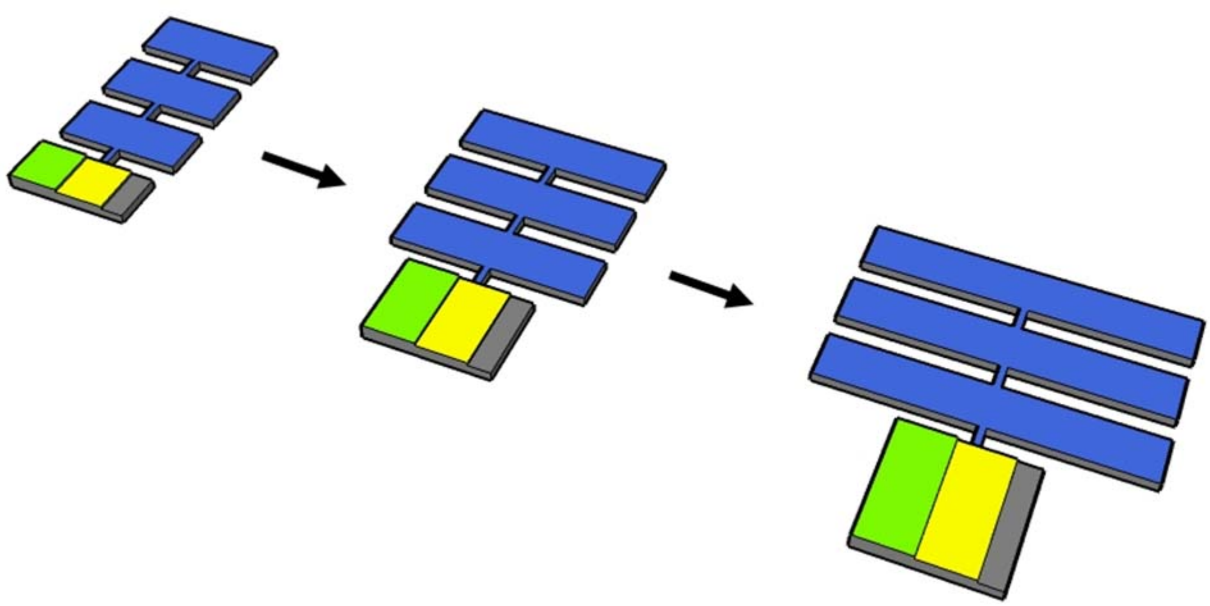

Figure 172: Concept of Base Case School Building

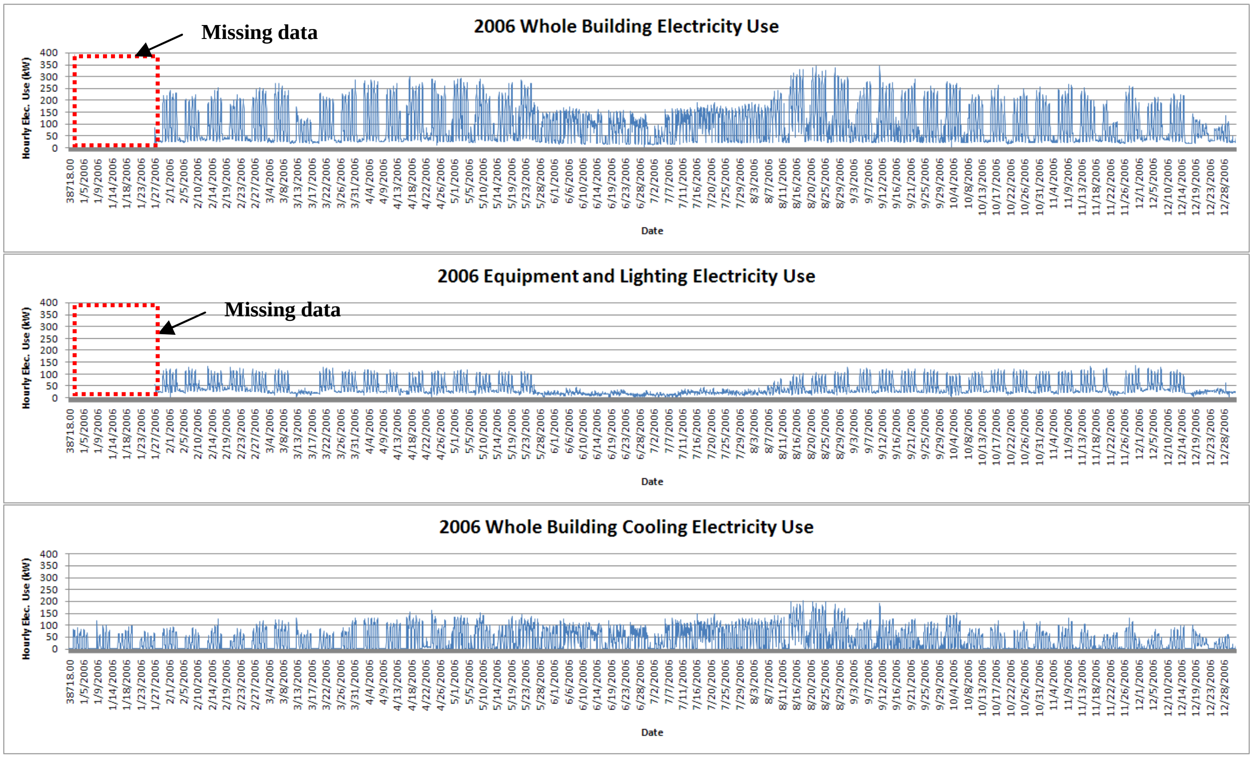

Figure 173: 2006 Time Series Plots from the Data logger Installed in the Case Study School

