# 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 2008 – December 2008



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# ENERGY SYSTEMS LABORATORY

Texas Engineering Experiment Station Texas A&M University System



# **ENERGY SYSTEMS LABORATORY**

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

September 21<sup>st</sup>, 2009

Chairman Bryan W. Shaw, Ph.D. Texas Council 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. Claud

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

Enclosure

cc: Commissioner Buddy Garcia Commissioner Carlos Rubinstein Executive Director Mark Vickery

#### 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 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, <u>Energy Efficiency/Renewable Energy (EE/RE) Impact in the Texas Emissions Reduction Plan (Preliminary Report)</u> 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 Day<sup>1</sup> (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 2008, the cumulative total annual electricity savings from all programs is 20,380,240 MWh/year (12, 727 tons-NOx/year). The total cumulative OSD electricity savings from all programs is 48,602 MWh/day, which would be a 2,025 MW average hourly load reduction during the OSD period (31.38 tons-NOx/day). By 2013, the total cumulative annual electricity savings from will be 32,736,151 MWh/year (20,395 tons-NOx/year). The total cumulative OSD electricity savings from all programs will be 80,866 MWh/day, which would be a 3,369 MW average hourly load reduction during the OSD period (52.10 tons-NOx/day). A summary of the savings for 2008 and 2013 is presented in the table below.

	2008	2013
Annual Electricity Savings (MWh/yr)	20,380,240	32,736,151
Annual Emissions reductions (tons NOx/yr)	12,727	20,395
OSD Electricity Savings (MWh/day)	48,602	80,866
OSD Emissions reductions (tons NOx/day)	31.38	52.10

<sup>&</sup>lt;sup>1</sup> 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 77<sup>th</sup> 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 78<sup>th</sup>, 79<sup>th</sup> and 80<sup>th</sup> Legislatures enhanced the use of EE/RE programs for meeting the TERP. The 78<sup>th</sup> 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 79<sup>th</sup> 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 80<sup>th</sup> 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 the 2006 cumulative analysis are:

- ESL Single-family new construction
- ESL Multi-family new construction
- ESL Commercial new construction
- Federal Buildings
- Furnace Pilot Light Program
- PUC Senate Bill 7 and Senate Bill 5 Program
- SECO Senate Bill 5 Program

- Electricity generated by wind farms in Texas (ERCOT)<sup>2</sup>
- 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 (MBtu) savings are from the Laboratory's Annual Reports to the TCEQ (Haberl et al., 2002 - 2007).

*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 2008. 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 2008 reporting year SECO submitted annual energy savings values for 149 projects, which included 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 2008, 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 2008 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 programs<sup>3</sup>. This value was taken from a study by Kats et al. (1996).

<sup>&</sup>lt;sup>2</sup> ERCOT is the Electric Reliability Council of Texas.

<sup>&</sup>lt;sup>3</sup> 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

*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 Commission<sup>4</sup>. 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 models<sup>5</sup>. The base case is taken as the average characteristics of single- and multi-family residences for Texas published by the National Association of Home Builders for 1999 (NAHB 1999). The OSD consumption is the average daily consumption for the period between July 15 and September 15, 1999. The annual electricity savings from PUC programs were calculated using deemed savings tables and spreadsheets created for the utilities incentive programs by Frontier Associates in Austin, Texas (PUC 2007).

The SECO electricity savings were submitted as annual savings by project<sup>6</sup>. 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

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.

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

<sup>&</sup>lt;sup>5</sup> 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.

<sup>&</sup>lt;sup>6</sup> 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 2007 use the adjusted values from 2004 as shown, <u>www.seco.cpa.state.tx.us</u>.

by SIP area, evaluation for all ERCOT counties except Houston/Galveston, and evaluation within a 200 km radius of Dallas/Ft.Worth.

## **Calculation Procedure**

*ESL Single-family and Multi-family.* The calculation of the annual and OSD electricity savings reported for the years 2002 through 2008 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 2008, 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 2008, 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 2008 through 2020<sup>7</sup>. The projected energy savings through 2020, according to county, were then divided into the different Power Control Authorities (PCA) in eGRID. To determine which PCA was to be used, or in counties with multiple PCA, the allocation to each PCA by county was obtained from PUC's listing published in the Laboratory's 2005 annual report<sup>8</sup>.

For the 2008 annual and OSD NOx emissions calculations, the US EPA's 2007 eGRID were used<sup>9</sup>. An example of the eGRID spreadsheet<sup>10</sup> 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 2006 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 2002 through 2008 for commercial buildings were obtained from the annual reports for 2005 and 2007 submitted by the Laboratory to TCEQ<sup>11</sup>. These savings were also tabulated by county and program. Using the calculated values through 2008, savings were then projected to 2020 by incorporating the different adjustment factors mentioned above<sup>12</sup>. In the projected 2008 cumulative electricity savings, it was assumed that the same amount of electricity savings from 2008 would be achieved for each year after 2008 through 2020. Similarly to the single family calculations, the projected

<sup>&</sup>lt;sup>7</sup> This would include the appropriate discount and degradation factors for each year.

<sup>&</sup>lt;sup>8</sup> Haberl et al., 2005, pp. 197.

