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

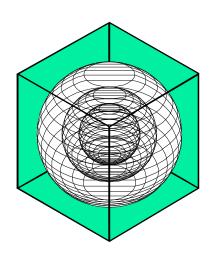
# PRELIMINARY REPORT: INTEGRATED NOX EMISSIONS SAVINGS FROM EE/RE PROGRAMS STATEWIDE

Annual Report to the Texas Commission on Environmental Quality January 2009 – December 2009



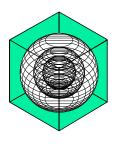
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July 2010



## ENERGY SYSTEMS LABORATORY

Texas Engineering Experiment Station Texas A&M University System



#### **ENERGY SYSTEMS LABORATORY**

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July 28, 2010

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

David E. Clarify

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

In this preliminary report, the NOx emissions savings from the energy-efficiency programs from multiple Texas State Agencies working under Senate Bill 5 and Senate Bill 7 in a uniform format to allow the TCEQ to consider the combined savings for Texas' State Implementation Plan (SIP) planning purposes. This required that the analysis should include the cumulative savings estimates from all projects projected through 2020 for both the annual and Ozone Season 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 2009, the cumulative total annual electricity savings from all programs is 25,585,081 MWh/year (15,327 tons-NOx/year). The total cumulative OSD electricity savings from all programs is 70,442 MWh/day, which would be a 2,935 MW average hourly load reduction during the OSD period (40.72 tons-NOx/day). By 2013, the total cumulative annual electricity savings from will be 31,979,929 MWh/year (19,314 tons-NOx/year). The total cumulative OSD electricity savings from all programs will be 92,099 MWh/day, which would be a 3,837 MW average hourly load reduction during the OSD period (54.15 tons-NOx/day). A summary of the savings for 2009 and 2013 is presented in the table below.

	2009	2013
Annual Electricity Savings (MWh/yr)	25,585,081	31,979,929
Annual Emissions reductions (tons NOx/yr)	15,327	19,314
OSD Electricity Savings (MWh/day)	70,442	92,099
OSD Emissions reductions (tons NOx/day)	40.72	54.15

<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 (MMBtu) 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 2009. 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 2009 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 2009, 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 2009 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>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

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

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

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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, <a href="http://www.puc.state.tx.us/electric/maps/gen\_tables.xls">http://www.puc.state.tx.us/electric/maps/gen\_tables.xls</a>. 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, <a href="https://www.seco.cpa.state.tx.us">www.seco.cpa.state.tx.us</a>.

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 2009 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 2009, 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 2009, 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 2009 through 2020. 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 2009 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 2009 for commercial buildings were obtained from the annual reports for 2005 and 2008 submitted by the Laboratory to TCEQ<sup>11</sup>. These savings were also tabulated by county and program. Using the calculated values through 2009, savings were then projected to 2020 by incorporating the different adjustment factors mentioned above<sup>12</sup>. In the projected 2009 cumulative electricity savings, it was assumed that the same amount of electricity savings from 2009 would be achieved for each year after 2009 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

<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 2009. This includes savings (estimated) from energy conservation measures implemented in Federal Buildings in Texas. The 2009 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 2009, it was assumed that the electricity savings from 2006 would also be achieved for each year from 2009 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 2009 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 2009 until 2020. The 2009 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 2009, 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

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<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/MMBtu 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 2009 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 2009 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 2009 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 2009, savings through 2020 were projected incorporating the different adjustment factors mentioned above. The 2009 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 each of the different counties.

SEER 13 Single-Family and Multi-family. In January of 2006, Federal regulations mandated that the minimum efficiency for residential air conditioners be increased to SEER 13 from the previous SEER 10. Although the electricity savings from new construction reflected this change in values, the annual and OSD electricity savings from the replacement of the air conditioning units by air conditioners with an efficiency of SEER 13 in existing residences needed to be calculated.

In the 2009 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 2009, 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 2008, 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>&</sup>lt;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>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 2009 (Table 3), the cumulative annual electricity savings<sup>23</sup> from code-compliant residential and commercial construction is calculated to be 1,688,687 MWh/year (6.6% of the total electricity savings), savings from retrofits to Federal buildings is 251,708 MWh/year (1.0%), savings from furnace pilot light retrofits is 2,548,904 MMBtu/year (2.9%), which is equivalent to 746,822 MWh/year, savings from the PUC's Senate Bill 5 and Senate Bill 7 programs is 2,347,661 MWh/year (9.2%), savings from SECO's Senate Bill 5 program is 457,921 MWh/year (1.8%), electricity savings from green power purchases (wind) is 18,808,351 MWh/year (73.5%), and savings from residential air conditioner retrofits<sup>24</sup> is 1,283,931 MWh/year (5.0%). The total savings from all programs is 25,585,081 MWh/year (24,838,258 MWh/year and 2,548,904 MMBtu/year).

