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

VOLUME I—TECHNICAL REPORT

Annual Report to the
Texas Commission on Environmental Quality
January 2017-December 2017

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December 2018

ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

TEXAS A&M ENGINEERING EXPERIMENT STATION

Energy Systems Laboratory

December 10, 2018

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

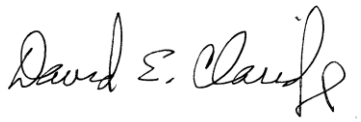
Dear Mr Gifford:

The Energy Systems Laboratory (ESL) at the Texas A&M Engineering Experiment Station of the Texas A&M University System is pleased to provide its annual report, "Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP)," as required under Texas Health and Safety Code 386.205, 386.252, 388.006, 389.003 (e), and under Texas Utilities Code Sec. 39.9051 (g) (h), and Sec. 39.9052 (c) (d).

The ESL is required to annually report the energy savings from statewide adoption of the Texas Building Energy Performance Standards in Senate Bill 5 (SB 5), as amended, and the relative impact of proposed local energy code amendments in the Texas non-attainment and near-non-attainment counties as part of the Texas Emissions Reduction Plan (TERP).

Please contact me at (979) 845-9213 should you or any of the TCEQ staff have any questions concerning this report or any of the work presently being done to quantify emissions reduction from energy efficiency and renewable energy measures as a result of the TERP implementation.

Sincerely,



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

Enclosure

cc: Commissioner Jon Niermann
Commissioner Emily Lindley
Executive Director Toby Baker

Disclaimer

This report is provided by the Energy Systems Laboratory of the Texas A&M Engineering Experiment Station (TEES) as required under Sections 386.205, 386.252, 388.006, and 388.003 (e) of the Texas Health and Safety Code and Sections 39.9051 (g) (h), and 39.9052 (c) (d) of the Texas Utilities Code. The information provided in this report is intended to be the best available information at the time of publication. TEES makes no claim or warranty, express or implied, that the report or data herein is necessarily error-free. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not constitute or imply its endorsement, recommendation, or favoring by the Energy Systems Laboratory or any of its employees. The views and opinions of authors expressed herein do not necessarily state or reflect those of the Texas A&M Engineering Experiment Station or the Energy Systems Laboratory.

VOLUME I – TECHNICAL REPORT

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

Executive Summary

The Energy Systems Laboratory (Laboratory), a division of the Texas A&M Engineering Experiment Station and a member of The Texas A&M University System, in fulfillment of its responsibilities under Sections 386.205, 386.252, 388.006, and 388.003 (e) of the Texas Health and Safety Code and Sections 39.9051 (g) (h), and 39.9052 (c) (d) of the Texas Utilities Code, submits its annual report, Energy Efficiency/Renewable Energy (EE/RE) Impact in the Texas Emissions Reduction Plan (TERP) to the Texas Commission on Environmental Quality.

The report is organized in two volumes.

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

The ESL worked with the EPA and TCEQ regarding a new version of eGRID for all ERCOT counties in Texas. A new version of eGRID was developed and presented in this report, which is based on the ERCOT competitive load zones.

Accomplishments:

a. Energy Code Amendments

The Laboratory was requested by several Councils of Governments (COGs) and municipalities to analyze the stringency of several proposed residential and commercial energy code amendments, including: the 2015 IECC and the ASHRAE Standards 90.1-2013. Results of the analysis are included in this Volume I-Technical Report.

b. Technical Assistance

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

c. NOx Emissions Reduction

Under the TERP legislation, the Laboratory must determine the energy savings from energy code adoption and, when applicable, from more stringent local codes or above-code performance ratings, and must report these reductions annually to the TCEQ.

Figure 1 shows the integrated NOx emissions reduction through 2022 for the electricity and natural gas savings from the various EE/RE programs.

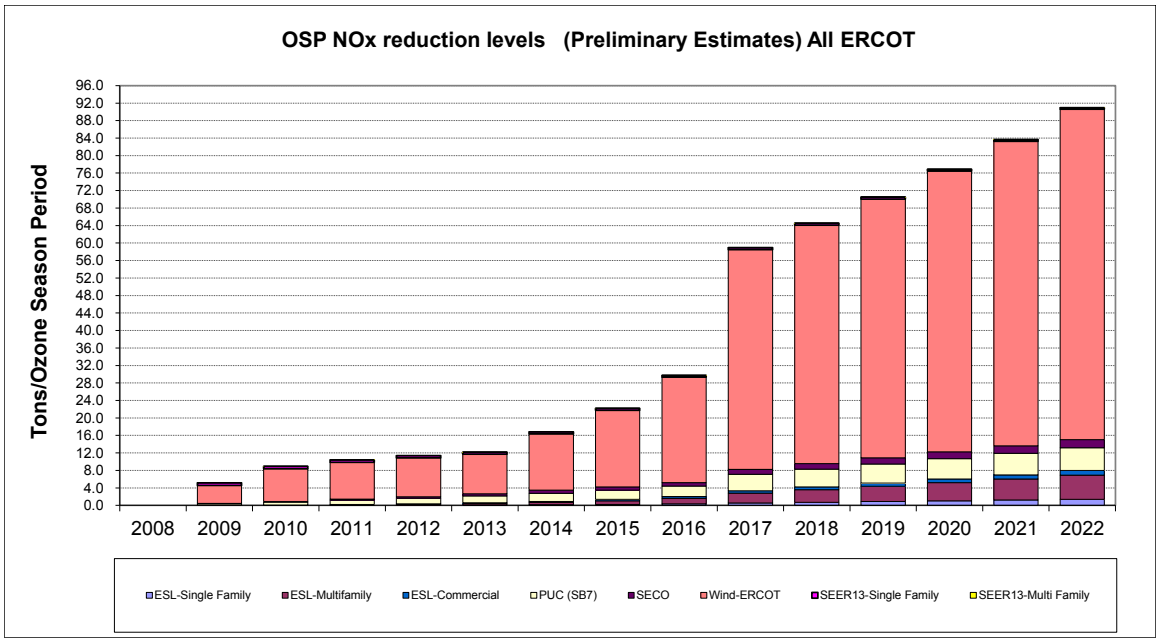


Figure 1: Integrated OSP NOx Emissions Reduction Projections through 2022 (Base Year 2008)

In 2017 (Table 1), the total integrated annual savings from all programs are 56,457,081 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction are 4,034,136 MWh/year (7.1% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program are 3,844,949 MWh/year (6.8%),
- Savings from SECO's Senate Bill 5 program are 1,275,938 MWh/year (2.3%),
- Electricity savings from renewable power generation are 47,055,032 MWh/year (83.3%), and
- Savings from residential air conditioner retrofits[1] are 247,025 MWh/year (0.4%).

By 2022, the total integrated annual savings from all programs will be 87,687,961 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction will be 9,380,917 MWh/year (10.7% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program will be 5,332,467 MWh/year (6.1%),
- Savings from SECO's Senate Bill 5 program will be 2,028,819 MWh/year (2.3%),
- Electricity savings from renewable power generation will be 70,754,614 MWh/year (80.7%), and
- Savings from residential air conditioner retrofits will be 191,143 MWh/year (0.2%).

In 2017 (Table 2), the total integrated annual NOx emissions reductions from all programs are 27,065 tons-NOx/year. The integrated annual NOx emissions reductions from all the different programs are:

- NOx emissions reductions from code-compliant residential and commercial construction are 1,213 tons-NOx/year (4.5% of the total NOx savings),
- NOx emissions reductions from the PUC's Senate Bill 7 programs are 1,326 tons-NOx/year (4.9%),
- NOx emissions reductions from SECO's Senate Bill 5 program are 400 tons-NOx/year (1.5%),
- NOx emissions reductions from renewable power generation are 25,054 tons-NOx/year (88.9%), and
- NOx emissions reductions from residential air conditioner retrofits are 72 tons-NOx/year (0.3%).

By 2022, the total integrated annual NOx emissions reductions from all programs will be 41,612 tons-NOx/year. The integrated annual NOx emissions reductions from all the different programs are:

[1] 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.

- NOx emissions reductions from code-compliant residential and commercial construction will be 2,891 tons-NOx/year (6.9% of the total NOx savings),
- NOx emissions reductions from the PUC's Senate Bill 7 programs will be 1,833 tons-NOx/year (4.4%),
- NOx emissions reductions from SECO's Senate Bill 5 program will be 665 tons-NOx/year (1.6%),
- NOx emissions reductions from renewable power generation will be 36,169 tons-NOx/year (86.9%), and
- NOx emissions reductions from residential air conditioner retrofits will be 55 tons-NOx/year (0.1%).

Table 1: Annual and OSP Electricity Savings for the Different Programs (Base Year 2008)

PROGRAM	ANNUAL (MWh)														
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ESL-Single Family	0	25,031	47,000	74,109	153,562	215,164	275,535	360,010	533,473	722,595	916,125	1,114,311	1,317,411	1,525,690	1,739,422
ESL-Multifamily	0	50,784	108,018	200,414	332,835	527,292	774,578	1,225,617	1,856,682	2,472,527	3,115,886	3,788,639	4,492,777	5,230,406	6,003,760
ESL-Commercial	0	0	24,066	83,255	119,422	247,952	400,015	559,947	696,924	839,015	986,534	1,139,810	1,299,190	1,465,038	1,637,735
PUC (SB7)	0	538,841	976,984	1,437,883	1,831,318	2,267,414	2,675,295	3,079,759	3,498,867	3,844,949	4,173,727	4,486,067	4,782,789	5,064,675	5,332,467
SECO	0	71,910	154,786	347,175	508,375	705,060	1,004,828	1,005,713	1,100,775	1,275,938	1,442,344	1,600,428	1,750,609	1,893,281	2,028,819
Renewables-ERCOT	0	3,454,992	8,351,369	12,158,649	13,392,752	17,028,343	18,753,002	20,883,590	34,193,486	47,055,032	51,054,710	55,394,360	60,102,881	65,211,626	70,754,614
SEER13-Single Family	0	343,330	326,163	309,855	294,362	279,644	265,662	252,379	239,760	227,772	216,383	205,564	195,286	185,522	176,246
SEER13-Multi Family	0	29,021	27,569	26,191	24,881	23,637	22,456	21,333	20,266	19,253	18,290	17,376	16,507	15,682	14,897
Total Annual (MWh)	**0**	**4,513,907**	**10,015,955**	**14,637,531**	**16,657,507**	**21,294,506**	**24,171,371**	**27,388,349**	**42,140,233**	**56,457,081**	**61,923,999**	**67,746,556**	**73,957,450**	**80,591,919**	**87,687,961**

PROGRAM	OZONE SEASON PERIOD - OSP (MWh/day)														
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ESL-Single Family	0	69	129	203	421	589	755	986	1,462	1,980	2,510	3,053	3,609	4,180	4,766
ESL-Multifamily	0	139	296	549	912	1,445	2,122	3,358	5,087	6,774	8,537	10,380	12,309	14,330	0
ESL-Commercial	0	0	66	228	327	679	1,096	1,534	1,909	2,299	2,703	3,123	3,559	4,014	4,487
PUC (SB7)	0	1,476	2,677	3,939	5,017	6,212	7,330	8,438	9,586	10,534	11,435	12,291	13,104	13,876	14,609
SECO	0	197	424	951	1,393	1,932	2,753	2,755	3,016	3,496	3,952	4,385	4,796	5,187	5,558
Renewables-ERCOT	0	15,037	26,234	30,736	32,528	31,695	46,338	63,604	86,957	96,446	104,644	113,538	123,189	133,660	145,021
SEER13-Single Family	0	2,445	2,323	2,207	2,097	1,992	1,892	1,798	1,708	1,622	1,541	1,464	1,391	1,321	1,255
SEER13-Multi Family	0	195	186	176	167	159	151	144	136	130	123	117	111	106	100
Total OSP (MWh)	**0**	**19,559**	**32,334**	**38,990**	**42,862**	**44,703**	**62,436**	**82,617**	**109,861**	**123,280**	**135,444**	**148,350**	**162,069**	**176,674**	**175,797**

Table 2: Annual and OSP NOx Emissions Reductions Values for the Different Programs (Base Year 2008)

PROGRAM	ANNUAL (in tons NOx)														
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ESL-Single Family	0	3	8	15	34	50	65	86	129	206	263	320	379	440	502
ESL-Multifamily	0	4	19	43	77	127	190	305	468	810	1,028	1,256	1,494	1,744	2,006
ESL-Commercial	0	0	5	16	22	47	79	114	141	197	232	267	304	343	383
PUC (SB7)	0	135	246	362	460	567	669	770	874	1,326	1,438	1,545	1,646	1,742	1,833
SECO	0	19	43	92	133	183	264	265	294	400	458	514	567	617	665
Renewables-ERCOT	0	951	2,645	3,258	3,561	4,693	5,116	5,683	9,360	24,054	26,098	28,317	30,724	33,335	36,169
SEER13-Single Family	0	81	77	73	69	66	62	59	56	66	63	60	57	54	51
SEER13-Multi Family	0	7	6	6	6	6	5	5	5	6	5	5	5	5	4
Total Annual (Tons NOx)	**0**	**1,199**	**3,048**	**3,864**	**4,363**	**5,738**	**6,451**	**7,287**	**11,328**	**27,065**	**29,585**	**32,283**	**35,175**	**38,279**	**41,612**

PROGRAM	OZONE SEASON PERIOD - OSP (in tons NOx/day)														
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ESL-Single Family	0.00	0.01	0.02	0.04	0.09	0.14	0.18	0.24	0.35	0.57	0.73	0.89	1.05	1.22	1.39
ESL-Multifamily	0.00	0.01	0.05	0.12	0.21	0.35	0.52	0.83	1.28	2.24	2.84	3.47	4.13	4.82	5.54
ESL-Commercial	0.00	0.00	0.01	0.04	0.06	0.13	0.22	0.31	0.39	0.54	0.64	0.74	0.84	0.94	1.05
PUC (SB7)	0.00	0.37	0.67	0.99	1.26	1.55	1.83	2.11	2.39	3.75	4.07	4.37	4.65	4.93	5.19
SECO	0.00	0.05	0.12	0.25	0.37	0.50	0.72	0.73	0.81	1.12	1.28	1.44	1.58	1.72	1.85
Renewables-ERCOT	0.00	4.15	7.53	8.42	8.91	9.03	12.87	17.55	24.11	50.25	54.53	59.16	64.19	69.65	75.57
SEER13-Single Family	0.00	0.57	0.54	0.51	0.49	0.46	0.44	0.42	0.40	0.48	0.46	0.44	0.41	0.39	0.37
SEER13-Multi Family	0.00	0.05	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.04	0.04	0.03	0.03	0.03	0.03
Total OSP (Tons NOx)	**0.00**	**5.20**	**8.99**	**10.41**	**11.42**	**12.20**	**16.82**	**22.22**	**29.76**	**59.00**	**64.58**	**70.53**	**76.90**	**83.71**	**91.00**

d. Technology Transfer

In 2017, The Laboratory, hosted the 2018 Texas Energy Summit (formerly called the Clean Air Through Energy Efficiency/CATEE conference), which is attended by top experts and policy makers in Texas and from around the country. In the 2017 conference, the latest educational programs and technology were presented and discussed, including efforts by the Laboratory, and others, to reduce air pollution in Texas through energy efficiency and renewable energy. These efforts have produced significant success in bringing EE/RE closer to US EPA acceptance in the Texas SIP. The Laboratory will continue to provide superior technology to the State of Texas through such efforts with the TCEQ and the US EPA.

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

These efforts have been recognized nationally by the US EPA. In 2007, the Laboratory was awarded a National Center of Excellence on Displaced Emissions Reduction (CEDER) by the US EPA so that these accomplishments could be rapidly disseminated to other states for their use. The benefits of CEDER include:

- Reducing the financial, technical, and administrative costs of determining the emissions reduction from EE/RE measures;
- Continuing to accelerate implementation of EE/RE strategies as a viable clean air effort in Texas and other states;
- Helping other states better identify and prioritize cost-effective clean air strategies from EE/RE; and
- Communicating the results of quantification efforts through case-studies and a clearinghouse of information.

The Energy Systems Laboratory provides the annual report, Energy Efficiency/Renewable Energy (EE/RE) Impact in the Texas Emissions Reduction Plan (TERP), to the Texas Commission on Environmental Quality (TCEQ) in fulfillment of its responsibilities under Sections 386.205, 386.252, 388.006, and 388.003 (e) of the Texas Health and Safety Code and Sections 39.9051 (g) (h), and 39.9052 (c) (d) of the Texas Utilities Code. If any questions arise, please contact us by phone at (979) 845-9213.

Acknowledgements

This work has been completed as a fulfillment of Sections 386.205, 386.252, 388.006, and 388.003 (e) of the Texas Health and Safety Code and Sections 39.9051 (g) (h), and 39.9052 (c) (d) of the Texas Utilities Code, which require the Laboratory to assist TCEQ in quantifying emissions reductions credits from energy efficiency and renewable energy programs.

The authors are also grateful for the timely input provided by the following individuals, and agencies: Art Diem, US EPA, for providing the eGRID database and Vincent Meiller and Robert Gifford, TCEQ.

Numerous additional individuals at the Laboratory contributed significantly to this report, including, Sungkyun Jung, Farshad Kheiri, Minjae Shin and Chul Kim.

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1 Overview

The Energy Systems Laboratory (Laboratory), at the Texas A&M Engineering Experiment Station (TEES) of the Texas A&M University System, is pleased to provide our annual report, Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP), to the Texas Commission on Environmental Quality (TCEQ) in fulfillment of its responsibilities under Sections 386.205, 386.252, 388.006, and 388.003 (e) of the Texas Health and Safety Code and Sections 39.9051 (g) (h), and 39.9052 (c) (d) of the Texas Utilities Code. This annual report:

- Provides an estimate of the energy savings and NOx reductions from energy code compliance in new residential construction in all Electric Reliability Council of Texas (ERCOT) counties;
- Provides an estimate of the standardized, cumulative, integrated energy savings and NOx reductions from the TERP programs implemented by the Laboratory, , the State Energy Conservation Office (SECO), the Public Utility Commission (PUC) and ERCOT in all ERCOT Texas;
- Describes the technology developed to enable the TCEQ to substantiate energy and emissions reduction credits from energy efficiency and renewable energy initiatives (EE/RE) to the U.S. Environmental Protection Agency (US EPA), including the development of a web-based emissions reduction calculator; and
- Outlines progress in advancing EE/RE strategies for credit in the Texas State Implementation Plan (SIP).

The report is organized in two volumes.

Volume I – Technical Report – provides a detailed report of activities, methodologies and findings, including an executive summary and overview;

Volume II – Technical Appendix – contains detailed data from simulations for each of the counties included in the analysis.

1.1 Legislative Background

The TERP was established in 2001 by the 77th Legislature through the enactment of Senate Bill 5 to:

- Ensure that Texas air meets the Federal Clean Air Act requirements (Section 707, Title 42, United States Code); and
- Reduce NOx emissions in non-attainment and near-non-attainment counties through mandatory and voluntary programs, including the implementation of energy efficiency and renewable energy programs (EE/RE).

To achieve the clean air and emissions reduction goals of the TERP, Senate Bill 5 created a number of EE/RE programs for credit in the SIP:

- The Texas Building Energy Performance Standards (TBEPS) as the building energy code for all new residential and commercial buildings;
- A municipality or county may request the Laboratory to determine the energy impact of proposed energy code changes;
- An annual evaluation by the Public Utility Commission of Texas (PUCT), in cooperation with the Laboratory, of the emissions reduction of energy demand, peak electric loads and the associated air contaminant reductions from utility-sponsored programs established under Senate Bill 5, and utility-sponsored programs established under the electric utility restructuring act (Section 39.905 Utilities Code);
- A 5% electricity reduction goal each year for facilities of political subdivisions in non-attainment and near-non-attainment counties from 2002 through 2009; and
- Annual report to TCEQ to be provided by the Laboratory on the energy savings and resultant emissions reduction from implementation of building energy codes and which identifies the municipalities and counties whose codes are more or less stringent than the un-amended code.

Passed during the 78th Legislature (2003), HB 1365 and HB 3235 amended TERP to enhance its effectiveness with these additional energy efficiency initiatives:

- TCEQ is required to conduct outreach to non-attainment and near-non-attainment counties on the benefits of implementing energy efficiency measures as a way to meet the air quality goals under the federal Clean Air Act;

- TCEQ is required develop a methodology for computing emissions reduction from energy efficiency initiatives;
- A voluntary Energy-Efficient Building Program at the General Land Office (GLO), in consultation with the Laboratory, for the accreditation of buildings that exceed the state energy code requirements by 15% or more;
- Municipalities are allowed to adopt an optional, alternate energy code compliance mechanism through the use of accredited energy efficiency programs determined to be code-compliant by the Laboratory, as well as the US EPA's Energy Star New Homes program; and
- The Laboratory is required to develop and administer a statewide training program for municipal building inspectors seeking to become code-certified inspectors for enforcement of energy codes.

Senate Bill 5 was again amended during the 79th Legislature (2005) through SB 20, HB 2481 and HB 2129. These enhanced the effectiveness of Senate Bill 5 by adding the following energy efficiency initiatives:

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

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

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

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

The 82nd Legislature (2011) increased the Laboratory's responsibilities under TERP with the introduction of new energy efficiency initiatives:

- Each political subdivision, institution of higher education or state agency shall establish a goal to reduce the electric consumption by the entity by at least 5% each fiscal year for 10 years, beginning September 1, 2011. Each entity shall report annuallt to SECO, on forms provided by SECO, regarding the entity's goal, the entity's efforts to meet the goal, and progress the entity has made. The Laboratory is required to calculate energy savings and emissions reduction for each political subdivision, institution of higher education or state agency, based on the information collected by SECO.
- Beginning April 1, 2012, all electric cooperatives that had retail sales of more than 500,000 MWh in 2005 and all municipally owned utilities must report annually to SECO, on a standardized form developed by SECO, information regarding the combined effects of the energy efficiency activities of the electric cooperative/utility from the previous calendar year, including the annual goals, programs enacted to achieve those goals, and any achieved energy demand or savings goals. The Laboratory is required to calculate energy savings and emissions reduction for municipally owned utilities and for electric cooperatives, based on the information collected by SECO.
- SECO is required to appoint a new advisory committee for selecting high-performance building design evaluation systems. The Laboratory will send a representative to participate at the new advisory committee.
- The Laboratory may conduct outreach to the real estate industry on the value of energy code compliance and above code construction.

The 83rd Legislature (2013) did not change any of the Laboratory's previously established responsibilities under TERP.

During the 84th Legislature session (2015), changes to the Sec. 388.003. Adoption of Building Energy Efficiency Performance Standards, with the passage of HB 1736, affected the Laboratory's responsibilities under TERP:

- 2015 residential energy codes (IRC/IECC) editions are in effect starting Sept 1, 2016. 2015 commercial energy codes (IECC) are in effect starting Nov 1, 2016. The Laboratory's responsibilities of reviewing new energy codes and local code amendments remain. New codes will be reviewed no sooner than every 6 years.
- The legislation introduces a new energy rating index (ERI) as a voluntary compliance path for local code amendments. With the introduction of the ERI as another compliance path, the Laboratory is required to consider it when local amendments are reviewed, and needs to update the web-based code compliance tool and emissions reduction calculator to allow for the new optional compliance path.

The 85th Legislature (2017) did not change any of the Laboratory's previously established responsibilities under TERP.

