

**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 2015 – December 2015**



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October 2016



ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION



**TEXAS A&M ENGINEERING
EXPERIMENT STATION**

ENERGY SYSTEMS LABORATORY

October 16, 2016

Vincent Meiller
Air Quality Planning Section
Air Quality Division, Office of Air
Texas Commission on Environmental Quality Austin, TX 78711-3087

Dear Mr Meiller:

The Energy Systems Laboratory (ESL) at the Texas A&M 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) (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) 845-9213 should you or any of the TCEQ staff have any questions concerning this report or any of the work presently being done to quantify emissions reductions from energy efficiency and renewable energy measures as a result of the TERP implementation.

Sincerely,

A handwritten signature in black ink that reads "David E. Claridge".

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

Enclosure

cc: Commissioner Toby Baker
Commissioner Jon Niermann
Executive Director Richard A. Hyde, P. E.

Disclaimer

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

This preliminary report shows the NOx emissions reductions 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 integrated savings estimation from all projects projected through 2020 for both the annual and Ozone Season Day (OSD)¹ NOx reductions. The year of 2008 was used for the baseline year to estimate the emissions. The NOx emissions reductions from all these programs were calculated using estimated emissions factors for 2010 from the US Environmental Protection Agency (US EPA) eGRID database, which had been specially prepared for this purpose.

In 2015, the integrated total electricity savings from all programs are:

- Annual electricity savings is 29,795,642 MWh/year (8,174 tons-NOx/year) and
- OSD electricity savings is 93,560 MWh/day, which would be a 3,898 MW average hourly load reduction during the OSD period (25.65 tons-NOx/day).

By 2020, the integrated total electricity savings from all programs are:

- Annual electricity savings will be 45,126,247 MWh/year (12,377 tons-NOx/year) and
- OSD electricity savings will be 140,426 MWh/day, which would be a 5,851 MW average hourly load reduction during the OSD period (38.54 tons-NOx/day).

A summary of the savings for 2015 and 2020 is presented in the table below. (Base year 2008)

	2015	2020
Annual Electricity Savings (MWh/year)	29,795,642	45,126,247
Annual Emissions Reductions (tons NOx/year)	8,174	12,377
OSD Electricity Savings (MWh/day)	93,560	140,426
OSD Emissions Reductions (tons NOx/day)	25.65	38.54

¹ 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 2007, the 78th, 79th and 80th 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.

The 81st Legislature (2009) extended the data of the TERP to 2019 and required the TCEQ to contract with Laboratory to compute emissions reduction from wind and other renewable energy resources for the SIP.

The 82nd Legislature (2011), the Laboratory's responsibilities under TERP increased as new legislatively allocated energy efficiency initiatives were introduced.

The 83rd and 84th Legislatures (2013 and 2015, respectively) the Laboratory's responsibilities under TERP were kept the same as previous years.

Calculation of Integrated NO_x 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 NO_x emissions reductions 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 integrated savings estimation from all projects projected through 2020 for both the annual and Ozone Season Day (OSD) NO_x reductions. The NO_x emissions reductions from all these programs were calculated using estimated emissions factors for 2010 from the US

Environmental Protection Agency (US EPA) eGRID database, which had been specially prepared for this purpose. The different programs included in this 2015 integrated analysis are:

- ESL Single-family new construction
- ESL Multi-family new construction
- ESL Commercial new construction
- PUC Senate Bill 7 Program
- SECO Senate Bill 5 Program
- Electricity generated by wind farms in Texas (ERCOT)²
- SEER 13 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. The baseline to estimate energy savings uses the published data on residential construction characteristics by the 2008 National Association of Home Builders (NAHB 2008) based on the IECC 2006 building code (ICC 2006). Annual electricity savings (MWh) are obtained from the Laboratory's Annual Reports to the TCEQ (Haberl et al., 2002 - 2015).

The Laboratory's commercial program includes the energy savings attained by constructing new commercial buildings in Texas, including office, apartment, healthcare, education, retail, food and lodging as defined by Dodge building type (Dodge 2011). Energy savings were estimated from code compliant buildings (ASHRAE Standard 90.1-2007) against pre-code buildings (ASHRAE Standard 90.1-2004) using EUI in the USDOE report and constructed square footage in Dodge data (Dodge 2016).

