ESL-TR-11-10-01

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

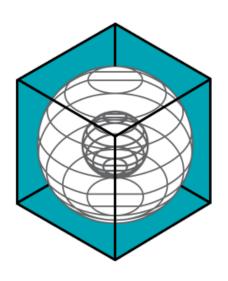
PRELIMINARY REPORT: INTEGRATED NOX EMISSIONS SAVINGS FROM EE/RE PROGRAMS STATEWIDE

Annual Report to the Texas Commission on Environmental Quality January 2010 – December 2010



Jeff Haberl, Ph.D., P.E.; Charles Culp, Ph.D., P.E. Bahman Yazdani, P.E.; Zi Liu, Ph.D.; Juan-Carlos Baltazar, Ph.D. Hyojin Kim; Don Gilman, P.E.; Cynthia Lewis; Kathy McKelvey, Jaya Mukhopadhyay; Larry Degelman, P.E.; Sunglok Do, Keehan Kim.

October 2011



ENERGY SYSTEMS LABORATORY

Texas Engineering Experiment Station The Texas A&M University System



ENERGY SYSTEMS LABORATORY

Texas Engineering Experiment Station The Texas A&M University System 3581 TAMU College Station, Texas 77843-3581

September 29, 2011

Chairman Bryan W. Shaw, Ph.D. Texas Commission on Environmental Quality P. O. Box 13087 Austin, TX 78711-3087

Dear Chairman Shaw:

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

The ESL is required to annually report the energy savings from statewide adoption of the Texas Building Energy Performance Standards in 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 reductions from energy efficiency and renewable energy measures as a result of the TERP implementation.

Sincerely,

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

David E. Claudo

Director

Enclosure

cc: Commissioner Buddy Garcia

Commissioner Carlos Rubinstein Executive Director Mark Vickery

Disclaimer

This report is provided by the Texas Engineering Experiment Station (TEES) as required under Section 388.003 (e) of the Texas Health and Safety Code and is distributed for purposes of public information. The information provided in this report is intended to be the best available information at the time of publication. TEES makes no claim or warranty, express or implied, that the report or data herein is necessarily error-free. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not constitute or imply its endorsement, recommendation, or favoring by the Energy Systems Laboratory or any of its employees. The views and opinions of authors expressed herein do not necessarily state or reflect those of the Texas Engineering Experiment Station or the Energy Systems Laboratory.

PRELIMINARY REPORT: INTEGRATED NOX EMISSIONS SAVINGS FROM EE/RE STATEWIDE

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

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 this sixth annual report, Energy Efficiency/Renewable Energy (EE/RE) Impact in the Texas Emissions Reduction Plan (Preliminary Report) to the Texas Commission on Environmental Quality.

In this preliminary report, the NOx emissions savings from the energy-efficiency programs from multiple Texas State Agencies working under Senate Bill 5 and Senate Bill 7 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 Day¹ (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.

In 2010, the cumulative total electricity savings from all programs are:

- Annual electricity savings of 31,731,502 MWh/year (18,907 tons-NOx/year) and
- OSD electricity savings equal to 84,150 MWh/day, which would be a 3,506 MW average hourly load reduction during the OSD period (51.58 tons-NOx/day).

By 2013, the cumulative total electricity savings from all programs are:

- Annual electricity savings will be 35,758,047 MWh/year (21,396 tons-NOx/year) and
- OSD electricity savings will be 98,298 MWh/day, which would be a 4,096 MW average hourly load reduction during the OSD period (60.61 tons-NOx/day).

A summary of the savings for 2010 and 2013 is presented in the table below.

	2010	2013
Annual Electricity Savings (MWh/yr)	31,731,502	35,758,047
Annual Emissions reductions (tons NOx/yr)	18,907	21,396
OSD Electricity Savings (MWh/day)	84,150	98,298
OSD Emissions reductions (tons NOx/day)	51.58	60.61

-

An ozone season day (OSD) represents the daily average emissions during the period that runs from mid-July to mid -September.

Legislative Background

In 2001, the Texas Emissions Reduction Plan (TERP), established by the 77th Texas Legislature with the enactment of Senate Bill 5 (SB 5), identified that Energy Efficiency and Renewable Energy (EE/RE) measures make an important contribution to a comprehensive approach for meeting the minimum federal ambient air quality standards. In 2003 through 2011, the 78th through 82nd Legislatures enhanced the use of EE/RE programs for meeting the TERP. The 78th Legislature enhanced the use of EE/RE programs for meeting TERP goals by requiring the Texas Commission on Environmental Quality (TCEQ) to promote EE/RE as a means to improve air quality standards and to develop a methodology for computing emissions reduction for use in the State Implementation Plan (SIP) from EE/RE programs.

The 79th Legislature expanded the scope of the SIP-eligible credits by adding savings from the State Renewable Portfolio Standards from the generation of electricity from renewable sources; specifically requiring the TCEQ to develop methods to quantify emissions reductions from renewable energy; and 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.

In the 80th Legislature several new energy efficiency initiatives were introduced, including: requiring 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; requiring the Laboratory to develop a standardized report format to be used by providers of home energy ratings; and encouraging the Laboratory to cooperate with an industry organization or trade association to develop guidelines for home energy ratings, including training.

Calculation of Integrated NOx Emissions Reductions from Multiple State Agencies Participating in the Texas Emissions Reduction Plan (TERP)

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 (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 this 2010 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)²
- SEER13 upgrades to Single-family and Multi-family residences

The Laboratory's single-family 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 (MMBtu) savings are from the Laboratory's Annual Reports to the TCEQ (Haberl et al., 2002-2010).