In 2009, the cumulative OSD electricity savings from code-compliant residential and commercial construction is calculated to be 9,510 MWh/day (13.5%), savings from retrofits to Federal buildings is 690 MWh/day (1.0%), savings from furnace pilot light retrofits is 6,983 MMBtu/day (2.9%), which is equivalent to 2,046 MWh/day, savings from the PUC's Senate Bill 5 and Senate Bill 7 programs is 6,432 MWh/day (9.1%), savings from SECO's Senate Bill 5 program is 1,255 MWh/day (1.8%), electricity savings from green power purchases (wind) are 41,403 MWh/day (58.8%), and savings from residential air conditioner retrofits are 9,106 MWh/day (12.9%). The total savings from all programs is 70,442 MWh/day (68,396 MWh/day and 6,983 MMBtu/day), which would be a 2,935 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 2,176,034 MWh/year (6.8% of the total electricity savings), savings from retrofits to Federal buildings will be 402,732 MWh/year (1.3%), savings from furnace pilot light retrofits will remain at 2,548,904 MMBtu/year (2.3%), which is equivalent to 746,822 MWh/year, savings from the PUC's Senate Bill 5 and Senate Bill 7 programs will be 3,451,976 MWh/year (10.8%), savings from SECO's Senate Bill 5 program will be 489,440 MWh/year (1.5%), electricity savings from green power purchases (wind) will be 22,426,692 MWh/year (70.1%), and savings from residential air conditioner retrofits<sup>25</sup> will be 2,286,233 MWh/year (7.1%). The total savings from all programs will be 31,979,929 MWh/year (31,233,107 MWh/year and 2,548,904 MMBtu/year).

By 2013, the cumulative OSD electricity savings from code-compliant residential and commercial construction is calculated to be 12,567 MWh/day (13.6%), savings from retrofits to Federal buildings will be 1,103 MWh/day (1.2%), savings from furnace pilot light retrofits will remain at 6,983 MMBtu/day (2.2%), which is equivalent to 2,046 MWh/day, savings from the

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<sup>&</sup>lt;sup>23</sup> This includes the savings from 2001 through 2009.

<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.

PUC's Senate Bill 5 and Senate Bill 7 programs will be 9,457 MWh/day (10.3%), savings from SECO's Senate Bill 5 program will be 1,341 MWh/day (1.5%), electricity savings from green power purchases (wind) will be 49,369 MWh/day (53.6%), and savings from residential air conditioner retrofits will be 16,216 MWh/day (17.6%). The total savings from all programs will be 92,099 MWh/day (90,053 MWh/day and 6,983 MMBtu/day), which would be a 3,837 MW average hourly load reduction during the OSD period.

In 2009 (Table 4), the cumulative annual NOx emissions reduction<sup>26</sup> from code-compliant residential and commercial construction is calculated to be 1,189 tons-NOx/year (7.8% of the total NOx savings), savings from retrofits to Federal buildings is 193 tons-NOx/year (1.3%), savings from furnace pilot light retrofits is 117 tons-NOx/year (0.8%), savings from the PUC's Senate Bill 5 and Senate Bill 7 programs is 1,637 tons-NOx/year (10.7%), savings from SECO's Senate Bill 5 program is 349 tons-NOx/year (2.3%), electricity savings from green power purchases (wind) is 10,957 tons-NOx/year (71.5%), and savings from residential air conditioner retrofits is 884 tons-NOx/year (5.8%). The total NOx emissions reduction from all programs is 15,327 tons-NOx/year.

In 2009, the cumulative OSD NOx emissions reduction from code-compliant residential and commercial construction is calculated to be 6.57 tons-NOx/day (16.1%), savings from retrofits to Federal buildings is 0.51 tons-NOx/day (1.2%), savings from furnace pilot light retrofits is 0.32 tons-NOx/day (0.8%), savings from the PUC's Senate Bill 5 and Senate Bill 7 programs is 4.39 tons-NOx/day (10.8%), savings from SECO's Senate Bill 5 program is 0.95 tons-NOx/day (2.3%), electricity savings from green power purchases (wind) are 21.79 tons-NOx/day (53.5%), and savings from residential air conditioner retrofits are 6.19 tons-NOx/day (15.2%). The total NOx emissions reduction from all programs is 40.72 tons-NOx/day.

By 2013, the cumulative NOx emissions reduction from code-compliant residential and commercial construction is calculated to be 1,540 tons-NOx/year (8.0% of the total NOx savings), savings from retrofits to Federal buildings will be 308 tons-NOx/year (1.6%), 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 2,336 tons-NOx/year (12.1%), savings from SECO's Senate Bill 5 program will be 373 tons-NOx/year (1.9%), electricity savings from green power purchases (wind) will be 13,065 tons-NOx/year (67.6%), and savings from residential air conditioner retrofits will be 1,575 tons-NOx/year (8.2%). The total NOx emissions reduction from all programs will be 19,314 tons-NOx/year.

By 2013, the cumulative OSD NOx emissions reduction from code-compliant residential and commercial construction is calculated to be 8.72 tons-NOx/day (16.1%), savings from retrofits to Federal buildings will be 0.81 tons-NOx/day (1.5%), 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 6.28 tons-NOx/day (11.6%), 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 25.99 tons-NOx/day (48.0%), and savings from residential air conditioner retrofits will be 11.03 tons-NOx/day (20.4%). The total NOx emissions reduction from all programs will be 54.15 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 2009, the cumulative total annual electricity savings from all programs is 25,585,081 MWh/year (15,327 tons-NOx/year). The total cumulative OSD electricity savings from all programs is 70,442 MWh/day, which would be a 2,935 MW average hourly load reduction during the OSD period (40.72 tons-NOx/day). By 2013, the total cumulative annual electricity savings from will be 31,979,929 MWh/year (19,314 tons-NOx/year). The total cumulative OSD electricity savings from all programs will be 92,099 MWh/day, which would be a 3,837 MW average hourly load reduction during the OSD period (54.15 tons-NOx/day).

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

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

<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.