The Public Utility Commission of Texas (PUC) Senate Bill 7 program includes the energy efficiency programs implemented by electric utilities under the Public Utility Regulatory Act §39.905. The PUC regulated energy efficiency program was adopted pursuant to 1999 legislation (SB 7) and subsequent legislation in 2001 (SB 5), 2007 (HB 3693), and 2011 (SB 1125). 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 claimed by the utilities were reported for the different programs completed in the years 2001 through 2015.

The Texas State Energy Conservation Office (SECO) funds energy-efficiency programs that are directed towards school districts, government agencies, city and county governments, private industries and residential energy consumers. For the 2015 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. Actual measured electricity productions for 2001 through 2015 were included. For projections to 2020, the annual growth factor was estimated using the last six years installed wind power capacity.

Finally, NO_x emissions reductions from *the installation of SEER 13 air conditioners in existing residences* are also reported.

² ERCOT is the Electric Reliability Council of Texas.

Description of the Analysis Method

Annual and Ozone Season Day (OSD) NO_x emissions reductions were calculated for 2015 and integrated from 2009 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 2% was used for ESL Single-family, Multi-family, and Commercial programs and an annual degradation factor of 5% was used for all other programs³. The value of the 5% degradation factor 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, multi-family and commercial program, the discount factor was assumed to be 20%. For PUC's Senate Bill 7 program, the discount factor was taken as 10%. For the savings in the SECO program, the discount factor was 60%. For the electricity from wind, the discount factor was taken as 5%. In addition, the discount factor for SEER 13 single-family and SEER 13 multi-family program was 20%.

Growth factor: The growth factors shown in Table 1 were used to account for several different factors. Growth factors for single-family (4.1%), multi-family residential (6.1%), and commercial (5.3%) construction are projections based on the average growth rate for these housing types from recent U.S. Census data for Texas. Growth factor for wind energy (8.5%) is a linear projection based on the installed wind power capacity for 2009 through 2015 from the Public Utility Commission of Texas. No growth was assumed for PUC programs, SECO, and SEER 13 entries.

Figure 1 shows the overall information flow that was used to calculate the NO_x emissions savings from the annual and OSD electricity savings (MWh) from all programs. For the Laboratory's single-family and multi-family code-implementation programs, the annual and OSD were calculated from DOE-2 hourly simulation models⁴. 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 2008 (NAHB 2008). The annual electricity savings from PUC's energy efficiency programs were calculated using PUC approved demand savings

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.

⁴ These values are based on a performance analysis as defined by Chapter 4 of IECC 2006. This analysis is discussed in the Laboratory's annual reports to the TCEQ.

calculations or tables or industry accepted measurement and verification methods (PUC 2016). The OSD consumption is the average daily consumption for the period between July 15 and September 15.

The SECO electricity savings were submitted as annual savings by project⁵. 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.

Calculation Procedure

The electricity savings in this report was estimated based on the baseline year of 2008. In addition, the emissions estimation throughout this report was based on the 2010 eGrid database which is using the four different Congestion Management (CM) zones: Houston, North, West, and South. This report calculates the OSD emissions reductions by dividing the annual emissions reductions with 365 since the 2010 eGrid estimates the annual emissions only. However, the OSD emissions reductions from the Electricity Generated by Wind Farms were estimated by actual measured data.

ESL Single-family and Multi-family. The calculation of the annual electricity savings reported for the years 2002 through 2015 included the savings from code-compliant new housing in all 36 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). From 2009 to 2015, based on year 2008, the annual electricity savings were calculated for new residential construction in all the counties in ERCOT region, which includes the 36 non-attainment and affected counties. These savings were then tabulated by county and program. Using the calculated values through 2015, 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 2015 through 2020⁶. The projected energy savings through 2020, according to county, were then divided into the CM zones in the 2010 eGRID. To determine which CM zone was to be used, or in counties with multiple CM zone, the allocation to each CM zone by county was obtained from CM zone's listing published in the Laboratory's 2010 annual report⁷.