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 2010. 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 are directed towards school districts, government agencies, city and county governments, private industries and residential energy consumers. For the 2010 reporting year SECO submitted annual energy savings values for projects funded by SECO and by Energy Service projects.

The Electric Reliability Council of Texas (ERCOT) electricity production from currently installed green power generation (wind) in Texas is reported. Projections through 2013 include planned projects by ERCOT, annual growth factors beyond 2013 comply with the Legislative requirements. Actual measured electricity production for 2001 through 2010, were included.

Finally, NOx emissions reductions from several other programs are also reported, including: energy efficiency measures applied to Federal buildings in Texas, reductions from the elimination of pilot lights in residential furnaces, and reductions from the installation of SEER 13 air conditioners in existing residences.

Description of the Analysis Method

Annual and Ozone Season Day (OSD) NOx emissions reduction were calculated for 2010 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 1, 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. With the exception of electricity generated from wind, an annual degradation factor of 5% was used for all the programs³. This value was taken from a study by Kats et al. (1996).

--

² ERCOT is the Electric Reliability Council of Texas.

³ 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. For wind energy, a degradation factor of 0% was used. The choice of a 0% degradation factor for wind is based on two year's of analysis of measured wind data from all Texas wind farms that shows no degradation, on average, for a two year period after the wind farms became operational.

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 7 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 1 were used to account for several different factors. Growth factors for single-family (3.25%) and multi-family residential (1.54%) construction are projections based on the average growth rate for these housing types from recent U.S. Census data for Texas. Growth factors for wind energy are from the Texas Public Utilities Commission⁴. No growth was assumed for Federal buildings, pilot lights, PUC programs and SECO entries.

Figure 1 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 savings were calculated from DOE-2 hourly simulation models⁵. 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 project⁶. A description of the measures completed for the project was also submitted for information purposes. The electricity production from wind farms in Texas was from the actual on-site metered data measured at 15-minute intervals.

Integration of the savings from the different programs into a uniform format allowed for creditable NOx emissions to be evaluated using different criteria as shown in Table 1. These include evaluation across programs, evaluation across individual counties by program, evaluation by SIP area, evaluation for all ERCOT counties except Houston/Galveston, and evaluation within a 200 km radius of Dallas/Ft.Worth.

-

⁴ The growth factors for wind energy through 2012 are based on permitted wind farms registered with the Texas Public Utilities Commission, http://www.puc.state.tx.us/electric/maps/gen_tables.xls. Growth factors for 2013 through 2020 assume a linear projection based on the permits for 2011 and 2012.

⁵ 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.

⁶ 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. Annual savings were reported by SECO in 2004. Values for 2005 to 2010 use the adjusted values from 2004.

Calculation Procedure

ESL Single-family and Multi-family. The calculation of the annual and OSD electricity savings reported for the years 2002 through 2010 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. From 2005 to 2010, 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 through 2010, 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 codecomplaint construction would be achieved for each year after 2010 through 20207. 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 2009 annual report⁸.

For the 2010 annual and OSD NOx emissions calculations, the US EPA's 2007 eGRID were used⁹. An example of the eGRID spreadsheet¹⁰ is given in Table 2. 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 2005 through 2020 is provided in Table 3. NOx emissions reduction is provided in Table 4.

ESL-Commercial Buildings. The annual and OSD electricity savings for 2004 through 2009 for commercial buildings were obtained from the annual reports for 2004 through 2009 submitted by the Laboratory to TCEQ¹¹. These savings were also tabulated by county and program. Using the calculated values through 2010, savings were then projected to 2020 by incorporating the different adjustment factors mentioned above ¹². In the projected annual electricity savings, it was assumed that the same 2010 amount of electricity savings would be achieved for each year 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).

⁷ This would include the appropriate discount and degradation factors for each year.

⁸ Haberl et al., 2010, pp. 265.

⁹ 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

¹⁰ 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

¹¹ These savings include new construction in office, assembly, education, retail, food, lodging and warehouse construction as defined by Dodge building type (Dodge 2005), using energy savings from the Pacific Northwest National Laboratory (USDOE 2004), and data from CBECS (1995 - 2003).

¹² This also includes the appropriate discount and degradation factors for each year.

Federal Buildings. Energy savings achieved from Energy Savings Performance Contracts (ESPCs) were also reported in 2010. This includes savings (estimated) from energy conservation measures implemented in Federal Buildings in Texas. The 2010 savings include projects implemented in 13 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 ¹³. In the calculation for 2010, 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 and T&D loss 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 natural gas (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 an estimated 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 (OSD) 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 area¹⁴.

PUC-Senate Bill 7. For the PUC Senate Bill 7 program savings, the annual electricity savings for 2001 through 2010 were obtained from the Public Utilities Commission¹⁵. Using these values savings were projected through 2020 by incorporating the different adjustment factors mentioned above. Similar savings were assumed for each year after 2010 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 was 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 ¹⁶. The annual and average day electricity savings were then proportioned according to the PCA and program. Using the actual reported numbers through 2003, savings through 2020 were projected incorporating the different adjustment factors mentioned above ¹⁷. The 2007 annual and OSD eGRID were used to calculate the NOx emissions savings for PUC-Senate Bill 5

_

¹³ 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.

These use the NOx/MMBtu values provided in the US EPA AP 42 guideline.

 ¹⁵ In a similar fashion to the previous programs, to obtain the Ozone Season Day (OSD) savings, the annual electricity savings were divided by 365.
¹⁶ In a similar fashion as the PUC's Senate Bill 7 program, the annual electricity savings numbers were then divided by 365 to get

¹⁶ 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 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.

¹⁷ 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.