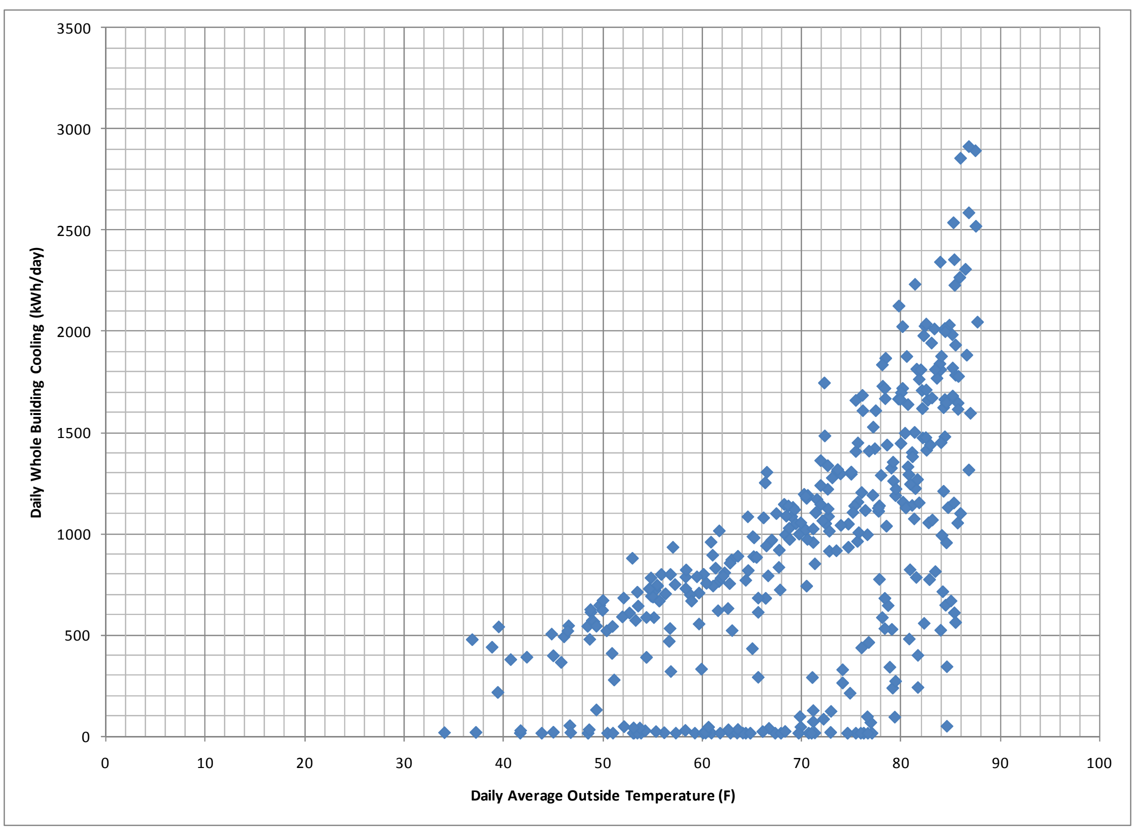

Figure 174: Scatter Plot: Outside Temperature (F) vs. Daily Whole Building Cooling Use (kWh/day)

9.2.3 Residential Building

Work on the calibrated simulation of the residential building (Figure 175) using the occupied Habitat for Humanity house in Bryan, Texas, was completed in 2006. This building is a single story, 1,050 square foot, three-bedroom residence that has central air conditioning, a gas-fired furnace, DHW, and kitchen stove/oven (Kootin-Sanwu 2004).

The monitored data from this building is being provided by a logger that was installed as part of a project to verify the performance of a low-income house. The logger records energy and environmental data, including electricity use, natural gas use, indoor, slab, attic and ambient conditions, as shown in (Figure 176 and Figure 177). This was then used to develop a calibrated simulation (Figure 178). Data for the year 2006 are shown in Figure 179.

In 2006, a duct model was developed and tested using a calibrated simulation of the Habitat House. Results of this work can be found in Kim (2006).

Figure 175: Habitat for Humanity House, Bryan, Texas (Source: Kim 2006).

Figure 176: Data logger (Synergistic Data Logger C180E) (Source: Kim 2006)

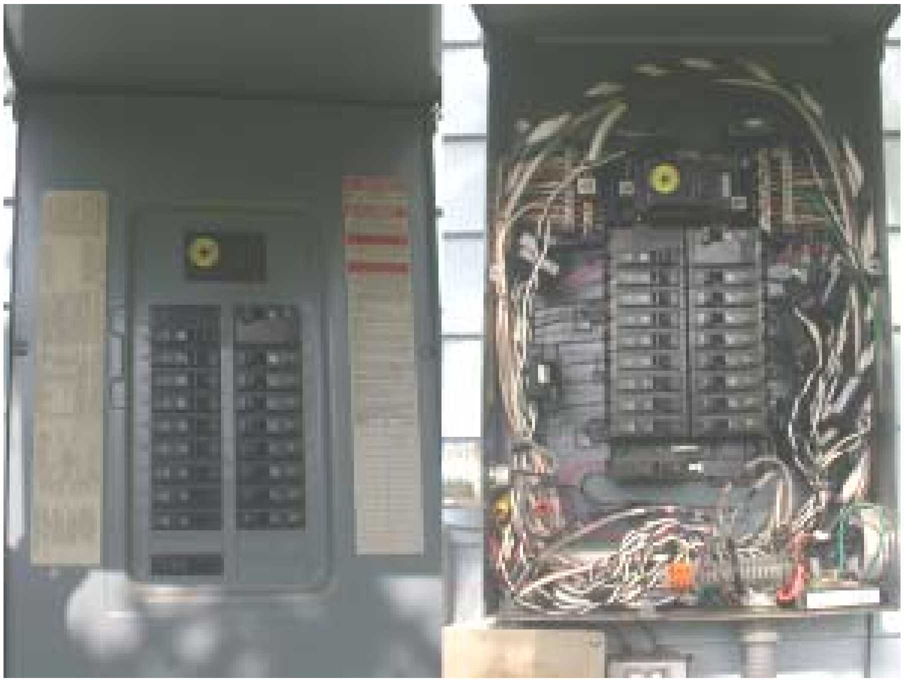

Figure 177: Electrical panel with the current transducers, face on (left) and face off (right) (Source: Kim 2006)