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

	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 9	7.00%	7.00%	7.00%	7.00%	0.00%	7.00%	7.00%	7.00%	0.00%	7.00%	7.00%
Initial Discount Factor 12	20.00%	20.00%	20.00%	20.00%	20.00%	25.00%	25.00%	60.00%	25.00%	20.00%	20.00%
Growth Factor	3.25%	1.54%	3.25%	0.00%	0.00%	0.00%	0.00%	0.00%	Actual Rates	N.A.	N.A.
Weather Normalized	Yes	Yes	Yes	No	No	No	No	No	See note 7	Yes	Yes

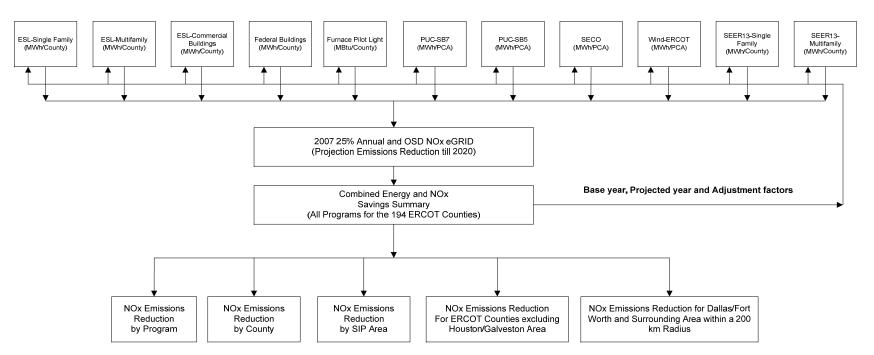


Figure 1: Process Flow Diagram of the NOx Emissions Reduction Calculations

Table 2: Example of NOx Emissions Reduction Calculations using eGRID

		American																					$\overline{}$
		Electric Power -						Lower Colorado															1
		West (FRCOT)	NOx Reductions	Austin	NOx Reductions	Brownsville Public Utils	NOx Reductions	River	NOx Reductions	Reliant Energy	NOx Reductions	San Antonio Public Service	NOx Reductions	South Texas Flectric Coon	NOx Reductions	Texas Municipal	NOx Reductions	Texas-New Mexico Power	NOx Reductions		NOx Reductions	Total Nox Reductions	Total Nox Reductions
Area	County	/PCA	(lbs)	Energy/PCA	(lbs)	Board/PCA	(lbs)	/PCA	(lbs)	HL&P/PCA	(lbs)	Bd/PCA	(lbs)	INC/PCA	(lbs)	Power Pool/PCA	(lbs)	Co/PCA	(lbs)	TXU Electric/PCA	(lbs)	(lbs)	(Tons)
	Brazoria	0.008831132	226.0465792	0.010890729	8.193488679	0.006522185	0	0.003944232	14.32402746	0.065444292	3035.079423	0.014877434	272.3666894	0.006262315	0	0.004817148	0	0.121274957	139.7235344	0.00816387	940.7285451	4636.462287	2.318231144
	Chambers Fort Bend	0.021762222	557.0379581 1802.797078	0.026955801	20.27982242	0.016072371 0.052016606	0	0.009076193	32.96145962 106.6764342	0.164940225 0.533812376	7649.355979 24756.36787	0.037472294 0.121275295	686.0191605 2220.231709	0.015055623 0.048726002	0	0.009553214	0	0.011518588 0.037278747	13.2708178	0.015818592 0.051195276	1822.787617 5899.267979	10781.71281 34893.92432	5.390856407 17.44696216
Houston-	Galveston	0.033856739	866.6159501	0.041710519	31.3803294	0.025004711	0	0.015351589	55.75143316	0.249587379	11574.99759	0.056747051	1038.889275	0.024143087	0	0.019297151	0	0.567751219	654.118618	0.032836887	3783.817742	18005.57093	9.002785467
Galveston Area	Harris	0.068267332	1747.408655	0.084559408	63.61709594	0.050418468	0	0.028471701	103.3989497	0.517411736	23995.76304	0.117549281	2152.01819	0.047228963	0	0.029968099	0	0.03613341	41.63009278	0.049622373	5718.021208	33821.85723	16.91092861
	Liberty Montgomery	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Waller	0	0	Ö	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Ö	0	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
Arthur Area	Jefferson Orange	0	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	0.019166247	0	0.07668094	0	0.00086441	0.995905867	0.004000199	460.945804	666.7538738	0.333376937
	Dallas	0.004539471	116.1948312	0.004683963	3.523914222	0.003352602	0	0.00774211	28.1165509	0.002085611	96.72341896	0.00068106	12.46842352	0.007502816	0	0.026717045	0	0.007524933	8.669640256	0.040370454	4651.916039	4917.612818	2.458806409
	Denton Tarrant	0.00047388 0.012162492	12.12970385	0.000872802	9.228387517	0.000349982 0.008982543	0	0.001396994 0.020308652	5.073377767 73.75369976	0.000585443 0.005316504	27.15083393 246.5610524	0.000168971	3.093405773 32.08377752	0.00454374 0.017326428	0	0.018187155	0	0.000186605 0.020603444	0.214992277	0.000849405	97.87758499 12749.95959	146.1965387	0.073098269 6.723321056
	Ellis	0.003279814	83.95193355	0.003307809	2.488584531	0.002422289	0	0.005476558	19.88888265	0.001433682	66.48919108	0.000472592	8.651911537	0.004672353	0	0.016238427	0	0.005556053	6.401250735	0.029837824	3438.233618	3626.105373	1.813052686
Dallas/ Fort	Johnson	0.000286058	7.322112154 161 9098051	0.000526868	0.396381687	0.000211267	0	0.000843297	3.062551359	0.000353404	16.38963767 128.2311379	0.000101999	1.867338584 16.68608752	0.002742835	0	0.010978701	0	0.000112645	0.129780379	0.000512745	59.08393672 6630.9817	88.25173856 6993.311403	0.044125869