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 39 counties through 2005 were obtained from the State Energy Conservation Office ¹⁸. These submittals included information gathered from SECO's website ¹⁹ and paper submittals ²⁰. The annual and average day electricity values were then summarized according to county and program. Using the actual reported numbers for 2005, savings through 2020 were projected using the different adjustment factors mentioned above. In a similar fashion to the previous programs, it was assumed that the same amount of electricity savings will be achieved for each year through 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 2010 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 2010, 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 farms²¹. The total electricity savings for each PCA was 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 2010 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 were calculated. Using the numbers for 2010, the savings through 2020 were projected by incorporating the appropriate adjustment factors. ²² In this analysis it was assumed that an equal number of existing houses had their air conditioners replaced 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.

_

¹⁸ 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.

This web site was developed for SECO by the Laboratory, at the request of the TCEQ.

²⁰ 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. ²¹ 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.

²² Additional details about this calculation are contained in the Laboratory's 2006 Annual Report to the TCEQ, available at the ESL's web site "esl.tamu.edu", under TERP.

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 1 for 2005 through 2020 as shown in Table 3. 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 4. In Tables 3 and 4 annual integrated values are shown for 2006 through 2020. The OSD NOx emissions reduction is also shown in Figure 2 as stacked bar charts and in Figure 3 for the individual components.

In 2010 (Table 3), the total cumulative annual savings from all programs in 2010 is 31,731,502 MWh/year (30,984,680 MWh/year and 2,548,904 MMBtu/year). The annual integrated electricity savings²³ from all the different programs is:

- Savings from code-compliant residential and commercial construction is 1,854,699 MWh/year (5.8% of the total electricity savings),
- Savings from retrofits to Federal buildings is 293,659 MWh/year (0.9%).
- Savings from furnace pilot light retrofits is 2,548,904 MMBtu/year (2.4%), which is equivalent to 746,822 MWh/year,
- Savings from the PUC's Senate Bill 5 and Senate Bill 7 programs is 2,595,953 MWh/year (8.2%),
- Savings from SECO's Senate Bill 5 program is 468,611 MWh/year (1.5%),
- Electricity savings from green power purchases (wind) is 24,210,883 MWh/year (76.3%),
- Savings from residential air conditioner retrofits²⁴ is 1,560,875 MWh/year (4.9%).

In 2010, the total cumulative OSD savings from all programs in 2010 is 84,150 MWh/day (82,104 MWh/day and 6,983 MMBtu/day), which would be a 3,506 MW average hourly load reduction during the OSD period. The cumulative OSD electricity savings from all the different programs is:

- Savings from code-compliant residential and commercial construction is 10,641 MWh/day (12.6%),
- Savings from retrofits to Federal buildings is 805 MWh/day (1.0%),
- Savings from furnace pilot light retrofits is 6,983 MMBtu/day (2.4%), which is equivalent to 2,046 MWh/day,
- Savings from the PUC's Senate Bill 5 and Senate Bill 7 programs is 7,113 MWh/day (8.5%),
- Savings from SECO's Senate Bill 5 program is 1,284 MWh/day (1.5%),
- Electricity savings from green power purchases (wind) are 51,190 MWh/day (60.8%), and
- Savings from residential air conditioner retrofits are 11,071 MWh/day (13.2%).

By 2013, the total cumulative annual savings from all programs will be 35,758,047 MWh/year (35,011,225 MWh/year and 2,548,904 MMBtu/year). The cumulative annual electricity savings from all the different programs is:

Savings from code-compliant residential and commercial construction will be 2,311,539 MWh/year (6.5% of the total electricity savings),

²³ This includes the savings from 2005 through 2010.

²⁴ 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.

- Savings from retrofits to Federal buildings will be 402,732 MWh/year (1.1%),
- Savings from furnace pilot light retrofits will remain at 2,548,904 MMBtu/year (2.1%), which is equivalent to 746,822 MWh/year,
- Savings from the PUC's Senate Bill 5 and Senate Bill 7 programs will be 3,224,560 MWh/year (9.0%),
- Savings from SECO's Senate Bill 5 program will be 489,440 MWh/year (1.4%),
- Electricity savings from green power purchases (wind) will be 26,296,721 MWh/year (73.5%), and
- Savings from residential air conditioner retrofits²⁵ will be 2,286,233 MWh/year (6.4%).

By 2013, the total cumulative OSD savings from all programs will be 98,298 MWh/day (96,252 MWh/day and 6,983 MMBtu/day), which would be a 4,096 MW average hourly load reduction during the OSD period. The cumulative OSD electricity savings from all the different programs is:

- Savings from code-compliant residential and commercial construction will be 13,157 MWh/day (13.4%),
- Savings from retrofits to Federal buildings will be 1,103 MWh/day (1.1%),
- Savings from furnace pilot light retrofits will remain at 6,983 MMBtu/day (2.1%), which is equivalent to 2,046 MWh/day,
- Savings from the PUC's Senate Bill 5 and Senate Bill 7 programs will be 8,835 MWh/day (9.0%),
- Savings from SECO's Senate Bill 5 program will be 1,341 MWh/day (1.4%),
- Electricity savings from green power purchases (wind) will be 55,600 MWh/day (56.6%), and
- Savings from residential air conditioner retrofits will be 16,216 MWh/day (16.5%).

In 2010 (Table 4), the total cumulative annual NOx emissions reduction from all programs is 18,907 tons-NOx/year. The cumulative annual NOx emissions reduction ²⁶ from all the different programs is:

- NOx emissions reduction from code-compliant residential and commercial construction is 1,303 tons-NOx/year (6.9% of the total NOx savings),
- NOx emissions reduction from retrofits to Federal buildings is 225 tons-NOx/year (1.2%),
- NOx emissions reduction from furnace pilot light retrofits is 117 tons-NOx/year (0.6%),
- NOx emissions reduction from the PUC's Senate Bill 5 and Senate Bill 7 programs is 1,783 tons-NOx/year (9.4%),
- NOx emissions reduction from SECO's Senate Bill 5 program is 357 tons-NOx/year (1.9%),
- NOx emissions reduction from green power purchases (wind) is 14,047 tons-NOx/year (74.3%), and
- NOx emissions reduction from residential air conditioner retrofits is 1,075 tons-NOx/year (5.7%).