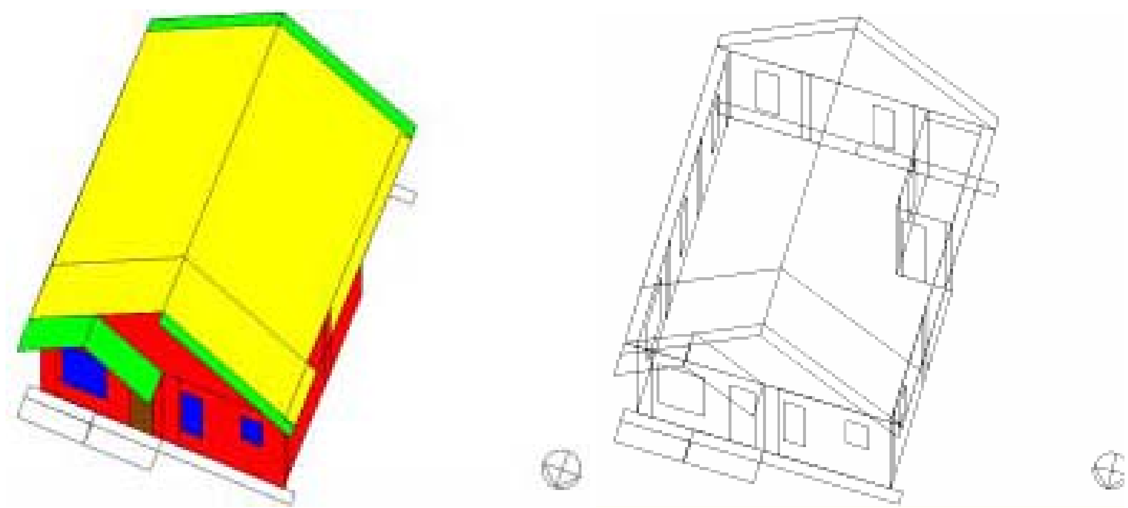

Figure 178: Computer Simulation (DOE-2.1E) of Habitat for Humanity House (Source: Kim 2006)

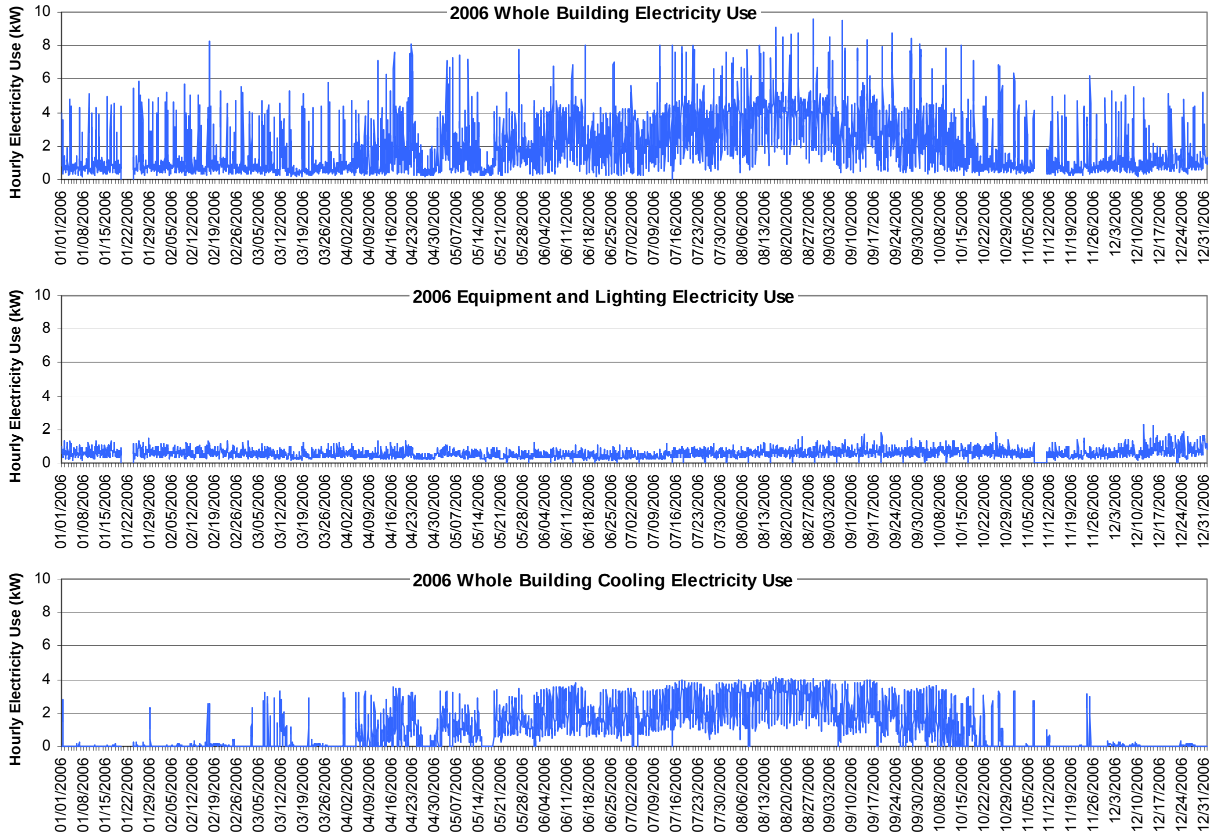

Figure 179: 2006 Time Series Plots from the Data logger Installed in the Habitat House

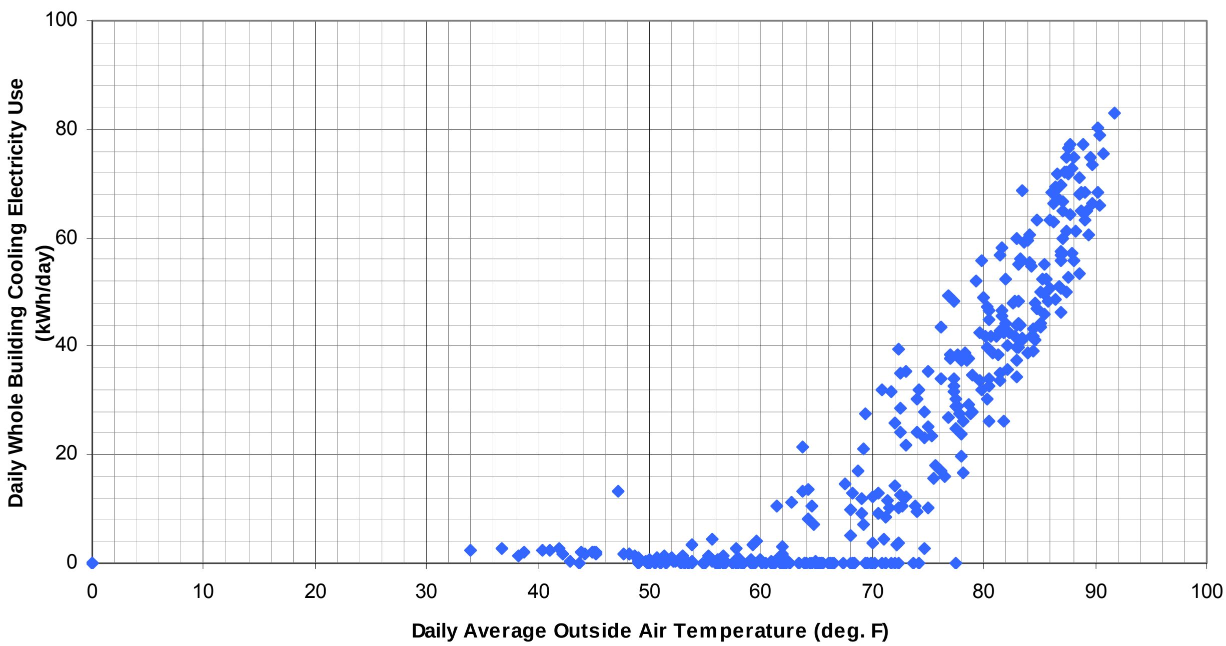

Figure 180: Scatter Plot: Outside Temperature (deg. F) vs. Daily Whole Building Cooling Use (kWh/day)