Worth Area	Kaufman Parker	0.006325453	161.9098051 5.566981877	0.006379446	4.799487271	0.004671629	0	0.010562096	2 328449436	0.002765	128.2311379	0.000911441 7.75498E-05	16.68608752	0.009011105	0	0.031317452	0	0.010715411 8.56434E-05	0.098671668	0.057545265	6630.9817 44.92135575	67 00755584	3.496655701 0.033548778
	Rockwall	0.000217403	0.500501077	0.000400570	0.501507514	0.000100020	0	0.000041137	0	0.000200032	0	0	0	0.00200000	0	0.000047070	0	0.554542 05	0.030071000	0.0000000000	0	07.03733304	0
	Henderson	0.000819895	20.98648722	0.000826893	0.622101782	0.000605529	0	0.001369042	4.971866208	0.000358395	16.62111282	0.00011814	2.162823693	0.001168005	0	0.004059317	0	0.001388914	1.600198603	0.007458924	859.4971295	906.4617199	0.45323086
	Hood	0.01252711	320.6508812 158.3801895	0.012634039	9.505044007 4.694858985	0.009251829	0	0.020917482	75.96475123 37.5215301	0.005475887	253.9526704 125.4357135	0.001805044	33.04561243 16.32233268	0.017845854	0	0.062021991 0.030634735	0	0.021221112	24.4493081	0.113964315	13132.18878 6486.427041	13849.75705 6840.857996	6.924878523 3.420428998
El Paso Area	El Paso	0	0		0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0
	Bexar	0.033413751	855.276978	0.051775843	38.95283667	0.024677545	0	0.090663423	329.2568536	0.001141841	52.95463998	1.143571754	20935.7914	0.046873844	0	0.004669544	0	0.000519582	0.598622181	0.002503865	288.5221599	22501.3535	11.25067675
San Antonio Area	Comal Guadalupe	0.002000467	51.20507169	0.076378745	57.46248772	0.001477434	0	0.133848731	486.0903138	0.001237133	57.37392999	0.003554796	65.07897116	0.001061766	0	0.001855699	0	0.000401718	0.462828487	0.001835165	211.4673431	929.140946	0.464570473
	Wilson	0	0	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	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	0.002389654	0	0.004176513	0	0.000904124	1.041660856	0.004130298	475.937112	2091.162881	1.04558144
Austin Area	Havs	0.002458599	62.93167289	0.093870431	70.62211537	0.001815785	0	0.164501762	597.4110691	0.001520452	70.51327681	0.004368889	79.98286869	0.001304924	0	0.002280677	0	0.000493717	0.568821994	0.00225544	259.8960069	1141.925832	0.570962916
	Travis	0.000510007	13.05442349	0.299602906	225.4020851	0.000376663	0	0.033939476	123.2559365	0.000334709	15.52263338	0.000906121	16.58869273	0.000271138	0	0.000471744	0	0.000103327	0.119045148	0.000467336	53.85143207	447.7942484	0.223897124
	Williamson	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gregg Harrison	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	- 0
North East Texas Area	Rusk	0.000685965	17.55833805	0.00069182	0.520481264	0.000506616	0	0.001145408	4.159710327	0.000299851	13.90604891	9.88414E-05	1.809525774	0.000977211	0	0.003396227	0	0.001162035	1.338805667	0.006240507	719.0980079	758.3909179	0.379195459
	Smith Upshur	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	- 0
Corpus Christi	Nueces	0.22756873	5824.975938	0.004556851	3.428283791	0.168069652	0	0.007612767	27.64682441	0.001680888	77.95375313	0.001626796	29.78235622	0.046792036	0	0.007246366	0	0.001609426	1.854254911	0.008283395	954.5014455	6920.142856	3.460071428
Area	San Patricio	0.050313351	1287.848557	0.001007478	0.757961986	0.037158653	0	0.001683113	6.112458369	0.000371629	17.2348572	0.00035967	6.584604794	0.010345288	0	0.001602105	0	0.000355829	0.409958691	0.001831382	211.0314828	1529.979881	0.76498994
Victoria Area	Victoria Andrews	0.021836736 2.47421E-05	558.9452467 0.633312124	0.002215582 2.49533E-05	1.666862472 0.018773251	0.016127403 1.82731E-05	0	0.003612695 4.13138E-05	13.12000619	0.001199621 1.08153E-05	55.63426979 0.501577618	0.000555389 3.56511E-06	10.16770824	0.52545648 3.5247E-05	0	0.032412721	0	0.000476855 4.19135E-05	0.549395481	0.002254849 0.000225089	259.8278678 25.93716362	899.9113567 27.35442055	0.449955678
	Angelina	0.00031082	7.955919749	0.000313473	0.235837079	0.000229554	0	0.000519	1.884820844	0.000135867	6.301018286	4.47864E-05	0.81992053	0.000442787	0	0.000122499	0	0.000526534	0.606630902	0.000223089	325.8330045	343.6371519	0.171818576
	Bosque	0.000595392	15.23997933	0.001096604	0.825014503	0.000439723	0	0.001755208	6.374283599	0.000735562	34.11279889	0.000212298	3.88661097	0.005708837	0	0.02285067	0	0.000234455	0.270120186	0.001067208	122.9751683	183.6839758	0.091841988