1.2 Laboratory Funding for the TERP

The Laboratory expended $181,855 in FY 2002; $372,226 in FY 2003; $635,683.84 in FY 2004; $1,107,366.13 in FY 2005; $952,012.70 in 2006; $947,114.62 in FY 2007; $908,512.65 in FY 2008; $949,927.94 in FY 2009; $902,843.35 in FY 2010, $853,421.69 in FY 2011; $434,481.91 in FY 2012 (with the 50% Legislature cut in ESL funding), $447,907.94 in FY 2013; $453,122.25 in FY 2014; $454,571.79 in FY 2015; and $459,845.41 in FY 2016. In FY 2017 the Laboratory expended $462,043.00. Throughout the years, the Laboratory has also supplemented these funds with competitively awarded Federal and State grants to provide the needed statewide training for the new mandatory energy codes and to provide technical assistance to cities and counties in helping them implement adoption of the legislated energy efficiency codes. In addition, the ESL received an award from the US EPA in the spring of 2007 to establish a Center of Excellence for the Determination of Emissions Reduction (CEDER) which has helped to enhance the EE/RE emissions calculations.

1.3 Code Adoption

One of the TERP's energy efficiency programs to reduce emissions from stationary sources was the establishment of the Texas Building Energy Performance Standards (TBEPS) that define the building energy codes for all new residential and commercial construction statewide. The original TBEPS were based on the energy efficiency chapter of the 2000 International Residential Code (IRC), including the 2001 Supplement, for Single-Family residences, (i.e., one- and two-family residences of three stories or less above grade) and the 2000 International Energy Conservation Code (IECC), including the 2001 Supplement, for commercial, industrial and residential buildings over three stories.

Over the years since the establishment of the TERP, newer editions of the IRC and the IECC have been published. The Energy Systems Laboratory is mandated to review the stringency of the new code editions and provide recommendations to the State on whether to upgrade the TBEPS to the new editions.

In the time frame of 2002-2009, the laboratory provided recommendations and considered additional input from stakeholder meetings and public comment periods on new editions of the IRC/IECC energy efficiency codes. The State of Texas did not adopt any of the newer editions of the energy efficiency codes as the TBEPS. During this timeframe, several individual jurisdictions did adopt the newer editions of the IRC and the IECC.

With the laboratory's recommendation, on April 1, 2011, SECO updated the TBEPS commercial and residential (excluding single-family) energy codes to the 2009 International Energy Conservation Code (IECC). On January 1, 2012, the TBEPS for single-family residential was updated to Chapter 11 (Energy Efficiency) of the 2009 International Residential Code (IRC).

In the timeframe of 2012-2015, the laboratory provided recommendations and considered additional input from stakeholder meetings and public comment periods on new editions of the IRC/IECC energy efficiency codes. The State of Texas did not adopt either edition of the energy efficiency codes as the TBEPS. During this time, several individual jurisdictions did adopt the newer editions of the IRC and the IECC. As of the time of this report, SECO announced a timeline to adopt the 2015 IRC/IECC effective September 1, 2016.

During the 84th Legislature session (2015), the legislator adopted the 2015 residential energy codes (IRC/IECC) editions to be in effect starting September 1, 2016. 2015 commercial energy codes (IECC) were also set to be in effect starting Nov 1, 2016. The Laboratory's responsibilities of reviewing new energy codes and local code amendments remain. New codes will be reviewed no sooner than every 6 years (next review will be of 2021 code editions). The 2015 residendial energy codes also established a new energy rating index (ERI) as a voluntary compliance path and the legislation amended the index values published in the IECC. With the introduction of the ERI as another compliance path, the Laboratory is required to consider it when local amendments are reviewed. During 2016, the Laboratory has update the IC3 web-based code compliance tool and emissions reduction calculator to allow for the new optional compliance path.

1.4 Accomplishments since January 2017

Since January 2017, the Laboratory has accomplished the following:

- Calculated energy and resultant NOx reductions from implementation of the Texas Building Energy Performance Standards (IECC/IRC codes) to new residential and commercial construction for all non-attainment and near-non-attainment counties;
- Enhanced the Laboratory's IECC/IRC Code-Traceable Test Suite for determining emissions reduction due to code and above-code programs;
- Enhanced the IC3 calculator, which is an energy code compliance software based on the Texas Building Energy Performance Standards by resolving minor defects found in the model and webpage.
- Continued development and testing of key procedures for validating simulations of building energy performance;
- Provided energy code training workshops, including: residential, commercial, IECC/IRC energy code training sessions at the 24th Building Professional Institute (BPI), UT Arlington.
- Provided energy code training workshops, including: residential, commercial, IECC/IRC energy code training sessions to the Building Owners and Managers Association (BOMA); North Central Texas Council of Governments (NCTCOG); Roof Coatings Manufacturer's Association (RCMA); and the Clean Air through Energy Efficiency (CATEE).
- Maintained and updated the Laboratory's Texas Emissions Reduction Plan (TERP) website;
- Maintained a builder's residential energy code Self-Certification Form (Ver.1.3) for use by builders outside municipalities;
- Hosted the Clean Air Through Energy Efficiency (CATEE) Conference in December 2016, in San Antonio, Texas. Conference sessions included key talks by the TCEQ, PUCT, ERCOT, EPA, SECO, several ISDs and cities, and the Laboratory about quantifying emissions reduction from EE/RE opportunities and guidance on key energy efficiency and renewable energy topics; the various topics covered: Learning from Green Schools and Exisiting Buildings; Innovative Technologies and Techniques; PACE as a New Program in Texas; Alternative Financing for Energy Efficiency; Commercial & Institutional Green Building Performance; Collaboration is the Key – Public/Private Partnerships; Utilities – Efficiency Resources; Energy Codes Discussion; and Regional Applications.
- Provided technical assistance to the TCEQ regarding specific issues, including:
  - Enhancement of the standardized, integrated NOx emissions reduction reporting procedures to the TCEQ for EE/RE projects, and
  - Enhancement of the procedures for weather normalizing NOx emissions reduction from renewable projects.
- Participated as exhibitors at several conferences, including at the Clean Air Through Energy Efficiency Conference in San Antonio, Texas, the Texas Green Home Summit in Plano, Texas, and TCEQ Environmental Trade Fair and Conference, Austin, Texas; and
- The ESL participated in the South-central Partnership for Energy Efficiency as a Resource (SPEER), funded and administered by the Texas Comptroller of Public Accounts State Energy Conservation Office (SECO).
- Continued worked toward the code compliance tools for commercial buildings, retail and school buildings, and new Application Programming Interface (API)

1.5 Technology Transfer

To accelerate the transfer of technology developed as part of the TERP program, the Laboratory:

- Updated previously developed database of other renewable projects in Texas, including: solar photovoltaic, geothermal, hydroelectric, and Landfill Gas-fired Power Plants;
- Applied previously developed estimation techniques for hourly solar radiation from limited data sets;
- Along with the TCEQ and the US EPA, is host to the annual Clean Air Through Energy Efficiency (CATEE) Conference attended by top Texas and national experts, and policy makers; and
- Continued the National Center of Excellence on Displaced Emissions Reduction (CEDER) by the US EPA. The benefits of CEDER include:
    - Reducing the financial, technical, and administrative costs of determining the emissions reduction from EE/RE measures;
    - Continuing to accelerate implementation of EE/RE strategies as a viable clean air effort in Texas and other states;
    - Helping other states identify and prioritize cost-effective clean air strategies from EE/RE, and;
    - Communicating the results of quantification efforts through case-studies and a clearinghouse of information.

Two presentations to the Clean Air Through Energy Efficiency Conference held in Dallas/Plano, Texas, November 2017.

- Ellis, S., 2017 "Energy Code Software – Details that Matter" *Clean Air Through Energy Efficiency Conference,* Dallas/Plano, Texas, November 2017
- Haberl, J.; Yazdani, B.; Baltazar, J., 2017 "Energy Efficiency and Renewable Energy Impacts on NOx Emission Reductions" *Clean Air Through Energy Efficiency Conference,* Dallas/Plano, Texas, November 2017

The Laboratory has and will continue to provide leading-edge technical assistance to the TCEQ, counties and communities working toward obtaining full SIP credit for the energy efficiency and renewable energy projects that are lowering emissions and improving the air quality for all Texans. The Laboratory will continue to provide superior technology to the State of Texas through efforts with the TCEQ and US EPA. The efforts taken by the Laboratory have produced significant success in bringing EE/RE closer to US EPA acceptance in the SIP. These activities were designed to more accurately calculate the creditable NOx emissions reduction from EE/RE initiatives contained in the TERP and to assist the TCEQ, local governments, and the building industry with standardized, effective implementation and reporting.

1.6 Energy and NOx Reductions from New Residential and Commercial Construction, Including Residential Air Conditioner Retrofits

State adoption of the energy efficiency provisions of the International Residential Code (IRC) and International Energy Conservation Code (IECC) became effective September 1, 2001. The Laboratory has developed and delivered training to assist municipal inspectors to become certified energy inspectors. The Laboratory also supported code officials with guidance on interpretations as needed. This effort, based on a requirement of HB 3235, 78th Texas Legislature, supports a more uniform interpretation and application of energy codes throughout the state. In general, the State is experiencing a true market transformation from low energy efficiency products to high energy efficiency products. These include: low solar heat gain windows, higher efficiency appliances, high efficiency air conditioners and heat pumps, increased insulation, lower thermal loss ducts and in-builder participation in "above-code" code programs such as Energy Star New Homes, which previously had no state baseline and almost no participation.

In 2017, the following savings were calculated:

- In 2017, the annual electricity savings from code-compliant residential and commercial construction are 4,034,136 MWh/year (7.1% of the total electricity savings),
- Savings from residential air conditioner retrofits[2] are 247,025 MWh/year (0.4%).

- In 2017, the OSP electricity savings from code-compliant residential and commercial construction are 11,052 MWh/day (9.0%),
- Savings from residential air conditioner retrofits are 1,752 MWh/day (1.4%).

- By 2022, the annual electricity savings from code-compliant residential and commercial construction will be 9,380,917 MWh/year (10.7% of the total electricity savings),
- Savings from residential air conditioner retrofits will be 191,143 MWh/year (0.2%).

- By 2022, the OSP electricity savings from code-compliant residential and commercial construction will be 25,701 MWh/day (13.4%),
- Savings from residential air conditioner retrofits will be 1,356 MWh/day (0.7%).

- In 2017, the annual NOx emissions reduction from code-compliant residential and commercial construction are 1,213 tons-NOx/year (4.5% of the total NOx savings),
- NOx emissions reductions from residential air conditioner retrofits are 72 tons-NOx/year (0.3%).

- In 2017, the OSP NOx emissions reduction from code-compliant residential and commercial construction are 3.36 tons-NOx/day (5.7%)
- NOx emissions reductions from residential air conditioner retrofits are 0.52 tons-NOx/day (0.9%).

- By 2022, the NOx emissions reduction from code-compliant residential and commercial construction will be 2,891 tons-NOx/year (6.9% of the total NOx savings),
- NOx emissions reductions from residential air conditioner retrofits will be 55 tons-NOx/year (0.1%).

- By 2022, the OSP NOx emissions reduction from code-compliant residential and commercial Construction will be 7.99 tons-NOx/day (8.8%),
- NOx emissions reductions from residential air conditioner retrofits will be 0.40 tons-NOx/day (0.4%).

[2] 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.

1.7 Integrated NOx Emissions Reductions Reporting Across State Agencies

In 2005, the Laboratory began to work with the TCEQ to develop a standardized, integrated NOx emissions reduction across state agencies implementing EE/RE programs so that the results can be evaluated consistently. As required by the legislation, the TCEQ receives the following reports:

- From the Laboratory, savings from code compliance and renewables;
- From the Laboratory, in cooperation with the Electric Reliability Council of Texas (ERCOT), the savings from electricity generated from wind power;
- From the Public Utility Commission of Texas (PUCT) on the impacts of the utility-administered programs designed to meet the mandated energy efficiency goals of SB7 and SB5; and
- From the State Energy Conservation Office (SECO) on the impacts of energy conservation in state agencies and political subdivisions.

In 2017, the total integrated annual savings from all programs are 56,457,081 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction are 4,034,136 MWh/year (7.1% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program are 3,844,949 MWh/year (6.8%),
- Savings from SECO's Senate Bill 5 program are 1,275,938 MWh/year (2.3%),
- Electricity savings from renewable power generation are 47,055,032 MWh/year (83.3%), and
- Savings from residential air conditioner retrofits[3] are 247,025 MWh/year (0.4%).

In 2017, the total integrated OSP savings from all programs are 123,280 MWh/day, which would be a 5,137 MW average hourly load reduction during the OSP. The integrated OSP electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction are 11,052 MWh/day (9.0%),
- Savings from the PUC's Senate Bill 7 programs are 10,534 MWh/day (8.5%),
- Savings from SECO's Senate Bill 5 program are 3,496 MWh/day (2.8%),
- Electricity savings from renewable power generation are 96,446 MWh/day (78.2%), and
- Savings from residential air conditioner retrofits are 1,752 MWh/day (1.4%).

By 2022, the total integrated annual savings from all programs will be 87,687,961 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction will be 9,380,917 MWh/year (10.7% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program will be 5,332,467 MWh/year (6.1%),
- Savings from SECO's Senate Bill 5 program will be 2,028,819 MWh/year (2.3%),
- Electricity savings from renewable power generation will be 70,754,614 MWh/year (80.7%), and
- Savings from residential air conditioner retrofits will be 191,143 MWh/year (0.2%).

By 2022, the total integrated OSP savings from all programs will be 192,246 MWh/day, which would be a 8,010 MW average hourly load reduction during the OSP period. The integrated OSP electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction will be 25,701 MWh/day (13.4%),
- Savings from the PUC's Senate Bill 7 programs will be 14,609 MWh/day (7.6%),
- Savings from SECO's Senate Bill 5 program will be 5,558 MWh/day (2.9%),
- Electricity savings from renewable power generation will be 145,021 MWh/day (75.4%), and
- Savings from residential air conditioner retrofits will be 1,356 MWh/day (0.7%).

[3] 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.

In 2017, the total integrated annual NOx emissions reductions from all programs are 27,065 tons-NOx/year. The integrated annual NOx emissions reductions from all the different programs are:

- NOx emissions reductions from code-compliant residential and commercial construction are 1,213 tons-NOx/year (4.5% of the total NOx savings),
- NOx emissions reductions from the PUC's Senate Bill 7 programs are 1,326 tons-NOx/year (4.9%),
- NOx emissions reductions from SECO's Senate Bill 5 program are 400 tons-NOx/year (1.5%),
- NOx emissions reductions from renewable power generation are 25,054 tons-NOx/year (88.9%), and
- NOx emissions reductions from residential air conditioner retrofits are 72 tons-NOx/year (0.3%).

In 2017, the total integrated OSP NOx emissions reductions from all programs are 59.00 tons-NOx/day. The integrated OSP NOx emissions reductions from all the different programs are:

- NOx emissions reductions from code-compliant residential and commercial construction are 3.36 tons-NOx/day (5.7%),
- NOx emissions reductions from the PUC's Senate Bill 7 programs are 3.75 tons-NOx/day (6.4 %),
- NOx emissions reductions from SECO's Senate Bill 5 program are 1.12 tons-NOx/day (1.9%),
- NOx emissions reductions from renewable power generation are 50.25 tons-NOx/day (85.2%), and
- NOx emissions reductions from residential air conditioner retrofits are 0.52 tons-NOx/day (0.9%).

By 2022, the total integrated annual NOx emissions reductions from all programs will be 41,612 tons-NOx/year. The integrated annual NOx emissions reductions from all the different programs are:

- NOx emissions reductions from code-compliant residential and commercial construction will be 2,891 tons-NOx/year (6.9% of the total NOx savings),
- NOx emissions reductions from the PUC's Senate Bill 7 programs will be 1,833 tons-NOx/year (4.4%),
- NOx emissions reductions from SECO's Senate Bill 5 program will be 665 tons-NOx/year (1.6%),
- NOx emissions reductions from renewable power generation will be 36,169 tons-NOx/year (86.9%), and
- NOx emissions reductions from residential air conditioner retrofits will be 55 tons-NOx/year (0.1%).

By 2022, the total integrated OSP NOx emissions reductions from all programs will be 91.00 tons-NOx/day. The integrated OSP NOx emissions reductions from all the different programs are:

- NOx emissions reductions from code-compliant residential and commercial construction will be 7.99 tons-NOx/day (8.8%),
- NOx emissions reductions from the PUC's Senate Bill 7 programs will be 5.19 tons-NOx/day (5.7%),
- NOx emissions reductions from SECO's Senate Bill 5 program will be 1.85 tons-NOx/day (2.0%),
- NOx emissions reductions from renewable power generation will be 75.57 tons-NOx/day (83.0%), and
- NOx emissions reductions from residential air conditioner retrofits will be 0.40 tons-NOx/day (0.4%).

Table 3: Adjustment Factors used for the Calculation of the Annual and OSP NOx Savings for the Different Programs

	ESL-Single Family	ESL-Multifamily	ESL-Commercial	PUC (SB7)	SECO	Renewables-ERCOT	SEER13 Single Family	SEER13 Multi Family
Annual Degradation Factor	2.0%	2.0%	2.0%	5.0%	5.0%	0.0%	5.0%	5.0%
T&D Loss	7.0%	7.0%	7.0%	7.0%	7.0%	0.0%	7.0%	7.0%
Initial Discount Factor	20.0%	20.0%	20.0%	10.0%	60.0%	5.0%	20.0%	20.0%
Growth Factor	4.1%	6.1%	5.3%	0.0%	0.0%	8.5%	N.A.	N.A.
Weather Normalized	Yes	Yes	Yes	No	No	No	Yes	Yes

Note: For Renewables- ERCOT, the OSP energy consumption is the average daily consumption of the measured data from mid-July to mid-September.

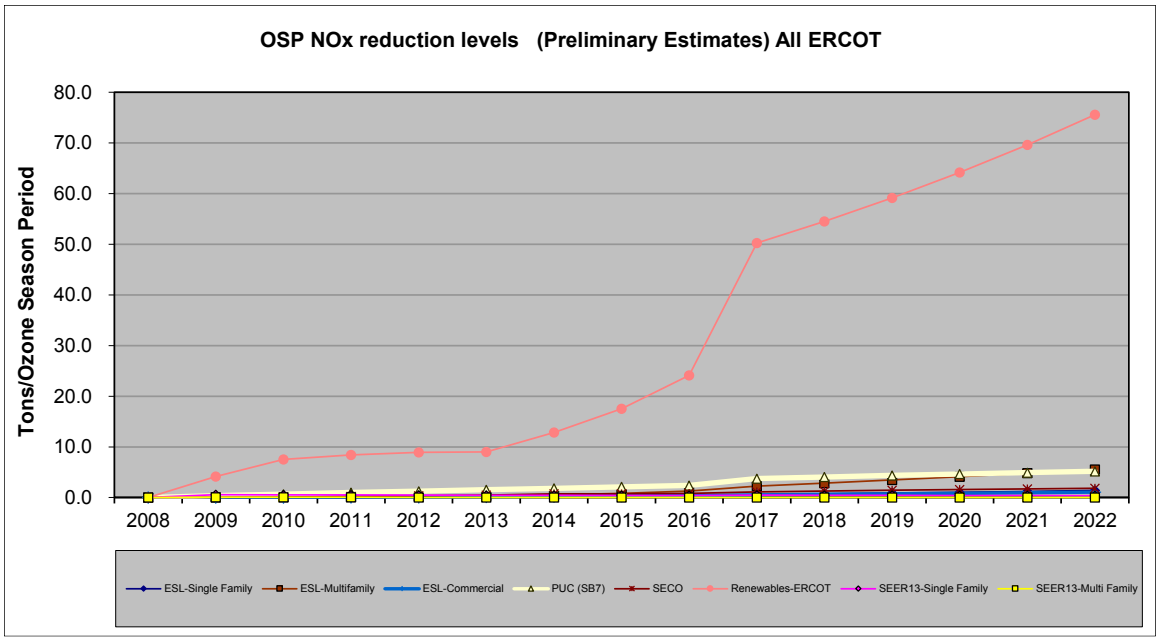


Figure 2: Integrated OSP Individual Programs NOx Emissions Reduction Projections through 2022 (Base Year 2008)

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

In 2004 and 2005, the Laboratory developed a web-based Emissions Reduction Calculator, known as "*eCalc*," which contains the underlying technology for determining NOx emissions reduction from power plants that generate the electricity for the user[4]. The emissions reduction calculator was being used to calculate emissions reduction for consideration for SIP credits from energy efficiency and renewable energy programs in the TERP.

In 2007, the Laboratory enhanced the calculator to provide additional functions and usability, including:

- Renaming the product IC3 v2.0
- Enhanced the Laboratory's IECC/IRC Code-Traceable Test Suite for determining emissions reduction due to code and above-code programs;
- Enhanced web-based emissions calculator, including:
  - Use of the calculator to determine 15% above code residential and commercial options.
  - Gathered, cleaned and posted weather data archive for 17 NOAA stations;
  - Performed comparative testing of the calculator vs. other, non-web-based simulation programs;
  - Developed and tested radiant barrier simulation;
  - Using the web-based emissions calculator, started development of the derivative version Texas Climate Vision calculator for the City of Austin;
- Continued the development of verification procedures, including:
  - Completed the calibrated simulation of a high-efficiency office building in Austin, Texas;
  - Continued work to develop a calibrated simulation of an office building in College Station; and
  - Continued work to develop a calibrated simulation of a K-12 school in College Station;

In 2008, work on both web based calculators continued;

- Deployed IC3 v3.2 to handle a wider selection of Single-Familybuilding configurations (http://ic3.tamu.edu);
- Delivered TCV v1.0 to the City of Austin for their testing;
- Continued to operate the original eCalc;
- Supported modeling efforts by building enhanced tools for batch simulation;
- Provided training on both IC3 and TCV.

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

In 2009, IC3 developments included:

- A sister product, AIM was created for the State Comptroller's office.
- Usage statistics continue to climb.
- Updated to v3.6 which included 3 story houses, external cladding, more sophisticated ceiling/roof models, enhanced foundation modeling and the ability to copy projects

In 2010 there were several software updates including:

- IC3
  - 3.9.0 – Slab Insulation Support
  - 3.7.0 – 3.8.0 First Version of Multifamily Released along with numerous tweaks and fixes
  - 3.6.2 – New Building Model Integrated, Updated Artwork and Illustrations
- DDP
  - 1.7.05 – Added Heat Reject Recording for Electric and Gas
- Web Reports and Texas Building Registry
  - Registry 0.x – First versions of the Web Reports on TCV, eCalc, and IC3
  - Registry 1.0 – City and County Reports
  - Registry 1.1 – Cross-linked Reports for City and County
  - IC3 Reports 1.0 – Updated Certificate Reports which replace Registry 1.1 and evolve into the Texas Building Registry

The 2011 software updates include:

- IC3
  - 3.9.4 – Added approval workflow to start a new 2009 IECC job as further refinements were needed to the BDL
  - 3.9.5 – Various IECC 2009 fixes and refinements implemented
  - 3.9.6 – Updated BDL to 4.01.08, SHGC max does not apply to Climate Zone 4, 0.35 ACH minimum to all projects, Ventilation Fans added to % Air Conditioning Calculation
  - 3.9.7 - Corrected Certificate and Status screens to reflect insulation and floor construction.
  - 3.9.8- Set minimum R-value for insulated sheathing to R-2;
  - 3.10.0 - Updated and corrected problems with several text and value fields; Corrected and printed MF and SF Certificates;
  - 3.10.3 - Changed Certificate to Energy Audit Report; Added a new Certificate to be printed out; Added Inspector's list for a project; Added Pagination in projects page
  - 3.11.0 12/22/2011-Added Austin Energy 2009 IECC Energy Code Support
- Web Reports and Texas Building Registry
  - TBR Reports 1.0.5 – Added 4 new reports
  - TBR Reports 1.0.6 – Added 9 new reports
  - Registry 2.0 – Included 7 new Parameterized reports

The 2012 software updates include:

- IC3
  - 3.12 – Deprecated the 2000/2001 and 2006 Code (as of 1/1/2012)
  - 3.12.1 – Added a version of the energy report with a signature line, as requested by some municipalities. Improved the algorithm.
  - 3.12.2 – Alter help text to be more clear. Improved the algorithm.
  - 3.12.3 – Alter help pictures to make them clearer.
  - 3.12.4 – Added optional input for water heaters to allow for better detail. Updated user manual. Improved the transform algorithms.