9.2.4 Solar Test Bench

In 2006 the Laboratory recalibrated the Solar Test Bench to accommodate the testing of energy-efficient glazing for purposes of verifying the calibrated simulations. Figure 181 shows photos of the instrumentation at the test bench, and Figure 182 shows weekly inspection plots from the solar test bench. Figure 183 shows preliminary results from tests at the REJ building. These tests show that the low-e glazing installed at the building are performing as expected, when measured using the proper instrumentation (i.e., photovoltaic type sensor versus thermopile type sensor). These tests are useful for verifying the simulations of the energy savings from energy efficient glazing.

Figure 181: Photos of the Laboratory's Solar Test Bench.

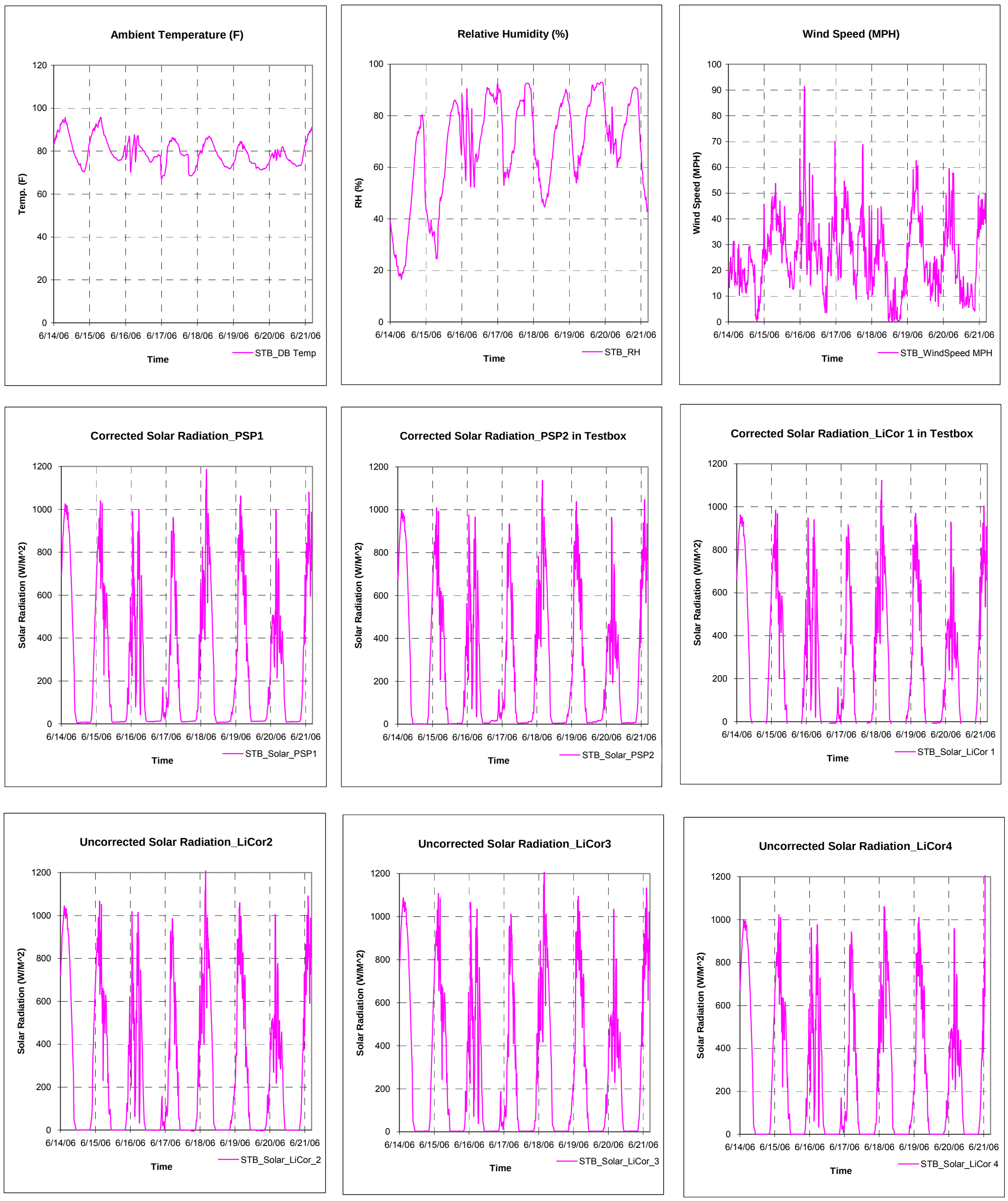

Figure 182: Weekly Inspection Plots from the Laboratory's Solar Test Bench.