In 2010, the total cumulative OSD NOx emissions reduction from all programs is 51.58 tons-NOx/day. The cumulative OSD NOx emissions reduction from all the different programs is:

-

²⁵ 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.

²⁶ These NOx emissions reductions were calculated with the US EPA's 2007 eGRID for annual (25% capacity factor) and Ozone Season Day OSD.

- NOx emissions reduction from code-compliant residential and commercial construction is 7.34 tons-NOx/day (14.2%),
- NOx emissions reduction from retrofits to Federal buildings is 0.59 tons-NOx/day (1.1%),
- NOx emissions reduction from furnace pilot light retrofits is 0.32 tons-NOx/day (0.6%),
- NOx emissions reduction from the PUC's Senate Bill 5 and Senate Bill 7 programs is 4.79 tons-NOx/day (9.3%),
- NOx emissions reduction from SECO's Senate Bill 5 program is 0.97 tons-NOx/day (1.9%),
- NOx emissions reduction from green power purchases (wind) are 30.04 tons-NOx/day (58.2%), and
- NOx emissions reduction from residential air conditioner retrofits are 7.53 tons-NOx/day (14.6%).

By 2013, the total cumulative annual NOx emissions reduction from all programs will be 21,396 tons-NOx/year. The cumulative annual NOx emissions reduction from all the different programs is:

- NOx emissions reduction from code-compliant residential and commercial construction will be 1,620 tons-NOx/year (7.6% of the total NOx savings),
- NOx emissions reduction from retrofits to Federal buildings will be 308 tons-NOx/year (1.4%),
- NOx emissions reduction from furnace pilot light retrofits will be 117 tons-NOx/year (0.5%).
- NOx emissions reduction from the PUC's Senate Bill 5 and Senate Bill 7 programs will be 2,147 tons-NOx/year (10.0%),
- NOx emissions reduction from SECO's Senate Bill 5 program will be 373 tons-NOx/year (1.7%),
- NOx emissions reduction from green power purchases (wind) will be 15,257 tons-NOx/year (71.3%), and
- NOx emissions reduction from residential air conditioner retrofits will be 1,574 tons-NOx/year (7.4%).

By 2013, the total cumulative OSD NOx emissions reduction from all programs is 60.61 tons-NOx/day. The cumulative OSD NOx emissions reduction from all the different programs is:

- NOx emissions reduction from code-compliant residential and commercial construction will be 9.03 tons-NOx/day (14.9%),
- NOx emissions reduction from retrofits to Federal buildings will be 0.81 tons-NOx/day (1.3%),
- NOx emissions reduction from furnace pilot light retrofits will be 0.32 tons-NOx/day (0.5%),
- NOx emissions reduction from the PUC's Senate Bill 5 and Senate Bill 7 programs will be 5.78 tons-NOx/day (9.5%),
- NOx emissions reduction from SECO's Senate Bill 5 program will be 1.01 tons-NOx/day (1.7%),
- NOx emissions reduction from green power purchases (wind) will be 32.63 tons-NOx/day (53.8%), and
- NOx emissions reduction from residential air conditioner retrofits will be 11.03 tons-NOx/day (18.2%).

Summary

This preliminary report on the NOx emissions savings from the energy-efficiency programs from multiple Texas State Agencies working under Senate Bill 5 and Senate Bill 7 in a uniform format allows 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 (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.

In 2010, the cumulative total electricity savings from all programs are:

- Annual electricity savings is 31,731,502 MWh/year (18,907 tons-NOx/year) and
- OSD electricity savings is 84,150 MWh/day, which would be a 3,506 MW average hourly load reduction during the OSD period (51.58 tons-NOx/day).

By 2013, the cumulative total electricity savings from all programs are:

- Annual electricity savings will be 35,758,047 MWh/year (21,396 tons-NOx/year) and
- OSD electricity savings will be 98,298 MWh/day, which would be a 4,096 MW average hourly load reduction during the OSD period (60.61 tons-NOx/day).

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.

If any questions arise, please contact us by phone at 979-845-6065 or email us at terpinfo@tees.tamus.edu.

Table 1: 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%	0.00%	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%	Actual Rates	N.A.	N.A.
Weather Normalized	Yes	Yes	Yes	No	No	No	No	No	See note 7	Yes	Yes