<sup>&</sup>lt;sup>9</sup> This required two separate versions of the 2007 eGRID, which were specially prepared for Texas by Mr. Art Diem at the US EPA. One of the versions contains estimates of annual SOx, NOx and CO2 data for 2007, using a 25% capacity factor. The second version contains estimates of SOx, NOx and CO2 data for 2007 for an average day in the ozone season period, which runs from Mid July to Mid September.

<sup>&</sup>lt;sup>10</sup> To use this spreadsheet electricity savings for each PCA is entered in the bottom row of the spreadsheet (MWh). The spreadsheet then allocates the MWh of electricity savings according to the counties (blue columns) where the PCA owned and operated a power plant. Totals for all PCAs are then listed on the far right columns (white columns). Similar spreadsheets for the 2007 eGRID exist for SOx and CO2.

<sup>&</sup>lt;sup>11</sup> 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).

<sup>&</sup>lt;sup>12</sup> This also includes the appropriate discount and degradation factors for each year.

energy saving numbers through 2020, by county, were allocated into the appropriate Power Control Authorities (PCA).

*Federal Buildings*. Energy savings achieved from Energy Savings Performance Contracts (ESPCs) were also reported in 2008. This includes savings (estimated) from energy conservation measures implemented in Federal Buildings in Texas. The 2008 savings include projects implemented in 14 Federal buildings reported by the regional office of the Department of Energy. Annual kWh savings reported for each of the projects were divided by 365 to obtain the average Ozone Season Day savings<sup>13</sup>. In the calculation for 2008, it was assumed that the electricity savings from 2006 would also be achieved for each year from 2008 through 2020 after the appropriate degradation factors were applied. Similarly to the single family calculations, the projected energy saving numbers through 2020, by county, were proportioned into the PUC's Power Control Authorities (PCA) and the cumulative NOx emission reduction values calculated.

*Furnace Pilot Light Program.* For the furnace pilot light program savings, the N.G. energy savings achieved by retrofitting existing furnaces in single-family and multi-family residences for the entire residential stock for Texas have been projected until 2020. Pilot light removal saves 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 are calculated by dividing the annual number by 365. It is also being assumed that of the total furnaces that were retrofitted, 75% are operational during the Ozone Season Period. Cumulative NOx emissions reduction for the N.G. savings from the removal of furnace pilot lights were also calculated by county for 2006 through 2020 by SIP area<sup>14</sup>.

*PUC-Senate Bill 7*. For the PUC Senate Bill 7 program savings, the annual electricity savings for 2001 through 2008 were obtained from the Public Utilities Commission<sup>15</sup>. Using these values savings were projected through 2020 by incorporating the different adjustment factors mentioned above. Similar savings were assumed for each year after 2008 until 2020. The 2008 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<sup>16</sup>. The annual and average day electricity savings were then proportioned according to the PCA and program. Using the actual reported numbers through 2008, savings through 2020 were projected incorporating the different adjustment factors mentioned above<sup>17</sup>. The 2008 annual and OSD eGRID were used to calculate the NOx emissions savings for PUC-Senate Bill 5

<sup>&</sup>lt;sup>13</sup> 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.

<sup>&</sup>lt;sup>14</sup> These use the NOx/MBtu values provided in the US EPA AP 42 guideline.

<sup>&</sup>lt;sup>15</sup> In a similar fashion to the previous programs, to obtain the Ozone Season Day (OSD) savings, the annual electricity savings were divided by 365.

<sup>&</sup>lt;sup>16</sup> 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.

<sup>&</sup>lt;sup>17</sup> 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 35 counties through 2008 were obtained from the State Energy Conservation Office<sup>18</sup>. These submittals included information gathered from SECO's website<sup>19</sup> and paper submittals<sup>20</sup>. The annual and average day electricity values were then summarized according to county and program. Using the actual reported numbers for 2004, savings through 2020 were projected using the different adjustment factors mentioned above. In a similar fashion to the previous programs, it was assumed that the same amount of electricity savings will be achieved for each year after 2005 until 2020. The 2008 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 2008 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 2008, savings through 2020 were projected incorporating the different adjustment factors mentioned above. The 2008 annual and OSD eGRID were then used to calculate the NOx emissions reduction for the electricity generated by Texas' wind farms<sup>21</sup>. The total electricity savings for each PCA was used to calculate the NOx emissions reduction for 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 2008 report to the TCEQ, the annual and OSD electricity savings for all the counties in ERCOT region as well as the 41 non-attainment and affected counties was calculated for the retrofit. Using the numbers for 2008, the savings through 2020 were projected by incorporating the appropriate adjustment factors<sup>22</sup>. In this analysis it was assumed that an equal number of existing houses had their air conditioners replaced, as reported for 2007, 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.

<sup>&</sup>lt;sup>18</sup> 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.

<sup>&</sup>lt;sup>19</sup> This web site was developed for SECO by the Laboratory, at the request of the TCEQ.

 $<sup>^{20}</sup>$  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.

<sup>&</sup>lt;sup>21</sup> 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.

<sup>&</sup>lt;sup>22</sup> Additional details about this calculation are contained in the Laboratory's 2006 Annual Report to the TCEQ, available at the Senate Bill 5 web site "eslsb5.tamu.edu".