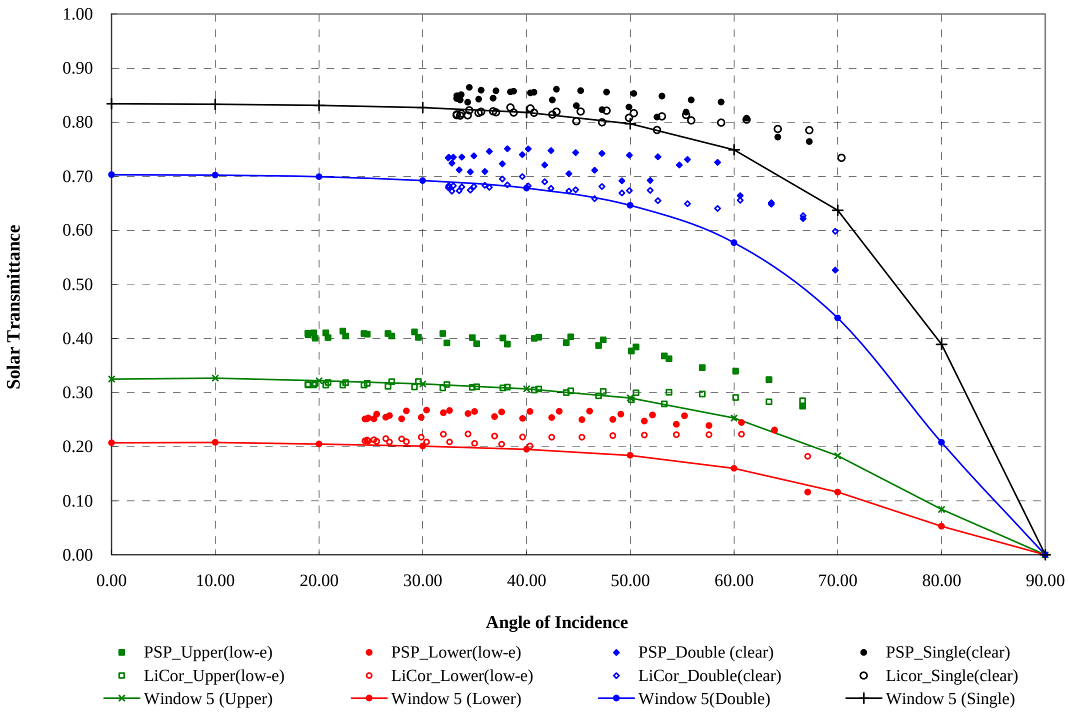

Figure 183: Results From Measured Transmittance Tests from the Laboratory's Solar Test Bench.

10 REFERENCES

Abushakra, B., Sreshthaputra, A., Haberl, J., Claridge, D. 2001. "Compilation of Diversity Factors and Schedules for Energy and Cooling Load Calculations – Final Report," submitted to ASHRAE under Research Project 1093-RP, *Energy Systems Laboratory Report No. ESL-TR-01-04-01*, Texas A&M University.

Anderson, R. C. Christensen, G. Barker, S. Horowitz, A. Courtney, T. Givler, K. Tupper. 2004. Analysis of System Strategies Targeting Near-Term Building America Energy-Performance Goals for New Single-Family Homes. NREL/TP-550-36920. Golden, CO: National Renewable Energy Laboratory.

ASHRAE. 1993. ANSI/ASHRAE Standard 136-1993 (RA 2006) - A Method of Determining Air Change Rates in Detached Dwellings. Atlanta, GA: American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.

ASHRAE. 2001. ANSI/ASHRAE Standard 62-2001 Ventilation for Acceptable Indoor Air Quality. Atlanta, GA: American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.

ASHRAE. 2003. ASHRAE Handbook - HVAC Applications. Atlanta, GA: American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.

ASHRAE 90.1 1989 Energy Standard for Buildings Except Low-Rise Residential Buildings. American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc., Atlanta, GA.

ASHRAE 90.1 1999 Energy Standard for Buildings Except Low-Rise Residential Buildings. American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc., Atlanta, GA.

ASHRAE 2004. "Advanced Energy Design Guide for Small Office Buildings," American Society of Heating, Refrigeration and Air-conditioning Engineers, Atlanta, GA.

CBECS 1995, 1999, 2003. USDOE Commercial Building Energy Characteristics Survey. U.S.D.O.E. Energy Information Agency Report.

Cho, S., Mukhopadhyay, J., Culp, C., Haberl, J. S., Yazdani, B., 2007. "Recommendations for 15% Above-Code Energy-Efficiency Measures for Commercial Office Buildings," *Energy Systems Laboratory Report No. ESL-TR-07-09-01,* Texas A&M University (in preparation).

Dodge. 2005. MarkeTrack: McGraw-Hill Construction Analytics. McGraw-Hill Construction Information Group, 148 Princeton-Hightstown Rd., Hightstown, N.J. http://dodge.construction.com.

Haberl, J., Culp, C., Yazdani, B., Fitzpatrick, and Turner, D., 2002, "Texas's senate Bill 5 Legislation for Reducing Pollution in Non-attainment and Affected Areas," Annual Report to the Texas Natural Resource Conservation Commission, July, Energy Systems Laboratory Report ESL-TR-02/07-01.

Haberl, J., Culp, C., Yazdani, B., Fitzpatrick, T., Bryant, J., Turner, D., 2003, "Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP)," Volume II – Technical Report, Annual Report to the Texas Commission on Environmental Quality, September 2002 to August 2003, Energy Systems Laboratory Report ESL-TR-03/12-04.

Haberl, J., Culp, C., Yazdani, B., Gilman, D., Fitzpatrick, T., Muns, S., Verdict, M., Ahmed, M., Liu, B., Baltazar-Cervantes, J.C., Bryant, J., Degelman, L., Turner, D. 2004. "Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP)", Volume II – Technical Report, Annual Report to the Texas Commission on Environmental Quality, September 2003 to August 2004, Energy Systems Laboratory Report ESL-TR-04/12-04.

Haberl, J., Culp, C., Yazdani, B., Gilman, D., Fitzpatrick, T., Muns, S., Verdict, M., Ahmed, M., Liu, B., Baltazar-Cervantes, J.C., Bryant, J., Degelman, L., and Turner, D. 2006. "Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP)", Volume II – Technical Report, Annual Report to the Texas Commission on Environmental Quality, September 2004 to December 2005, Energy Systems Laboratory, Report ESL-TR-06-06-08.

Huang, J. and Franconi, E. 1999. "Commercial Heating and Cooling Loads Component Analysis," *Environmental Energy Technologies Division, Report No. LBL-37208*, Lawrence Berkeley National Laboratory.

ICC. 1999. 2000 International Energy Conservation Code. Falls Church, VA: International Code Council, Inc.

ICC. 2001. 2001 Supplement to the International Energy Conservation Code. Falls Church, VA: International Code Council, Inc.

Kats, G.H. et al. 1996. "Energy Efficiency as a Commodity," *ACEEE Summer Study on Energy Efficiency in Buildings*.

Kavanaugh, S. 2003. "Estimating Demand and Efficiency," *ASHRAE Journal*, Vol.45, No. 7, pp. 36-40, July.

Kim, S. 2006. An Analysis of International Energy Conservation Code (IECC)-Compliant Single-Family Residential Energy Use. Ph.D. Dissertation, College Station, TX: Texas A&M University.