	Brazos Calhoun	0.001939725	49.65028649 2116.830355	0.003572622 0.001655986	2.687812467	0.001432574	0	0.005718288	20.7667609	0.002396384	111.1359931 28.32885022	0.000691644	12.66217912 10.8230826	0.018598805 0.0170045	0	0.074445136	0	0.000763829 0.000584875	0.880023807	0.003476855 0.003010234	400.6404605 346.8714129	598.4235164 2514.820424	0.299211758
	Cameron	0.048371747	1238.150172	0.000968599	0.728712051	0.297964476	0	0.002768324	5.876577133	0.000357288	16.56975992	0.00034579	6.330503314	0.009946061	0	0.002633372	0	0.000342098	0.394138287	0.003010234	202.8877272	1470.93759	0.735468795
	Cherokee	0.003503899	89.68774747	0.003533808	2.658611083	0.002587786	0	0.00585073	21.24774271	0.001531635	71.03190513	0.00050488	9.243032581	0.00499158	0	0.017347879	0	0.005935657	6.838600793	0.031876422	3673.14266	3873.8503	1.93692515
	Coke	0.001298787	33.24447222	2.6007E-05	0.019566001	0.000959212	0	4.34478E-05	0.157786761	9.59321E-06	0.444899929	9,2845E-06	0.16997473	0.000267053	0	4.13567E-05	0	9.18536E-06	0.010582658	4,72752E-05	5.447558433	39.49484073	0.01974742
	Crockett	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ector	0.003535748	90.50296541	0.003565928	2.682776563	0.002611307	0	0.005903911	21.44087434	0.001545556	71.67755054	0.00050947	9.327047245	0.005036951	0	0.017505563	0	0.00598961	6.900760344	0.032166163	3706.529738	3909.061712 7801.340048	1.954530856
	Fannin Fayette	0.007056315	180.6173605	0.007116546	5.354034748	0.005211403	0	0.011782473	42.78969328	0.003084477	143.0473568	0.001016752	18.61404924	0.010052276	0	0.034935966	0	0.011953503	13.77189259	0.064194222	7397.14566	7801.340048	3.900670024
	Freestone	0.003677178	94.12308402	0.003708565	2.790087625	0.00271576	0	0.006140067	22.29850932	0.001607379	74.54465257	0.000529848	9.700129134	0.005238429	0	0.018205785	0	0.006229194	7.176790757	0.033452809	3854.790927	4065.42418	2.03271209
	Frio Grimes	0.008588335	219.8317964	0.000871383	0.655572927	0.006342868	0	0.001420864	5.160066298	0.000471808	21.88082203	0.000218433	3.998934744	0.206660746	0	0.012747844	0	0.000187546	0.216075897	0.000886827	102.189664	353.9329323	0.176966466
	Hardeman	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Haskell	0	0	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hidalgo Howard	0.188527456	4825.653746 14.20898268	0.003775086	2.840133709 0.421196428	0.139235931	0	0.006306735	22.9037859 3.366221326	0.001392518	64.58015017 11.25338899	0.001347706 7.99868E-05	24.6729498 1.464348181	0.03876448	0	0.006003193	0	0.001333316	1.536142338	0.006862311	790.7489276 581.9258697	5732.935836 613.723428	2.866467918 0.306861714
	Jack	0.002121449	54.30177924	0.000339851	1.609665938	0.001566784	0	0.003542346	12.86452461	0.000242633	43.00653033	0.000305682	5.596228347	0.00302217	0	0.002748377	0	0.003593766	4.140456206	0.019299698	2223.917843	2345.437027	1.172718514
Other ERCOT	Jones	0.040718722	1042.259088	0.000815354	0.613420549	0.030072592	0	0.001362147	4.946827986	0.00030076	13.94821343	0.000291082	5.32893728	0.008372468	0	0.001296587	0	0.000287974	0.331780603	0.001482142	170.7883116	1238.216579	0.61910829
counties	Lamar Limestone	0.000950838	24.33817497	0.000958954	0.721455757	0.000702236	0	0.001587687	5.765907769	0.000415633	19.27561996	0.000137007	2.508241656 22 68917849	0.001354543	0	0.004707619	0	0.001610734	1.855761432	0.008650166	996.7647898	1051.229951 356 5909243	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	0.000657172	0	0.001148571	0	0.000248641	0.286464175	0.001135861	130.8861051	575.0847279	0.287542364
	McLennan	0.024534317	627.9940467	0.024743738	18.61560781	0.018119687	0	0.040966843	148.7767984	0.010724513	497.3657473	0.003535175	64.71975936	0.034951066	0	0.121469933	0	0.041561501	47.88391622	0.22319886	25719.36288	27124.71876	13.56235938
I	Milam Mitchell	0.002245405 0.014943169	57.4746346 382.493668	0.002264571	1.703718789 11.3382478	0.001658332 0.011036196	0	0.003749326 0.024951762	13.61619935 90.61580067	0.000981518	45.51940379 302.9316123	0.000323543 0.002153177	5.923216216 39.41900132	0.003198756 0.02128772	0	0.011117048	0	0.00380375 0.025313952	4.382383245 29.16475857	0.02042738 0.135944204	2353.86146 15664 94698	2482.481016 16520.91007	1.241240508 8.260455036