For the 2015 annual NOx emissions calculations, the US EPA's 2010 eGRID were used. An example of the eGRID spreadsheet⁸ is given in the Table 2. The total electricity savings for each

⁵ 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.

⁶ This would include the appropriate discount and degradation factors for each year.

⁷ Haberl et al., 2010, pp. 265.

⁸ To use this spreadsheet electricity savings for each eGrid zone 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 CM zone owned and operated a power plant. Totals for all CM zones are then listed on the far right columns (white columns). Similar spreadsheets for the 2010 eGRID exist for SOx and CO2.

CM zone were used to calculate the NO_x emissions reductions 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.

ESL-Commercial Buildings. The annual electricity savings for 2004 through 2015 for commercial buildings were obtained from the annual reports for 2004 through 2015 submitted by the Laboratory to TCEQ⁹. From 2009 to 2015, based on year 2008, the annual electricity savings were also calculated for new commercial construction by county. Using the calculated savings through 2015, savings were then projected to 2020 by incorporating the different adjustment factors mentioned above¹⁰. In the projected annual electricity savings, it was assumed that the same 2015 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 CM zones.

PUC-Senate Bill 7. For the PUC Senate Bill 7 program savings, the annual electricity savings for 2001 through 2015 were obtained from the Public Utility Commission of Texas. Using these values savings were projected through 2020 by incorporating the different adjustment factors mentioned above. Similar savings were assumed for each year after 2015 until 2020. The 2010 annual eGRID was also used to calculate the NO_x emissions savings for the PUC-Senate Bill 7 program. The total electricity savings for each CM zone were used to calculate the NO_x emissions reductions for each county using the emissions factors contained in the US EPA's eGRID spreadsheet. The integrated NO_x emissions reductions for each county were then calculated.

SECO Savings. The annual electricity consumption reported by political subdivisions for 47 counties through 2015 were obtained from the State Energy Conservation Office (SECO). Using the reported consumption, the annual and OSD electricity savings resulted from energy conservation projects were then calculated. To achieve this, the annual energy use intensity (EUI) for each county was estimated and the county's energy savings for each year against the baseline year of 2008 were then calculated¹¹. In addition, the 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 2010 annual eGRID was also used to calculate the NO_x 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 2015 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. Using the reported numbers for 2015, savings through 2020 were projected incorporating the different adjustment factors mentioned above. The 2010 annual eGRID was then used to calculate the NO_x emissions reductions for the electricity generated by Texas' wind farms¹². The total electricity savings for each CM zone were used to calculate the NO_x emissions reductions for each of the different counties.

⁹ These savings include new construction in office, education, retail, food, lodging and warehouse construction as defined by Dodge building type (Dodge 2011), using energy savings from the US DOE's report (USDOE 2011), and data from CBECS (1995 - 2003) and Dodge (2016).

¹⁰ This also includes the appropriate discount and degradation factors for each year.

¹¹ In the 2015 report, EUI values were used to calculate the electricity savings. This calculation method was also applied to savings estimation for the previous years from 2009 to 2014.

¹² 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.

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 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.

In the 2015 report to the TCEQ, the annual and OSD electricity savings for all the counties in ERCOT region as well as the 36 non-attainment and affected counties were calculated. Using the numbers for 2008, the savings after 2008 until 2020 were projected by incorporating the appropriate adjustment factors¹³. The total electricity savings for each CM zone were used to calculate the NOx emissions reductions for each of the different county using the emissions factors contained in the 2010 eGRID. Integrated NOx emissions reductions for each county by SIP area were also calculated.

Results

The total integrated annual and OSD electricity savings for all the different programs in the integrated format were calculated for 2009 through 2020 as shown in Table 3, using the adjustment factors shown in Table 1. Annual and OSD NOx emissions reductions from the electricity savings (presented in Table 3) for all the programs in the integrated format were shown in Table 4.

In 2015, the total integrated annual savings from all programs are 29,759,642 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction are 1,158,444 MWh/year (3.9% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program are 3,100,439 MWh/year (10.4%),
- Savings from SECO's Senate Bill 5 program are 940,372 MWh/year (3.2%),
- Electricity savings from green power purchases (wind) are 24,322,675 MWh/year (81.6%), and
- Savings from residential air conditioner retrofits¹⁴ are 273,712 MWh/year (0.9%).