The 2013 software updates include:

- IC3
    - 3.12.5 – Bug fix in energy report
    - 3.13.0 – Added support for manual J. Added NCTCOG 2012 amendments

There were no significant enhancements to IC3 in the calendar year 2014. We performed routine maintenance on the program and the database during this time. The API interface was under development.

The 2015 software updates include:

- IC3
    - Version 4.0 – Single Family version of IC3 version 4, implementing IECC 2015
    - Version 4.0.1 –Added builder information. Changed format of energy report

The 2016 software updates include:

- IC3
    - Version 4.0.2 – Clarified some error messages. Revised model of attic. Added check for fresh air standards,
    - Version 4.1 – Added ERI
    - Version 4.1.1 – Some bug fixes
    - Version 4.1.2 – Altered appliance energy calculation in ERI to improve accuracy
    - Version 4.2 – Added NCTCOG 2015 IECC amendment

The 2017 software updates include:

- IC3
    - Version 4.3 – Added Austin Energy IECC 2015 ammendment. Improved accuracy of duct model
    - Version 4.3.1– Added NCTCOG 2015 ERI ammendment

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

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

- In 2017, the Laboratory continued to work with the TCEQ to develop an integrated NOx emissions reductions calculation that provided the TCEQ with a creditable NOx emissions reductions from energy efficiency and renewable energy (EE/RE) programs reported to the TCEQ in 2017by the Laboratory, PUCT, SECO, and ERCOT (i.e., renewables).
- At the request of the TCEQ, the Laboratory has continued the development of procedures for quantifying NOx emissions reductions from renewables and the quantification of NOx emissions reductions from the new Federal regulations for SEER 13 air conditioners.

1.10 Planned Focus for 2018

In FY 2018, the Energy Systems Laboratory will continue in its cooperative efforts with the TCEQ, PUCT, SECO, US EPA and others to evaluate the energy savings resulted from the EE/RE measures and programs of the TERP and their impact on air quality, and continue with the energy code state-wide implementation assistance under the Texas Building Energy Performance Standards program of the TERP. The Laboratory team will:

- Assist the TCEQ to obtain SIP credits from energy efficiency and renewable energy using the Laboratory's Emissions Reduction Calculator technology.

- Verify, document and report energy efficiency and renewable energy savings in all TERP EE/RE programs for the SIP in each non-attainment and affected county using the TCEQ/US EPA approved technology.
- Assist the PUCT with determining emissions reductions credits from energy efficiency programs funded by SB 7 and SB 5.
- Assist political subdivisions and Councils of Governments with calculating emissions reductions from local code changes and voluntary EE/RE programs for SIP inclusion.
- Continue to refine the cost-effective techniques to implement 15% above code (2009 IECC) energy efficiency in low-priced and moderately-priced residential housing.
- Continue to refine the cost-effective methods and techniques to implement 15% above code energy efficiency in commercial buildings.
- Continue to develop creditable procedures for calculating NOx emissions reductions from green renewable technologies, including wind power, solar energy and geothermal energy systems.
- Continue development of well-documented, integrated NOx emissions reductions methodologies for calculating and reporting NOx reductions, including a unified database framework for required reporting to TCEQ of potentially creditable measures from the ESL, PUCT, and SECO SB 5 initiatives.
- Upon request, provide written recommendations to the State Energy Conservation Office (SECO) about whether or not the energy efficiency provisions of latest published edition of the International Residential Code (IRC), or the International Energy Conservation Code (IECC), are equivalent to, or better than, the energy efficiency and air quality achievable under the editions adopted under the 2009 IRC/IECC. This will consider comments made by persons who have an interest in the adoption of the energy codes in the recommendations made to SECO.
- Develop a standardized report format to be used by providers of home energy ratings, including different report formats for rating newly constructed residences from those for existing residences.
- Continue to cooperate with an industry organization or trade association to: develop guidelines for home energy ratings; provide training for individuals performing home energy ratings and providers of home energy ratings; and provide a registry of completed ratings for newly constructed residences and residential improvement projects for the purpose of computing the energy savings and emissions reductions benefits of the home energy ratings program.
- Include all benefits attained from this program in an annual report to the commission.
- Engage production builders and municipalities in overcoming obstacles to use IC3 for their new home construction.
- Complete RESNET certification for ERI path in IC3. Complete multifamily process in IC3.
- Evaluate 2018 IECC. This is not mandated by the state and will only be added to IC3 upon request by a city or COG.
- Update all websites managed by the lab to meet the new TEES standards.

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

If any questions arise, please contact us by phone at 979-845-9213.

2 Introduction

2.1 Background

In 2001, the Texas Legislature adopted the Texas Emissions Reduction Plan, identifying thirty-eight counties in Texas where a focus on air quality improvements was deemed critical to public health and economic growth. In 2008, twenty counties were designated as non-attainment counties that include: Brazoria, Chambers, Collin, Dallas, Denton, Ellis, Fort Bend, Hardin, Harris, Jefferson, Galveston, Johnson, Kaufman, Liberty, Montgomery, Orange, Parker, Rockwall, Tarrant, and Waller. There were also fourteen counties designated as Ozone Early Action Compact counties include: Bastrop, Bexar, Caldwell, Comal, Gregg, Guadalupe, Harrison, Hays, Rusk, Smith, Travis, Upshur, Williamson, and Wilson. By 2017, fourty-two counties are designated as non-attainment counties that include: Bastrop, Bexar, Brazoria, Caldwell, Chambers, Collin, Comal, Dallas, Denton, El Paso, Ellis, Fort Bend, Galvestion, Gregg, Guadalupe, Hardin, Harris, Harrison, Hays, Henderson, Hood, Hunt, Jefferson, Kaufman, Liberty, Montgomery, Nueces, Orange, Parker, Rockwall, Rusk, San Patricio, Smith, Tarrant, Travis, Upshur, Victoria, Waller, Williamson, Wilson, and Wise (TCEQ 2016). These areas are shown on the map in Figure 3 as non-attainment and near nonattainment.

These counties represent several geographic areas of the state, which have been assigned to different climate zones by the 2015 IECC[5] as shown in Figure 4, based primarily on Cooling Degree Days (CDD) and Heating Degree Days (HDD). These include climate zone 3 (i.e., $4{,}500 < CDD_{50} \leq 6{,}300$ and $HDD_{65} \leq 5{,}400$) for the Dallas-Ft. Worth and El Paso areas, and climate zones 2 (i.e., $6{,}300 < CDD_{50} \leq 9{,}000$) for the Houston-Galveston-Beaumont-Port Arthur-Brazoria areas. Also shown in Figure 4 are the locations of the various weather data sources, including the Typical Meteorological Year (TMY2) (NREL 1995) stations, the Weather Year for Energy Calculations (WYEC2) (Stoffel 1995) weather stations, the Local Climatological Data (LCD) (NOAA 2018), the ASHRAE 90.1 1989 weather locations[6], the ASHRAE 90.1 1999 weather locations, the solar stations measured by the TCEQ[7], and F-CHART and PV F-CHART weather locations[8].

[5] The "2000 IECC" notation is used to signify the 2000 International Residential Code (IRC), which includes the International Energy Conservation Code (IECC) as modified by the 2001 Supplement (IECC 2001), published by the ICC in March of 2001, as required by Senate Bill 5. The latest version adoption of IECC in Texas is IECC 2015.

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

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

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

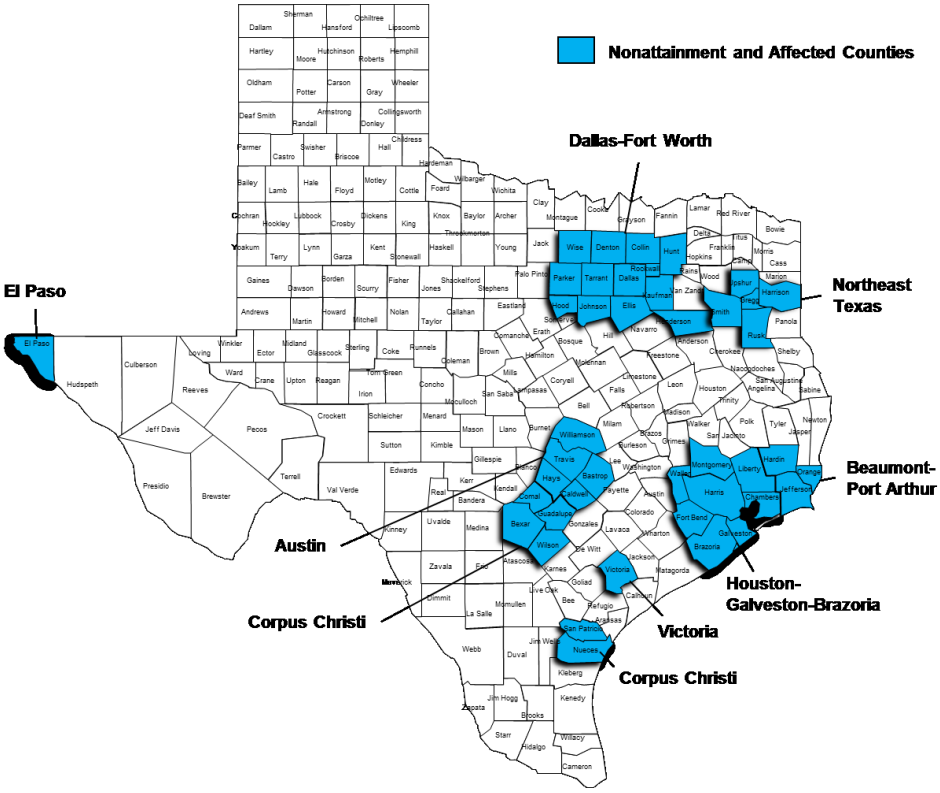


Figure 3: TCEQ Nonattainment and Affected Counties

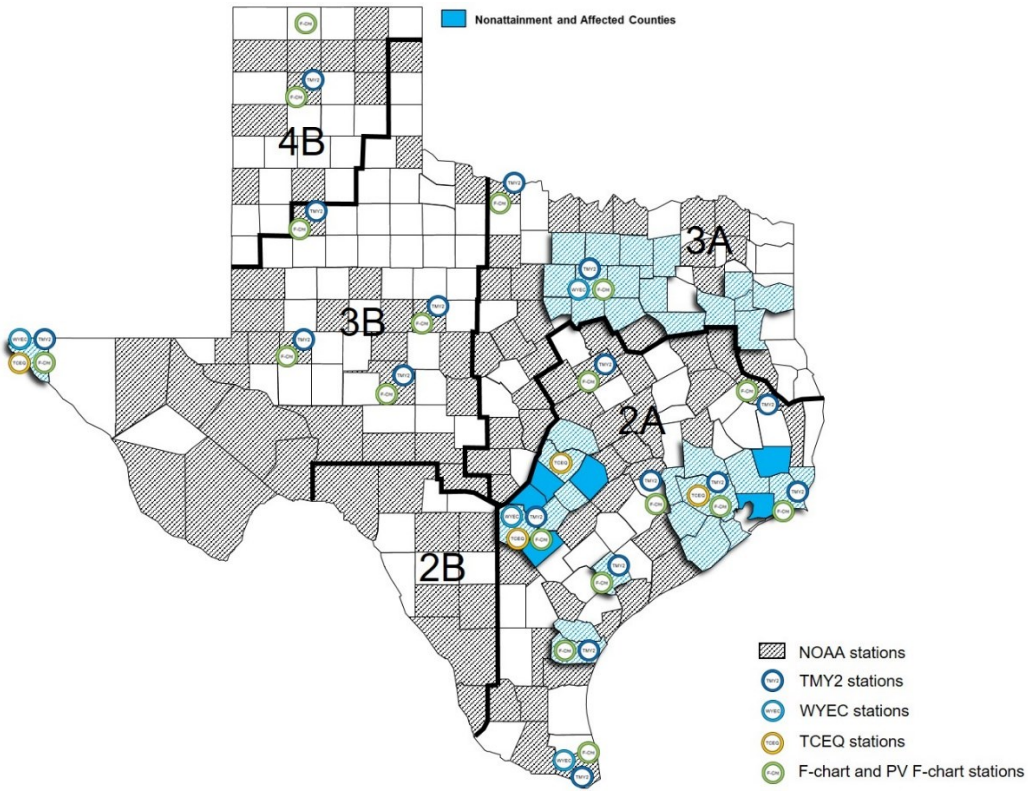


Figure 4: Available LCD, TMY2 and WYEC2 weather files compared to IECC/IRC weather zones for Texas

	County	NOAA LCD	TMY2 station	WYEC	TCEQ	F/PV charts
1	Anderson	O	-	-	-	-
2	Andrews	O	-	-	-	-
3	Angelina	O	O	-	-	O
4	Aransas	O	-	-	-	-
5	Atascosa	O	-	-	-	-
6	Austin	-	O	-	-	O
7	Bailey	O	-	-	-	-
8	Bee	O	-	-	-	-
9	Bell	O	-	-	-	-
10	Bexar	O	O	O	O	O
11	Bazoria	O	-	-	-	-
12	Brazos	O	-	-	-	-
13	Brewster	O	-	-	-	-
14	Brooks	O	-	-	-	-
15	Brown	O	-	-	-	-
16	Burleson	O	-	-	-	-
17	Burnet	O	-	-	-	-
18	Caldwell	O	-	-	-	-
19	Calhoun	O	-	-	-	-
20	Cameron	O	O	O	-	O
21	Cherokee	O	-	-	-	-
22	Childress	O	-	-	-	-
23	Coke	O	-	-	-	-
24	Coleman	O	-	-	-	-
25	Collin	O	-	-	-	-
26	Comanche	O	-	-	-	-
27	Cooke	O	-	-	-	-
28	Coryell	O	-	-	-	-
29	Crockett	O	-	-	-	-
30	Culberson	O	-	-	-	-
31	Dallas	O	-	-	-	-
32	Deaf Smith	O	-	-	-	-
33	Denton	O	-	-	-	-
34	Dimmit	O	-	-	-	-
35	Ector	O	-	-	-	-
36	Edwards	O	-	-	-	-
37	Ellis	O	-	-	-	-
38	El Paso	O	O	O	O	O
39	Erath	O	-	-	-	-
40	Fayette	O	-	-	-	-
41	Fort Bend	O	-	-	-	-
42	Gaines	O	-	-	-	-
43	Galveston	O	-	-	-	-
44	Gillespie	O	-	-	-	-
45	Gonzles	O	-	-	-	-
46	Gray	O	-	-	-	-
47	Grayson	O	-	-	-	-
48	Gregg	O	-	-	-	-
49	Guadalupe	O	-	-	-	-
50	Hale	O	-	-	-	-
51	Hamilton	O	-	-	-	-
52	Harris	O	-	-	O	-
53	Harrison	O	-	-	-	-
54	Hartley	O	-	-	-	-
55	Hemphill	O	-	-	-	-
56	Henderson	O	-	-	-	-
57	Hidalgo	O	-	-	-	-
58	Hill	O	-	-	-	-
59	Hood	O	-	-	-	-
60	Hopkins	O	-	-	-	-
61	Houston	O	O	-	-	O
62	Howard	O	-	-	-	-
63	Hunt	O	-	-	-	-
64	Hutchinson	O	-	-	-	-
65	Jasper	O	-	-	-	-
66	Jefferson	O	-	-	-	-
67	Jim Hogg	O	-	-	-	-
68	Jim Wells	O	-	-	-	-
69	Johnson	O	-	-	-	-
70	Kaufman	O	-	-	-	-

	County	NOAA LCD	TMY2 station	WYEC	TCEQ	F/PV charts
71	Kendall	O	-	-	-	-
72	Kerr	O	-	-	-	-
73	Kimble	O	-	-	-	-
74	Kleberg	O	-	-	-	-
75	Lamar	O	-	-	-	-
76	Lampasas	O	-	-	-	-
77	La Salle	O	-	-	-	-
78	Lee	O	-	-	-	-
79	Liberty	O	-	-	-	-
80	Limestone	O	-	-	-	-
81	Llano	O	-	-	-	-
82	Lubbock	O	O	-	-	O
83	McCulloch	O	-	-	-	-
84	McLennan	O	O	-	-	O
85	Matagorda	O	-	-	-	-
86	Medina	O	-	-	-	-
87	Midland	O	O	-	-	O
88	Milam	O	-	-	-	-
89	Montague	O	-	-	-	-
90	Montgomery	O	-	-	-	-
91	Moore	O	-	-	-	-
92	Nacogdoches	O	-	-	-	-
93	Navarro	O	-	-	-	-
94	Nolan	O	-	-	-	-
95	Nueces	O	O	-	-	O
96	Ochiltree	O	-	-	-	-
97	Orange	O	-	-	-	-
98	Palo Pinto	O	-	-	-	-
99	Parker	O	-	-	-	-
100	Pecos	O	-	-	-	-
101	Potter	O	-	-	-	-
102	Presidio	O	-	-	-	-
103	Randall	-	O	-	-	O
104	Red River	O	-	-	-	-
105	Reeves	O	-	-	-	-
106	Roberts	O	-	-	-	-
107	Roberson	O	-	-	-	-
108	Rockwall	O	-	-	-	-
109	Rusk	O	-	-	-	-
110	San Patricio	O	-	-	-	-
111	Scurry	O	-	-	-	-
112	Sherman	-	-	-	-	O
113	Smith	O	-	-	-	-
114	Stephens	O	-	-	-	-
115	Sutton	O	-	-	-	-
116	Tarrant	O	-	-	-	-
117	Taylor	O	O	-	-	O
118	Terrell	O	-	-	-	-
119	Titus	O	-	-	-	-
120	Tom Green	O	O	O	-	O
121	Travis	O	-	-	O	-
122	Upshur	O	-	-	-	-
123	Uvalde	O	-	-	-	-
124	Val Verde	O	-	-	-	-
125	Victoria	O	O	-	-	O
126	Walker	O	-	-	-	-
127	Waller	O	-	-	-	-
128	Ward	O	-	-	-	-
129	Washington	O	-	-	-	-
130	Webb	O	-	-	-	-
131	Wharton	O	-	-	-	-
132	Wichita	O	O	-	-	O
133	Wilbarger	O	-	-	-	-
134	Williamson	O	-	-	-	-
135	Winkler	O	-	-	-	-
136	Wise	O	-	-	-	-
137	Wood	O	-	-	-	-
138	Young	O	-	-	-	-
139	Zapata	O	-	-	-	-

Figure 5: Available LCD, TMY2 and WYEC2 weather files compared to IECC/IRC weather zones for Texas (Continued)

2.2 Energy Systems Laboratory's Responsibilities in the TERP

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

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

In 2003 these responsibilities were modified by the following:

- House Bill 1365, including modifications to:
  - Sec. 388.004. Enforcement of Energy Standards Outside of Municipality
  - Sec. 388.009. Energy-Efficient Building Program
- House Bill 3235 which includes modifications to
  - Sec. 388.009. Certification of Municipal Building Inspectors.

In 2005 these same responsibilities were further updated:

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

These responsibilities were further updated in 2007:

- with Senate Bill 12 and House Bill 3693.

These responsibilities were further updated in 2009:

- with House Bill 1796.

These responsibilities were further updated in 2011:

- with Senate Bills 898 and 924, and House Bill 51.

These responsibilities were not updated in 2012. They remained unchanged in 2013. They were not updated in 2014.

These responsibilities were further updated in 2015:

- Changes to Sec. 388.003. Adoption of Building Energy Efficiency Performance Standards
- with House Bill 1736.

These responsibilities were not updated in 2017.

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

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

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

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

In 2003 and 2004, the Laboratory worked with the TCEQ to identify a method to help the PUCT more accurately report their deemed savings as peak-day savings in 1999, using the Laboratory's new emissions reductions calculator.

In 2005, this method was implemented in the TCEQ's Integrated Emissions Calculations, which was reported in previous (from 2005-2016) annual reports.

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

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

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

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

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

- the building is certified by a national, state, or local accredited energy efficiency program;
- the building was subjected to inspections from private code-certified inspectors using the energy efficiency chapter of the International Residential Code or International Energy Conservation Code; or
- the builder who does not have access to either of the above methods for a building certifies compliance using a form provided by the Laboratory, enumerating the code-compliance features of the building.

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

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

2.2.5 (SB 5) Sec. 388.008. Development of Home Energy Ratings

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

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

At the 78th Legislature (2003), House Bill 1365 modified Section 388.004 of The TERP to include the following new requirements:

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

To help builders comply with these requirements, the Laboratory did enhance the current form, which is posted on the Laboratory's The TERP website.

2.2.7 (HB 1365) Sec. 388.009. Energy-Efficient Building Program, renamed in 2005 (HB 2129) Sec. 388.012. Development of Alternative Energy-Saving Methods.

In this Section, the laboratory shall develop at least three alternative methods for achieving a 15% greater potential energy savings in residential, commercial, and industrial construction than the potential energy savings of construction that is in minimum compliance with Section 388.003. The alternative methods:

(1) may include both prescriptive and performance-based approaches, such as the approach of the United States Environmental Protection Agency's Energy Star qualified new home labeling program; and
(2) must include estimates of the implementation costs and energy savings to consumers and the related emissions reductions.

2.2.8 (HB 3235) Sec. 388.009. Certification of Municipal Inspectors renamed in 2005 (HB 2018) Sec. 388.011. Certification of Municipal Building Inspectors.

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

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

The 79th Legislature (2005), through SB 20, HB 2481 and HB 2129, amended SB 5 to enhance its effectiveness by adding the following additional energy-efficiency initiatives, including requiring 5,880 MW of generating capacity from renewable energy technologies by 2015, and 500 MW from non-wind renewables.

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

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

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

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

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

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

2.2.11 (HB 1796). TERP Term & Additional Energy- Efficiency Initiatives

The 81st Legislature (2009), through HB 1796, amended sections Sec. 386.252 (a) and (b), to extend the date of the TERP to 2019 and require the TCEQ to contract with Laboratory to compute emissions reduction from wind and other renewable energy resources for the SIP.

2.2.12 (HB 51, SB 898, SB 924). Additional Energy-Efficiency Initiatives & Refinement of Ongoing Initiatives

The 82nd Legislature (2011) through HB-1, the Laboratory's responsibilities under TERP increased:

The 82nd Legislature (2011), through SB 898, amended Sec 388.005 (c), (d) and (e), which per the amendment, requires each political subdivision, institution of higher education or state agency to establish a goal to reduce the electric consumption by the entity by at least 5% each fiscal year for 10 years, beginning September 1, 2011. SB 898 further elaborated and enhanced the annual reporting requirements for those entities, and required SECO to develop a standardized form for reporting. SB 898 adds the Laboratory as the entity in charge of calculating energy savings and estimated emissions reduction for each political subdivision, institution of higher education or state agency, based on the information collected by SECO. The Laboratory shall share the analysis with the TCEQ, EPA and ERCOT.

The 82nd Legislature (2011), through SB 924, amended Sec 39.9051, Utilities Code, (f), (g) and (h), to enhance the reporting requirements by all municipally owned utilities and electric cooperatives that had retail sales of more than

500,000 MWh in 2005, regarding combined effects of their energy efficiency activities. Per the amended sections, beginning April 1, 2012, these entities must report each year to SECO, on a standardized form developed by SECO. The report of information regarding the combined effects of the energy efficiency activities of the electric cooperative/utility from the previous calendar year should include the annual goals, programs enacted to achieve those goals, and any achieved energy demand or savings goals. SB 924 adds the Laboratory as the entity in charge of calculating energy savings and estimated emissions reduction for municipally owned utilities and for electric cooperatives, based on the information collected by SECO. The Laboratory shall share the analysis with the PUCT, ERCOT, EPA and TCEQ.