Klein, S.A., W.A. Beckman. 1983. F-Chart Solar Energy System Analysis: DOS Version 5.6. F-Chart Software. Middleton, WI. www.fchart.com.

LBL. 1993. DOE-2 BDL Summary Version 2.1E. LBL Report No. 349346. Berkley, CA: Lawrence Berkeley Laboratory.

Malhotra, M. 2005. An Analysis of Maximum Residential Energy-Efficiency in Hot and Humid Climates. MS Thesis, College Station, TX: Texas A&M University.

Malhotra, M. and J. Haberl. 2006. An Analysis of Maximum Residential Energy Efficiency in Hot and Humid Climates. Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates. Orlando, FL.

Malhotra, M., J. Mukhopadhyay, B. Liu, J. Haberl, C. Culp, B. Yazdani. 2007. Recommendations for 15% Above-Code Energy Efficiency Measures for Single-Family Residences. Energy Systems Laboratory Report No. ESL-TR-07-09-01.

Means, R. 2006. "Building Construction Cost Data" *R.S. Means,* Kingston, Massachusetts.

NAECA. 2006. National Appliance Energy Conservation Act.

NAHB 1999. Builder Practices Survey Reports, National Association of Home Builders, Research Center, Upper Marlboro, Maryland (September).

NAHB. 2003. The Builders Practices Survey Reports. National Association of Home Builders. Upper Marlboro, MD: NAHB Research Center.

NREL. 2001. Building America house performance analysis procedures. (NREL/TP-550-27754) Golden, CO: National Renewable Energy Laboratory. p.34

Parker, D., P. Fairey, and L. Gu. 1993. Simulation of the effects of duct leakage and heat transfer on residential space cooling energy use. Energy and Buildings, 20(2):97-113.
Appendix

Parker, D.S., P.W. Fairey, III, and J.E.R. McIlvaine. 1997. Energy-Efficient Office Building Design for Florida's Hot and Humid Climate. *ASHRAE Journal*. Vol.39, No.4, pp. 49-57.

Public Utility Commission of Texas, PUC, 2007, Available at: http://www.puc.state.tx.us/

Scorecard link, "Defining Nonattainment Areas" (November 14, 2007): http://www.scorecard.org/env-releases/def/cap_naa.html

Sylvester, K.E., S. Song, J.S. Haberl, and W.D. Turner. 2002. "Sustainability Assessment of the Robert E. Johnson State Office Building, Final Report," *Energy Systems Laboratory Report ESL-TR-02-01-02*, College Station, TX: Energy Systems Laboratory, Texas A&M University

Texas State Energy Conservation Office (SECO), 2007, available at: http://www.seco.cpa.state.tx.us/

Torcellini, P., R. Judkoff, and D.B. Crawley. 2004. High Performance Buildings. *ASHRAE Journal*, Vol. 46, No. 9. pp. S4-S11.

USDOE 2005. Analysis of Texas Code Adoption Analysis: Lighting Requirement, Pacific Northwest National Laboratory (PNNL), U.S.D.O.E., Washington, D.C.

11 BIBLIOGRAPHY

ACEEE. 2004. The Most Energy-Efficient Appliances. Washington, DC: American Council for An Energy Efficient Economy.

Ahmed, M., Gilman, D., Mukhopadhyay, J., Haberl, J., Culp, C. 2005a. "Development of a Web-based Emissions Reduction Calculator for Code-compliant Single-family and Multi-family Construction," *Proceedings of the 5th International Conference for Enhanced Building Operations*, Pittsburg, PA (October).

Ahmed, M., Gilman, D., Kim, S., Haberl, J., Culp, C. 2005b. "Development of a Web-based Emissions Reduction Calculator for Code-compliant Commercial Construction," *Proceedings of the 5th International Conference for Enhanced Building Operations*, Pittsburg, PA (October).

ARI 2001. Unpublished ARI Internal Report by Karim Amrane, Ph.D., Air Conditioning and Refrigeration Institute, Arlington, VA (July).

ASHRAE Task Group on Energy Requirements. 1975. Procedures for determining heating and cooling loads for computerized energy calculations; algorithms for building heat transfer subroutines. Atlanta: American Society of Heating Refrigeration and Air-Conditioning Engineers, Inc.

ASHRAE 1989. Energy Efficient Design of New Buildings Except Low-rise Residential Buildings. ASHRAE Standard 90.1-1989.

ASHRAE 2004. Energy Efficient Design of New Buildings Except Low-rise Residential Buildings. ASHRAE Standard 90.1-2004.

Baltazar-Cervantes, J.C., Liu, Z., Gilman, D., Haberl, J., Culp, C. 2005a. "Development of a Web-based Emissions Reduction Calculator for Retrofits to Municipal Water Supply and WasteWater Facilities," *Proceedings of the 5th International Conference for Enhanced Building Operations*, Pittsburg, PA (October).

Baltazar-Cervantes, J.C., Gilman, D., Haberl, J., Culp, C. 2005b. "Development of a Web-based Emissions Reduction Calculator for Solar Thermal and Solar Photovoltaic Installations," *Proceedings of the 5th International Conference for Enhanced Building Operations*, Pittsburg, PA (October).

Bankrate. 2005. Federal Discount Rate. Bankrate, Inc. Retrieved June 23, 2005, from: www.bankrate.com.

Dodge. 2005. MarkeTrack: McGraw-Hill Construction Analytics. McGraw-Hill Construction Information Group, 148 Princeton-Hightstown Rd., Hightstown, N.J. <http://dodge.construction.com>

Erbs, D., Klein, G., Duffie, S. 1982. "Estimation of the diffuse fraction for hourly, daily and monthly-average global radiation," *Solar Energy*, Vol. 28, pp. 293-301.

Haberl, J., Culp, C., Yazdani, B., Gilman, D., Fitzpatrick, T., Muns, S., Verdict, M., Ahmad, M., Liu, B., Baltazar-Cervantes, J.C., Bryant, J., Degelman, L., Turner, D. 2004a. "Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reductions Plan (TERP)," Vol. III – Appendix, Annual Report to the Texas Commission on Environmental Quality, September 2003 to August 2004, Energy Systems Laboratory Report No. ESL-TR-04-12-05 (December).