In 2015, the total integrated OSD savings from all programs are 93,560 MWh/day, which would be a 3,898 MW average hourly load reduction during the OSD period. The integrated OSD electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction are 3,631 MWh/day (3.9%),
- Savings from the PUC's Senate Bill 7 programs are 8,494 MWh/day (9.1%),
- Savings from SECO's Senate Bill 5 program are 2,576 MWh/day (2.8%),
- Electricity savings from green power purchases (wind) are 76,917 MWh/day (82.2%), and

¹³ Additional details about this calculation are contained in the Laboratory's 2008 Annual Report to the TCEQ, available at the Senate Bill 5 web site "<http://esl.tamu.edu/>".

¹⁴ 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 residential air conditioner retrofits are 1,941 MWh/day (2.1%).

By 2020, the total integrated annual savings from all programs will be 45,126,247 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction will be 2,454,765 MWh/year (5.4% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program will be 4,927,777 MWh/year (10.9%),
- Savings from SECO's Senate Bill 5 program will be 958,959 MWh/year (2.1%),
- Electricity savings from green power purchases (wind) will be 36,572,954 MWh/year (81.0%), and
- Savings from residential air conditioner retrofits will be 211,793 MWh/year (0.5%).

By 2020, the total integrated OSD savings from all programs will be 140,426 MWh/day, which would be a 5,851 MW average hourly load reduction during the OSD period. The integrated OSD electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction will be 7,139 MWh/day (5.1%),
- Savings from the PUC's Senate Bill 7 programs will be 13,501 MWh/day (9.6%),
- Savings from SECO's Senate Bill 5 program will be 2,627 MWh/day (1.9%),
- Electricity savings from green power purchases (wind) will be 115,657 MWh/day (82.4%), and
- Savings from residential air conditioner retrofits will be 1,502 MWh/day (1.1%).

In 2015 (Table 4), the total integrated annual NO_x emissions reductions from all programs are 8,174 tons-NO_x/year. The integrated annual NO_x emissions reductions from all the different programs are:

- NO_x emissions reductions from code-compliant residential and commercial construction are 292 tons-NO_x/year (3.6% of the total NO_x savings),
- NO_x emissions reductions from the PUC's Senate Bill 7 programs are 775 tons-NO_x/year (9.5%),
- NO_x emissions reductions from SECO's Senate Bill 5 program are 243 tons-NO_x/year (3.0%),
- NO_x emissions reductions from green power purchases (wind) are 6,800 tons-NO_x/year (83.2%), and
- NO_x emissions reductions from residential air conditioner retrofits are 64 tons-NO_x/year (0.8%).

In 2015, the total integrated OSD NO_x emissions reductions from all programs are 25.65 tons-NO_x/day. The integrated OSD NO_x emissions reductions from all the different programs are:

- NO_x emissions reductions from code-compliant residential and commercial construction are 0.91 tons-NO_x/day (3.6%),
- NO_x emissions reductions from the PUC's Senate Bill 7 programs are 2.12 tons-NO_x/day (8.3 %),
- NO_x emissions reductions from SECO's Senate Bill 5 program are 0.67 tons-NO_x/day (2.6%),
- NO_x emissions reductions from green power purchases (wind) are 21.50 tons-NO_x/day (83.8%), and
- NO_x emissions reductions from residential air conditioner retrofits are 0.45 tons-NO_x/day (1.8%).

By 2020, the total integrated annual NO_x emissions reductions from all programs will be 12,377 tons-NO_x/year. The integrated annual NO_x emissions reductions from all the different programs are:

- NO_x emissions reductions from code-compliant residential and commercial construction will be 620 tons-NO_x/year (5.0% of the total NO_x savings),
- NO_x emissions reductions from the PUC's Senate Bill 7 programs will be 1,230 tons-NO_x/year (9.9%),
- NO_x emissions reductions from SECO's Senate Bill 5 program will be 252 tons-NO_x/year (2.0%),
- NO_x emissions reductions from green power purchases (wind) will be 10,225 tons-NO_x/year (82.6%), and
- NO_x emissions reductions from residential air conditioner retrofits will be 50 tons-NO_x/year (0.4%).