#### 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 2001 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 Table 3 and Table 4 annual values are shown for 2005, and cumulative annual values are shown 2006 through 2020. The OSD NOx emissions reduction is also shown in Figure 2 as stacked bar charts and in Figure 3 for the individual components.

In 2008 (Table 3), the cumulative annual electricity savings<sup>23</sup> from code-compliant residential and commercial construction is calculated to be 1,551,569 MWh/year (6.8% of the total electricity savings), savings from retrofits to Federal buildings is 206,960 MWh/year (0.9%), savings from furnace pilot light retrofits is 2,548,904 MBtu/year, savings from the PUC's Senate Bill 5 and Senate Bill 7 programs is 2,015,453 MWh/year (8.8%), savings from SECO's Senate Bill 5 program is 445,357 MWh/year (1.9%), electricity savings from green power purchases (wind) is 15,171,518 MWh/year (66.2%), and savings from residential air conditioner retrofits<sup>24</sup> is 989,385 MWh/year (4.3%). The total savings from all programs is 22,929,144 MWh/year.

In 2008, the cumulative OSD electricity savings from code-compliant residential and commercial construction is calculated to be 6,904 MWh/day (14.2%), savings from retrofits to Federal buildings is 567 MWh/day (1.2%), savings from furnace pilot light retrofits is 6,983 MBtu/day, savings from the PUC's Senate Bill 5 and Senate Bill 7 programs is 5,522 MWh/day (11.4%), savings from SECO's Senate Bill 5 program is 1,220 MWh/day (2.5%), electricity savings from green power purchases (wind) are 25,575 MWh/day (52.6%), and savings from residential air conditioner retrofits are 7,017 MWh/day (14.5%). The total savings from all programs is 48,602 MWh/day, which would be a 2,025 MW average hourly load reduction during the OSD period.

By 2013, the cumulative annual electricity savings from code-compliant residential and commercial construction is calculated to be 2,045,171 MWh/year (5.8% of the total electricity savings), 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 MBtu/year, savings from the PUC's Senate Bill 5 and Senate Bill 7 programs will be 3,527,334 MWh/year (10.0%), 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 23,985,240 MWh/year (68.0%), and savings from residential air conditioner retrofits<sup>25</sup> will be 2,286,233 MWh/year (6.5%). The total savings from all programs will be 35,285,055 MWh/year.

By 2013, the cumulative OSD electricity savings from code-compliant residential and commercial construction is calculated to be 12,110 MWh/day (15%), savings from retrofits to Federal buildings will be 1,103 MWh/day (1.4%), savings from furnace pilot light retrofits will remain at 6,983 MBtu/day, savings from the PUC's Senate Bill 5 and Senate Bill 7 programs will be 9,664 MWh/day (11.9%), savings from SECO's Senate Bill 5 program will be 1,341 MWh/day (1.7%), electricity savings from green power purchases (wind) will be 40,432 MWh/day (50.0%), and savings from residential air conditioner retrofits will be 16,216 MWh/day

<sup>&</sup>lt;sup>23</sup> This includes the savings from 2001 through 2008.

<sup>&</sup>lt;sup>24</sup> 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.

<sup>&</sup>lt;sup>25</sup> 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.

(20%). The total savings from all programs will be 80,866 MWh/day, which would be a 3,369 MW average hourly load reduction during the OSD period.

In 2008 (Table 4)), the cumulative annual NOx emissions reduction<sup>26</sup> from code-compliant residential and commercial construction is calculated to be 1,091 tons-NOx/year (8.6% of the total NOx savings), savings from retrofits to Federal buildings is 158 tons-NOx/year (1.2%), savings from furnace pilot light retrofits is 117 tons-NOx/year (0.9%), savings from the PUC's Senate Bill 5 and Senate Bill 7 programs is 1,426 tons-NOx/year (11.2%), savings from SECO's Senate Bill 5 program is 340 tons-NOx/year (2.7%), electricity savings from green power purchases (wind) is 8,914 tons-NOx/year (70.0%), and savings from residential air conditioner retrofits is 682 tons-NOx/year (5.3%). The total NOx emissions reduction from all programs is 12,727 tons-NOx/year.

In 2008, the cumulative OSD NOx emissions reduction from code-compliant residential and commercial construction is calculated to be 6 tons-NOx/day (19.2%), savings from retrofits to Federal buildings is 0.42 tons-NOx/day (1.3%), savings from furnace pilot light retrofits is 0.32 tons-NOx/day (1.0%), savings from the PUC's Senate Bill 5 and Senate Bill 7 programs is 3.82 tons-NOx/day (12.1%), savings from SECO's Senate Bill 5 program is 0.92 tons-NOx/day (2.9%), electricity savings from green power purchases (wind) are 15.13 tons-NOx/day (48.2%), and savings from residential air conditioner retrofits are 4.77 tons-NOx/day (15.2%). The total NOx emissions reduction from all programs is 31.38 tons-NOx/day.