Haberl, J., Culp, C., Yazdani, B., Gilman, D., Fitzpatrick, T., Muns, S., Verdict, M., Ahmad, M., Liu, B., Baltazar-Cervantes, J.C., Bryant, J., Degelman, L., Turner, D. 2004b. "Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reductions Plan (TERP)," Vol. II – Technical Report, Annual Report to the Texas Commission on Environmental Quality, September 2003 to August 2004, Energy Systems Laboratory Report No. ESL-TR-04-12-04 (December).

Haberl, J., Culp, C., Yazdani, B., Gilman, D., Fitzpatrick, T., Muns, S., Verdict, M., Ahmad, M., Liu, B., Baltazar-Cervantes, J.C., Bryant, J., Degelman, L., Turner, D. 2004c. "Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reductions Plan (TERP)," Vol. I – Summary Report, Annual Report to the Texas Commission on Environmental Quality, September 2003 to August 2004, Energy Systems Laboratory Report No. ESL-TR-04-12-01 (December).

Haberl, J., Im, P., Culp, C. 2004. "NOx Emissions Reductions From Implementation of the 2000 IECC/IRC Conservation Code to Residential Construction in Texas," *Proceedings of the 14th Symposium on Improving Building Systems in Hot and Humid Climates*, Texas A&M University, Richardson, Texas, accepted for publication (February), pp. 139-150.

Haberl, J., Cho, S. 2004a. "Literature Review of Uncertainty of Analysis Methods: F-Chart Program," Energy Systems Laboratory Report, No. ESL-TR-04-08-04 (October).

Haberl, J., Cho, S. 2004b. "Literature Review of Uncertainty of Analysis Methods: PV F-Chart Program," Energy Systems Laboratory Report, No. ESL-TR-04-10-02 (October).

Haberl, J., Cho, S. 2004c. "Literature Review of Uncertainty of Analysis Methods: ASHRAE Inverse Model Toolkit (IMT)," Energy Systems Laboratory Report, No. ESL-TR-04-10-03 (October).

Haberl, J., Cho, S. 2004d. "Literature Review of Uncertainty of Analysis Methods: Cool Roofs," Energy Systems Laboratory Report, No. ESL-TR-04-10-04 (October).

Haberl, J., Cho, S. 2004e. "Literature Review of Uncertainty of Analysis Methods: DOE-2 Program," Energy Systems Laboratory Report, No. ESL-TR-04-11-01 (November).

Haberl, J.S. 1993. “Economic Calculations for ASHRAE Handbook,” Energy Systems Laboratory Report, No. ESL-TR-93-04-07 (April).

Haberl, J., Culp, C., Yazdani, B., Fitzpatrick, T., Bryant, J., and Turner, D. 2003. “Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reductions Plan (TERP). Volume II - Technical Report, Annual Report to the Texas Commission on Environmental Quality, September 2002 to August 2003,” Energy Systems Laboratory Report ESL-TR-03-12-04.

Haberl, J., Im, P., Culp, C., Yazdani, B., Fitzpatrick, T., Bryant, J., Turner, D. 2005. “A Simulation Methodology to Estimate NOx Emissions Reductions From the Implementation of the 2000 IECC/IRC Conservation Code in Texas,” *IBPSA Newsletter*, Vol. 15, No. 2, pp. 39-48 (October).

IESNA. 2000. The IES Lighting Handbook, Reference and Application, 9th Edition. New York: Illuminating Engineering Society of North America.

Inflationdata. 2005. Current Inflation Rate. Financial Trend Forecaster®. Retrieved June 23, 2005, from: inflationdata.com/inflation.

Im, P. 2003. “A Methodology to Evaluate Energy Savings and NOx Emissions Reduction from the Adoption of the 2000 IECC to New Residences in Non-attainment and Affected Counties in Texas,” *Master’s Thesis*, Department of Architecture, Texas A&M University (December).

Kissock, K., Haberl, J.S., Claridge, D.E. 2002. “Development of a Toolkit for Calculating Linear, Change-point Linear and Multiple-Linear Inverse Building Energy Analysis Models,” Final Report for ASHRAE Research Project, No. 1050-RP.

Klein, S.A., Beckman, W.A. 1985. “PV F-Chart User’s Manual: DOS Version,” F-Chart Software, 4406 Fox Bluff Road, Middleton, Wisc. 53562, www.fchart.com.

Klein, S.A., Beckman, W.A. 1993. “F-Chart Solar Energy System Analysis: Version 6.17W,” F-Chart Software, 4406 Fox Bluff Road, Middleton, Wisc. 53562, www.fchart.com.

Kootin-Sanwu, V. 2004. “Development of Energy Efficient Housing for Low-Income Families,” *Ph.D. Dissertation*, Department of Architecture, Texas A&M University (May).

LBNL. 1981. “DOE-2 Reference Manual Version 2.1A. LBL-8706 Rev. 1,” Lawrence Berkeley National Laboratory, Berkeley, CA, and Los Alamos Scientific Laboratory, Santa Fe, NM.

Mukhopadhyay, J. 2005. “Analysis of improved fenestration for code-compliant residential buildings in hot and humid climates,” *Masters Thesis*, Department of Architecture, Texas A&M University.

Liu, Z., Gilman, D., Haberl, J., Culp, C. 2005a. “Development of a Web-based Emissions Reduction Calculator for Street Light and Traffic Light Retrofits,” *Proceedings of the 5th International Conference for Enhanced Building Operations*, Pittsburg, PA (October).

Liu, Z., Baltazar-Cervantes, J.C., Gilman, D., Haberl, J., Culp, C. 2005b. “Development of a Web-based Emissions Reduction Calculator for Green Power Purchases from Texas Wind Energy Providers,” *Proceedings of the 5th International Conference for Enhanced Building Operations*, Pittsburg, PA (October).

LBNL 1995. Residential Sector End-use Forecasting With EPRI REEPS 2.1: Summary Input Assumptions and Results, J. Koomey, R. Brown, R. Richey, F. Johnson, A. Sanstad, and L. Shown, Lawrence Berkeley National Laboratory Report No. LBL-34044-UC-1600 (December).

LBNL 2000. “DOE-2.1e, ver. 107,” Documentation Update Package #2, Simulation Research Group, Lawrence Berkeley National Laboratory, University of California at Berkeley, Berkeley, CA (March).

Malhotra, M. 2005. “An Analysis of Maximum Residential Energy Efficiency in Hot and Humid Climates,” *M.S. Thesis,* Department of Architecture, Texas A&M University.

Malhotra, M. and Haberl, J. 2006. “An Analysis of Building Envelope Upgrades for Residential Energy Efficiency in Hot and Humid Climates,” Conference Paper for Presentation at SimBuild 2006, Second National Conference of IBPSA-USA. Cambridge, MA (in preparation).