The 82nd Legislature, through HB 51, required SECO to appoint a new advisory committee for selecting high-performance building design evaluation systems. The committee includes a representative from the Laboratory and meets at least once every two years.

The 82nd Legislature, through HB 51, modified Sec 388.003 (e) on the Laboratory's review of proposed local code amendments, which should be compared to the unamended code (instead of the "base" code), and added to Sec 388.007 (c) the fact that Laboratory is allowed to provide technical assistance concerning the implementation of local code amendments.

In addition, HB 51 added Sec 388.007 (d), which allows The Laboratory to conduct outreach to the real estate industry on the value of energy code compliance and above code construction.

The 83rd Legislature (2013) did not change any of the Laboratory's previously established responsibilities under TERP.

During the 84th Legislature session (2015), changes to the Sec. 388.003. Adoption of Building Energy Efficiency Performance Standards, with the passage of HB 1736, affected the Laboratory's responsibilities under TERP:

- 2015 residential energy codes (IRC/IECC) editions are in effect starting Sept 1, 2016. 2015 commercial energy codes (IECC) are in effect starting Nov 1, 2016. The Laboratory's responsibilities of reviewing new energy codes and local code amendments remain. New codes will be reviewed no sooner than every 6 years.
- The legislation introduces a new energy rating index (ERI) as a voluntary compliance path for local code amendments. With the introduction of the ERI as another compliance path, the Laboratory is required to consider it when local amendments are reviewed, and needs to update the web-based code compliance tool and emissions reduction calculator to allow for the new optional compliance path.

The 85th Legislature (2017) did not change any of the Laboratory's previously established responsibilities under TERP.

3 Statewide Air Emissions Calculations from Wind and Other Renewables

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

The report is organized in several deliverables:

- a summary report, which details the key areas of work
- supporting documentation
- supporting data files, including weather data, and wind production data,

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

- continuation of stakeholder's meetings
- analysis of power generation from wind farms using improved method and 2017 data
- analysis of emissions reductions from wind farms
- updates on degradation analysis
- analysis of other renewables, including solar PV, solar thermal, biomass, hydroelectric, geothermal, and landfill gas
- review of electricity generation by renewable sources and transmission planning study reported by ERCOT

3.1 Analysis of wind farms using an improved method and 2017 data

In this report, the weather normalization procedures, developed together with the Stakeholders, were presented and applied to all the wind farms that reported their data to ERCOT during the 2017 measurement period, together with wind data from the nearby NOAA weather stations or the zone average wind speed provided from ERCOT.

In the previous Wind and Renewables report to the TCEQ, weather normalization analysis methods were reviewed. This report used the same analysis method as the previous reports to present the same weather normalization procedure, including:

- the processing of weather and power generation data, modeling of daily power generation versus daily wind speed using the ASHRAE Inverse Model Toolkit (IMT) for two separate periods, i.e., Ozone Season Period (OSP), from July 15 to September 15, and Non-Ozone Season Period (Non-OSP);
- predicting 2008 wind power generation as a baseline, using developed coefficients from 2017 daily OSP and Non-OSP models for all the wind farms; and
- the analysis on monthly capacity factors generated using the models.

A summary of total wind power production in the base year (2008) for all of the wind farms in the ERCOT region using the developed procedure is presented, and the twenty six new wind farms which started operation in 2016 and 2017 were added, A summary of total wind power production in the base year (2008) for all of the wind farms in the ERCOT region using the developed procedure is presented, and the thirty two new wind farms which started operation in 2016 and 2017 were added, including Cotton Plains Wind, Dermott Wind 1_1, Dermott Wind 1_2, Doug Colbeck's Corer (CONWAY) A, Doug Colbeck's Corer (CONWAY) B, Electra Wind 1, Electra Wind 2, Falvez Astra Wind, Gunsight Mountain Wind, Hereford Wind V, Hidalgo & Starr Wind 11, Hidalgo & Starr Wind 12, Hidalgo & Starr Wind 21, Horse Creek Wind 1, Horse Creek Wind 2, Javelina II Wind 1, Javelina II Wind 2, Javelina II Wind 3, Los Vientos IV Wind, Mariah Del Norte 1, Mariah Del Norte 2, Old Settler Wind, Rock Springs Val Verde Wind (FERMI) 1, Rock Springs Val Verde Wind (FERMI) 2, Saltfork_Unit1, Saltfor_Unit2, San Roman Wind, South Plains Wind II A, South Plains Wind II B, Tyler Bluff Wind, Wake Wind 1, and Wake Wind 2. Figure *6* shows the measured annual wind power generation in 2017 and the estimated wind power generation in 2008 using the developed method for those wind farms in the ERCOT region. The total measured wind power generation in 2017 is 61,318,323 MWh/yr., which is 8% lower than what the same wind farms would have produced in 2008. Figure 7 shows the same comparison but for the Ozone Season Period. The measured wind power generation in the OSP of 2017 is 117,729 MWh/day, which is 0.7% lower than the 2008 OSP baseline wind production. For the

analysis of this year, the measured 2017 wind power generation is slightly lower than the 2008 baseline wind power production.

This report also includes an uncertainty analysis that was performed on all the daily regression models for the entire year and Ozone Season Period.

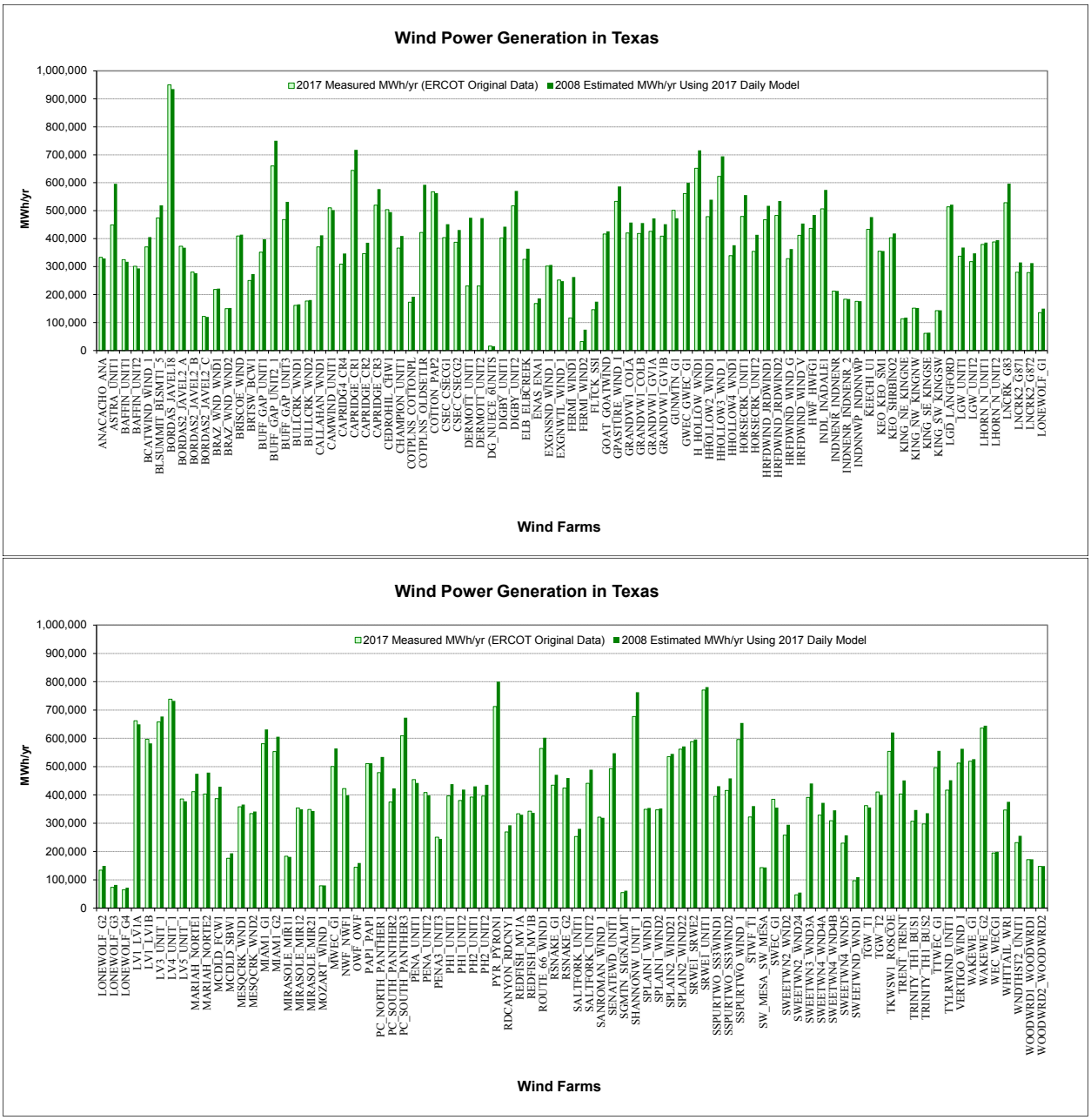


Figure 6: Comparison of 2017 Measured and 2008 Estimated Wind Power Production for Each Wind Farm

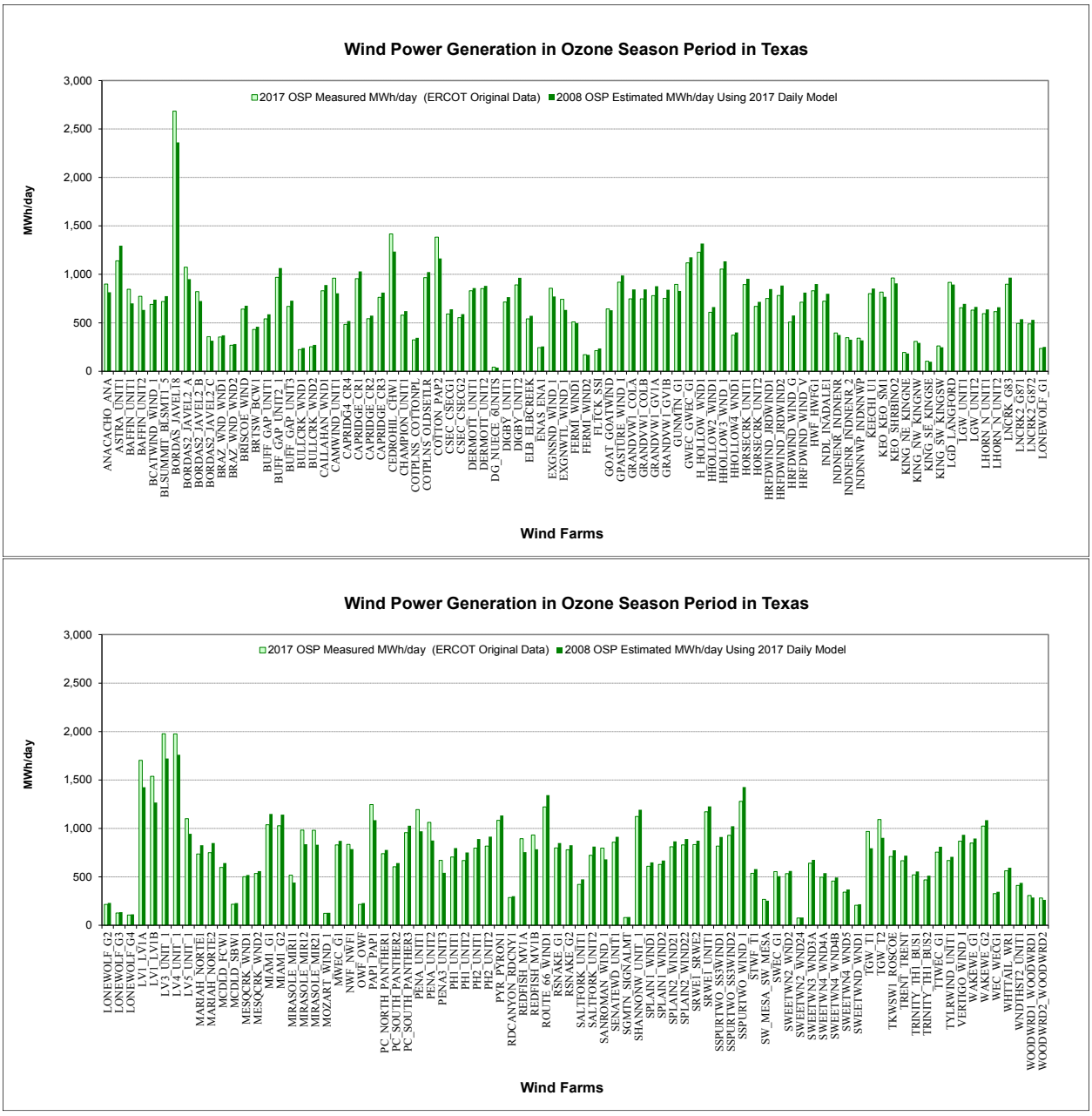


Figure 7: Comparison of 2017 OSP Measured and 2008 OSP Estimated Wind Power Production for Each Wind Farm

3.2 Analysis of emissions reductions from wind farms

In this report, the procedure for calculating annual and peak-day, county-wide NOx reductions from electricity savings from wind projects implemented in the Competitive Load (CL) zones in ERCOT was presented. The calculation of the NOx emission reductions is based on the 2016 eGRID as modified according to ESL-TR-08-12-04 report (US EPA and ESL, 2008). As shown in , Table 4 based on the 2017 measured ERCOT data, the total MWh savings for all the wind farms within the ERCOT region are 61,318,323 MWh/yr and 117,729 MWh/day for an average day in the OSP. The total NOx emissions reductions in 2017 across all the counties amount are 31,263 tons/yr and 61.89 tons/day for the OSP.

Table 4: Electricity Generation and NOx Emission Reductions for All the Wind Farms in ERCOT Region in 2017

	Annual	**OSP**
Actual Measured Electricity Generation in 2017	61,318,323 [MWh/yr]	117,729 [MWh/day]
NOx Emission Reductions in 2017	31,263 [tons/yr]	61.89 [tons/day]

3.3 Degradation analysis

This report contains an updated analysis to determine what degradation could be observed in the measured power from Texas wind farms. By TCEQ request on reference to the degradation of the wind farm power output, the ESL has been evaluating observed degradations from the measured data for all the Texas wind farms.

In this analysis, a sliding statistical index was established for each site that used the 10th, 25th, 50th, 75th, 90th, and 99th percentiles of the hourly power generation over a 12-month sliding period, as well as mean, minimum and maximum hourly power generation of the same 12-month period. These indices were then displayed using one data symbol for each 12-month slide, beginning from the first 12-month period until the last 12-month period for each of the wind farms.

As shown in *Table 5*, of the ninety seven sites[9] analyzed, sixty one sites showed an increase when one compares the 90th percentile of the whole period to the 90th percentile of the first 12-month period, ranging from 0.1% to 62.1%. The remaining thirty six sites showed a decrease from -0.2% to -21.9%. The weighted average of this increase across all wind farms studied is 5.7% (positive), which indicates that no degradation was observed from the aggregated energy production from these wind farms over the studied operation period. Based on the observations, special attention needs to be paid to sites Southwest Mesa Wind (-10.8%), Penascal Wind 3 (-10.9%), Papalote Creek Wind Farm (-12.1%), Big Spring Wind Power (-17.8%), and Sherbino 2 Wind (-21.9%). Those wind farms have comparison percentages larger than 10%, which may be caused by wind farm operation issues, meter problems or other similar issues.

[9] The ninety seven sites presented in the degradation analysis section include one hundred and sixteen individual wind farms.

Table 5: Summary of 90th Percentile Hourly Wind Power Analysis for Ninety Seven Sites in Texas

Wind Farm	12-Month Sliding 90th Percentile Hourly Wind Report								No. of Months of Data	Capacity (MW)
	First Year		Average		Minimum		Maximum			
	First 12-mo Ending Mo.	MW	MW	% Diff. vs. First 12-mo	MW	% Diff. vs. First 12-mo	MW	% Diff. vs. First 12-mo		
Anacacho Wind	Nov-13	83.4	87.1	4.4%	83.1	-0.4%	89.2	6.9%	50	100
Blue Summit Wind	Oct-13	121.9	120.4	-1.2%	114.9	-5.8%	128.5	5.4%	51	135
Bobcat Bluff Wind	Nov-13	115.0	111.7	-2.9%	100.2	-12.8%	127.9	11.2%	50	150
Brazos Wind Ranch	Dec-04	127.5	125.7	-1.4%	93.5	-26.7%	139.4	9.3%	157	160
Barton Chapel Wind 1	Apr-10	74.3	78.0	5.0%	68.2	-8.2%	89.1	19.9%	97	120
Buffalo Gap 1	Nov-06	100.9	97.9	-3.0%	75.4	-25.2%	105.7	4.8%	134	120
Buffalo Gap 2	Apr-08	183.4	177.4	-3.3%	104.9	-42.8%	207.6	13.2%	117	233
Buffalo Gap 3	Jun-09	86.4	135.7	57.1%	86.4	0.0%	152.1	76.0%	103	170
Bull Creek Wind Plant	Dec-09	93.9	93.7	-0.2%	41.5	-55.8%	130.4	38.9%	97	180
Big Spring Wind Power	Dec-02	27.2	22.4	-17.8%	15.3	-43.8%	27.2	0.0%	181	41
Callahan Divide Wind	Feb-06	93.3	93.9	0.6%	83.9	-10.0%	101.5	8.8%	143	114
Capricorn Ridge Wind 1&2	Aug-08	258.0	250.0	-3.1%	174.5	-32.4%	291.2	12.8%	113	364
Capricorn Ridge Wind 3	Jan-09	120.3	134.8	12.1%	97.9	-18.6%	153.5	27.6%	108	186
Capricorn Ridge Wind 4	May-09	83.5	85.1	1.9%	67.6	-19.0%	95.4	14.3%	104	112.5
Camp Springs Wind Energy Center	Apr-08	111.3	108.7	-2.4%	95.0	-14.6%	120.9	8.6%	117	130
Camp Springs Energy Expension	Jan-09	94.0	98.9	5.3%	88.9	-5.4%	107.9	14.8%	108	120
Cedro Hill Wind	Dec-11	136.3	123.2	-9.6%	101.9	-25.2%	136.9	0.4%	73	150
Champion Wind Farm	Jan-09	89.4	102.4	14.5%	87.7	-1.9%	113.2	26.6%	108	126.5
Desert Sky	Dec-02	89.0	118.2	32.7%	83.1	-6.7%	134.4	50.9%	181	160.5
Elbow Creek Wind	Dec-09	94.5	97.0	2.7%	82.5	-12.7%	104.5	10.6%	97	121.9
Forest Creek Wind Farm	Dec-07	105.2	105.5	0.3%	97.3	-7.5%	111.2	5.7%	121	124.2
Goat Wind	Feb-09	61.4	99.5	62.1%	61.4	0.0%	122.6	99.8%	107	150
Goldthwaite Wind 1	Dec-14	122.8	126.1	2.7%	115.8	-5.7%	134.4	9.4%	37	149
Grandview Wind 1 (Conway) GV1A	Nov-15	99.3	99.9	0.6%	97.5	-1.8%	101.4	2.2%	26	107
Grandview Wind 1 (Conway) GV1B	Nov-15	94.0	95.8	1.8%	91.5	-2.7%	98.0	4.2%	26	104
Gulf Wind 1	Jun-10	108.6	105.6	-2.8%	85.2	-21.6%	119.4	9.9%	91	141.6
Gulf Wind 2	Jun-10	116.5	115.6	-0.8%	89.7	-23.0%	126.3	8.4%	91	141.6
Hackberry Wind	Dec-09	138.0	125.4	-9.1%	105.8	-23.3%	140.6	1.9%	97	165.5
Harbor Wind	Jan-13	6.1	5.6	-8.6%	3.7	-40.3%	7.1	15.9%	60	9
Horse Hollow Phase 1	Jun-06	157.0	164.9	5.1%	141.3	-10.0%	185.1	17.9%	139	213
Horse Hollow Phase 2	Aug-07	145.7	137.1	-5.9%	99.0	-32.1%	151.5	4.0%	125	184
Horse Hollow Phase 3	May-07	169.2	165.8	-2.0%	123.9	-26.8%	187.7	11.0%	128	223.5
Horse Hollow Phase 4	Jun-07	88.6	88.7	0.1%	80.9	-8.7%	94.8	6.9%	127	115
Inadale Wind	Sep-10	117.9	137.9	17.0%	99.0	-16.0%	166.3	41.1%	88	197
Indian Mesa	Dec-02	48.0	56.1	16.9%	36.0	-24.9%	72.2	50.5%	181	82.5
King Mountain Wind Ranch-NE	Dec-02	41.8	45.5	8.7%	31.5	-24.8%	56.4	34.8%	181	79.3
King Mountain Wind Ranch-NW	Dec-02	44.7	53.8	20.5%	40.2	-10.1%	65.3	46.1%	181	79.3
King Mountain Wind Ranch-SE	Dec-02	21.6	22.8	5.3%	15.8	-27.1%	28.1	29.8%	181	40.3
King Mountain Wind Ranch-SW	Dec-02	41.6	45.6	9.7%	33.7	-18.9%	53.7	29.1%	181	79.3
Langford Wind	Dec-10	115.7	127.1	9.8%	114.4	-1.1%	134.3	16.0%	85	150
Lone Star - Post Oak Wind	Mar-09	149.1	155.3	4.2%	138.4	-7.2%	170.5	14.4%	106	200
Lone Star - Mesquite Wind	Sep-08	140.4	150.1	6.9%	129.9	-7.5%	168.1	19.7%	112	200
Loraine Windpark I	Dec-10	30.4	35.8	17.8%	25.9	-14.8%	42.3	39.2%	85	126
Loraine Windpark II	Dec-10	27.8	36.2	30.3%	25.7	-7.6%	43.3	55.7%	85	124.5
Loraine Windpark III	Jan-12	16.2	20.5	26.8%	16.2	0.0%	22.6	39.4%	72	26
Loraine Windpark IV	Dec-12	17.4	16.8	-3.7%	5.0	-71.5%	20.8	19.1%	61	24
Los Vientos Wind I	Oct-13	148.5	165.0	11.1%	148.5	0.0%	175.1	17.9%	51	200.1
Los Vientos Wind II	Nov-13	153.3	152.2	-0.8%	134.4	-12.3%	164.3	7.2%	50	201.6
Magic Valley Wind (Redfish) 1A	Apr-13	88.6	86.2	-2.7%	79.3	-10.5%	90.7	2.4%	57	99.8
Magic Valley Wind (Redfish) 1B	Jul-13	94.2	89.7	-4.8%	83.8	-11.1%	94.6	0.4%	54	103.5
McAdoo Wind	Dec-09	111.7	136.0	21.7%	111.7	0.0%	143.6	28.5%	97	150
Miami Wind G1	Aug-15	125.8	130.7	3.9%	125.8	0.0%	132.6	5.4%	29	144
Miami Wind G2	Aug-15	126.0	131.3	4.2%	126.0	0.0%	133.4	5.9%	29	144
Notrees Windpower	Feb-10	103.7	113.1	9.1%	103.7	0.0%	122.9	18.6%	95	153
Ocotillo Windpower	Dec-09	39.1	41.2	5.3%	36.6	-6.4%	47.2	20.7%	97	58.8

Table 6: Summary of 90th Percentile Hourly Wind Power Analysis for Ninety Seven Sites in Texas (Continued)