By 2013, the cumulative NOx emissions reduction from code-compliant residential and commercial construction is calculated to be 1,435 tons-NOx/year (7% of the total NOx savings), savings from retrofits to Federal buildings will be 308 tons-NOx/year (1.5%), savings from furnace pilot light retrofits will be 117 tons-NOx/year (0.6%), savings from the PUC's Senate Bill 5 and Senate Bill 7 programs will be 2,495 tons-NOx/year (12.2%), savings from SECO's Senate Bill 5 program will be 373 tons-NOx/year (1.8%), electricity savings from green power purchases (wind) will be 14,092 tons-NOx/year (69.1%), and savings from residential air conditioner retrofits will be 1,574 tons-NOx/year (7.7%). The total NOx emissions reduction from all programs will be 20,395 tons-NOx/year.

By 2013, the cumulative OSD NOx emissions reduction from code-compliant residential and commercial construction is calculated to be 8.32 tons-NOx/day (15.9%), savings from retrofits to Federal buildings will be 0.81 tons-NOx/day (1.6%), savings from furnace pilot light retrofits will be 0.32 tons-NOx/day (0.6%), savings from the PUC's Senate Bill 5 and Senate Bill 7 programs will be 6.69 tons-NOx/day (12.8%), savings from SECO's Senate Bill 5 program will be 1.01 tons-NOx/day (1.9%), electricity savings from green power purchases (wind) will be 23.92 tons-NOx/day (45.9%), and savings from residential air conditioner retrofits will be 11.03 tons-NOx/day (21.2%). The total NOx emissions reduction from all programs will be 52.10 tons-NOx/day.

<sup>&</sup>lt;sup>26</sup> These NOx emissions reduction were calculated with the US EPA's 2007 eGRID for annual (25% capacity factor) and Ozone Season Day OSD.

#### Summary

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 Day<sup>27</sup> (OSD) NOx reductions. The NOx emissions reduction from all these programs were calculated using estimated emissions factors for 2009 from the US Environmental Protection Agency (US EPA) eGRID database, which had been specially prepared for this purpose.

In 2008, the cumulative total annual electricity savings from all programs is 22,929,144 MWh/year (12,727 tons-NOx/year). The total cumulative OSD electricity savings from all programs is 48,602 MWh/day, which would be a 2,025 MW average hourly load reduction during the OSD period (31.38 tons-NOx/day). By 2013, the total cumulative annual electricity savings from will be 35,285,055 MWh/year (20,395 tons-NOx/year). The total cumulative OSD electricity savings from all programs will be 80,866 MWh/day, which would be a 3,369 MW average hourly load reduction during the OSD period (52.10 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 979-862-2804 or email us at <u>terpinfo@tees.tamus.edu</u>.

<sup>&</sup>lt;sup>27</sup> An ozone season day (OSD) represents the daily average emissions during the period that runs from mid-July to mid -September.

	ESL-Single Family <sup>16</sup>	ESL-Multifamily <sup>16</sup>	ESL- Commercial <sup>16</sup>	Federal Buildings <sup>15</sup>	Furnace Pilot Light Program <sup>15</sup>	PUC (SB7) <sup>15</sup>	PUC (SB5 Grant Program) <sup>15</sup>	SECO <sup>15</sup>	Wind-ERCOT <sup>8</sup>	SEER13 Single Family	SEER13 Multifamily
Annual Degradation Factor <sup>11</sup>	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 <sup>9</sup>	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 <sup>12</sup>	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