NAHB 2000. Builder Practices Survey Reports, National Association of Home Builders, Research Center, Upper Marlboro, Maryland (September).

NREL. 1995. Users Manual for TMY2’s (Typical Meteorogical Years). NREL/SP-463-7668, and TMY2s, Typical Meteorological Years Derived from the 1961-1990. National Solar Radiation Data Base, June 1995 [CD-ROM]. Golden, Colorado: National Renewable Energy Laboratory.

NOAA 1993. Automated Surface Observing System Guide for Pilots, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, National Weather Service (April).

NREL 1995. User’s Manual for TMY2s (Typical Meteorological Years), NREL/SP-463-7668, National Renewable Energy Laboratory (June).

Ottinger, R.L., Wooley, D.R., Robinson, N.A., Hodas, D.R., and Babb, S.E. 1991. *Environmental Costs of Electricit*y. Oceana Publications, Inc., New York, N.Y.

Parker, D.S., Dunlop, J.P., Barkaszi, S.F., Sherwin, J.R., Anello, M.T., and Sonne, J.K. 2000. “Towards Zero Energy Demand: Evaluation of Super Efficient Building Technology with Photovoltaic Power for New Residential Housing,” *Proceedings of the 2000 ACEEE Summer Study of Energy Efficiency in Buildings*, 1.207-1.223.

RECenter 2005. Texas Real Estate Research Center, College of Business, Texas A&M University, College Station, Texas. URL: recenter.tamu.edu.

Reilly, M., Winkelmann, D., Arasteh, D., and Caroll, W. 1992. “Modeling windows in DOE-2.1e. Proceedings of Thermal Performance of the Exterior Envelopes of Buildings VI,” American Society of Heating Refrigeration and Air-Conditioning Engineers, 1992.

Song, S. 2006. “Development of New Methodologies for Evaluating the Energy Performance of New Commercial Buildings,” Texas A&M University, in preparation, (August).

U.S. Census 1999. County Population Estimates for July 1, 1999 and Population Change for July 1, 1998 to July 1, 1999, CO-99-1, U.S. Department of Commerce, March 9, 1999, URL: www.census.org.

USCB. 2002. Square Footage by Household and Unit Size, Income, and Costs—Occupied Units. American Housing Survey for the United States: 2001, p. 84. U.S. Census Bureau, Current Housing Reports, Series H150/01. Washington, DC: U.S. Government Printing Office.

USDOE 2004. Building Energy Standards Program: Determination Regarding Energy Efficiency Improvements in the Energy Standard for Buildings, Except Low-Rise Residential Buildings, ASHRAE/IESNA Standard 90.1-1999. Docket No. (Docket No. EE-DET-02-001). Washington, D.C. <http://www.energycodes.gov/implement/pdfs/FR_com_notice.pdf>

12 REPORTS CONTAINED ON THE ACCOMPANYING CDROM

12.1 Volume I Summary Report

12.2 Volume II Technical Report

12.3 Volume III Technical Report

12.4 Technical Papers Published in the 15th Symposium on Improving Building Systems in Hot and Humid Climates, in Orlando, Florida, July 2006, including:

12.4.1 Malhotra, M., Haberl, J. 2006. "An Analysis of Maximum Residential Energy Efficiency in Hot and Humid Climates," Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).

12.4.2 Cho, S., Haberl, J. 2006. "A Survey of High-performance Office Buildings for Hot and Humid Climates," Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).

12.4.3 Im, P., Haberl, J. 2006. "A Survey of High-performance Schools for Hot and Humid Climates," Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).

12.4.4 Ahmed, M., Im, P., Mukhopadhyay, J., Malhotra, M., Haberl, J., Culp, C., Yazdani, B. 2006. "Impact of the Implementation of the 2000/2001 IECC on Residential Energy use in Texas: Analysis of Residential Savings," Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).

12.4.5 Ahmed, M., Kim, S., Im, P., Chongcharoensuk, C., Haberl, J., Culp, C., Yazdani, B. 2006. "Impact of the Implementation of the 2000/2001 IECC on Commercial Energy use in Texas: Analysis of Commercial Savings," Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).

12.4.6 Mukhopadhyay, J., Haberl, J. 2006. "Comparison of Simulation Methods for Evaluating Improved Fenestration Using the DOE-2.1e Building Energy Simulation Program," Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).

12.4.7 Baltazar-Cervantes, J.C., Haberl, J., Culp, C., Yazdani, B. 2006. "Impact of the Implementation of the 2000/2001 on Residential Energy use in Texas: Verification of Residential Energy Savings," Proceedings of the Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, Texas A&M University, Orlando, Florida, published on CD ROM (July).

12.5 Presented two papers at the 2nd SimBuild Conference, Boston, MA, August 2006, including:

12.5.1 Mukhopadhyay, J., Haberl, J. 2006. "Comparing the Performance of High-performance Glazing in IECC Compliant Building Simulation Model," Proceedings of the 2nd SimBuild Conference, Boston, MA, published on CD ROM (August).

12.5.2 Malhotra, M., Haberl, J. 2006. "An Analysis of Building Envelope Upgrades for Residential Energy Efficiency in Hot and Humid Climates," Proceedings of the 2nd SimBuild Conference, Boston, MA, published on CD ROM (August).

12.6 Presented one Paper at the ACEEE Summer Study on Energy Efficiency, Asilomar, California, August 2006:

12.6.1 Verdict, M., Haberl, J., Culp, C., Yazdani, B., Fitzpatrick, T., Gilman, D., Ahmed, M., Liu, B., Baltazar, J. C, Muns, S., and Turner, D. 2006. “Quantification of NO_x Emissions Reduction for SIP Credits from Energy Efficiency and Renewable Energy Projects in Texas,” 2006 ACEEE Summer Study on Energy Efficiency in Buildings, American Council for an Energy Efficient Economy, Washington, D.C., published on CD ROM (August).

12.7 Presented one Paper at the 6th International Conference for Enhanced Building Operations, Shenzhen, China, October 2006:

12.7.1 Liu, Z., Haberl, J., Gilman, D., Culp, C., Yazdani, B. 2006. “Development of a Web-based Emissions Reduction Calculator for Storm Water/Infiltration Sanitary Sewage Separation,” Proceedings of the 6th International Conference for Enhanced Building Operations, Shenzhen, China, published on CD ROM (October).