By 2020, the total integrated OSD NO_x emissions reductions from all programs will be 38.54 tons-NO_x/day. The integrated OSD NO_x emissions reductions from all the different programs are:

- NO_x emissions reductions from code-compliant residential and commercial construction will be 1.80 tons-NO_x/day (4.7%),
- NO_x emissions reductions from the PUC's Senate Bill 7 programs will be 3.37 tons-NO_x/day (8.7%),
- NO_x emissions reductions from SECO's Senate Bill 5 program will be 0.69 tons-NO_x/day (1.8%),
- NO_x emissions reductions from green power purchases (wind) will be 32.33 tons-NO_x/day (83.9%), and
- NO_x emissions reductions from residential air conditioner retrofits will be 0.35 tons-NO_x/day (0.9%).

Summary

This preliminary report shows the NO_x emissions reductions 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 integrated savings estimation from all projects projected through 2020 for both the annual and OSD NO_x reductions. The NO_x emissions reductions from all these programs were calculated using estimated emissions factors for 2010 from the US Environmental Protection Agency (US EPA) eGRID database, which had been specially prepared for this purpose.

In 2015, the integrated total electricity savings from all programs are:

- Annual electricity savings is 29,795,642 MWh/year (8,174 tons-NO_x/year) and
- OSD electricity savings is 93,560 MWh/day, which would be a 3,898 MW average hourly load reduction during the OSD period (25.65 tons-NO_x/day).

By 2020, the integrated total electricity savings from all programs are:

- Annual electricity savings will be 45,126,247 MWh/year (12,377 tons-NO_x/year) and
- OSD electricity savings will be 140,426 MWh/day, which would be a 5,851 MW average hourly load reduction during the OSD period (38.54 tons-NO_x/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 979-845-9213 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 ¹⁶ - Multifamily	ESL ¹⁶ - Commercial	PUC (SB7) ¹⁵	SECO ¹⁵	Wind-ERCOT ⁸	SEER13 Single Family	SEER13 Multi Family
Annual Degradation Factor ¹¹	2.0%	2.0%	2.0%	5.0%	5.0%	0.0%	5.0%	5.0%
T&D Loss ⁹	7.0%	7.0%	7.0%	7.0%	7.0%	0.0%	7.0%	7.0%
Initial Discount Factor ¹²	20.0%	20.0%	20.0%	10.0%	60.0%	5.0%	20.0%	20.0%
Growth Factor	4.1%	6.1%	5.3%	0.0%	0.0%	8.5%	N.A.	N.A.
Weather Normalized	Yes	Yes	Yes	No	No	No	Yes	Yes

Note:

- For Wind-ERCOT, the OSD energy consumption is the average daily consumption of the measured data in the months of July, August and September.