	Nolan	0.000564654	14.45319062	0.000569473	0.428435476	0.000417022	0	0.000942846	3.424076134	0.000246823	11.44679952	8.13615E-05	1.489515743	0.000804394	0	0.002795613	0	0.000956532	1.102041289	0.005136889	591.9273539	624.2714127	0.312135706
I	Palo Pinto	0.003206998	82.08811543	0.005906709	4.443830552	0.002368511	0	0.009454195	34.33422818	0.003962005	183.7440401	0.001143513	20.93471146	0.030749889	0	0.123082087	0	0.001262858	1.454966345	0.005748375	662.3893373	989.3892293	0.494694615
	Pecos Presidio	4.09677E-05	1.048631523	4.13174E-05	0.031084551	3.02565E-05	0	6.84069E-05	0.248429171	1.79079E-05	0.830506919	5.90308E-06	0.108069782	5.83617E-05	0	0.000202832	0	6.93999E-05	0.079957102	0.0003727	42.94648142	45.29316047	0.02264658
	Red River	0	0	Č	0	0	0	0	0	0	0	0	0	0	0	Ö	0	0	0	0	0	0	0
	Robertson Taylor	0.000737708	18.88277792	0.000835096	0.628273174	0.00054483	0	0.000735917	2.67258533	0.003149678	146.0711407	0.000730875	13.38040458	0.00076086	0	0.001866305	0	0.191632518	220.7840225	0.003397737	391.5236901	793.9428943	0.396971447
	Titus	0.005696437	145.8091831	0.005745061	4.322217039	0.004207073	0	0.009511781	34.54335843	0.002490043	115.4795873	0.000820806	15.02679093	0.008115023	0	0.028203184	0	0.00964985	11.11780398	0.051822854	5971.584145	6297.883086	3.148941543
	Tom Green	0.001482448	37.94556586	2.96846E-05	0.022332825	0.001094854	0	4.95918E-05	0.180099353	1.09498E-05	0.507813132	1.05974E-05	0.19401082	0.000304817	0	4.72049E-05	0	1.04843E-05	0.012079149	5.39604E-05	6.217896494	45.07979763	0.022539899
l	Upton	3.11661E-05 0.018559529	0.797745539 475.0600294	3.14322E-05 0.01871795	0.023647546 14.08218954	2.30176E-05 0.013707039	0	5.20405E-05 0.030990277	0.188992281	1.36234E-05 0.008112796	0.631807433 376.2433542	4.49076E-06 0.002674262	0.082213995 48.95869786	4.43986E-05 0.026439509	0	0.000154304	0	5.27959E-05 0.03144012	0.060827297	0.000283531	32.67149923 19455.98267	34.45673333 20519.0953	0.017228367 10.25954765
	Ward Webb	0.018559529	475.0600294 512.2978652	0.000400768	14.08218954 0.301512399	0.014781473	0	0.030990277	2.431496589	0.008112796	376.2433542 6.855915242	0.000143074	48.95869786 2.619313398	0.026439509	0	0.091888626	0	0.00144012	36.22285079 0.163078928	0.16884373	19455.98267 83.94696529	608.6161471	0.304308074
	Wharton	0.00014434	3.694599265	0.000178787	0.134507561	0.000106601	0	6.01986E-05	0.218619544	0.001093979	50.7349716	0.000248538	4.550077512	9.98576E-05	0	6.33625E-05	0	7.6398E-05	0.088019771	0.000104918	12.08978615	71.5105814	0.035755291
	Wichita Wilbarger	0.000207633 0.028616818	5.314695266 732.4920115	0.000209406	0.157543345 0.431107444	0.000153346 0.021134796	0	0.000346701	1.259093698 3.476594279	9.07612E-05 0.000211372	4.209191786 9.802701684	2.99181E-05 0.00020457	0.547721432 3.745137877	0.00029579	0	0.001027996 0.000911232	0	0.000351734 0.000202386	0.405240184	0.001888925 0.001041639	217.6622165 120.0287677	229.5557022 870.2094935	0.114777851 0.435104747
	Wise	0.002844488	732.4920115	0.000873028	2.16823872	0.0021134796	0	0.00476997	17.32281236	0.000211372	58.25242144	0.00020457	7.565361234	0.005884109	0	0.000911232	0	0.000202386	5.527817073	0.025761411	2968.505674	3132.151412	1.566075706
l	Young	0.006235856	159.6164509	0.006289085	4.731505443	0.004605458	0	0.010412491	37.81441029	0.002725836	126.4148216	0.000898531	16.44973921	0.008883468	0	0.030873859	0	0.010563634	12.17059429	0.056730171	6537.057865	6894.255386	3.447127693
	Total	1.121837219	28715.17018	1.172570094	882.1668247	1.090766584	0	1.189130767	4318.494059	1.629360006	75564.06999	1.542362643	28236.60382	1.359385821	0	1.231642808	0	1.221806085	1407.669558	1.528786947	176163.2035	315287.3779	157.643689
Energy				1																i			i
Savings by PCA				l																			I
(MWh)	l	25 507		763	,	0		3 632		46 377		18 307						1 169		115 231			I
		23,097		. 702		U		3,032		-0,377		13,307						1,102		110,231			