Wind Farm	12-Month Sliding 90th Percentile Hourly Wind Report								No. of Months of Data	Capacity (MW)
	First Year		Average		Minimum		Maximum			
	First 12-mo Ending Mo.	MW	MW	% Diff. vs. First 12-mo	MW	% Diff. vs. First 12-mo	MW	% Diff. vs. First 12-mo		
Panhandle Wind 1 U1	May-15	94.5	98.6	4.4%	93.8	-0.7%	101.3	7.2%	32	109
Panhandle Wind 1 U2	May-15	90.6	95.2	5.0%	90.5	-0.1%	98.0	8.2%	32	109
Panhandle Wind 2 U1	Oct-15	88.2	89.5	1.5%	88.2	0.0%	90.0	2.0%	27	94
Panhandle Wind 2 U2	Sep-15	90.2	92.1	2.2%	90.2	0.0%	93.4	3.6%	28	97
Panther Creek 1	Dec-09	114.4	121.4	6.1%	107.8	-5.8%	128.9	12.7%	97	142.5
Panther Creek 2	Dec-09	91.8	97.0	5.7%	85.2	-7.2%	104.2	13.5%	97	115.5
Panther Creek 3	Aug-10	128.5	154.0	19.9%	120.0	-6.6%	177.1	37.8%	89	199.5
Papalote Creek Wind Farm	Dec-10	150.1	131.9	-12.1%	39.6	-73.6%	157.9	5.2%	85	180
Papalote Creek Wind Farm II	Dec-11	174.2	166.1	-4.7%	155.0	-11.0%	176.3	1.2%	73	200.1
Penascal Wind 1	Feb-11	133.2	125.3	-5.9%	99.7	-25.2%	141.5	6.2%	83	161
Penascal Wind 2	Dec-09	83.3	108.4	30.1%	80.7	-3.1%	125.4	50.5%	97	142
Penascal Wind 3	May-11	87.1	77.6	-10.9%	65.7	-24.6%	88.8	2.0%	80	101
Pyron Wind Farm	Dec-09	157.2	191.2	21.7%	151.4	-3.7%	220.1	40.0%	97	249
Red Canyon 1	Aug-07	76.4	75.3	-1.4%	71.0	-7.0%	79.1	3.6%	125	84
Roscoe Wind Farm	Dec-08	169.4	154.2	-9.0%	108.1	-36.2%	179.8	6.2%	109	209
Sand Bluff Wind Farm	Nov-08	69.4	66.4	-4.3%	51.7	-25.5%	75.4	8.6%	110	90
Senate Wind	Sep-13	127.1	126.6	-0.4%	119.0	-6.4%	132.2	4.0%	52	150
Sherbino I Wind	Dec-09	104.7	111.0	6.0%	91.8	-12.3%	128.1	22.4%	97	150
Sherbino 2 Wind	Dec-12	125.7	98.2	-21.9%	38.0	-69.8%	125.7	0.0%	61	150
Silver Star Wind	Apr-09	40.6	45.4	11.8%	39.5	-2.7%	50.5	24.4%	105	60
South Trent Wind Farm	Dec-09	67.7	84.2	24.3%	65.4	-3.5%	91.0	34.4%	97	101.2
Southwest Mesa Wind	Dec-02	51.1	45.6	-10.8%	31.3	-38.8%	56.5	10.6%	181	74.6
Stanton Wind Energy	Dec-08	79.4	97.2	22.4%	79.4	0.0%	107.1	34.8%	109	120
Spinning Spur Wind Two	May-15	140.9	145.8	3.5%	140.9	0.0%	149.4	6.1%	32	161
Sweetwater Wind 1	Dec-04	34.1	32.7	-4.1%	28.8	-15.4%	34.9	2.4%	157	37.5
Sweetwater Wind 2 (unit 1)	Jan-06	71.4	81.5	14.2%	71.4	0.0%	88.0	23.3%	144	97.5
Sweetwater Wind 2 (unit 2)	Mar-08	13.1	13.7	4.8%	12.0	-8.7%	14.8	13.3%	118	16
Sweetwater Wind 3	Dec-06	99.6	100.9	1.3%	67.1	-32.7%	111.2	11.6%	133	135
Sweetwater Wind 4	Mar-08	161.0	170.4	5.8%	153.2	-4.9%	182.2	13.2%	118	240.8
Sweetwater Wind 5	Dec-08	66.5	62.9	-5.5%	56.3	-15.3%	69.3	4.3%	109	80.5
Snyder Wind Project	Dec-08	46.5	44.8	-3.6%	36.1	-22.3%	50.9	9.6%	109	63
Stephens Ranch Wind 1	Nov-15	182.9	189.6	3.7%	182.9	0.0%	193.1	5.6%	26	211
Trent Mesa	Dec-02	108.8	119.3	9.7%	90.7	-16.7%	132.8	22.0%	181	150
Trinity Hills Wind Farm 1	Dec-12	78.8	81.6	3.6%	62.8	-20.3%	89.3	13.3%	61	118
Trinity Hills Wind Farm 2	Dec-12	74.8	79.7	6.6%	63.5	-15.0%	88.0	17.7%	61	108
Turkey Track Wind Energy Center	Dec-09	77.4	125.1	61.6%	76.5	-1.1%	143.1	85.0%	97	169.5
Whirlwind	Dec-08	54.0	51.2	-5.2%	39.8	-26.3%	56.9	5.4%	109	60
Whitetail Wind	Oct-13	72.9	69.3	-4.9%	64.2	-11.9%	73.1	0.3%	51	92
Windthorst 2 Wind	Oct-15	50.3	57.0	13.3%	50.3	0.0%	59.4	18.1%	27	68
WKN Mozart Wind	Oct-13	22.4	22.7	1.1%	20.5	-8.5%	25.8	15.0%	51	30
Wolf Ridge Wind	Dec-09	105.9	104.0	-1.9%	93.0	-12.2%	108.8	2.7%	97	112.5
Woodward Mountain Ranch	Dec-02	85.3	96.1	12.8%	80.4	-5.7%	112.4	31.8%	181	159.7
Weighted Average:				**6.2%**		**-14.7%**		**18.6%**	**Total:**	**12683.2**

3.4 Analysis of other renewable sources

Five specific renewable sources were determined: solar, biomass, hydroelectric, geothermal, and landfill gas-fired. To generate/save energy throughout the State of Texas, six types of renewable energy projects were identified: solar photovoltaic (PV) including solar power, solar thermal, biomass power, hydroelectric power, geothermal HVAC, and landfill gas-fired power projects. The solar photovoltaic project accounts for non-utility scale PV installations in Texas whereas the solar power project accounts for utility scale (solar power plant) constructions. Table 7 presents the number of newly located renewable energy projects and total renewable energy projects included in this report.

This report also presents county-wide annual/OSP energy savings and annual NOx emission reductions for solar photovoltaic including solar power, solar thermal, biomass, and hydroelectric projects. The annual/OSP energy savings calculation for solar photovoltaic and solar thermal was conducted using the eCalc tool. The power generation data for the other renewable energy projects (solar power, biomass, and hydroelectric), which were obtained from the ERCOT, were used to evaluate the annual/OSP energy generation. Then, the annual NOx emission reductions calculation was conducted with the special version of Texas 2016 eGrid.

In 2017, the total annual/OSP energy savings from each renewable projects across all the counties were:

- solar photovoltaic projects (non-utility scale) : 342,792 MWh/yr and 1,033 MWh/day;
  in addition, solar power projects (utility scale) : 2,186,173 MWh/yr and 5,990 MWh/day,
- solar thermal projects : 232 MWh/yr and 0.6 MWh/day,
- biomass projects : 544,193 MWh/yr and 1,491 MWh/day, and
- hydroelectric projects : 855,842 MWh/yr and 2,345 MWh/day.

In 2017, the annual NOx emission reductions from renewable projects across all the counties were:

- solar photovoltaic projects (non-utility scale): 129.7 tons/yr;
  in addition, solar power projects (utility scale): 1,118.4 tons/yr,
- solar thermal projects: 0.1 tons/yr, and
- hydroelectric projects: 305.4 tons/yr.

Table 7: Number of Identified Projects for Other Renewable Sources

Renewable Energy Projects	Number of 2017 New Projects	Total Number of Projects	Annual Measured/ Estimated Electricity Generation in 2017 [MWh/yr]	OSP Measured/ Estimated Electricity Generation in 2017 [MWh/day]	NOx Emission Reductions in 2017 [tons/yr]
Solar photovoltaic[10, 11]	36	4,786	342,792	1,033	129.7
Solar Power [3]	7	30	2,186,173	5,990	1,118.4
Solar Thermal [3]	0	38	232	0.6	0.1
Biomass[12]	0	14	544,193	1,491	-
Hydroelectric	0	29	855,842	2,345	305.4
Geothermal	0	286	-	-	-
Landfill Gas-Fired[13]	0	35	-	-	-

[10] The Open PV project database of National Renewable Energy Laboratory (NREL) (https://openpv.nrel.gov/), which was checked in March, 2018, provides updated PV projects for 2006, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, and 2017. Thus, the total number of PV projects until 2017, including PV projects from various websites, is now 4,786. Previously, it was 4,750.
[11] The utility scale solar power is measured while both non-utility scale solar photovoltaic and non-utility solar thermal are estimated.
[12] Four Biomass projects had no generation. Therefore, they are excluded from the list for this year. Also, NOx emission reductions for biomass is not reported since biomass itself has high NOx emissions.
[13] Landfill gas-fired projects information from EPA have seven sub-categories for their status: operational, candidates, potential, construction, shutdown, planned, and other. EPA rearranged/added/removed some projects information within the seven sub-categories. Operational projects were considered for the number of the projects.

3.5 Review of electricity savings and transmission planning study reported by ERCOT

In this report, the information posted on ERCOT's Renewable Energy Credit (REC) Program site www.texasrenewables.com was reviewed. In particular, information posted under the "Public Reports" tab was downloaded and assembled into an appropriate format for review. This includes ERCOT's 2001 through 2017 reports to the Legislature and information from ERCOT's listing of REC generators.

Each year ERCOT is required to compile a list of grid-connected sources that generate electricity from renewable energy and report them to the Legislature. Table 8 contains the data reported by ERCOT from 2001 to 2017. Figure 8 is included to better illustrate the annual data collected by ERCOT. Other sources present different renewable electricity generation values on biomass, wind and hydro, but those are explained in general because the numbers reported in this report are focused on the ERCOT region.

Table 8: Annual Electricity Generation by Renewable Resources (MWh, ERCOT: 2001 - 2017)[14]

Year	Biomass (MWh)	Hydro (MWh)	Landfill gas (MWh)	Solar[6] (MWh)	Wind (MWh)	Total (MWh)
2001	0	30,639	0	0	565,597	596,236
2002	0	312,093	29,412	87	2,451,484	2,793,076
2003	39,496	239,684	154,206	220	2,515,482	2,949,087
2004	36,940	234,791	203,443	211	3,209,630	3,685,014
2005	58,637	310,302	213,777	227	4,221,568	4,804,512
2006	60,569	210,077	306,087	470	6,530,928	7,108,131
2007	54,101	382,882	356,339	1,844	9,351,168	10,146,333
2008	70,833	445,428	387,110	3,338	16,286,440	17,193,150
2009	73,364	507,507	412,923	4,492	20,596,105	21,594,390
2010	97,535	609,257	464,904	14,449	26,828,660	28,014,805
2011	137,004	267,113	497,645	36,580	30,769,674	31,708,016
2012	288,988	389,197	549,037	139,439	32,746,534	34,113,195
2013	200,564	294,238	550,845	178,326	36,909,385	38,133,358
2014	343,469	240,792	518,580	312,757	40,644,362	42,059,961
2015	349,600	414,289	561,915	410,318	45,165,341	46,901,462
2016	247,643	393,740	518,403	848,410	57,796,161	59,804,357
2017	216,431	444,453	446,119	2,289,394	66,076,742	69,473,139

NOTE: The REC Program tracks renewable generation in Texas, including non-ERCOT regions of Texas[15].

[14] Solar includes the utility scale solar power only
[15] https://www.texasrenewables.com/reports.asp

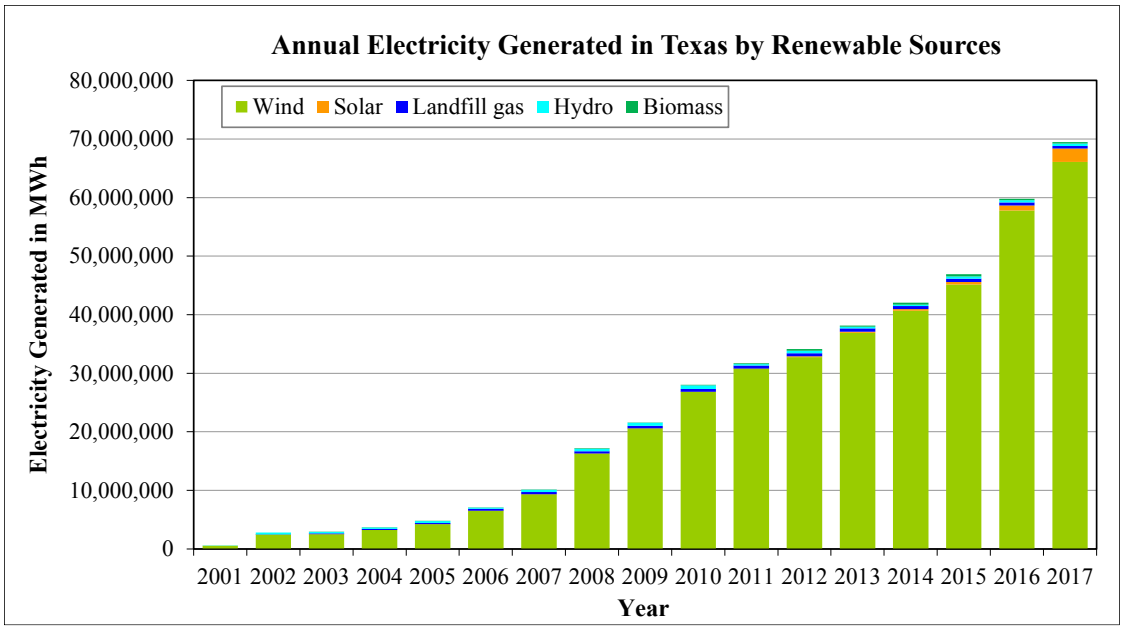


Figure 8: Electricity Generation by Renewable Resources (ERCOT: 2001–2017 Annual)

4 Calculated NOx Reductions Potential from Energy Savings of New Construction in 2017

A complete reporting of the savings, using 2008 base year (the implementation of the 2015 IECC and the ASHRAE Standard 90.1-2013), requires tracking and analyzing savings for new construction buildings that undergo a building permit. The adoption of the energy code and standard in Texas is expected to impact the following types of buildings:

- single-family residential
- multi-family residential
- commercial
- industrial

The following sections report the calculated energy savings associated with new construction activities for both residential (i.e., single-family and multi-family[16]) and commercial buildings.

4.1 2017 Results for New Single-family Residential Construction

This section provides the potential electricity and natural gas savings and the associated NOx emissions reductions in 2017 using the 2008 base year which implemented the 2015 IECC for new single-family residences in the 42 non-attainment and affected counties as well as other counties in the ERCOT region[17]. To calculate the NOx emissions reductions, the following procedures were adopted. First, new construction activity was determined by county. To accomplish this, the number of 2017 building permits per county was obtained from the real estate center at Texas A&M University (REC 2018). Next, energy savings attributable to the 2015 IECC were calculated using the Laboratory's code-traceable, DOE-2.1e simulation, which was developed for the TERP. For the savings calculation, the 2016 Home Innovation Research Labs (HIRL) data[18] were used to determine the appropriate construction data corresponding to housing types. Then the NOx reductions potential from the electricity and natural gas savings in each county was calculated using the US EPA's 2016 eGRID database (USEPA 2016)[19].

In Table 9, the 2017 new single-family and 2015 IECC code-compliant building characteristics are shown for each county. The building characteristics reflect those published by the HIRL, ARI, and GAMA for Texas. The 2015 IECC code-compliant characteristics are the minimum building code characteristics required for each county for single-family residences (i.e., Type A.1). In Table 9, the rows are first sorted by the US EPA's non-attainment, affected designation, and then other ERCOT counties alphabetically. Next, in the fourth column, the HIRL's survey classification is listed. The fifth through eighth columns show the HIRL's survey data: average glazing U-value, Solar Heat Gain Coefficient (SHGC), roof insulation, and wall insulation, respectively. In addition, the ninth through twelfth columns show the 2015 IECC minimum requirements for glazing U-value, SHGC, roof insulation, and wall insulation.

The corresponding values in IECC and effective regulations are applied to the air-conditioner efficiency, furnace efficiency (AFUE), and domestic water heater efficiency. The values shown in Table 9 represent the only changes that were made to the simulation to obtain the savings calculations. In cases where the 2017 values were more efficient than the 2015 IECC requirements, the 2017 values were used in the 2017 new single-family simulations. Otherwise, the 2015 IECC values were used in both simulations[20]. For example, in the Collin County, according to the HIRL's survey data, the roof insulation is R-25.77, which is less than the code-required insulation of R-38. Therefore, R-38 was used in the 2017 simulation.

[16] The potential energy savings and NOx reductions analysis from energy savings of new single- and multi-family constructions in 2016 and 2017 includes the related provisions for both *systems* and *envelope* in 2015 IECC, whereas in previous years analysis only the related provisions to the *envelope* from the corresponding code were included.
[17] The three new counties added in the 2003 Legislative session (i.e., Henderson, Hood, and Hunt) were included in the ERCOT region.
[18] In 2013, the NAHB Research Center announced that it has changed its name to Home Innovation Research Labs (HIRL). See more at: http://www.homeinnovation.com
[19] This preliminary analysis does not include actual power transfers on the grid, and assumes transmission and distribution losses of 7%. Counties were assigned to utility service districts as indicated.
[20] 2016 HIRL data and 2015 IECC are used for the 2017 new code-compliant simulations and 2008 NAHB data and 2006 IECC are used for the base-year simulations

In Table 10, the code-traceable simulation results for single-family residences are shown for each county. In a similar fashion to Table 9, Table 10 is first divided into the US EPA's non-attainment and affected classifications, followed by an alphabetical list of other ERCOT counties. In the third column, the 2015 IECC climate zone is listed followed by the number of new projected housing units[21] in the fourth column. In the fifth column, the total simulated energy use is listed if all new Construction had been built to pre-code specifications. In the sixth column, the total county-wide energy use for code-compliant Construction is shown. The values in the fifth and sixth columns come from the associated 24 simulation runs for each county, which were then distributed according to the HIRL's survey data, to account for 1 story, 2 story, slab-on-grade, crawlspace, and three different system types (i.e., central air conditioning with electric resistance heating, heat pump heating, or a natural gas-fired furnace). In the seventh column, the total annual electricity savings are shown for each county. A 7% transmission and distribution loss is used in the 2017 report, which represents a fixed 1.07 multiplier for the electricity use. In the eighth and ninth columns, the total annual pre-code and code-compliant natural gas use is shown for those residences that had natural gas-fired furnaces and domestic water heaters. Finally, in the tenth column, the total annual natural gas savings are shown for each county.

In Table 11, the Competitive Load (CL) Zones[22] assignments for each county are shown. In Table 12, the annual electricity savings are assigned to CL Zones provider(s) according to Table 11[23]. The total electricity savings for each CL Zone, as shown in Table 12, then entered into the bottom row of Table 13, which is the 2016 US EPA's eGRID database[24] for Texas. Next, the county's NOx reductions (lbs) are calculated using the assigned 2016 eGrid proportions (lbs-NOx/MWh) to each CL zone in the county. The calculated NOx reductions are presented in the columns adjacent to the corresponding CL Zone columns. By adding the NOx reductions values in each row, then, the total of the NOx reductions per county (lbs and Tons) is calculated. Counties that do not show NOx reductions represent counties that do not have power plants in eGRID's database.

[21] The number of the new housing units in 2017 were obtained from the Real Estate Center at Texas A&M University.
[22] ERCOT region has employed the Competitive Load (CL) zones, and it is currently divided into four zones: Houston (H), North (N), South (S), and West (W).
[23] Of a total of 202 counties, 138 counties are not included in this table since the corresponding providers could not be assigned for these 138 counties.
[24] This preliminary analysis does not include actual power transfers on the grid, and assumes transmission and distribution losses of 7%. Counties were assigned to CL Zones as indicated.

Table 9: 2016 and 2015 IECC Code-compliant Building Characteristics Used in the DOE-2 Simulations for New Single-family Residences

	County	Climate Zone	Division	2017 Average				2015 IECC			
			East or West	Glazing U-value (Btu/hr-ft^2-F)	SHGC	Roof Insulation (hr-ft^2-F/Btu)	Wall Insulation (hr-ft^2-F/Btu)	Glazing U-value (Btu/hr-ft^2-F)	SHGC	Roof Insulation (hr-ft^2-F/Btu)	Wall Insulation (hr-ft^2-F/Btu)
Non-attainment	BRAZORIA	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	CHAMBERS	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	COLLIN	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	DALLAS	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	DENTON	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	EL PASO	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	ELLIS	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	FORT BEND	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	GALVESTON	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	HARRIS	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	JOHNSON	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	KAUFMAN	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	LIBERTY	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	MONTGOMERY	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	PARKER	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	ROCKWALL	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	TARRANT	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	WALLER	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	WISE	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
Affected	BASTROP	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	BEXAR	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	CALDWELL	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	COMAL	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	GREGG	3	East Texas	0.39	0.53	25.604	13.533	0.35	0.25	38	20
	GUADALUPE	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	HARRISON	3	East Texas	0.39	0.53	25.604	13.533	0.35	0.25	38	20
	HAYS	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	NUECES	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	RUSK	3	East Texas	0.39	0.53	25.604	13.533	0.35	0.25	38	20
	SAN PATRICIO	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	SMITH	3	East Texas	0.39	0.53	25.604	13.533	0.35	0.25	38	20
	TRAVIS	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	UPSHUR	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	VICTORIA	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	WILLIAMSON	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	WILSON	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
ERCOT	ANDERSON	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	ANDREWS	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	ANGELINA	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	ARANSAS	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	ARCHER	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	ATASCOSA	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	AUSTIN	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	BANDERA	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	BASTROP	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	BAYLOR	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	BEE	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	BELL	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	BEXAR	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	BLANCO	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	BORDEN	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	BOSQUE	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	BRAZORIA	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	BRAZOS	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	BREWSTER	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	BRISCOE	4	West Texas	0.39	0.53	25.772	14.358	0.35	0.4	49	20
	BROOKS	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	BROWN	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	BURLESON	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	BURNET	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	CALDWELL	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	CALHOUN	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	CALLAHAN	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	CAMERON	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	CHAMBERS	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	CHEROKEE	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	CHILDRESS	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	CLAY	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	COKE	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	COLEMAN	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	COLLIN	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	COLORADO	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	COMAL	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	COMANCHE	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	CONCHO	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	COOKE	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	CORYELL	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	COTTLE	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	CRANE	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	CROCKETT	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	CROSBY	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	CULBERSON	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	DALLAS	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	DAWSON	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	DE WITT	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	DELTA	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	DENTON	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	DICKENS	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	DIMMIT	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	DUVAL	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	EASTLAND	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	ECTOR	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	EDWARDS	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	ELLIS	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	ERATH	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	FALLS	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	FANNIN	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	FAYETTE	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	FISHER	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	FOARD	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	FORT BEND	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	FRANKLIN	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	FREESTONE	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13

Table 7: 2016 and 2015 IECC Code-compliant Building Characteristics Used in the DOE-2 Simulations for New Single-family Residences (Continued)