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



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

		American Electric Power - West				Brownsville		Lower Colorado River				San Antonio		South Texas				Texas-New				Total Nox	Total Nox
Area	County	(ERCOT) /PCA	NOx Reductions (Ibs)	Austin Energy/PCA	NOx Reductions (lbs)	Public Utils Board/PCA	NOx Reductions (lbs)	Auhotrity /PCA	NOx Reductions (lbs)	Reliant Energy HL&P/PCA	NOx Reductions (lbs)	Public Service Bd/PCA	NOx Reductions (lbs)	Electric Coop INC/PCA	NOx Reductions (lbs)	Texas Municipal Power Pool/PCA	NOx Reductions (Ibs)	Mexico Power Co/PCA	NOx Reductions (lbs)	TXU Electric/PCA	NOx Reductions (lbs)	Reductions (lbs)	Reductions (Tons)
	Brazoria	0.008831132	226.0465792	0.010890729	8.193488679	0.006522185	0	0.003944232	14.32402746	0.065444292	3035.079423	0.014877434	272.3666894	0.00626231	5 (	0.004817148	0	0.121274957	139.7235344	0.00816387	940.7285451	4636.462287	2.318231144
	Fort Bend	0.070431234	1802.797078	0.087239726	65.63359654	0.052016606	0	0.029374182	106.6764342	0.533812376	24756.36787	0.121275295	2220.231709	0.04872600	2 (	0.030918012	0	0.037278747	42.94966114	0.051195276	5899.267979	34893.92432	17.44696216
Houston- Galveston Area	Galveston Harris	0.033856739	866.6159501 1747.408655	0.041710519	31.3803294 63.61709594	0.025004711	C	0.015351589	103.3989497	0.249587379	23995.76304	0.056747051	1038.889275 2152.01819	0.02414308	3 0	0.019297151	0	0.567751219	41.63009278	0.032836887	3783.817742 5718.021208	18005.57093 33821.85723	9.002785467 16.91092861
	Liberty	(	0	0	C	0	C	0	0	0	0	0	0		0 0	0 0	0	c (	0 0	0 0	0	C	0
	Montgomery Waller		0	0	0	0	C	0 0	0	0	0	0	0	-		0 0	0			0 0	0	C	0
Beaumont/ Port	Hardin	(	0	0	0	0	0	0	0	0	0	0	0		0 0	0 0	0	0	0 (	0 0	0	C	0
Arthur Area	Orange	(	0	0	0	0	0	0	0	0	0	0	0			0 0	0	0		0 0	0	0	0
	Collin	0.002039135	52.19483875	0.003716345	2.795940278	0.001505992	0	0.005950953	21.61171382	0.002481478	115.0823578	0.000717051	13.12731328	0.01916624	7 (	0.07668094	0	0.00086441	0.995905867	0.004000199	460.945804	666.7538738	0.333376937
	Denton	0.00047388	12.12970385	0.000872802	0.656640103	0.000349982	0	0.001396994	5.073377767	0.000585443	27.15083393	0.000168971	3.093405773	0.0045437	4 (	0.018187155	0	0.000186605	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	0.001752506	32.08377752 8.651911537	0.01732642	B () 3 ()	0.060216761	0	0.020603444	4 23.73767965 6 401250735	0.110647237	12749.95959 3438 233618	13446.64211 3626 105373	6.723321056 1.813052686
Dallas/ Fort	Johnson	0.000286058	7.322112154	0.000526868	0.396381687	0.000211267	0	0.000843297	3.062551359	0.000353404	16.38963767	0.000101999	1.867338584	0.00274283	5 (	0.010978701	0	0.000112645	0.129780379	0.000512745	59.08393672	88.25173856	0.044125869
Worth Area	Kaulman Parker	0.006325453	5.566981877	0.006379446	4.799487271 0.301367914	0.004671629	C	0.010562096	38.3577242 2.328449436	0.002765	128.23113/9 12.46099677	0.000911441 7.75498E-05	16.68608752	0.00901110	7 0	0.031317452	0	0.010715411 8.56434E-05	12.34546025	0.057545265	44.92135575	6993.311403 67.09755584	3.496655701 0.033548778
	Rockwall	0.00004.0000	0	0	0.0004.04700	0	C	0	0	0	0	0	0	0.00440000	0	0 00	0	0	0 (	0	0	0	0
	Henderson Hood	0.000819895	20.98648722 320.6508812	0.000826893	9.505044007	0.000605529	C	0.001369042	4.971866208 75.96475123	0.000358395	16.62111282 253.9526704	0.00011814	2.162823693 33.04561243	0.00116800	4 0	0.004059317	0	0.001388914	1.600198603 24.4493081	0.007458924	859.4971295 13132.18878	906.4617199	0.45323086 6.924878523
F1 D	Hunt	0.006187558	158.3801895	0.006240374	4.694858985	0.004569788	C	0.010331844	37.5215301	0.002704724	125.4357135	0.000891572	16.32233268	0.00881466	4 (	0.030634735	0	0.010481817	12.0763306	0.056290785	6486.427041	6840.857996	3.420428998
C. Paso Ared	Bexar	0.033413751	855.276978	0.051775843	38.95283667	0.024677545	0	0.090663423	329.2568536	0.001141841	52.95463998	1.143571754	20935.7914	0.04687384	4 (	0.004669544	0	0.000519582	0.598622181	0.002503865	288.5221599	22501.3535	11.25067675
San Antonio Area	Comal Guadalupe	0.002000467	0 51,20507169	0.076378745	57,46248772	0.001477434	0	0.133848731	0 486.0903138	0.001237133	0 57.37392999	0.003554796	65.07897116	0.00106176	6 (	0 0.001855699	0	0.000401718	0.462828487	0.001835165	211.4673431	0 929,140946	0.464570473
	Wilson	(	0	0	0	0	0	0	0	0	0	0	0		0 0	0 0	0	0	0 (	0 0	0	0	0
1	Bastrop Caldwell	0.004502334	115.2442433	0.171901148	129.3274415	0.003325174	0	0.301245466	1094.014881	0.002784342	129.1281298	0.008000571	146.4694129	0.00238965	4 () D ()	0.004176513	0	0.000904124	1.041660856	0.004130298	475.937112	2091.162881	1.04558144