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

2222244	ANNUAL															
PROGRAM	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family (MWh)	225,389	1,001,051	1,197,537	1,256,764	1,252,530	1,247,084	1,240,311	1,232,099	1,222,335	1,210,907	1,197,702	1,182,608	1,165,511	1,146,299	1,124,859	1,101,079
ESL-Multifamily (MWh)	9,228	37,821	51,312	63,156	165,765	264,701	359,882	451,226	538,652	622,078	701,421	776,601	847,536	914,144	976,342	1,034,050
ESL-Commercial (MWh)	63,456	129,063	192,036	231,649	270,392	308,184	344,944	380,592	415,047	448,228	480,055	510,445	539,320	566,597	592,196	616,037
Federal Buildings (MWh)	52,276	109,073	159,415	206,960	251,708	293,659	332,813	369,171	402,732	433,496	461,464	486,635	509,009	528,586	545,366	559,350
Furnace Pilot Light Program (MMBtu)	2,209,050	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904	2,548,904
PUC (SB7) (MWh)	302,192	1,362,701	1,630,383	2,003,432	2,336,446	2,647,008	2,935,118	3,200,777	3,443,984	3,664,739	3,863,043	4,038,895	4,192,295	4,323,244	4,431,741	4,517,786
PUC (SB5 grant program) (MWh)	0	13,633	12,827	12,021	11,215	10,409	9,603	8,797	7,991	7,186	6,380	5,574	4,768	3,962	3,156	2,350
SECO (MWh)	115,360	293,764	353,701	445,357	457,921	468,611	477,428	484,371	489,440	492,636	493,959	493,408	490,983	486,685	480,513	472,468
Wind-ERCOT (MWh)	2,867,049	6,699,696	9,193,504	15,171,518	18,808,351	20,647,822	21,127,684	21,767,500	22,426,692	23,105,846	23,805,568	24,526,479	25,269,222	26,034,457	26,822,866	27,635,151
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	24,838,258	27,448,353	28,648,015	29,956,546	31,233,107	32,478,022	33,691,635	34,874,306	36,026,415	37,148,362	38,000,330	38,731,679
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 SE	ASON DAY -	OSD													
PROGRAM	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family (MWh)	776	5,537	6,519	6,904	6,981	7,227	7,274	7,312	7,338	7,353	7,356	7,346	7,322	7,284	7,230	7,160
ESL-Multifamily (MWh)	36	192	271	351	829	1,295	1,738	2,162	2,568	2,956	3,324	3,673	4,001	4,310	4,598	4,865
ESL-Commercial (MWh)	0	800	1,189	1,447	1,700	1,966	2,205	2,436	2,660	2,876	3,082	3,280	3,467	3,645	3,811	3,967
Federal Buildings (MWh)	0	299	437	567	690	805	912	1,011	1,103	1,188	1,264	1,333	1,395	1,448	1,494	1,532
Furnace Pilot Light Program (MMBtu)	5,819	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983
PUC (SB7) (MWh)	828	3,733	4,467	5,489	6,401	7,252	8,041	8,769	9,436	10,040	10,584	11,065	11,486	11,845	12,142	12,377
PUC (SB5 grant program) (MWh)	0	37	35	33	31	29	26	24	22	20	17	15	13	11	9	6
SECO (MWh)	316	805	969	1,220	1,255	1,284	1,308	1,327	1,341	1,350	1,353	1,352	1,345	1,333	1,316	1,294
Wind-ERCOT (MWh)	5,836	14,936	20,763	25,575	41,403	45,453	46,509	47,918	49,369	50,864	52,404	53,991	55,626	57,310	59,046	60,834
SEER13-Single Family (MWh)	0	2,666	4,449	6,503	8,442	10,268	11,979	13,576	15,059	16,428	17,683	18,824	19,851	20,764	19,969	18,451
SEER13-Multifamily (MWh)	0	213	354	514	664	803	931	1,049	1,157	1,254	1,341	1,418	1,485	1,542	1,479	1,365
Total Annual (MWh)	7,791	29,219	39,453	48,602	68,396	76,381	80,924	85,585	90,053	94,328	98,410	102,298	105,992	109,492	111,093	111,853
Total Annual (MMBtu)	5,819	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983	6,983

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

2222244	ANNUAL	(in tons NOx	)													
PROGRAM	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family	158	708	843	883	879	874	869	862	854	845	835	823	810	796	780	762
ESL-Multifamily	6	26	35	44	119	191	261	328	392	453	511	566	618	667	712	755
ESL-Commercial	44	90	136	164	192	218	245	270	295	319	341	363	384	403	421	438
Federal Buildings	40	84	122	158	193	225	255	283	308	332	353	373	390	405	418	428
Furnace Pilot Light Program	102	117	117	117	117	117	117	117	117	117	117	117	0	0	0	0
PUC (SB7)	237	1,074	1,157	1,421	1,633	1,830	2,012	2,179	2,332	2,471	2,594	2,703	2,797	2,876	2,941	3,367
PUC (SB5 grant program)	0	6	5	5	5	4	4	4	3	3	3	2	2	2	1	1
SECO	67	224	270	340	349	357	364	369	373	376	377	376	374	371	366	360
Wind-ERCOT	2,465	4,152	5,688	8,914	10,957	12,029	12,308	12,681	13,065	13,461	13,868	14,288	14,721	15,167	15,626	16,099
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	15,327	16,921	17,688	18,513	19,314	20,092	20,846	21,577	22,167	22,852	23,348	24,135