	County	Climate Zone	Division	2017 Average				2015 IECC			
			East or West	Glazing U-value (Btu/hr-ft^2-F)	SHGC	Roof Insulation (hr-ft^2-F/Btu)	Wall Insulation (hr-ft^2-F/Btu)	Glazing U-value (Btu/hr-ft^2-F)	SHGC	Roof Insulation (hr-ft^2-F/Btu)	Wall Insulation (hr-ft^2-F/Btu)
ERCOT	FRIO	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	GALVESTON	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	GILLESPIE	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	GLASSCOCK	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	GOLIAD	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	GONZALES	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	GRAYSON	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	GRIMES	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	GUADALUPE	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	HALL	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	HAMILTON	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	HARDEMAN	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	HARRIS	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	HASKELL	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	HAYS	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	HENDERSON	3	East Texas	0.39	0.53	25.604	13.533	0.35	0.25	38	20
	HIDALGO	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	HILL	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	HOOD	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	HOPKINS	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	HOUSTON	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	HOWARD	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	HUDSPETH	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	HUNT	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	IRION	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	JACK	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	JACKSON	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	JEFF DAVIS	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	JIM HOGG	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	JIM WELLS	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	JOHNSON	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	JONES	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	KARNES	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	KAUFMAN	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	KENDALL	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	KENEDY	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	KENT	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	KERR	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	KIMBLE	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	KING	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	KINNEY	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	KLEBERG	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	KNOX	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	LA SALLE	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	LAMAR	3	East Texas	0.39	0.53	25.604	13.533	0.35	0.25	38	20
	LAMPASAS	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	LAVACA	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	LEE	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	LEON	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	LIMESTONE	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	LIVE OAK	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	LLANO	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	LOVING	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	MADISON	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	MARTIN	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	MASON	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	MATAGORDA	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	MAVERICK	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	MCCULLOCH	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	MCLENNAN	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	MCMULLEN	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	MEDINA	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	MENARD	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	MIDLAND	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	MILAM	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	MILLS	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	MITCHELL	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	MONTAGUE	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	MONTGOMERY	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	MOTLEY	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	NACOGDOCHES	3	East Texas	0.39	0.53	25.604	13.533	0.35	0.25	38	20
	NAVARRO	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	NOLAN	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	NUECES	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	PALO PINTO	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	PARKER	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	PECOS	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	PRESIDIO	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	RAINS	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	REAGAN	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	REAL	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	RED RIVER	3	East Texas	0.39	0.53	25.604	13.533	0.35	0.25	38	20
	REEVES	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	REFUGIO	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	ROBERTSON	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	ROCKWALL	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	RUNNELS	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	RUSK	3	East Texas	0.39	0.53	25.604	13.533	0.35	0.25	38	20
	SAN PATRICIO	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	SAN SABA	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	SCHLEICHER	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	SCURRY	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	SHACKELFORD	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	SMITH	3	East Texas	0.39	0.53	25.604	13.533	0.35	0.25	38	20
	SOMERVELL	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	STARR	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	STEPHENS	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	STERLING	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	STONEWALL	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	SUTTON	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	TARRANT	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	TAYLOR	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	TERRELL	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	THROCKMORTON	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	TITUS	3	East Texas	0.39	0.53	25.604	13.533	0.35	0.25	38	20
	TOM GREEN	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	TRAVIS	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	UPTON	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	UVALDE	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	VAL VERDE	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	VAN ZANDT	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	VICTORIA	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	WALLER	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	WARD	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	WASHINGTON	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	WEBB	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	WHARTON	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	WICHITA	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	WILBARGER	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	WILLACY	2	East Texas	0.39	0.53	25.604	13.533	0.4	0.25	38	13
	WILLIAMSON	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	WILSON	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	WINKLER	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	WISE	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	YOUNG	3	West Texas	0.39	0.53	25.772	14.358	0.35	0.25	38	20
	ZAPATA	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13
	ZAVALA	2	West Texas	0.39	0.53	25.772	14.358	0.4	0.25	38	13

Table 10: 2017 Annual Electricity Savings from New Single-family Residences

2017 Summary TRY 2008									
	County	Climate Zone	No. of Projected Units (2014)	Precode Total Annual Elec. Use (MWh/yr)	Code-compliant Total Annual Elec. Use (MWh/yr)	Total Annual Elec. Savings (MWh/yr) w/ 7% of T&D Loss	Precode Total NG Use (Therm/yr)	Code-compliant Total NG Use (Therm/yr)	Total Annual NG Savings (Therm/yr)
Nonattain-ment County	BRAZORIA	3	3,132	57,057	51,302	**6,158**	548,666	514,917	**33,749**
	CHAMBERS	3	526	9,472	8,561	**975**	92,188	88,053	**4,135**
	COLLIN	3	9,497	169,661	149,271	**21,818**	2,908,552	2,732,133	**176,419**
	DALLAS	3	4,946	88,226	77,712	**11,250**	1,525,060	1,430,609	**94,450**
	DENTON	3	6,665	119,068	104,758	**15,312**	2,041,224	1,917,413	**123,811**
	EL PASO	2	2,373	41,624	36,314	**5,682**	670,373	641,101	**29,273**
	ELLIS	3	1,959	34,944	30,780	**4,456**	604,042	566,632	**37,410**
	FORT BEND	3	7,711	140,493	126,309	**15,176**	1,350,818	1,265,441	**85,377**
	GALVESTON	3	2,095	38,166	34,316	**4,119**	367,003	344,429	**22,574**
	HARDIN	2	278	5,008	4,525	**517**	48,605	46,420	**2,185**
	HARRIS	2	16,980	309,372	278,140	**33,419**	2,974,567	2,786,563	**188,004**
	JEFFERSON	2	377	6,792	6,136	**702**	65,914	62,951	**2,963**
	JOHNSON	2	604	10,774	9,490	**1,374**	186,239	174,704	**11,534**
	KAUFMAN	2	903	16,132	14,193	**2,074**	276,553	259,779	**16,774**
	LIBERTY	2	544	9,916	8,913	**1,074**	95,068	89,044	**6,023**
	MONTGOMERY	3	5,290	96,383	86,652	**10,411**	926,705	868,134	**58,571**
	ORANGE	2	485	8,739	7,894	**904**	84,792	80,980	**3,812**
	PARKER	2	465	8,307	7,309	**1,068**	142,411	133,773	**8,638**
	ROCKWALL	2	1,468	26,225	23,074	**3,372**	449,590	422,320	**27,270**
	TARRANT	2	7,630	136,102	119,883	**17,355**	2,352,650	2,206,945	**145,705**
	WALLER	2	36	656	590	**71**	6,307	5,908	**399**
	WISE	3	83	1,483	1,305	**191**	25,420	23,878	**1,542**
Affected County	BASTROP	2	166	3,181	2,833	**373**	33,050	29,698	**3,351**
	BEXAR	2	3,706	66,159	58,921	**7,745**	856,123	764,255	**91,868**
	CALDWELL	3	254	4,561	4,066	**530**	61,503	55,339	**6,164**
	COMAL	3	2,375	42,398	37,760	**4,963**	548,649	489,775	**58,874**
	GREGG	3	160	3,075	2,739	**359**	37,105	36,767	**338**
	GUADALUPE	2	1,007	17,977	16,010	**2,104**	232,627	207,664	**24,963**
	HARRISON	2	44	844	753	**97**	10,314	10,191	**123**
	HAYS	2	2,862	51,416	45,824	**5,984**	693,000	622,057	**70,943**
	NUECES	3	818	15,000	13,393	**1,719**	106,970	100,876	**6,095**
	RUSK	2	2	37	33	**4**	393	385	**8**
	SAN PATRICIO	2	205	3,759	3,357	**431**	26,808	25,281	**1,527**
	SMITH	2	472	9,053	8,083	**1,038**	111,041	109,663	**1,377**
	TRAVIS	3	8,655	155,488	138,577	**18,095**	2,095,706	1,881,167	**214,540**
	UPSHUR	3	5	98	87	**12**	1,266	1,187	**79**
	VICTORIA	2	57	1,026	919	**114**	8,362	7,935	**426**
	WILLIAMSON	3	4,182	75,130	66,959	**8,743**	1,012,622	908,959	**103,663**
	WILSON	2	53	946	843	**111**	12,244	10,930	**1,314**
ERCOT	ANDERSON	2	14	257	228	**31**	2,752	2,694	**58**
	ANDREWS	3	18	320	282	**41**	6,394	6,032	**362**
	ANGELINA	2	47	861	764	**104**	9,237	9,044	**194**
	ARANSAS	2	155	2,842	2,538	**326**	20,269	19,115	**1,155**
	ARCHER	3	7	135	118	**18**	2,898	2,705	**193**
	ATASCOSA	2	36	643	572	**75**	8,325	7,443	**882**
	AUSTIN	2	34	619	557	**67**	5,956	5,580	**376**
	BANDERA	2	1	18	16	**2**	230	213	**17**
	BAYLOR	3	0	0	0	**0**	0	0	**0**
	BEE	2	8	144	129	**16**	1,174	1,114	**60**
	BELL	2	1,600	28,742	25,694	**3,262**	471,160	425,272	**45,887**
	BLANCO	3	12	216	192	**25**	2,906	2,608	**297**
	BORDEN	3	19	394	355	**41**	7,113	6,698	**414**
	BOSQUE	2	8	144	128	**16**	2,356	2,126	**229**
	BRAZOS	2	1,059	19,295	17,347	**2,084**	185,516	173,791	**11,725**
	BREWSTER	3	5	90	80	**12**	1,769	1,658	**111**
	BRISCOE	4	7	139	124	**16**	4,335	4,038	**297**
	BROOKS	2	2	68	60	**8**	424	391	**32**
	BROWN	3	146	2,623	2,345	**298**	42,993	38,806	**4,187**
	BURLESON	2	16	292	262	**31**	2,803	2,626	**177**
	BURNET	3	372	6,683	5,956	**778**	90,075	80,854	**9,221**
	CALHOUN	2	64	1,152	1,032	**128**	9,388	8,910	**479**
	CALLAHAN	3	4	73	64	**10**	1,412	1,318	**94**
	CAMERON	2	1,139	21,166	18,753	**2,583**	129,842	120,209	**9,633**
	CHEROKEE	2	7	128	114	**16**	1,376	1,347	**29**
	CHILDRESS	3	0	0	0	**0**	0	0	**0**
	CLAY	3	1	19	17	**3**	414	386	**28**
	COKE	3	0	0	0	**0**	0	0	**0**
	COLEMAN	3	0	0	0	**0**	0	0	**0**
	COLORADO	2	11	200	180	**22**	1,927	1,805	**122**
	COMANCHE	3	0	0	0	**0**	0	0	**0**
	CONCHO	3	1	18	16	**2**	354	332	**22**
	COOKE	3	70	1,250	1,100	**160**	21,547	20,211	**1,337**
	CORYELL	2	156	2,802	2,505	**318**	45,938	41,464	**4,474**
	COTTLE	3	0	0	0	**0**	0	0	**0**
	CRANE	3	1	18	16	**2**	356	335	**21**
	CROCKETT	3	19	344	302	**44**	6,723	6,302	**421**
	CROSBY	3	0	0	0	**0**	0	0	**0**
	CULBERSON	3	6	105	92	**14**	1,694	1,620	**74**
	DAWSON	3	0	0	0	**0**	0	0	**0**
	DEWITT	2	3	54	48	**6**	440	418	**22**
	DELTA	3	5	89	79	**11**	1,531	1,438	**93**
	DICKENS	3	0	0	0	**0**	0	0	**0**
	DIMMIT	2	0	0	0	**0**	0	0	**0**
	DUVAL	2	0	0	0	**0**	0	0	**0**
	EASTLAND	3	0	0	0	**0**	0	0	**0**
	ECTOR	3	492	8,745	7,703	**1,115**	174,758	164,869	**9,889**
	EDWARDS	2	0	0	0	**0**	0	0	**0**
	ERATH	3	38	692	606	**92**	13,413	12,522	**891**
	FALLS	2	1	18	16	**2**	294	266	**29**
	FANNIN	3	31	553	487	**71**	9,542	8,950	**592**
	FAYETTE	2	9	164	147	**18**	1,577	1,477	**100**
	FISHER	3	0	0	0	**0**	0	0	**0**
	FOARD	3	0	0	0	**0**	0	0	**0**
	FRANKLIN	3	2	36	31	**5**	613	575	**37**
	FREESTONE	2	5	90	80	**10**	1,472	1,329	**143**
	FRIO	2	7	125	111	**15**	1,619	1,447	**172**

Table 8: 2017 Annual Electricity Savings from New Single-family Residences (Continued)

2017 Summary TRY 2008									
	County	Climate Zone	No. of Projected Units (2014)	Precode Total Annual Elec. Use (MWh/yr)	Code-compliant Total Annual Elec. Use (MWh/yr)	Total Annual Elec. Savings (MWh/yr) w/ 7% of T&D Loss	Precode Total NG Use (Therm/yr)	Code-compliant Total NG Use (Therm/yr)	Total Annual NG Savings (Therm/yr)
	GILLESPIE	3	54	970	865	**113**	13,075	11,737	**1,339**
	GLASSCOCK	3	0	0	0	**0**	0	0	**0**
	GOLIAD	2	4	72	65	**8**	587	557	**30**
	GONZALES	2	15	268	238	**31**	3,465	3,093	**372**
	GRAYSON	3	666	11,889	10,466	**1,523**	205,008	192,291	**12,718**
	GRIMES	2	48	875	786	**94**	8,409	7,877	**531**
	HALL	3	0	0	0	**0**	0	0	**0**
	HAMILTON	3	3	54	48	**6**	883	797	**86**
	HARDEMAN	3	1	19	17	**3**	414	386	**28**
	HASKELL	3	3	55	48	**7**	1,059	989	**70**
	HENDERSON	2	95	1,822	1,627	**209**	22,349	22,072	**277**
	HIDALGO	2	2,698	50,137	44,420	**6,118**	307,562	284,743	**22,818**
	HILL	2	16	287	257	**33**	4,712	4,253	**459**
	HOPKINS	3	21	375	330	**48**	6,431	6,041	**390**
	HOUSTON	2	0	0	0	**0**	0	0	**0**
	HOWARD	3	28	498	438	**63**	9,946	9,383	**563**
	HOOD	2	180	3,211	2,828	**409**	55,502	52,064	**3,437**
	HUDSPETH	3	0	0	0	**0**	0	0	**0**
	HUNT	2	190	3,392	2,986	**435**	58,486	54,858	**3,628**
	IRION	3	0	0	0	**0**	0	0	**0**
	JACK	3	0	0	0	**0**	0	0	**0**
	JACKSON	2	5	90	81	**10**	733	696	**37**
	JEFF DAVIS	3	0	0	0	**0**	0	0	**0**
	JIM HOGG	2	0	0	0	**0**	0	0	**0**
	JIM WELLS	2	14	257	229	**29**	1,831	1,726	**104**
	JONES	3	0	0	0	**0**	0	0	**0**
	KARNES	2	47	814	729	**91**	8,940	8,069	**871**
	KENDALL	3	327	5,834	5,079	**808**	75,200	69,793	**5,407**
	KENEDY	2	0	0	0	**0**	0	0	**0**
	KENT	3	0	0	0	**0**	0	0	**0**
	KERR	3	40	719	640	**84**	9,686	8,694	**992**
	KIMBLE	3	2	36	32	**5**	708	663	**44**
	KING	3	0	0	0	**0**	0	0	**0**
	KINNEY	2	1	18	16	**2**	231	206	**25**
	KLEBERG	2	5	92	82	**11**	654	617	**37**
	KNOX	3	0	0	0	**0**	0	0	**0**
	LA SALLE	2	2	36	32	**4**	339	305	**33**
	LAMAR	3	26	499	445	**58**	6,092	6,021	**72**
	LAMPASAS	3	33	593	530	**67**	9,718	8,771	**946**
	LAVACA	2	9	162	145	**18**	1,316	1,248	**68**
	LEE	2	9	162	144	**19**	2,179	1,961	**218**
	LEON	2	0	0	0	**0**	0	0	**0**
	LIMESTONE	2	3	54	48	**6**	883	797	**86**
	LIVE OAK	2	0	0	0	**0**	0	0	**0**
	LLANO	3	234	4,204	3,747	**489**	56,660	50,860	**5,800**
	LOVING	3	0	0	0	**0**	0	0	**0**
	MADISON	2	3	55	49	**6**	526	492	**33**
	MARTIN	3	5	89	78	**11**	1,776	1,675	**100**
	MASON	3	0	0	0	**0**	0	0	**0**
	MATAGORDA	2	141	2,537	2,274	**282**	20,684	19,630	**1,054**
	MAVERICK	2	63	1,122	1,001	**129**	10,665	9,613	**1,051**
	MCCULLOCH	3	1	18	16	**2**	354	332	**22**
	MCLENNAN	2	767	13,778	12,317	**1,564**	225,862	203,865	**21,997**
	MCMULLEN	2	0	0	0	**0**	0	0	**0**
ERCOT	MEDINA	2	30	536	477	**63**	6,930	6,187	**744**
	MENARD	3	0	0	0	**0**	0	0	**0**
	MIDLAND	3	761	13,527	11,914	**1,725**	270,307	255,011	**15,296**
	MILAM	2	8	139	125	**15**	1,812	1,618	**194**
	MILLS	3	0	0	0	**0**	0	0	**0**
	MITCHELL	3	0	0	0	**0**	0	0	**0**
	MONTAGUE	3	0	0	0	**0**	0	0	**0**
	MOTLEY	3	0	0	0	**0**	0	0	**0**
	NACOGDOCHES	3	2	37	33	**4**	393	385	**8**
	NAVARRO	3	249	4,473	3,999	**508**	73,324	66,183	**7,141**
	NOLAN	3	4	73	64	**10**	1,412	1,318	**94**
	PALO PINTO	3	4	73	64	**10**	1,412	1,318	**94**
	PECOS	3	1	18	16	**2**	358	332	**22**
	POTTER	4	479	11,386	10,238	**1,229**	109,488	102,753	**6,735**
	PRESIDIO	3	14	253	223	**33**	4,954	4,644	**311**
	RAINS	3	4	71	63	**9**	1,225	1,151	**74**
	REAGAN	3	0	0	0	**0**	0	0	**0**
	REAL	2	0	0	0	**0**	0	0	**0**
	RED RIVER	3	0	0	0	**0**	0	0	**0**
	REEVES	3	4	71	63	**9**	1,421	1,340	**80**
	REFUGIO	2	10	180	161	**20**	1,467	1,392	**75**
	ROBERTSON	2	80	1,458	1,310	**157**	14,014	13,129	**886**
	RUNNELS	3	4	72	64	**9**	1,415	1,327	**89**
	SAN SABA	3	0	0	0	**0**	0	0	**0**
	SCHLEICHER	3	0	0	0	**0**	0	0	**0**
	SCURRY	3	8	166	150	**17**	2,995	2,820	**175**
	SHACKELFORD	3	0	0	0	**0**	0	0	**0**
	SOMERVELL	3	14	250	220	**32**	4,317	4,049	**267**
	STARR	2	0	0	0	**0**	0	0	**0**
	STEPHENS	3	0	0	0	**0**	0	0	**0**
	STERLING	3	0	0	0	**0**	0	0	**0**
	STONEWALL	3	0	0	0	**0**	0	0	**0**
	SUTTON	3	0	0	0	**0**	0	0	**0**
	TAYLOR	3	278	5,062	4,432	**674**	98,125	91,605	**6,520**
	TERRELL	3	0	0	0	**0**	0	0	**0**
	THROCKMORTON	3	0	0	0	**0**	0	0	**0**
	TITUS	3	26	499	445	**58**	6,092	6,021	**72**
	TOM GREEN	3	193	3,490	3,069	**451**	68,295	64,014	**4,281**
	UPTON	3	3	53	47	**7**	1,067	1,005	**62**
	UVALDE	2	20	357	318	**42**	4,620	4,124	**496**
	VAL VERDE	2	104	1,857	1,653	**217**	24,025	21,447	**2,578**
	VAN ZANDT	3	13	232	204	**30**	3,981	3,740	**241**
	WARD	3	4	71	63	**9**	1,421	1,340	**80**
	WASHINGTON	2	83	1,512	1,360	**163**	14,540	13,621	**919**
	WEBB	2	1,061	18,893	16,863	**2,172**	179,604	161,901	**17,704**
	WHARTON	2	78	1,404	1,258	**156**	11,442	10,859	**583**
	WICHITA	3	100	1,929	1,690	**255**	41,406	38,644	**2,763**
	WILBARGER	3	3	58	51	**8**	1,242	1,159	**83**
	WILLACY	2	10	186	165	**23**	1,140	1,055	**85**
	WINKLER	3	0	0	0	**0**	0	0	**0**
	WISE	3	83	1,483	1,305	**191**	25,420	23,878	**1,542**
	WOOD	3	3	195	173	**24**	2,532	2,374	**158**
	YOUNG	3	4	73	64	**10**	1,412	1,318	**94**
	ZAPATA	2	0	0	0	**0**	0	0	**0**
	ZAVALA	2	1	18	16	**2**	169	153	**17**
	TOTAL		**114,210**			**242,938**			**1,927,156**

Table 11: Allocation of CL Zones for Each of Applicable ERCOT Counties

County	Plant	CL Zones Percentage			
		H	N	W	S
Anderson	Apex Bethel Energy Center	13.35	81.87	3.95	0.84
Angelina	Aspen Biomass Power Plant	13.35	81.87	3.95	0.84
	Pinecrest Energy Center				
Atascosa	San Miguel	11.04	0.74	0.04	88.18
Bastrop	Bastrop Clean Energy Center	11.04	0.74	0.04	88.18
	Lost Pines 1				
	Sim Gideon				
Bell	Panda Temple Power Station	13.35	81.87	3.95	0.84
Bexar	Covel Gardens Gas Recovery	11.04	0.74	0.04	88.18
	J K Spruce				
	J T Deely				
	Leon Creek				
	Nelson Gardens Landfill Gas to Energy				
	O W Sommers				
	Tessman Road				
	V H Braunig				
	Mission Road				
	University of Texas at San Antonio				
	UTSA TEP II				
	W B Tuttle				
Bosque	Bosque County Power Plant	13.35	81.87	3.95	0.84
Brazoria	Ascend Performance Materials Texas Inc.	99.06	0.01	0.00	0.93
	BASF Freeport Works				
	Freeport Energy				
	Freeport Energy Center				
	Oyster Creek Unit VIII				
	Power Island				
	Sweeny Cogeneration Facility				
	Freeport LP Pretreatment Facility				
Brazos	Bryan (TX)	13.35	81.87	3.95	0.84
	Central Utility Plant - Texas A&M				
	Roland C. Dansby Power Plant				
Calhoun	CFB Power Plant	11.04	0.74	0.04	88.18
	Formosa Utility Venture Ltd				
	Point Comfort Operations				
	Seadrift Coke LP				
	Union Carbide Seadrift Cogen				
	Port Comfort Power LLC				
Cameron	Silas Ray	11.04	0.74	0.04	88.18
	La Palma				
	La Paloma Energy Center				
Chambers	Baytown	99.06	0.01	0.00	0.93
	Baytown Energy Center				
	Cedar Bayou				
	Cedar Bayou 4				
	Enterprise Products Operating				
	Mont Belvieu Cogeneration Unit				
Cherokee	Stryker Creek	13.35	81.87	3.95	0.84
	Neches Station, LLC				
Coke	Jameson Gas Processing Plant	0.10	0.58	99.31	0.01
Collin	McKinney LFG	13.35	81.87	3.95	0.84
	Ray Olinger				
	University of Texas at Dallas				
Colorado	Sky Global Power One	11.04	0.74	0.04	88.18
	Rockwood Energy Center LLC				
Comal	Mesquite Creek LFGTE Project	11.04	0.74	0.04	88.18
Dallas	Ameresco Dallas LLC	13.35	81.87	3.95	0.84
	Lake Hubbard				
	Mountain Creek Generating Station				
	Skyline Gas Recovery				
	State Farm Insur Support Center Central				
	C E Newman				
	North Lake				
	Parkdale				
Denton	Denton Power LLC	13.35	81.87	3.95	0.84
	DFW Gas Recovery				
	Farmers Branch Renewable Energy Facility				
	Spencer				
Ector	Ector County Energy Center	0.10	0.58	99.31	0.01
	Odessa Ector Generating Station				
	Quail Run Energy Center				
	Texas Clean Energy Project				
Ellis	Ennis Power Company, LLC	13.35	81.87	3.95	0.84
	Midlothian Energy				
Fayette	Sam Seymour	11.04	0.74	0.04	88.18
	Winchester Power Park				
Fort Bend	Brazos Valley Energy, LP	99.06	0.01	0.00	0.93
	Carbon Capture Plant				
	W A Parish				
Freestone	Big Brown	13.35	81.87	3.95	0.84
	Freestone Power Generation				
Frio	Pearsall	11.04	0.74	0.04	88.18
Galveston	Coastal Plains	99.06	0.01	0.00	0.93
	Power Station 4				
	South Houston Green Power Site				
	Texas City Cogeneration				
	Bacliff Generating Station				
	P H Robinson				
	Power Station 3				
Goliad	Coleto Creek	11.04	0.74	0.04	88.18
Grayson	Panda Sherman Power Station	13.35	81.87	3.95	0.84
	Van Alstyne Energy Center				
Grimes	Gibbons Creek Steam Electric Station	13.35	81.87	3.95	0.84
	Tenaska Frontier Generating Station				
Guadalupe	Guadalupe Generating Station	11.04	0.74	0.04	88.18
	Rio Nogales Power Project, LP				
	Clear Springs Energy Center				