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	0.00130492	4 (	0.002280677	0	0.000493717	0.568821994	0.00225544	259.8960069	1141.925832	0.570962916
	Williamson	0.000510007	13.05442349	0.299602906	225.4020851	0.000376663	0	0.033939476	123.2009305	0.000334709	15.52263338	0.000906121	16.58869273	0.00027113	0 (	0.000471744	0	0.000103327	0.119045148	0.000467336	53.85143207	447.7942484	0.22389/124
	Gregg	0	0	0	0	0	0	0	0	0	0	0	0		0 0	0 0	0	0	0 0	0 0	0	0	0
North East Texas	Rusk	0.000685965	17.55833805	0.00069182	0.520481264	0.000506616	C	0.001145408	4.159710327	0.000299851	13.90604891	9.88414E-05	1.809525774	0.00097721	1 0	0.003396227	0	0.001162035	1.338805667	0.006240507	719.0980079	758.3909179	0.379195459
	Smith	0	0	0	0	0	0	0	0	0	0	0	0		0 0	0 0	0	0		0 0	0	0	0
Corpus Christi	Nueces	0.22756873	5824.975938	0.004556851	3.428283791	0.168069652	C	0.007612767	27.64682441	0.001680888	77.95375313	0.001626796	29.78235622	0.04679203	6 0	0.007246366	0	0.001609426	1.854254911	0.008283395	954.5014455	6920.142856	3.460071428
Area Victoria Area	San Patricio Victoria	0.050313351	1287.848557	0.001007478	0.757961986	0.037158653	0	0.001683113	6.112458369	0.000371629	17.2348572	0.00035967	6.584604794	0.01034528	B (	0.001602105	0	0.000355829	0.409958691	0.001831382	211.0314828	1529.979881 899.9113567	0.76498994
	Andrews	2.47421E-05	0.633312124	2.49533E-05	0.018773251	1.82731E-05	C	4.13138E-05	0.150036693	1.08153E-05	0.501577618	3.56511E-06	0.065267829	3.5247E-0	5 (	0.000122499	0	4.19135E-05	0.048289414	0.000225089	25.93716362	27.35442055	0.01367721
	Angelina Bosque	0.00031082	7.955919749	0.000313473	0.235837079	0.000229554	C	0.000519	1.884820844 6.374283599	0.000135867	6.301018286 34.11279889	4.47864E-05 0.000212298	0.81992053 3.88661097	0.00044278	7 0	0.001538876	0	0.000526534	0.606630902	0.002827658	325.8330045	343.6371519	0.171818576
	Brazos	0.001939725	49.65028649	0.003572622	2.687812467	0.001432574	C	0.005718288	20.7667609	0.002396384	111.1359931	0.000691644	12.66217912	0.01859880	5 (	0.074445136	0	0.000763829	0.880023807	0.003476855	400.6404605	598.4235164	0.299211758
	Cameron	0.048371747	1238.150172	0.000968599	0.728712051	0.297964476	C	0.001618161	5.876577133	0.000357288	16.56975992	0.00034579	6.330503314	0.00994606	1 0	0.001540279	0	0.000342098	0.394138287	0.001760709	202.8877272	1470.93759	0.735468795
	Cherokee	0.003503899	89.68774747	0.003533808	2.658611083	0.002587786	0	0.00585073	21.24774271	0.001531635	71.03190513	0.00050488	9.243032581	0.0049915	B (	0.017347879	0	0.005935657	6.838600793	0.031876422	3673.14266	3873.8503	1.93692515
	Coleman	0.001298787	33.24447222	2.6007E-05	0.019566001	0.000959212	C	4.34478E-05	0.157786761	9.59321E-06	0.444899929	9.2845E-06	0.16997473	0.00026705	3	4.13567E-05	0	9.18536E-06	0.010582658	4.72752E-05	5.447558433	39.49484073	0.01974742
	Crockett Ector	0.003535748	90.50296541	0.003565928	2.682776563	0.002611307	0	0.005903911	21.44087434	0.001545556	0 71.67755054	0.00050947	9.327047245	0.00503695	0 0	0 0.017505563	0	0.00598961	0 0	0.032166163	3706.529738	3909.061712	0
	Fannin	0.007056315	180.6173605	0.007116546	5.354034748	0.005211403	C	0.011782473	42.78969328	0.003084477	143.0473568	0.001016752	18.61404924	0.01005227	6 (	0.034935966	0	0.011953503	13.77189259	0.064194222	7397.14566	7801.340048	3.900670024
	Freestone	0.003677178	94.12308402	0.003708565	2.790087625	0.00271576	0	0.006140067	22.29850932	0.001607379	74.54465257	0.000529848	9.700129134	0.00523842	9 (	0.018205785	0	0.006229194	4 7.176790757	0.033452809	3854.790927	4065.42418	2.03271209
	Frio	0.008588335	219.8317964	0.000871383	0.655572927	0.006342868	0	0.001420864	5.160066298	0.000471808	21.88082203	0.000218433	3.998934744	0.20666074	6 (	0.012747844	0	0.000187546	0.216075897	0.000886827	102.189664	353.9329323	0.176966466
	Hardeman		0	0	0	0	C	0	0	0	0	0	0		0 0	0 0	0	0	0	0	0	C	0
	Haskell Hidalgo	0.188527456	4825.653746	0.003775086	2.840133709	0.139235931	0	0.006306735	22.9037859	0.001392518	0 64.58015017	0.001347706	24.6729498	0.0387644	D (	0 0.006003193	0	0.001333316	0 ( 5 1.536142338	0.006862311	790.7489276	5732.935836	2.866467918
	Howard	0.000555113	14.20898268	0.000559851	0.421196428	0.000409976	C	0.000926915	3.366221326	0.000242653	11.25338899	7.99868E-05	1.464348181	0.00079080	2 (	0.002748377	0	0.00094037	1.083420679	0.005050094	581.9258697	613.723428	0.306861714