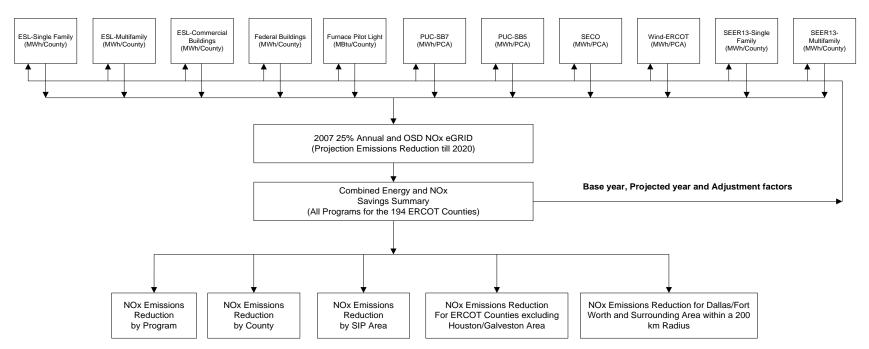


Figure 1: Process Flow Diagram of the NOx Emissions Reduction Calculations

Table 2: Example of NOx Emissions Reduction Calculations using eGRID

		American																				
		Electric Power -						Lower Colorado									T N				T	*************
		West (FRCOT)	NOx Reductions	Austin	NOx Reductions	Brownsville Public Utils	NOx Reductions	River Auhotrity	NOx Reductions	Reliant Energy	NOx Reductions	San Antonio Public Service	NOx Reductions	South Texas Flectric Coop	NOx Reductions	Texas Municipal NOx Reduc	Texas-New ons Mexico Power	NOx Reductions		NOx Reductions	Total Nox Reductions	Total Nox Reductions
Area	County	/PCA	(lbs)	Energy/PCA	(lbs)	Board/PCA	(lbs)	/PCA	(lbs)	HL&P/PCA	(lbs)	Bd/PCA	(lbs)	INC/PCA	(lbs)	Power Pool/PCA (lbs)	Co/PCA	(lbs)	TXU Electric/PCA	(lbs)	(lbs)	(Tons)
	Brazoria	0.008831132	226.0465792 557.0379581	0.010890729	8.193488679 20.27982242	0.006522185	0	0.003944232	14.32402746 32.96145962	0.065444292	3035.079423 7649.355979	0.014877434	272.3666894	0.006262315	0	0.004817148 0.009553214	0 0.12127495	7 139.7235344	0.00816387	940.7285451 1822.787617	4636.462287 10781.71281	2.318231144 5.390856407
	Chambers Fort Rend	0.021762222	1802 797078	0.026955801	20.27982242	0.016072371	0	0.009076193	32.96145962 106.6764342	0.164940225	7649.355979 24756.36787	0.037472294	686.0191605 2220.231709	0.015055623	0	0.009553214	0 0.01151858	3 13.2708178 7 42.94986114	0.015818592	1822.787617	10781.71281 34893.92432	5.390856407 17.44696216
Houston-	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 0.56775121	654.118618	0.032836887	3783.817742	18005.57093	9.002785467
Galveston Area	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	0.0361334	1 41.63009278	0.049622373	5718.021208	33821.85723	16.91092861
	Liberty Montgomery	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
Beaumont/ Port	Hardin	0	0	0	0	0	0	0	0	0	Ö	0	0	0	Ö	0	0 (0	0	Ö	Ö	ő
Arthur Area	Jefferson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 (0	0	0	0	0
	Orange	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 0.0008644	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 0.00752493	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	0.00018660	0.214992277	0.000849405	97.87758499	146.1965387	0.073098269
	Tarrant	0.012162492	311.3179263 83.95193355	0.012266309	9.228387517 2.488584531	0.008982543	0	0.020308652	73.75369976 19.88888265	0.005316504	246.5610524 66.48919108	0.001752506	32.08377752 8.651911537	0.017326428	0	0.060216761	0 0.020603444	23.73767965	0.110647237	12749.95959 3438.233618	13446.64211 3626.105373	6.723321056 1.813052686
Dallas/ Fort	Johnson	0.003279814	7.322112154	0.003307809	0.396381687	0.002422289	0	0.005476558	3.062551359	0.001433682	16.38963767	0.000472592	1.867338584	0.004672383	0	0.016238427	0 0.000112645	0.129780379	0.029837824	59.08393672	88.25173856	0.044125869
Worth Area	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	0.01071541	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-0	0.098671668	0.000389838	44.92135575	67.09755584	0.033548778
	Rockwall 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 0.00138891	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 0.02122111	2 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	0.01048181	7 12.0763306	0.056290785	6486.427041	6840.857996	3.420428998
El Paso Area	El Paso 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 0.00051958	0.598622181	0.002503865	288.5221599	22501.3535	11.25067675
Pan Antonio *	Comal	0.000413751	0.00.2.0070	0.001110043	0	0.02-0.7545	0	0.030000423	0	0.001141041	0	0	0	0.040073044	0	0	0.00031908	0.00002101	0.002.003000	0	0	0
San Antonio Area	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	0.00040171	0.462828487	0.001835165	211.4673431	929.140946	0.464570473
	Wilson 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 0.00090412	1 041660856	0.004130298	475 937112	2091 162881	1.04558144
1	Caldwell	0.004502334	115.2442433	0.171901148	129.3274415	0.003325174	0	0.301245466	1094.014881	0.002784342	129.1281298	0.008000571	140.4094129	0.002389654	0	0.0041/6513	0.00090412	1.041660856	0.004130298	4/5.93/112	ZU91.16Z881	1.04008144
Austin Area	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 0.00049371	0.568821994	0.00225544	259.8960069	1141.925832	0.570962916
1	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 0.00010332	0.119045148	0.000467336	53.85143207	447.7942484	0.223897124
-	Grego	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North East Texas	Harrison	Ö	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Area	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	0.00116203	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
Corpus Christi	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 0.00160942	1.854254911	0.008283395	954.5014455	6920.142856	3.460071428
Area	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	0.000355829	0.409958691	0.001831382	211.0314828	1529.979881	0.76498994
Victoria Area	Victoria	0.021836736 2.47421E-05	558.9452467 0.633312124	0.002215582 2.49533E-05	1.666862472 0.018773251	0.016127403 1.82731E-05	0	0.003612695 4.13138E-05	13.12000619	0.001199621 1.08153E-05	55.63426979 0.501577618	0.000555389 3.56511E-06	10.16770824 0.065267829	0.52545648 3.5247E-05	0	0.032412721 0.000122499	0 0.00047685	0.549395481 0.048289414	0.002254849	259.8278678 25.93716362	899.9113567 27.35442055	0.449955678
	Andrews Angelina	0.00031082	7.955919749	0.000313473	0.018773251	0.000229554	0	4.13138E-05 0.000519	1.884820844	0.000135867	6.301018286	4.47864E-05	0.81992053	0.000442787	0	0.000122499	0 0.00052653	0.606630902	0.000225089	325.8330045	343.6371519	0.01367721
	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 0.00023445	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	0.00076382	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 5.876577133	0.000610844	28.32885022	0.000591187	10.8230826 6.330503314	0.0170045	0	0.002633372	0 0.000584879	0.673847089	0.003010234	346.8714129 202.8877272	2514.820424 1470.93759	1.257410212