Table 9: Allocation of CL Zones for Each of Applicable ERCOT Counties (Continued)

County	Plant	CL Zones Percentage			
		H	N	W	S
Harris	Air Liquide Bayport Complex	99.06	0.01	0.00	0.93
	Atascosita				
	Bluebonnet				
	Channel Energy Center				
	Channelview Cogeneration Facility				
	Clear Lake Cogeneration				
	Deer Park Energy Center				
	Exelon Laporte Generating Station				
	ExxonMobil Baytown Refinery				
	ExxonMobil Baytown Turbine				
	Greens Bayou				
	Helios Plaza CHP Plant				
	Houston Chemical Complex Battleground				
	Optim Energy Altura Cogen, LLC				
	Pasadena Power Plant				
	PRSI FCC Generator				
	Rice University				
	San Jacinto Steam Electric Station				
	Shell Deer Park				
	T H Wharton				
	TECO CHP-1				
	Texas Petrochemicals				
	The Methodist Hospital, Gas Turbine				
	Westhollow Technology Center				
	Chamon Power LLC				
	Deer Park Plant				
	Friendswood Energy				
	NET Power La Porte Station				
	Pasadena				
	Sam Bertron				
	Webster				
Hays	Hays Energy Facility	11.04	0.74	0.04	88.18
Henderson	Trinidad	13.35	81.87	3.95	0.84
	Halyard Henderson Energy Center				
Hidalgo	Calpine Hidalgo Energy Center	11.04	0.74	0.04	88.18
	Frontera Generation Facility				
	Magic Valley Generating Station				
	Red Gate Power Plant				
	Rio Grande Valley Sugar Growers				
	J L Bates				
Hill	Hill County Generation Facility	13.35	81.87	3.95	0.84
Hood	Decordova	13.35	81.87	3.95	0.84
Hood	Wolf Hollow Generating Station				
Hood	Wolf Hollow II				
Howard	C. R. Wing Cogeneration Plant	0.10	0.58	99.31	0.01
Hunt	Power Lane Steam Plant	13.35	81.87	3.95	0.84
Johnson	Johnson County Generation Facility	13.35	81.87	3.95	0.84
Kaufman	Forney Power Plant	13.35	81.87	3.95	0.84
Lamar	Lamar Power Plant	13.35	81.87	3.95	0.84
	Paris Energy Center				
Limestone	Limestone	13.35	81.87	3.95	0.84
Llano	T C Ferguson Power Plant	11.04	0.74	0.04	88.18
McLennan	Sandy Creek Energy Station	13.35	81.87	3.95	0.84
	Lake Creek				
	Tradinghouse				
Milam	Sandow	11.04	0.74	0.04	88.18
	Sandow Station				
Mitchell	Morgan Creek	0.10	0.58	99.31	0.01
	FGE Texas I				
	FGE Texas II				
Montgomery	Lewis Creek	99.06	0.01	0.00	0.93
	Security				
	Conroe				
	Montgomery County				
Nacogdoches	Nacogdoches Power LLC	13.35	81.87	3.95	0.84
Nolan	Pecan Creek Energy Center	0.10	0.58	99.31	0.01
	TXU Sweetwater Generating Plant				
Nueces	Barney M. Davis	11.04	0.74	0.04	88.18
	Corpus Christi				
	Corpus Christi Energy Center				
	Corpus Refinery				
	Nueces Bay				
	Ticona Polymers Inc				
	Valero Refinery Corpus Christi West				
	Lon C Hill				
	Valero Refinery Corpus Christi East				
Palo Pinto	R W Miller	13.35	81.87	3.95	0.84
Parker	Westside Landfill Gas Recovery	13.35	81.87	3.95	0.84
	North Texas				
	Weatherford				
Pecos	Yates Gas Plant	0.10	0.58	99.31	0.01
Potter	Harrington Station	0.10	0.58	99.31	0.01
	Nichols Station				
Reagan	Midkiff Plant	0.10	0.58	99.31	0.01
Red River	River Crest	13.35	81.87	3.95	0.84
Robertson	Oak Grove	13.35	81.87	3.95	0.84
	Twin Oaks				
Rusk	Martin Lake	13.35	81.87	3.95	0.84
	Tenaska Gateway Generating Station				
San Patricio	Gregory Power Facility	11.04	0.74	0.04	88.18
	Ingleside Cogeneration				
Scurry	EG178 Facility	0.10	0.58	99.31	0.01
Tarrant	Handley Generating Station	13.35	81.87	3.95	0.84
	Village Creek Water Reclamation Facility				
	Eagle Mountain				
	North Main				
Titus	Monticello	13.35	81.87	3.95	0.84

Table 9: Allocation of CL Zones for Each of Applicable ERCOT Counties (Continued)

County	Plant	CL Zones Percentage			
		H	N	W	S
Travis	Austin Gas Recovery	11.04	0.74	0.04	88.18
	Central Utility Plant				
	Decker Creek				
	GRS Sunset Farms				
	Hal C Weaver Power Plant				
	Robert Mueller Energy Center				
	Sand Hill Energy Center				
	Domain Integrated Energy System				
	Holly Street				
Upton	Benedum Plant	0.10	0.58	99.31	0.01
Victoria	Sam Rayburn Plant	11.04	0.74	0.04	88.18
	Victoria Power Station				
	Victoria Texas Plant				
	Victoria City Power LLC				
	Victoria Port Power LLC				
Ward	Permian Basin	0.10	0.58	99.31	0.01
Webb	Laredo	11.04	0.74	0.04	88.18
Wharton	Colorado Bend Energy Center	11.04	0.74	0.04	88.18
	New Gulf Power Facility				
	Colorado Bend II				
	Halyard Wharton Energy Center				
Wichita	PPG Industries Works 4	0.10	0.58	99.31	0.01
	Signal Hill Generating LLC				
Wilbarger	Oklaunion Power Station	0.10	0.58	99.31	0.01
Wilson	Union Valley Energy Center	11.04	0.74	0.04	88.18
Wise	Bridgeport Gas Processing Plant	13.35	81.87	3.95	0.84
	Jack County Generation Facility				
	Wise County Power Company, LLC				
Wood	ExxonMobil Hawkins Gas Plant	13.35	81.87	3.95	0.84
Young	Graham	0.10	0.58	99.31	0.01

Table 12: 2017 Totalized Annual Electricity Savings by CL Zone from New Single-family Residences

CL Zone	Total Electricity Savings by CL Zone (MWh) [2017-TRY 2008]
Houston (H)	86,845
North (N)	70,015
West (W)	6,088
South (S)	48,482
Total	211,429

Table 13: 2017 Annual NOx Reductions from New Single-family Residences Using 2016 eGRID

Area	County	H	NOx Reductions (lbs)	N	NOx Reductions (lbs)	W	NOx Reductions (lbs/year)	S	NOx Reductions (lbs)	Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
Houston-Galveston Area	Brazoria	0.0584658	5077.43	0.0000074	0.52	0.0000004	0.00	0.0005477	26.56	5104.51	2.55
	Chambers	0.0186322	1618.10	0.0000024	0.17	0.0000001	0.00	0.0001746	8.46	1626.73	0.81
	Fort Bend	0.0713459	6196.00	0.0000091	0.63	0.0000004	0.00	0.0006684	32.41	6229.05	3.11
	Galveston	0.0137868	1197.30	0.0000017	0.12	0.0000001	0.00	0.0001292	6.26	1203.69	0.60
	Harris	0.1154764	10028.49	0.0000147	1.03	0.0000007	0.00	0.0010818	52.45	10081.97	5.04
	Montgomery	0.0105050	912.31	0.0000013	0.09	0.0000001	0.00	0.0000984	4.77	917.17	0.46
Dallas/ Fort Worth Area	Collin	0.0001062	9.22	0.0006516	45.62	0.0000315	0.19	0.0000066	0.32	55.36	0.03
	Dallas	0.0021209	184.19	0.0130108	910.95	0.0006284	3.83	0.0001327	6.44	1105.40	0.55
	Denton	0.0015536	134.92	0.0095304	667.27	0.0004603	2.80	0.0000972	4.71	809.70	0.40
	Henderson	0.0002047	17.78	0.0012557	87.92	0.0000607	0.37	0.0000128	0.62	106.68	0.05
	Hood	0.0011465	99.57	0.0070335	492.45	0.0003397	2.07	0.0000718	3.48	597.56	0.30
	Hunt	0.0000348	3.02	0.0002135	14.95	0.0000103	0.06	0.0000022	0.11	18.14	0.01
	Tarrant	0.0007633	66.29	0.0046826	327.85	0.0002262	1.38	0.0000478	2.32	397.84	0.20
	Ellis	0.0010011	86.94	0.0061414	429.99	0.0002966	1.81	0.0000627	3.04	521.78	0.26
	Johnson	0.0001415	12.29	0.0008683	60.79	0.0000419	0.26	0.0000089	0.43	73.77	0.04
	Kaufman	0.0028327	246.01	0.0173774	1216.68	0.0008394	5.11	0.0001773	8.60	1476.39	0.74
	Parker	0.0006458	56.08	0.0039616	277.37	0.0001914	1.16	0.0000404	1.96	336.58	0.17
	Wise	0.0026775	232.52	0.0164249	1149.98	0.0007933	4.83	0.0001676	8.12	1395.46	0.70
San Antonio Area	Bexar	0.0155850	1353.47	0.0010511	73.59	0.0000508	0.31	0.1244678	6034.44	7461.81	3.73
	Comal	0.0004218	36.63	0.0000284	1.99	0.0000014	0.01	0.0033689	163.33	201.96	0.10
	Guadalupe	0.0025417	220.73	0.0001714	12.00	0.0000083	0.05	0.0202988	984.13	1216.91	0.61
	Wilson	0.0001734	15.06	0.0000117	0.82	0.0000006	0.00	0.0013845	67.13	83.00	0.04
Austin Area	Bastrop	0.0020114	174.68	0.0001357	9.50	0.0000066	0.04	0.0160641	778.82	963.04	0.48
	Hays	0.0004548	39.50	0.0000307	2.15	0.0000015	0.01	0.0036324	176.10	217.76	0.11
	Travis	0.0037069	321.92	0.0002500	17.50	0.0000121	0.07	0.0296048	1435.30	1774.80	0.89
North East Texas Area	Rusk	0.0234887	2039.87	0.1440913	10088.53	0.0069599	42.37	0.0014701	71.27	12242.04	6.12
Corpus Christi Area	Nueces	0.0039261	340.96	0.0002648	18.54	0.0000128	0.08	0.0313555	1520.17	1879.75	0.94
	San Patricio	0.0065591	569.63	0.0004424	30.97	0.0000214	0.13	0.0523838	2539.66	3140.39	1.57
Victoria Area	Victoria	0.0013502	117.25	0.0000911	6.38	0.0000044	0.03	0.0107830	522.78	646.44	0.32
Other ERCOT counties	Anderson	0.0001010	8.77	0.0006194	43.36	0.0000299	0.18	0.0000063	0.31	52.62	0.03
	Angelina	0.0024008	208.49	0.0147275	1031.15	0.0007114	4.33	0.0001503	7.28	1251.26	0.63
	Atascosa	0.0055915	485.59	0.0003771	26.40	0.0000182	0.11	0.0446558	2165.00	2677.10	1.34
	Bell	0.0003222	27.98	0.0019766	138.39	0.0000955	0.58	0.0000202	0.98	167.93	0.08
	Bosque	0.0005680	49.33	0.0034846	243.98	0.0001683	1.02	0.0000356	1.72	296.05	0.15
	Brazos	0.0006415	55.71	0.0039355	275.54	0.0001901	1.16	0.0000402	1.95	334.36	0.17
	Calhoun	0.0088634	769.74	0.0005978	41.85	0.0000289	0.18	0.0707865	3431.86	4243.63	2.12
	Cameron	0.0003811	33.09	0.0000257	1.80	0.0000012	0.01	0.0030433	147.54	182.44	0.09
	Cherokee	0.0003216	27.93	0.0019730	138.14	0.0000953	0.58	0.0000201	0.98	167.63	0.08
	Coke	0.0000135	1.17	0.0000826	5.78	0.0140226	85.37	0.0000008	0.04	92.36	0.05
	Colorado	0.0014171	123.07	0.0000956	6.69	0.0000046	0.03	0.0113173	548.68	678.47	0.34
	Ector	0.0000634	5.51	0.0003891	27.24	0.0660667	402.21	0.0000040	0.19	435.15	0.22
	Fayette	0.0145787	1266.08	0.0009832	68.84	0.0000475	0.29	0.1164306	5644.77	6979.98	3.49
	Freestone	0.0121950	1059.07	0.0748103	5237.83	0.0036135	22.00	0.0007632	37.00	6355.90	3.18
	Frio	0.0070162	609.32	0.0004732	33.13	0.0000229	0.14	0.0560343	2716.65	3359.24	1.68
	Goliad	0.0048476	420.99	0.0003269	22.89	0.0000158	0.10	0.0387148	1876.97	2320.94	1.16
	Grayson	0.0003586	31.14	0.0021996	154.00	0.0001062	0.65	0.0000224	1.09	186.88	0.09
	Grimes	0.0040938	355.53	0.0251136	1758.33	0.0012130	7.38	0.0002562	12.42	2133.66	1.07
	Hidalgo	0.0019872	172.58	0.0001340	9.38	0.0000065	0.04	0.0158708	769.44	951.45	0.48
	Hill	0.0004818	41.84	0.0029556	206.93	0.0001428	0.87	0.0000302	1.46	251.11	0.13
	How ard	0.0000104	0.90	0.0000639	4.47	0.0108444	66.02	0.0000007	0.03	71.43	0.04
	Lamar	0.0021680	188.28	0.0132996	931.17	0.0006424	3.91	0.0001357	6.58	1129.94	0.56
	Limestone	0.0207580	1802.72	0.1273399	8915.69	0.0061507	37.44	0.0012992	62.99	10818.84	5.41
	Llano	0.0001816	15.77	0.0000122	0.86	0.0000006	0.00	0.0014501	70.30	86.93	0.04
	McLennan	0.0023590	204.86	0.0144710	1013.19	0.0006990	4.26	0.0001476	7.16	1229.46	0.61
	Milam	0.0070396	611.35	0.0004748	33.24	0.0000229	0.14	0.0562211	2725.71	3370.44	1.69
	Mitchell	0.0000196	1.70	0.0001204	8.43	0.0204490	124.49	0.0000012	0.06	134.69	0.07
	Nacogdoches	0.0001458	12.66	0.0008944	62.62	0.0000432	0.26	0.0000091	0.44	75.99	0.04
	Nolan	0.0000085	0.74	0.0000524	3.67	0.0088961	54.16	0.0000005	0.03	58.59	0.03
	Palo Pinto	0.0004954	43.02	0.0030391	212.79	0.0001468	0.89	0.0000310	1.50	258.21	0.13
	Pecos	0.0000002	0.02	0.0000011	0.07	0.0001806	1.10	0.0000000	0.00	1.19	0.00
	Potter	0.0004032	35.01	0.0024732	173.16	0.4199647	2556.69	0.0000252	1.22	2766.09	1.38
	Reagan	0.0000001	0.01	0.0000009	0.06	0.0001554	0.95	0.0000000	0.00	1.02	0.00
	Red River	0.0000376	3.26	0.0002305	16.14	0.0000111	0.07	0.0000024	0.11	19.58	0.01
	Robertson	0.0134304	1166.36	0.0823890	5768.45	0.0039795	24.23	0.0008406	40.75	6999.79	3.50
	Scurry	0.0000991	8.60	0.0006078	42.55	0.1032024	628.28	0.0000062	0.30	679.74	0.34
	Titus	0.0140204	1217.59	0.0860080	6021.84	0.0041543	25.29	0.0008775	42.54	7307.27	3.65
	Upton	0.0000001	0.01	0.0000008	0.06	0.0001352	0.82	0.0000000	0.00	0.89	0.00
	Ward	0.0000021	0.18	0.0000130	0.91	0.0022148	13.48	0.0000001	0.01	14.59	0.01
	Webb	0.0000283	2.46	0.0000019	0.13	0.0000001	0.00	0.0002259	10.95	13.54	0.01
	Wharton	0.0008796	76.39	0.0000593	4.15	0.0000029	0.02	0.0070246	340.57	421.13	0.21
	Wichita	0.0000013	0.11	0.0000079	0.56	0.0013464	8.20	0.0000001	0.00	8.87	0.00
	Wilbarger	0.0004088	35.50	0.0025077	175.58	0.4258276	2592.39	0.0000256	1.24	2804.71	1.40
	Wood	0.0000060	0.52	0.0000365	2.56	0.0000018	0.01	0.0000004	0.02	3.10	0.00
	Young	0.0000150	1.31	0.0000923	6.46	0.0156760	95.43	0.0000009	0.05	103.25	0.05
	Total	**0.4904222**	**42590.49**	**0.6972352**	**48816.83**	**1.1223498**	**6832.73**	**0.7248702**	**35143.08**	**133383.13**	**66.69**

Energy Savings by PCA (MWh)		86,845		70,015		6,088		48,482	

4.2 2017 Results for New Multi-family Residential Construction

This section provides the potential electricity and natural gas savings and the associated NOx emissions reductions in 2017 using the 2008 base year which implemented the 2015 IECC for new multi-family residences in the 42 non-attainment and affected counties as well as other counties in the ERCOT region[25]. To calculate the NOx emissions reductions, the following procedures were adopted. First, new construction activity was determined by county. To accomplish this, the number of 2017 building permits per county was obtained from the real estate center at Texas A&M University (REC 2018). Next, energy savings attributable to the 2015 IECC were calculated using the Laboratory's code-traceable, DOE-2.1e simulation, which was developed for the TERP. For the savings calculation, the 2016 HIRL's survey data[26] were used to determine the appropriate construction data corresponding to housing types. Then, the NOx reductions potential from the electricity and natural gas savings in each county was calculated using the US EPA's 2016 eGRID database[27].

In Table 14, the 2017 new multi-family and 2015 IECC code-compliant building characteristics are shown for each county. The 2015 IECC code-compliant characteristics are the minimum building code characteristics required for each county for multi-family residences (i.e., Type A.2). In Table 14, the rows are first sorted by the US EPA's non-attainment, affected designation, and other ERCOT counties, alphabetically. Next, in the fourth column, the HIRL's survey classification is listed. The fifth through eighth columns show the HIRL's survey data including: average glazing U-value, Solar Heat Gain Coefficient (SHGC), roof insulation, and wall insulation, respectively. In addition, the ninth through twelfth columns show the 2015 IECC minimum requirements for glazing U-value, SHGC, roof insulation, and wall insulation.

The corresponding values in IECC and effective regulations are applied to the air-conditioner efficiency, furnace efficiency (AFUE), and domestic water heater efficiency. The values shown in Table 14 represent the changes for building envelope that were made to the simulations to obtain the savings calculations.
In cases where the 2017 new multi-family values were more efficient than the 2015 IECC requirements, the 2017 new multi-family values were used in 2017 new multi-family simulations. Otherwise, the 2015 IECC values were used in both simulations. For the 2017 new multi-family simulations, the more efficient values from 2016 HIRL data and 2015 IECC were applied. Similarly, for the base-year simulations, the more efficient values from 2008 NAHB data and 2006 IECC were used.

In Table 15, the code-traceable simulation results for multi-family residences are shown for each county. In a similar fashion to Table 14, Table 15 is first divided into the US EPA's non-attainment and affected classifications, followed by an alphabetical list of other ERCOT counties. In the third column, the 2015 IECC climate zone is listed followed by the number of new projected housing units[28] in the fourth column. In the fifth column, the total simulated energy use is listed if all new Construction had been built to pre-code specifications. In the sixth column, the total county-wide energy use for code-compliant Construction is shown. The values in the fifth and sixth columns come from the associated 144 simulation runs for each county, which were then distributed according to the HIRL's survey data to account for 1, 2 or 3 story, and 3 different fuel options (i.e., central air conditioning with electric resistance heating, heat pump heating, or a natural gas-fired furnace). In the seventh column, the total annual electricity savings are shown for each county. A 7% transmission and distribution loss is used, which represents a fixed 1.07 multiplier for the electricity use. In the eighth and ninth columns, the total annual pre-code and code-compliant natural gas use is shown for those residences that had natural gas-fired furnaces and domestic water heaters. Finally, in the tenth column, the total annual natural gas savings are shown for each county.

The annual electricity savings from Table 15 are assigned to CL Zones[29] provider(s) in a similar fashion to the single-family residential assignments. The total electricity savings for each CL Zone, as shown in Table 16, are then entered into the bottom row of Table 17, the 2016 US EPA's eGRID database for Texas. Next, the county's NOx

[25] The three new counties added in the 2003 Legislative session (i.e., Henderson, Hood, and Hunt) were included in the ERCOT region.
[26] The NAHB Research Center announced that it has changed its name to Home Innovation Research Labs (HIRL). See more at: http://www.homeinnovation.com
[27] This analysis assumes transmission and distribution losses of 7%. Counties were assigned to utility service districts as indicated.
[28] The number of the new housing units in 2017 were obtained from the Real Estate Center at Texas A&M University.
[29] ERCOT region has employed the Competative Load (CL), and it is currently divided into four zones: Houston (H), North (N), South (S), and West (W).

reductions (lbs) are calculated using the assigned 2016 eGrid proportions (lbs-NOx/MWh) to each CL zone in the county. The calculated NOx reductions are presented in the columns adjacent to the corresponding CL Zone columns. By adding the NOx reductions values in each row, then, the total of the NOx reductions per county (lbs and Tons) is calculated. Counties that do not show NOx reductions represent counties that do not have power plants in eGRID's database.