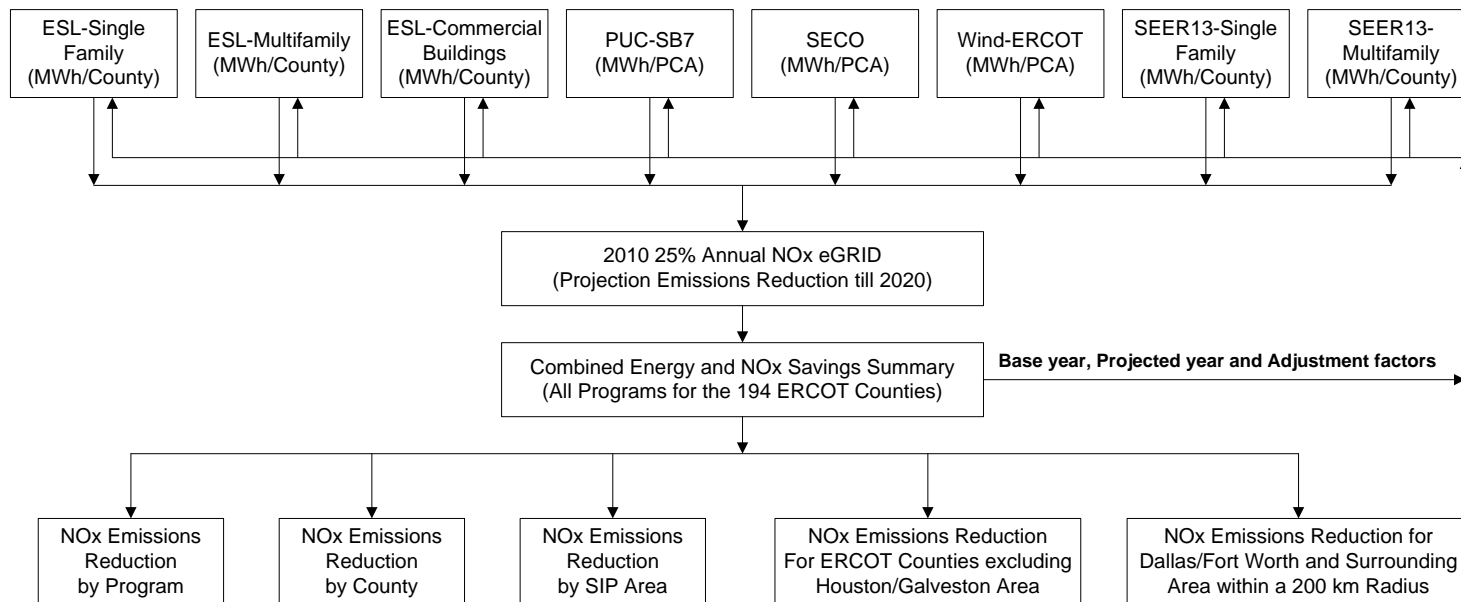


Figure 1: Process Flow Diagram of the NOx Emissions Reduction Calculations

Table 3: Annual and OSD Electricity Savings for the Different Programs (Base Year 2008)

PROGRAM	ANNUAL (MWh)												
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family	0	21,748	55,268	93,760	153,171	220,975	293,313	367,771	444,033	522,198	602,369	684,651	769,156
ESL-Multifamily	0	50,218	94,867	167,566	262,939	357,717	463,922	579,667	700,724	827,451	960,229	1,099,461	1,245,572
ESL-Commercial	0	0	25,750	54,550	87,230	126,228	170,173	211,006	253,367	297,350	343,053	390,579	440,036
PUC (SB7)	0	538,841	976,984	1,437,883	1,831,318	2,267,414	2,675,295	3,100,439	3,504,325	3,888,018	4,252,526	4,598,808	4,927,777
SECO	0	71,910	154,786	347,175	508,375	705,060	936,047	940,372	944,480	948,383	952,090	955,613	958,959
Wind-ERCOT	0	3,454,992	8,587,397	11,606,284	13,774,557	16,597,064	19,905,202	24,322,675	26,390,103	28,633,262	31,067,089	33,707,791	36,572,954
SEER13-Single Family	0	343,330	326,163	309,855	294,362	279,644	265,662	252,379	239,760	227,772	216,383	205,564	195,286
SEER13-Multi Family	0	29,021	27,569	26,191	24,881	23,637	22,456	21,333	20,266	19,253	18,290	17,376	16,507
Total Annual (MWh)	0	4,510,059	10,248,785	14,043,263	16,936,834	20,577,739	24,732,069	29,795,642	32,497,059	35,363,686	38,412,029	41,659,843	45,126,247