	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 0.00593565	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
	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-0	0.010582658	4.72752E-05	5.447558433	39.49484073	0.01974742
	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 0.0059896	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	0.01195350	13.77189259	0.064194222	7397.14566	7801.340048	3.900670024
	Fayette Freestone	0.003677178	94 12308402	0.003708565	2 790087625	0.00271576	0	0.006140067	22 29850932	0.001607379	74 54485257	0.000529848	9 700129134	0.005238429	0	0 018205785	0 0.00622919	7 176790757	0.033452809	3854 790927	4065 42418	2 03271209
	Frio	0.008588335	219.8317964	0.0009700303	0.655572927	0.006342868	0	0.001420864	5.160066298	0.000471808	21.88082203	0.000218433	3.998934744		0	0.012747844	0 0.00018754	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
	Hardeman Haskell	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 0.00133331	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	0.0009403	1.083420679	0.005050094	581.9258697	613.723428	0.306861714
1	Jack	0.002121449	54.30177924 1042.259088	0.002139557	1.609665938 0.613420549	0.001566784	0	0.003542346	12.86452461 4.946827986	0.000927334	43.00653033 13.94821343	0.000305682	5.596228347	0.00302217	0	0.010503338 0.001296587	0 0.00359376	4.140456206 4 0.331780603	0.019299698	2223.917843 170.7883116	2345.437027 1238.216579	1.172718514
Other ERCOT	Lamar	0.000950838	24.33817497	0.000958954	0.721455757	0.000702236	0	0.001587687	5.765907769	0.00030076	19.27561996	0.000291082	2.508241656	0.001354543	0	0.001296587	0 0.000287974	1.855761432	0.001482142	996.7647898	1051.229951	0.525614976
counties	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	0.00038096	0.438914787	0.000523179	60.28629516	356.5909243	0.178295462
1	Llano McLennan	0.001238174	31.69299001 627.9940467	0.047274044	35.56597012 18.61560781	0.000914447	0	0.082844655	300.8619059 148.7767984	0.000765714	35.51115798 497.3657473	0.002200214	40.28013466 64.71975936	0.000657172	0	0.001148571	0 0.00024864	1 0.286464175 1 47.88391622	0.001135861	130.8861051 25719.36288	575.0847279 27124.71876	0.287542364
	Milam	0.002245405	57.4746346	0.002264571	1.703718789	0.001658332	0	0.003749326	13.61619935	0.000981518	45.51940379	0.003335173	5.923216216	0.003198756	0	0.011117048	0 0.0038037	4.382383245	0.02042738	2353.86146	2482.481016	1.241240508
1	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	0.02531395	29.16475857	0.135944204	15664.94698	16520.91007	8.260455036
1	Nolan Palo Pinto	0.000564654	14.45319062 82.08811543	0.000569473	0.428435476 4.443830552	0.000417022	0	0.000942846	3.424076134 34.33422818	0.000246823	11.44679952 183.7440401	8.13615E-05 0.001143513	1.489515743 20.93471146	0.000804394	0	0.002795613 0.123082087	0 0.000956533	1.102041289 3 1.454966345	0.005136889	591.9273539 662.3893373	624.2714127 989.3892293	0.312135706
I	Pecos	0.003206998 4.09677E-05	1.048631523	4.13174E-05	4.443830552 0.031084551	0.002368511 3.02565E-05	0	0.009454195 6.84069E-05	0.248429171	0.003962005 1.79079E-05	0.830506919	0.001143513 5.90308E-06	0.108069782	0.030749889 5.83617E-05	0	0.123082087	0 0.00126285	0.079957102	0.005748375	662.3893373 42.94648142	989.3892293 45.29316047	0.494694615
I	Presidio	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 (0	0	0	0	0
I	Red River	0 00070	0	0.00000====	0 00003-	0 0005	0	0	0	0	146 0711407	0	0	0 00075	0	0 001866305	0 0 1015	0	0 00000	0	0	0
I	Robertson Taylor	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	0.396971447
I	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 0.0096498	11.11780398	0.051822854	5971.584145	6297.883086	3.148941543
	Tom Green	0.001482448 3.11661F-05	37.94556586	2.96846E-05 3.14322E-05	0.022332825	0.001094854 2.30176F-05	0	4.95918E-05 5.20405E-05	0.180099353	1.09498E-05 1.36234F-05	0.507813132	1.05974E-05 4.49076F-06	0.19401082	0.000304817 4.43986F-05	0	4.72049E-05 0.000154304	0 1.04843E-0	0.012079149	5.39604E-05 0.000283531	6.217896494	45.07979763 34.45673333	0.022539899
I	Upton	3.11661E-05 0.018559529	0.797745539 475.0600294	3.14322E-05	0.023647546	2.30176E-05 0.013707039	0	5.20405E-05 0.030990277	0.188992281	1.36234E-05 0.008112796	0.631807433 376 2433542	4.49076E-06 0.002674262	0.082213995 48 95869786	4.43986E-05 0.026439509	0	0.000154304	0 5.27959E-0	0.060827297	0.000283531	32.67149923 19455 98267	34.45673333 20519.0953	0.017228367
	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 0.00014154	0.163078928	0.000728512	83.94696529	608.6161471	0.304308074
I	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-0	0.088019771	0.000104918	12.08978615	71.5105814	0.035755291
	Wichita Wilbarger	0.000207633	5.314695266 732.4920115	0.000209406	0.157543345 0.431107444	0.000153346	0	0.000346701	1.259093698 3.476594279	9.07612E-05 0.000211372	4.209191786 9.802701684	2.99181E-05 0.00020457	0.547721432 3.745137877	0.00029579	0	0.001027996 0.000911232	0 0.00035173- 0 0.00020238	0.405240184 0.233172965	0.001888925	217.6622165 120.0287677	229.5557022 870.2094935	0.114777851 0.435104747
	Wilbarger	0.028616818	732.4920115	0.000573025	0.431107444 2.16823872	0.021134796	0	0.000957307	3.476594279 17.32281236	0.000211372	9.802701684 58.25242144	0.00020457	7.565361234	0.005884109	0	0.000911232	0 0.00020238	5 0.233172965 5 5.527817073	0.001041639	120.0287677 2968.505674	870.2094935 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	0.010563634	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 1.22180608	1407.669558	1.528786947	176163.2035	315287.3779	157.643689
Energy	-									+								 				
Savings	l														l			1				
by PCA (MWh)	l	25.597			J]		3,632		40		18.307		_	l			J.	115.231			
(MWN)	l	25,597		752	1	. 0		3,632		46,377		18,307		0	l	0	1,15	4	115,231			