	Jack Jones	0.002121449	54.30177924 1042.259088	0.002139557 0.000815354	1.609665938	0.001566784	0	0.003542346	12.86452461 4.946827986	0.000927334	43.00653033 13.94821343	0.000305682	5.596228347 5.32893728	0.0030221	7 ( B (	0.010503338 0.001296587	0	0.003593766	4.140456206 4 0.331780603	0.019299698	2223.917843 170.7883116	2345.437027 1238.216579	1.172718514 0.61910829
counties	Lamar	0.000950838	24.33817497	0.000958954	0.721455757	0.000702236	C	0.001587687	5.765907769	0.000415633	19.27561996	0.000137007	2.508241656	0.00135454	3 (	0.004707619	0	0.001610734	1.855761432	0.008650166	996.7647898	1051.229951	0.525614976
	Llano	0.001238174	31.69299001	0.047274044	35.56597012	0.000914447	0	0.082844655	300.8619059	0.000765714	35.51115798	0.002200214	40.28013466	0.00065717	2 (	0.001148571	0	0.000248641	0.286464175	0.000323175	130.8861051	575.0847279	0.287542364
	McLennan Milam	0.024534317	627.9940467 57.4746346	0.024743738	18.61560781	0.018119687	0	0.040966843	148.7767984	0.010724513	497.3657473 45.51940379	0.003535175	64.71975936 5.923216216	0.03495108	6 (	0.121469933	0	0.041561501	47.88391622	0.22319886	25719.36288	27124.71876	13.56235938
	Mitchell	0.014943169	382.493668	0.015070721	11.3382478	0.011036196	C	0.024951762	90.61580067	0.006532002	302.9316123	0.002153177	39.41900132	0.0212877	2 (	0.07398395	0	0.025313952	29.16475857	0.135944204	15664.94698	16520.91007	8.260455036
	Nolan Palo Pinto	0.000564654	14.45319062 82.08811543	0.000569473	0.428435476	0.000417022	0	0.000942846	3.424076134 34.33422818	0.000246823	11.44679952 183.7440401	8.13615E-05 0.001143513	1.489515743 20.93471146	0.00080439	9 0	0.002795613	0	0.000956532	2 1.102041289 1.454966345	0.005136889	591.9273539 662.3893373	624.2714127 989.3892293	0.312135706
	Pecos	4.09677E-05	1.048631523	4.13174E-05	0.031084551	3.02565E-05	C	6.84069E-05	0.248429171	1.79079E-05	0.830506919	5.90308E-06	0.108069782	5.83617E-0	5 (	0.000202832	0	6.93999E-05	0.079957102	0.0003727	42.94648142	45.29316047	0.02264658
	Red River		0	0	0	0	0	0 0	0	0	0	0	0	-		0 0	0	0		0 0	0	0	0
	Robertson	0.000737708	18.88277792	0.000835096	0.628273174	0.00054483	0	0.000735917	2.67258533	0.003149678	146.0711407	0.000730875	13.38040458	0.0007608	6 (	0.001866305	0	0.191632518	220.7840225	0.003397737	391.5236901	793.9428943	0.396971447
	Titus	0.005696437	145.8091831	0.005745061	4.322217039	0.004207073	0	0.009511781	34.54335843	0.002490043	115.4795873	0.000820806	15.02679093	0.00811502	3 (	0.028203184	0	0.00964985	11.11780398	0.051822854	5971.584145	6297.883086	3.148941543
	Tom Green Upton	0.001482448 3.11661E-06	37.94556586	2.96846E-05 3.14322E-05	0.022332825	0.001094854 2.30176F-05	0	4.95918E-05 5.20405F-05	0.180099353	1.09498E-05 1.36234E-05	0.507813132	1.05974E-05 4.49076F-06	0.19401082	0.00030481 4.43986F-0	7 (	0 4.72049E-05 0.000154304	0	1.04843E-05 5.27959E-05	0.012079149	5.39604E-05 0.000283531	6.217896494 32.67149923	45.07979763	0.022539899
1	Ward	0.018559529	475.0600294	0.01871795	14.08218954	0.013707039	0	0.030990277	112.54551	0.008112796	376.2433542	0.002674262	48.95869786	0.02643950	9 (	0.091888626	0	0.03144012	2 36.22285079	0.16884373	19455.98267	20519.0953	10.25954765
1	Wharton	0.02001432	512.2978652	0.000400768	0.301512399	0.014781473	0	0.000669531 6.01986E-05	2.431496589 0.218619544	0.000147832	6.855915242 50.7349716	0.000143074	2.619313398 4.550077512	0.00411528 9.98576E-0	5 (	0.000637307 0 6.33625E-05	0	0.000141547 7.6398E-05	0.163078928	0.000728512	83.94696529 12.08978615	608.6161471 71.5105814	0.304308074
1	Wichita	0.000207633	5.314695266	0.000209406	0.157543345	0.000153346	0	0.000346701	1.259093698	9.07612E-05	4.209191786	2.99181E-05	0.547721432	0.0002957	9 (	0.001027996	0	0.000351734	0.405240184	0.001888925	217.6622165	229.5557022	0.114777851
1	Wise	0.002844488	732.4920115	0.000573025	2.16823872	0.0021134796	0	0.000957307	3.476594279 17.32281236	0.000211372	58.25242144	0.00020457	3.745137877 7.565361234	0.00588410	4 (	0.000911232	0	0.000202386	5.527817073	0.025761411	2968.505674	3132.151412	1.566075706
	Young	0.006235856	159.6164509	0.006289085	4.731505443	0.004605458	0	0.010412491	37.81441029	0.002725836	126.4148216	0.000898531	16.44973921	0.00888346	B (	0.030873859	0	0.010563634	12.17059429	0.056730171	6537.057865	6894.255386	3.447127693
	roldi	1.12103/215	20/10.1/018	1.172570094	002.1008247	1.090706584	l i	1.109130/6/	4310.434059	1.025300006	10004.00393	1.042.002043	20230.00382	1.30936562		1.231042808		1.221000083	1407.009558	1.020700947	170103.2035	313207.3779	107.043669
Energy Savings							I																
by PCA		1													1	1		1					
(mwn)	1	25,597	1	752		0	1	3,632		46,377		18,307			U	0		1,152	2	115,231			