PROGRAM	OZONE SEASON DAY - OSD (MWh/day)												
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family	0	124	283	468	626	808	1,002	1,202	1,407	1,617	1,833	2,055	2,283
ESL-Multifamily	0	233	460	744	999	1,253	1,539	1,851	2,177	2,519	2,878	3,254	3,650
ESL-Commercial	0	0	71	149	239	346	466	578	694	815	940	1,070	1,206
PUC (SB7)	0	1,476	2,677	3,939	5,017	6,212	7,330	8,494	9,601	10,652	11,651	12,599	13,501
SECO	0	197	424	951	1,393	1,932	2,565	2,576	2,588	2,598	2,608	2,618	2,627
Wind-ERCOT	0	15,037	24,335	29,191	35,122	34,369	45,184	76,917	83,455	90,549	98,246	106,597	115,657
SEER13-Single Family	0	2,445	2,323	2,207	2,097	1,992	1,892	1,798	1,708	1,622	1,541	1,464	1,391
SEER13-Multi Family	0	195	186	176	167	159	151	144	136	130	123	117	111
Total OSD (MWh)	0	19,709	30,758	37,826	45,661	47,071	60,129	93,560	101,766	110,503	119,820	129,775	140,426

Table 4: Annual and OSD NOx Emissions Reduction Values for the Different Programs (Base Year 2008)

PROGRAM	ANNUAL (in tons NOx)													
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
ESL-Single Family	0	5	14	23	38	54	72	91	110	129	149	170	191	
ESL-Multifamily	0	13	24	43	67	91	118	148	179	211	245	280	317	
ESL-Commercial	0	0	6	14	22	32	43	53	64	75	87	99	111	
PUC (SB7)	0	135	246	362	460	567	669	775	876	971	1,062	1,148	1,230	
SECO	0	19	43	92	133	183	241	243	245	247	249	251	252	
Wind-ERCOT	0	945	2,388	3,222	3,851	4,643	5,577	6,800	7,378	8,005	8,685	9,424	10,225	
SEER13-Single Family	0	81	77	73	69	66	62	59	56	53	51	48	46	
SEER13-Multi Family	0	7	6	6	6	6	5	5	5	5	4	4	4	
Total Annual (Tons NOx)	0	1,204	2,803	3,834	4,646	5,642	6,788	8,174	8,912	9,697	10,532	11,424	12,377	

PROGRAM	OZONE SEASON DAY - OSD (in tons NOx/day)													
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
ESL-Single Family	0.00	0.03	0.07	0.11	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.51	0.57	
ESL-Multifamily	0.00	0.06	0.12	0.19	0.26	0.32	0.39	0.47	0.55	0.64	0.73	0.83	0.93	
ESL-Commercial	0.00	0.00	0.02	0.04	0.06	0.09	0.12	0.15	0.17	0.21	0.24	0.27	0.30	
PUC (SB7)	0.00	0.37	0.67	0.99	1.26	1.55	1.83	2.12	2.40	2.66	2.91	3.15	3.37	
SECO	0.00	0.05	0.12	0.25	0.37	0.50	0.66	0.67	0.67	0.68	0.68	0.69	0.69	
Wind-ERCOT	0.00	4.15	6.75	8.04	9.79	9.56	12.64	21.50	23.33	25.31	27.46	29.80	32.33	
SEER13-Single Family	0.00	0.57	0.54	0.51	0.49	0.46	0.44	0.42	0.40	0.38	0.36	0.34	0.32	
SEER13-Multi Family	0.00	0.05	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	
Total OSD (Tons NOx)	0.00	5.27	8.33	10.18	12.41	12.72	16.36	25.65	27.90	30.30	32.86	35.60	38.54	