Table 3: Annual and OSD Electricity Savings for the Different Programs

PROGRAM	ANNUAL															
PROGRAM	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family (MWh)	225,389	1,001,051	1,197,537	1,256,764	1,252,530	1,280,624	1,306,878	1,331,121	1,353,183	1,372,892	1,390,077	1,404,569	1,416,195	1,424,785	1,430,169	1,432,174
ESL-Multifamily (MWh)	9,228	37,821	51,312	63,156	165,765	265,891	362,247	454,747	543,309	627,848	708,280	784,522	856,489	924,098	987,265	1,045,906
ESL-Commercial (MWh)	63,456	129,063	192,036	231,649	270,392	308,184	344,944	380,592	415,047	448,228	480,055	510,445	539,320	566,597	592,196	616,037
Federal Buildings (MWh)	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 (MMBtu)	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) (MWh)	302,192	1,362,701	1,630,383	2,003,432	2,336,446	2,585,544	2,815,265	3,025,606	3,216,569	3,388,154	3,540,360	3,673,187	3,786,636	3,880,707	3,955,399	4,010,712
PUC (SB5 grant program) (MWh)	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 (MWh)	115,360	293,764	353,701	445,357	457,921	468,611	477,428	484,371	489,440	492,636	493,959	493,408	490,983	486,685	480,513	472,468
Wind-ERCOT (MWh)	2,867,049	6,699,696	9,193,504	15,171,518	18,808,351	24,210,883	24,773,552	25,523,777	26,296,721	27,093,073	27,913,540	28,758,854	29,629,768	30,527,055	31,451,515	32,403,970
SEER13-Single Family (MWh)	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 (MWh)	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
Total Annual (MWh)	3,634,950	10,052,682	13,467,886	20,380,242	24,838,259	30,984,680	32,242,961	33,640,194	35,011,225	36,356,418	37,676,159	38,970,855	40,240,941	41,486,864	42,468,869	43,336,376
Total Annual (MMBtu)	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

DDGCDANA	OZONE SE	ASON DAY -	OSD													
PROGRAM	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family (MWh)	776	5,537	6,519	6,904	6,981	7,335	7,488	7,630	7,759	7,875	7,977	8,063	8,133	8,185	8,219	8,234
ESL-Multifamily (MWh)	36	192	271	351	829	1,340	1,825	2,291	2,738	3,163	3,569	3,953	4,315	4,656	4,974	5,270
ESL-Commercial (MWh)	0	800	1,189	1,447	1,700	1,966	2,205	2,436	2,660	2,876	3,082	3,280	3,467	3,645	3,811	3,967
Federal Buildings (MWh)	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 (MMBtu)	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) (MWh)	828	3,733	4,467	5,489	6,401	7,084	7,713	8,289	8,813	9,283	9,700	10,064	10,374	10,632	10,837	10,988
PUC (SB5 grant program) (MWh)	0	37	35	33	31	29	26	24	22	20	17	15	13	11	9	6
SECO (MWh)	316	805	969	1,220	1,255	1,284	1,308	1,327	1,341	1,350	1,353	1,352	1,345	1,333	1,316	1,294
Wind-ERCOT (MWh)	5,836	14,936	20,763	25,575	41,403	51,190	52,380	53,966	55,600	57,284	59,019	60,806	62,648	64,545	66,499	68,513
SEER13-Single Family (MWh)	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 (MWh)	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 OSD (MWh)	7,792	29,218	39,453	48,603	68,396	82,104	86,767	91,599	96,252	100,721	105,005	109,108	113,026	116,761	118,607	119,620
Total OSD (MMBtu)	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 4: Annual and OSD NOx Emissions Reduction Values for the Different Programs