222224	OZONE SE	ASON DAY	OSD (in tor	s NOx/day)												
PROGRAM	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family	0.76	3.85	4.50	4.76	4.81	4.98	5.00	5.02	5.04	5.04	5.04	5.03	5.01	4.98	4.94	4.89
ESL-Multifamily	0.03	0.13	0.18	0.24	0.58	0.92	1.24	1.55	1.84	2.12	2.39	2.64	2.88	3.11	3.31	3.51
ESL-Commercial	0.26	0.55	0.82	1.00	1.17	1.36	1.52	1.68	1.84	1.98	2.13	2.26	2.39	2.52	2.63	2.74
Federal Buildings	0.11	0.22	0.32	0.42	0.51	0.59	0.67	0.74	0.81	0.87	0.93	0.98	1.02	1.06	1.10	1.12
Furnace Pilot Light Program	0.28	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.00	0.00	0.00	0.00
PUC (SB7)	0.64	2.61	3.10	3.81	4.38	4.91	5.40	5.85	6.27	6.64	6.97	7.26	7.52	7.73	7.91	8.04
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	21.79	23.93	24.48	25.22	25.99	26.77	27.59	28.42	29.28	30.17	31.08	32.02
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	40.72	45.51	48.42	51.35	54.15	56.81	59.33	61.72	63.64	65.75	66.55	66.78

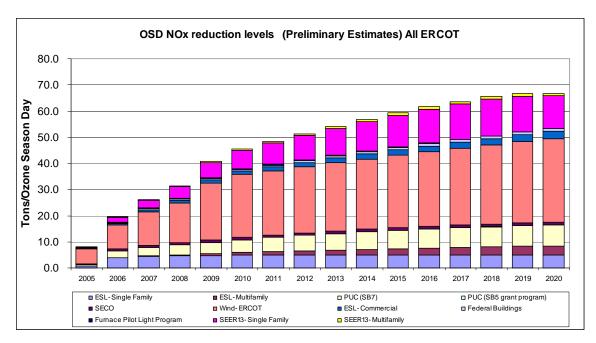


Figure 2: Cumulative OSD NOx Emissions Reduction Projections through 2020

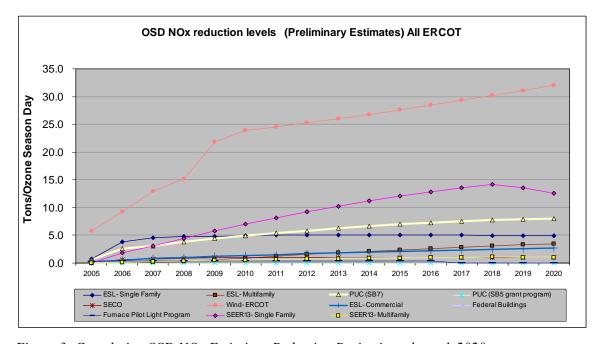


Figure 3: Cumulative OSD NOx Emissions Reduction Projections through 2020

#### References

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

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

ICC. 1999. 2000 International Energy Conservation Code. Falls Church, VA: International Code Council, Inc.

ICC. 2001. 2001 Supplement to the International Energy Conservation Code. Falls Church, VA: International Code Council, Inc.

Haberl, J., Culp, C., Yazdani, B., Fitzpatrick, and Turner, D., 2002, "Texas's senate Bill 5 Legislation for Reducing Pollution in Non-attainment and Affected Areas," Annual Report to the Texas Natural Resource Conservation Commission, July, Energy Systems Laboratory Report ESL-TR-02/07-01.

Haberl, J., Culp, C., Yazdani, B., Fitzpatrick, T., Bryant, J., Turner, D., 2003, "Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP)," Volume II – Technical Report, Annual Report to the Texas Commission on Environmental Quality, September 2002 to August 2003, Energy Systems Laboratory Report ESL-TR-03/12-04.

Haberl, J., Culp, C., Yazdani, B., Gilman, D., Fitzpatrick, T., Muns, S., Verdict, M., Ahmed, M., Liu, B., Baltazar-Cervantes, J.C., Bryant, J., Degelman, L., Turner, D. 2004. "Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP)", Volume II – Technical Report, Annual Report to the Texas Commission on Environmental Quality, September 2003 to August 2004, Energy Systems Laboratory Report ESL-TR-04/12-04.

Haberl, J., Culp, C., Yazdani, B., Gilman, D., Fitzpatrick, T., Muns, S., Verdict, M., Ahmed, M., Liu, B., Baltazar-Cervantes, J.C., Bryant, J., Degelman, L., and Turner, D. 2006. "Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP)", Volume II – Technical Report, Annual Report to the Texas Commission on Environmental Quality, September 2004 to December 2005, Energy Systems Laboratory, Report ESL-TR-06-06-08.

Haberl, J., Culp, C., Yazdani, B., Gilman, D., Fitzpatrick, T., Muns, S., Verdict, M., Ahmed, M., Liu, Z., Baltazar-Cervantes, J-C, Mukhopadhyay, J., Degelman, L, Turner, D. 2007. "Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP)", Volume II – Technical Report, Annual Report to the Texas Commission on Environmental Quality, September 2004 to December 2005, Energy Systems Laboratory, Report ESL-TR-07-12-01.

Haberl, J. S., Liu, Z., Baltazar-Carvantes, J. C., Subbarao, K., Gilman, D., Culp, C., Yazdani, B., Turner, W. D., Chandrasekaran, V. 2008. "Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP)", Volume II—Technical Report, Annual Report to the Texas Commission on Environmental Quality, January 2007 – December 2007, Energy Systems Laboratory, Report ESL-TR-08-08-01.

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

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

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

USDOE 2004. Building Energy Standards Program: Determination Regarding Energy Efficiency Improvements in the Energy Standard for Buildings, Except Low-Rise Residential Buildings, ASHRAE/IESNA Standard 90.1-1999. Docket No. (Docket No. EE-DET-02-001). Washington, D.C. <a href="http://www.energycodes.gov/implement/pdfs/FR\_com\_notice.pdf">http://www.energycodes.gov/implement/pdfs/FR\_com\_notice.pdf</a>