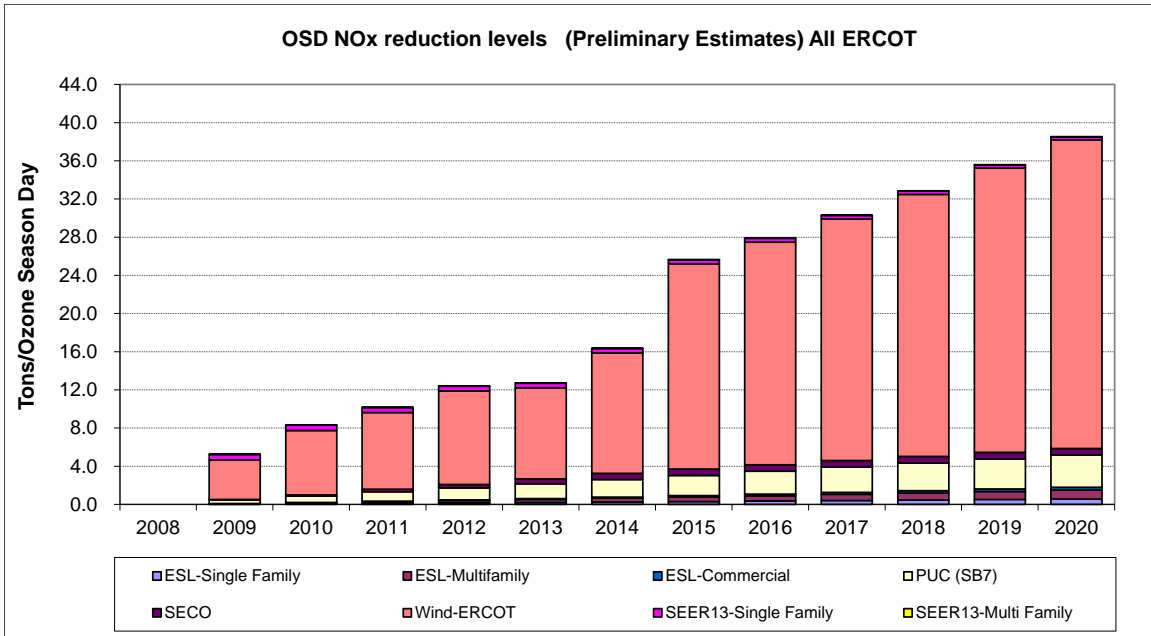


Figure 2: Integrated OSD NOx Emissions Reduction Projections through 2020 (Base Year 2008)

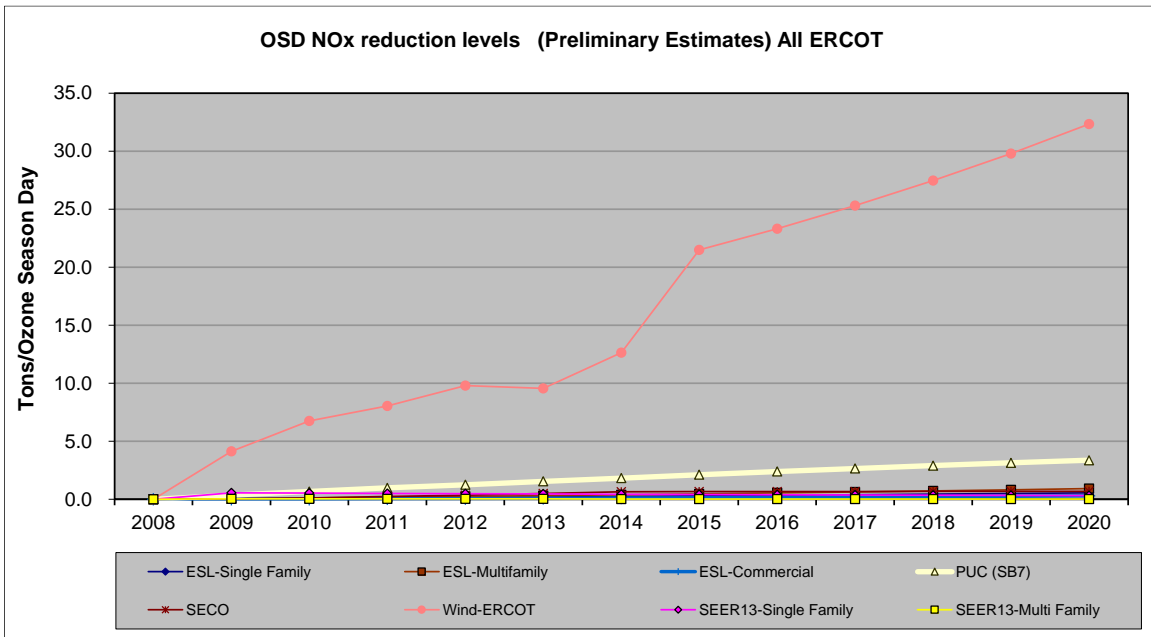


Figure 3: Integrated OSD Individual Programs NOx Emissions Reduction Projections through 2020 (Base Year 2008)

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