PROCEANA	ANNUAL (in tons NOx)															
PROGRAM	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family	158	708	843	883	879	898	916	932	947	960	971	980	988	993	996	997
ESL-Multifamily	6	26	35	44	119	187	254	317	378	436	491	543	593	639	682	722
ESL-Commercial	44	90	136	164	192	218	245	270	295	319	341	363	384	403	421	438
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	1,074	1,157	1,421	1,633	1,779	1,913	2,035	2,144	2,242	2,327	2,400	2,461	2,510	2,547	2,950
PUC (SB5 grant program)	0	6	5	5	5	4	4	4	3	3	3	2	2	2	1	1
SECO	67	224	270	340	349	357	364	369	373	376	377	376	374	371	366	360
Wind-ERCOT	2,465	4,152	5,688	8,914	10,957	14,047	14,373	14,808	15,257	15,719	16,195	16,685	17,191	17,711	18,248	18,800
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
Total Annual (Tons NOx)	3,119	6,761	8,839	12,728	15,328	18,907	19,694	20,555	21,396	22,221	23,022	23,804	24,455	25,200	25,761	26,620

DDOCDANA	OZONE SI	EASON DAY -	OSD (in ton	s NOx/day)												
PROGRAM	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family	0.76	3.85	4.50	4.76	4.81	5.05	5.15	5.24	5.32	5.40	5.46	5.52	5.56	5.59	5.61	5.62
ESL-Multifamily	0.03	0.13	0.18	0.24	0.58	0.93	1.26	1.57	1.87	2.15	2.43	2.69	2.93	3.16	3.37	3.57
ESL-Commercial	0.26	0.55	0.82	1.00	1.17	1.36	1.52	1.68	1.84	1.98	2.13	2.26	2.39	2.52	2.63	2.74
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	3.10	3.81	4.38	4.78	5.14	5.47	5.77	6.03	6.26	6.46	6.63	6.76	6.86	6.93
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	0.73	0.92	0.95	0.97	0.99	1.00	1.01	1.02	1.02	1.02	1.02	1.01	0.99	0.98
Wind-ERCOT	5.85	9.27	12.98	15.13	24.35	30.04	30.74	31.67	32.63	33.62	34.64	35.68	36.77	37.88	39.03	40.21
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 OSD (Tons NOx)	8.11	19.54	26.24	31.38	43.27	51.58	54.58	57.64	60.61	63.42	66.14	68.71	70.84	73.15	74.18	74.65

OSD NOx reduction levels (Preliminary Estimates) All ERCOT

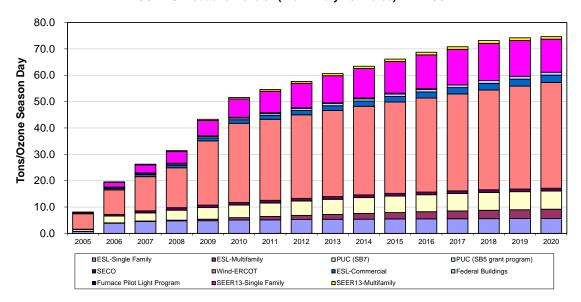


Figure 2: Cumulative OSD NOx Emissions Reduction Projections through 2020

OSD NOx reduction levels (Preliminary Estimates) All ERCOT

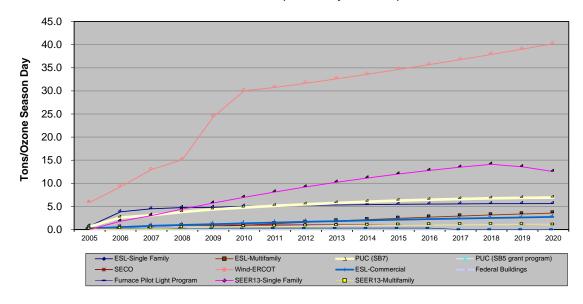


Figure 3: Cumulative OSD NOx Emissions Reduction Projections through 2020

References

CBECS 1995, 1999, 2003. USDOE Commercial Building Energy Characteristics Survey. U.S.D.O.E. Energy Information Agency Report.

Dodge. 2005. MarkeTrack: McGraw-Hill Construction Analytics. McGraw-Hill Construction Information Group, 148 Princeton-Hightstown Rd., Hightstown, N.J. http://dodge.construction.com.

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.

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.

Haberl, J., Culp, C., Yazdani, B., Gilman, D., Fitzpatrick, T., Muns, S., Verdict, M., Ahmed, M., Liu, Z., Baltazar-Cervantes, J-C, Mukhopadhyay, J., Degelman, L, Turner, D. 2007. "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, January 2006 to June 2007, Energy Systems Laboratory, Report ESL-TR-07-12-02.

Haberl, J. S., Liu, Z., Baltazar-Carvantes, J. C., Subbarao, K., Gilman, D., Culp, C., Yazdani, B., Turner, W. D., Chandrasekaran, V. 2008. "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, January 2007 – December 2007, Energy Systems Laboratory, Report ESL-TR-08-12-02.

Haberl, J. S., Liu, Z., Baltazar-Carvantes, J. C., Subbarao, K., Gilman, D., Culp, C., Yazdani, B., Turner, W. D., Chandrasekaran, V. 2009. "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, January 2008 – December 2008, Energy Systems Laboratory, Report ESL-TR-09-12-02.

Haberl, J. S., Liu, Z., Baltazar-Carvantes, J. C., Subbarao, K., Gilman, D., Culp, C., Yazdani, B., Turner, W. D., Chandrasekaran, V. 2010. "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, January 2009 – December 2009, Energy Systems Laboratory, Report ESL-TR-10-12-02.

NAHB 1999. Builder Practices Survey Reports, National Association of Home Builders, Research Center, Upper Marlboro, Maryland (September).

Kats, G.H. et al. 1996. "Energy Efficiency as a Commodity," ACEEE Summer Study on Energy Efficiency in Buildings.

PUC 2007, Public Utility Commission of Texas, available at: http://www.puc.state.tx.us/

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. https://www.energycodes.gov/implement/pdfs/FR com notice.pdf>