Table 2: Example of NOx Emissions Reduction Calculations using eGRID

Program	Annual															
	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	1,313,777	1,368,371	1,420,340	1,469,480	1,515,583	1,558,446	1,597,862	1,633,626	1,665,533	1,693,376	1,716,950	1,736,050
ESL-Multifamily (MWh)	9,228	37,821	51,312	63,156	74,493	85,311	95,599	105,346	114,541	123,171	131,227	138,696	145,568	151,830	157,472	162,483
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 Prog. (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	2,353,192	2,679,663	2,982,846	3,262,739	3,519,343	3,752,658	3,962,684	4,149,421	4,312,869	4,453,028	4,569,898	4,663,479
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	20,115,442	22,082,748	22,595,958	23,280,238	23,985,240	24,711,593	25,459,941	26,230,952	27,025,312	27,843,728	28,686,928	29,555,662
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)	3,634,949	10,052,682	13,467,885	20,380,240	26,132,070	28,857,830	30,079,762	31,422,747	32,736,151	34,020,320	35,275,615	36,502,419	37,701,133	38,872,181	39,775,770	40,561,288
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
Program	Ozone Sea	son Day - C	ISD													
	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	7,275	7,809	8,138	8,450	8,744	9,019	9,274	9,507	9,717	9,904	10,065	10,199
ESL-Multifamily (MWh)	36	192	271	351	428	508	577	643	706	765	820	871	919	962	1,002	1,037
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 Prog. (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	6,447	7,342	8,172	8,939	9,642	10,281	10,857	11,368	11,816	12,200	12,520	12,777
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	33,908	37,225	38,090	39,243	40,432	41,656	42,918	44,217	45,556	46,936	48,357	49,822
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

931

72,339

6,983

1,049

76,700

6,983

1,157

80,866

6,983

1,254

84,837

6,983

1,341

88,610

6,983

1,418

92,186

6,983

1,485

95,565

6,983

1,542

98,745

6,983

1,479

100,022

6,983

1,365

6,983

100,451

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

0

7,791 5,819 213

29,219

6,983

354

39,453

6,983

514

48,602

6,983

664

60,840

6,983

803

68,037

6,983

SEER13-Multifamily (MWh)

Total OSD (MWh)

Total OSD (MMBtu)

Program	Annual (in tons NOx)															
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family	158	708	843	883	922	960	996	1,029	1,061	1,090	1,117	1,141	1,163	1,182	1,198	1,210
ESL-Multifamily	6	26	35	44	51	59	66	73	79	85	91	96	100	105	109	112
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	1,668	1,899	2,113	2,311	2,492	2,657	2,805	2,937	3,052	3,151	3,234	3,553
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	11,818	12,974	13,276	13,678	14,092	14,519	14,958	15,411	15,878	16,359	16,854	17,365
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	6,760	8,839	12,727	16,200	17,889	18,689	19,554	20,395	21,214	22,009	22,782	23,415	24,143	24,683	25,392

# Table 4: Annual and OSD NOx Emissions Reduction Values for the Different Programs

Program	Ozone Sea	son Day - O	SD (in ton	s Nox/day)												
-	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	5.01	5.37	5.60	5.80	6.00	6.19	6.36	6.51	6.65	6.77	6.88	6.97
ESL-Multifamily	0.03	0.13	0.18	0.24	0.29	0.35	0.39	0.44	0.48	0.52	0.56	0.59	0.63	0.66	0.68	0.71
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	4.47	5.09	5.66	6.19	6.68	7.12	7.51	7.87	8.18	8.44	8.66	8.84
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	20.06	22.03	22.54	23.22	23.92	24.65	25.39	26.16	26.96	27.77	28.61	29.48
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)	8.09	19.53	26.24	31.38	38.99	43.61	46.48	49.36	52.10	54.70	57.17	59.49	61.36	63.40	64.15	64.31



Figure 2: Cumulative OSD NOx Emissions Reduction Projections through 2020



Figure 3: Cumulative OSD NOx Emissions Reduction Projections through 2020

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