Table 14: 2017 and 2015 IECC Code-compliant Building Characteristics Used in the DOE-2 Simulations for New Multi-family Residences

	County	Climate Zone	Division	2017 Average				2015 IECC			
			East or West	Glazing U-value (Btu/hr-ft²-F)	SHGC	Roof Insulation (hr-ft²-F/Btu)	Wall Insulation (hr-ft²-F/Btu)	Glazing U-value (Btu/hr-ft²-F)	SHGC	Roof Insulation (hr-ft²-F/Btu)	Wall Insulation (hr-ft²-F/Btu)
Non-attainment	BRAZORIA	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	CHAMBERS	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	COLLIN	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	DALLAS	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	DENTON	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	EL PASO	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	ELLIS	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	FORT BEND	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	GALVESTON	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	HARRIS	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	JOHNSON	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	KAUFMAN	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	LIBERTY	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	MONTGOMERY	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	PARKER	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	ROCKWALL	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	TARRANT	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	WALLER	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	WISE	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
Affected	BASTROP	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	BEXAR	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	CALDWELL	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	COMAL	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	GREGG	3	East Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	GUADALUPE	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	HARRISON	3	East Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	HAYS	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	NUECES	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	RUSK	3	East Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	SAN PATRICIO	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	SMITH	3	East Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	TRAVIS	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	UPSHUR	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	VICTORIA	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	WILLIAMSON	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	WILSON	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
ERCOT	ANDERSON	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	ANDREWS	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	ANGELINA	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	ARANSAS	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	ARCHER	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	ATASCOSA	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	AUSTIN	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	BANDERA	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	BASTROP	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	BAYLOR	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	BEE	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	BELL	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	BEXAR	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	BLANCO	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	BORDEN	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	BOSQUE	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	BRAZORIA	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	BRAZOS	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	BREWSTER	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	BRISCOE	4	West Texas	0.39	0.53	30.703	15.172	0.35	0.4	49	20
	BROOKS	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	BROWN	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	BURLESON	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	BURNET	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	CALDWELL	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	CALHOUN	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	CALLAHAN	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	CAMERON	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	CHAMBERS	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	CHEROKEE	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	CHILDRESS	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	CLAY	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	COKE	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	COLEMAN	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	COLLIN	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	COLORADO	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	COMAL	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	COMANCHE	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	CONCHO	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	COOKE	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	CORYELL	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	COTTLE	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	CRANE	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	CROCKETT	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	CROSBY	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	CULBERSON	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	DALLAS	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	DAWSON	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	DE WITT	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	DELTA	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	DENTON	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	DICKENS	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	DIMMIT	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	DUVAL	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	EASTLAND	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	ECTOR	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	EDWARDS	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	ELLIS	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	ERATH	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	FALLS	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	FANNIN	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	FAYETTE	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	FISHER	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	FOARD	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	FORT BEND	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	FRANKLIN	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	FREESTONE	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13

Table 12: 2017 and 2015 IECC Code-compliant Building Characteristics Used in the DOE-2 Simulations for New Multi-family Residences (Continued)

	County	Climate Zone	Division	2017 Average				2015 IECC			
			East or West	Glazing U-value (Btu/hr-ft²-F)	SHGC	Roof Insulation (hr-ft²-F/Btu)	Wall Insulation (hr-ft²-F/Btu)	Glazing U-value (Btu/hr-ft²-F)	SHGC	Roof Insulation (hr-ft²-F/Btu)	Wall Insulation (hr-ft²-F/Btu)
	FRIO	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	GALVESTON	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	GILLESPIE	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	GLASSCOCK	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	GOLIAD	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	GONZALES	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	GRAYSON	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	GRIMES	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	GUADALUPE	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	HALL	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	HAMILTON	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	HARDEMAN	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	HARRIS	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	HASKELL	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	HAYS	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	HENDERSON	3	East Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	HIDALGO	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	HILL	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	HOOD	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	HOPKINS	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	HOUSTON	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	HOWARD	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	HUDSPETH	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	HUNT	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	IRION	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	JACK	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	JACKSON	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	JEFF DAVIS	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	JIM HOGG	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	JIM WELLS	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	JOHNSON	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	JONES	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	KARNES	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	KAUFMAN	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	KENDALL	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	KENEDY	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	KENT	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	KERR	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	KIMBLE	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	KING	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	KINNEY	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	KLEBERG	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	KNOX	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	LA SALLE	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	LAMAR	3	East Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	LAMPASAS	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	LAVACA	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	LEE	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	LEON	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	LIMESTONE	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	LIVE OAK	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	LLANO	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	LOVING	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	MADISON	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	MARTIN	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	MASON	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	MATAGORDA	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	MAVERICK	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	MCCULLOCH	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	MCLENNAN	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	MCMULLEN	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	MEDINA	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	MENARD	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
ERCOT	MIDLAND	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	MILAM	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	MILLS	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	MITCHELL	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	MONTAGUE	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	MONTGOMERY	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	MOTLEY	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	NACOGDOCHES	3	East Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	NAVARRO	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	NOLAN	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	NUECES	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	PALO PINTO	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	PARKER	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	PECOS	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	PRESIDIO	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	RAINS	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	REAGAN	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	REAL	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	RED RIVER	3	East Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	REEVES	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	REFUGIO	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	ROBERTSON	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	ROCKWALL	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	RUNNELS	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	RUSK	3	East Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	SAN PATRICIO	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	SAN SABA	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	SCHLEICHER	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	SCURRY	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	SHACKELFORD	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	SMITH	3	East Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	SOMERVELL	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	STARR	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	STEPHENS	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	STERLING	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	STONEWALL	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	SUTTON	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	TARRANT	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	TAYLOR	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	TERRELL	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	THROCKMORTON	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	TITUS	3	East Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	TOM GREEN	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	TRAVIS	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	UPTON	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	UVALDE	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	VAL VERDE	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	VAN ZANDT	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	VICTORIA	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	WALLER	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	WARD	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	WASHINGTON	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	WEBB	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	WHARTON	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	WICHITA	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	WILBARGER	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	WILLACY	2	East Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	WILLIAMSON	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	WILSON	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	WINKLER	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	WISE	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	YOUNG	3	West Texas	0.39	0.53	30.703	15.172	0.35	0.25	38	20
	ZAPATA	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13
	ZAVALA	2	West Texas	0.39	0.53	30.703	15.172	0.4	0.25	38	13

Table 15: 2017 Annual Electricity Savings from New Multi-family Residences

			2017 Summary TRY 2008						
	County	Climate Zone	No. of Projected Units (2013)	Precode Total Annual Elec. Use (MWh/yr)	Code-compliant Total Annual Elec. Use (MWh/yr)	Total Annual Elec. Savings (MWh/yr) w/ 7% of T&D Loss	Precode Total NG Use (Therm/yr)	Code-compliant Total NG Use (Therm/yr)	Total Annual NG Savings (Therm/yr)
Nonattainment County	BRAZORIA	2	6	945	890	58.93	2,213	2,179	34.26
	CHAMBERS	2	0	0	0	0.00	0	0	0.00
	COLLIN	2	5,275	871,061	797,614	78,588.06	2,548,752	2,314,150	234,602.62
	DALLAS	2	14,482	2,389,732	2,189,487	214,262.02	7,019,178	6,369,844	649,333.92
	DENTON	2	1,620	267,511	244,954	24,135.10	782,745	710,696	72,048.58
	EL PASO	3	904	147,209	133,477	14,693.28	416,686	376,028	40,657.84
	ELLIS	3	319	52,639	48,229	4,719.62	154,614	140,311	14,303.10
	FORT BEND	2	91	14,333	13,496	895.16	33,567	33,047	519.64
	GALVESTON	2	34	5,354	5,042	333.94	12,541	12,347	194.15
	HARDIN	2	56	8,780	8,267	548.99	20,566	20,291	275.29
	HARRIS	2	5,838	919,496	865,825	57,427.84	2,153,439	2,120,102	33,336.85
	JEFFERSON	2	90	14,112	13,286	883.39	33,050	32,611	439.25
	JOHNSON	3	10	1,650	1,512	147.95	4,847	4,398	448.37
	KAUFMAN	2	343	56,640	51,864	5,110.09	165,729	150,475	15,254.73
	LIBERTY	3	2	315	297	19.75	737	726	10.72
	MONTGOMERY	3	4	630	593	39.35	1,475	1,453	22.84
	ORANGE	2	16	2,509	2,362	157.21	5,872	5,797	74.90
	PARKER	2	0	0	0	0.00	0	0	0.00
	ROCKWALL	2	230	37,980	34,777	3,426.59	111,130	100,901	10,229.12
	TARRANT	3	5,622	927,708	849,972	83,177.81	2,724,887	2,472,812	252,075.36
	WALLER	2	72	11,340	10,678	708.26	26,558	26,147	411.14
	WISE	3	2	330	302	29.80	966	877	88.95
Affected County	BASTROP	3	10	1,633	1,508	133.60	4,232	3,810	421.73
	BEXAR	3	3,791	613,580	565,728	51,202.22	1,540,588	1,379,734	160,854.03
	CALDWELL	3	4	653	603	53.44	0	0	0.00
	COMAL	3	952	154,083	142,066	12,857.96	386,874	346,480	40,393.84
	GREGG	2	20	3,230	3,025	218.84	8,607	8,755	-147.39
	GUADALUPE	3	238	38,521	35,517	3,214.49	96,719	86,620	10,098.46
	HARRISON	3	16	2,579	2,420	170.45	6,914	7,034	-119.62
	HAYS	3	631	103,044	95,154	8,442.55	266,906	240,295	26,611.45
	NUECES	2	2	315	296	21.07	631	624	7.22
	RUSK	2	0	0	0	0.00	0	0	0.00
	SAN PATRICIO	3	4	631	591	42.13	1,263	1,248	14.43
	SMITH	3	206	33,180	31,148	2,174.16	89,169	90,685	-1,515.87
	TRAVIS	3	8,074	1,318,512	1,217,552	108,027.18	3,415,216	3,074,707	340,508.52
	UPSHUR	3	0	0	0	0.00	0	0	0.00
	VICTORIA	2	0	0	0	0.00	0	0	0.00
	WILLIAMSON	2	1,862	304,071	280,788	24,912.88	787,606	709,079	78,526.98
	WILSON	2	0	0	0	0.00	0	0	0.00
ERCOT	ANDERSON	2	0	0	0	0.00	0	0	0.00
	ANDREWS	3	0	0	0	0.00	0	0	0.00
	ANGELINA	2	6	944	882	65.35	2,313	2,345	-31.75
	ARANSAS	2	2	315	296	21.07	631	624	7.22
	ARCHER	3	0	0	0	0.00	0	0	0.00
	ATASCOSA	2	0	0	0	0.00	0	0	0.00
	AUSTIN	2	0	0	0	0.00	0	0	0.00
	BANDERA	2	0	0	0	0.00	0	0	0.00
	BAYLOR	3	0	0	0	0.00	0	0	0.00
	BEE	2	0	0	0	0.00	0	0	0.00
	BELL	2	647	109,583	99,440	10,853.15	317,163	275,897	41,266.16
	BLANCO	3	0	0	0	0.00	0	0	0.00
	BORDEN	3	0	0	0	0.00	0	0	0.00
	BOSQUE	2	0	0	0	0.00	0	0	0.00
	BRAZOS	2	1,928	303,664	285,939	18,965.55	711,173	700,164	11,009.50
	BREWSTER	3	8	1,381	1,243	147.19	4,473	3,962	511.64
	BRISCOE	4	0	0	0	0.00	0	0	0.00
	BROOKS	2	0	0	0	0.00	0	0	0.00
	BROWN	3	134	22,696	20,595	2,247.79	65,688	57,141	8,546.62
	BURLESON	2	0	0	0	0.00	0	0	0.00
	BURNET	3	220	35,927	33,176	2,943.52	93,058	83,779	9,278.16
	CALHOUN	2	12	1,879	1,765	122.37	4,041	3,998	42.87
	CALLAHAN	3	0	0	0	0.00	0	0	0.00
	CAMERON	2	106	17,218	15,933	1,374.99	31,955	31,604	351.49
	CHEROKEE	2	0	0	0	0.00	0	0	0.00
	CHILDRESS	3	0	0	0	0.00	0	0	0.00
	CLAY	3	0	0	0	0.00	0	0	0.00
	COKE	3	0	0	0	0.00	0	0	0.00
	COLEMAN	3	0	0	0	0.00	0	0	0.00
	COLORADO	2	0	0	0	0.00	0	0	0.00
	COMANCHE	3	0	0	0	0.00	0	0	0.00
	CONCHO	3	0	0	0	0.00	0	0	0.00
	COOKE	3	0	0	0	0.00	0	0	0.00
	CORYELL	2	20	3,387	3,074	335.49	9,804	8,528	1,275.62
	COTTLE	3	0	0	0	0.00	0	0	0.00
	CRANE	3	0	0	0	0.00	0	0	0.00
	CROCKETT	3	0	0	0	0.00	0	0	0.00
	CROSBY	3	0	0	0	0.00	0	0	0.00
	CULBERSON	3	0	0	0	0.00	0	0	0.00
	DAWSON	3	0	0	0	0.00	0	0	0.00
	DE WITT	2	0	0	0	0.00	0	0	0.00
	DELTA	3	0	0	0	0.00	0	0	0.00
	DICKENS	3	0	0	0	0.00	0	0	0.00
	DIMMIT	2	0	0	0	0.00	0	0	0.00
	DUVAL	2	0	0	0	0.00	0	0	0.00
	EASTLAND	3	0	0	0	0.00	0	0	0.00
	ECTOR	3	0	0	0	0.00	0	0	0.00
	EDWARDS	2	0	0	0	0.00	0	0	0.00
	ERATH	3	173	30,150	27,062	3,303.37	98,161	86,681	11,480.53
	FALLS	2	0	0	0	0.00	0	0	0.00
	FANNIN	3	4	660	605	59.38	1,937	1,759	178.22
	FAYETTE	2	0	0	0	0.00	0	0	0.00
	FISHER	3	0	0	0	0.00	0	0	0.00
	FOARD	3	0	0	0	0.00	0	0	0.00
	FRANKLIN	3	0	0	0	0.00	0	0	0.00
	FREESTONE	2	0	0	0	0.00	0	0	0.00
	FRIO	2	0	0	0	0.00	0	0	0.00

Table 13: 2017 Annual Electricity Savings from New Multi-family Residences (Continued)

2017 Summary TRY 2008									
	County	Climate Zone	No. of Projected Units (2013)	Precode Total Annual Elec. Use (MWh/yr)	Code-compliant Total Annual Elec. Use (MWh/yr)	Total Annual Elec. Savings (MWh/yr) w/ 7% of T&D Loss	Precode Total NG Use (Therm/yr)	Code-compliant Total NG Use (Therm/yr)	Total Annual NG Savings (Therm/yr)
ERCOT	GILLESPIE	3	0	0	0	0.00	0	0	0.00
	GLASSCOCK	3	0	0	0	0.00	0	0	0.00
	GOLIAD	2	0	0	0	0.00	0	0	0.00
	GONZALES	2	0	0	0	0.00	0	0	0.00
	GRAYSON	3	177	29,218	26,762	2,627.40	85,723	77,836	7,886.43
	GRIMES	2	0	0	0	0.00	0	0	0.00
	HALL	3	0	0	0	0.00	0	0	0.00
	HAMILTON	3	0	0	0	0.00	0	0	0.00
	HARDEMAN	3	0	0	0	0.00	0	0	0.00
	HASKELL	3	0	0	0	0.00	0	0	0.00
	HENDERSON	2	0	0	0	0.00	0	0	0.00
	HIDALGO	2	1,599	259,738	240,353	20,741.56	482,038	476,736	5,302.12
	HILL	2	0	0	0	0.00	0	0	0.00
	HOOD	3	13	2,145	1,965	192.34	6,301	5,718	582.89
	HOPKINS	3	8	1,321	1,210	119.19	3,865	3,510	355.80
	HOUSTON	2	0	0	0	0.00	0	0	0.00
	HOWARD	3	0	0	0	0.00	0	0	0.00
	HUDSPETH	3	0	0	0	0.00	0	0	0.00
	HUNT	2	4	660	605	59.38	1,937	1,759	178.22
	IRION	3	0	0	0	0.00	0	0	0.00
	JACK	3	0	0	0	0.00	0	0	0.00
	JACKSON	2	64	10,022	9,412	652.66	21,550	21,322	228.64
	JEFF DAVIS	3	0	0	0	0.00	0	0	0.00
	JIM HOGG	2	0	0	0	0.00	0	0	0.00
	JIM WELLS	2	0	0	0	0.00	0	0	0.00
	JONES	3	0	0	0	0.00	0	0	0.00
	KARNES	2	0	0	0	0.00	0	0	0.00
	KENDALL	3	0	0	0	0.00	0	0	0.00
	KENEDY	2	0	0	0	0.00	0	0	0.00
	KENT	3	0	0	0	0.00	0	0	0.00
	KERR	3	96	15,677	14,477	1,284.45	40,607	36,558	4,048.65
	KIMBLE	3	0	0	0	0.00	0	0	0.00
	KING	3	0	0	0	0.00	0	0	0.00
	KINNEY	2	0	0	0	0.00	0	0	0.00
	KLEBERG	2	0	0	0	0.00	0	0	0.00
	KNOX	3	0	0	0	0.00	0	0	0.00
	LA SALLE	2	0	0	0	0.00	0	0	0.00
	LAMAR	3	20	3,303	3,024	297.96	9,664	8,774	889.49
	LAMPASAS	3	0	0	0	0.00	0	0	0.00
	LAVACA	2	0	0	0	0.00	0	0	0.00
	LEE	2	0	0	0	0.00	0	0	0.00
	LEON	2	0	0	0	0.00	0	0	0.00
	LIMESTONE	2	0	0	0	0.00	0	0	0.00
	LIVE OAK	2	0	0	0	0.00	0	0	0.00
	LLANO	3	0	0	0	0.00	0	0	0.00
	LOVING	3	0	0	0	0.00	0	0	0.00
	MADISON	2	0	0	0	0.00	0	0	0.00
	MARTIN	3	0	0	0	0.00	0	0	0.00
	MASON	3	0	0	0	0.00	0	0	0.00
	MATAGORDA	2	12	1,879	1,765	122.37	4,041	3,998	42.87
	MAVERICK	2	12	1,892	1,774	126.40	3,788	3,745	43.29
	MCCULLOCH	3	0	0	0	0.00	0	0	0.00
	MCLENNAN	2	239	40,480	36,733	4,009.13	117,159	101,916	15,243.61
	MCMULLEN	2	0	0	0	0.00	0	0	0.00
	MEDINA	2	0	0	0	0.00	0	0	0.00
	MENARD	3	0	0	0	0.00	0	0	0.00
	MIDLAND	3	0	0	0	0.00	0	0	0.00
	MILAM	2	0	0	0	0.00	0	0	0.00
	MILLS	3	0	0	0	0.00	0	0	0.00
	MITCHELL	3	0	0	0	0.00	0	0	0.00
	MONTAGUE	3	0	0	0	0.00	0	0	0.00
	MOTLEY	3	0	0	0	0.00	0	0	0.00
	NACOGDOCHES	3	2	315	294	21.78	771	782	-10.58
	NAVARRO	3	7	1,186	1,076	117.42	3,431	2,985	446.47
	NOLAN	3	0	0	0	0.00	0	0	0.00
	PALO PINTO	3	0	0	0	0.00	0	0	0.00
	PECOS	3	0	0	0	0.00	0	0	0.00
	POTTER	4	8	2,205	2,076	137.50	5,164	5,084	79.94
	PRESIDIO	3	0	0	0	0.00	0	0	0.00
	RAINS	3	0	0	0	0.00	0	0	0.00
	REAGAN	3	0	0	0	0.00	0	0	0.00
	REAL	2	0	0	0	0.00	0	0	0.00
	RED RIVER	3	0	0	0	0.00	0	0	0.00
	REEVES	3	0	0	0	0.00	0	0	0.00
	REFUGIO	2	0	0	0	0.00	0	0	0.00
	ROBERTSON	2	0	0	0	0.00	0	0	0.00
	RUNNELS	3	0	0	0	0.00	0	0	0.00
	SAN SABA	3	2	327	302	26.76	846	762	84.35
	SCHLEICHER	3	0	0	0	0.00	0	0	0.00
	SCURRY	3	0	0	0	0.00	0	0	0.00
	SHACKELFORD	3	0	0	0	0.00	0	0	0.00
	SOMERVELL	3	0	0	0	0.00	0	0	0.00
	STARR	2	2	325	301	25.94	603	596	6.63
	STEPHENS	3	0	0	0	0.00	0	0	0.00
	STERLING	3	0	0	0	0.00	0	0	0.00
	STONEWALL	3	0	0	0	0.00	0	0	0.00
	SUTTON	3	0	0	0	0.00	0	0	0.00
	TAYLOR	3	40	6,971	6,257	763.79	22,696	20,042	2,654.46
	TERRELL	3	0	0	0	0.00	0	0	0.00
	THROCKMORTON	3	0	0	0	0.00	0	0	0.00
	TITUS	3	0	0	0	0.00	0	0	0.00
	TOM GREEN	3	4	690	622	73.60	2,237	1,981	255.82
	UPTON	3	0	0	0	0.00	0	0	0.00
	UVALDE	2	2	324	298	27.01	813	728	84.86
	VAL VERDE	2	0	0	0	0.00	0	0	0.00
	VAN ZANDT	3	0	0	0	0.00	0	0	0.00
	WARD	3	0	0	0	0.00	0	0	0.00
	WASHINGTON	2	149	23,468	22,098	1,465.70	54,961	54,110	850.84
	WEBB	2	270	42,580	39,923	2,843.92	85,236	84,262	974.11
	WHARTON	2	0	0	0	0.00	0	0	0.00
	WICHITA	3	11	2,002	1,796	220.48	7,049	6,205	843.94
	WILBARGER	3	0	0	0	0.00	0	0	0.00
	WILLACY	2	0	0	0	0.00	0	0	0.00
	WINKLER	3	120	20,645	18,535	2,256.94	67,695	59,674	8,020.83
	WISE	3	2	330	302	29.80	966	877	88.95
	WOOD	3	2	330	302	29.72	969	880	88.67
	YOUNG	3	0	0	0	0.00	0	0	0.00
	ZAPATA	2	0	0	0	0.00	0	0	0.00
	ZAVALA	2	0	0	0	0.00	0	0	0.00
	TOTAL		**56,951**			**779,546**			**2,113,203**

Table 16: 2017 Totalized Annual Electricity Savings by CL Zone from New Multi-family Residences

CL Zone	Total Electricity Savings by CL Zone (MWh) [2017-TRY 2008]
Houston (H)	140,973
North (N)	367,744
West (W)	18,118
South (S)	188,595
Total	715,429

Table 17: 2017 Annual NOx Reductions from New Multi-family Residences Using 2016 eGRID

Area	County	H	NOx Reductions (lbs)	N	NOx Reductions (lbs)	W	NOx Reductions (lbs/year)	S	NOx Reductions (lbs)	Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
Houston-Galveston Area	Brazoria	0.0584658	8242.08	0.0000074	2.73	0.0000004	0.01	0.0005477	103.30	8348.11	4.17
	Chambers	0.0186322	2626.63	0.0000024	0.87	0.0000001	0.00	0.0001746	32.92	2660.42	1.33
	Fort Bend	0.0713459	10057.83	0.0000091	3.33	0.0000004	0.01	0.0006684	126.06	10187.22	5.09
	Galveston	0.0137868	1943.56	0.0000017	0.64	0.0000001	0.00	0.0001292	24.36	1968.56	0.98
	Harris	0.1154764	16279.02	0.0000147	5.39	0.0000007	0.01	0.0010818	204.03	16488.45	8.24
	Montgomery	0.0105050	1480.92	0.0000013	0.49	0.0000001	0.00	0.0000984	18.56	1499.98	0.75
Dallas/ Fort Worth Area	Collin	0.0001062	14.97	0.0006516	239.60	0.0000315	0.57	0.0000066	1.25	256.40	0.13
	Dallas	0.0021209	298.99	0.0130108	4784.63	0.0006284	11.39	0.0001327	25.03	5120.04	2.56
	Denton	0.0015536	219.01	0.0095304	3504.73	0.0004603	8.34	0.0000972	18.34	3750.42	1.88
	Henderson	0.0002047	28.86	0.0012557	461.77	0.0000607	1.10	0.0000128	2.42	494.14	0.25
	Hood	0.0011465	161.63	0.0070335	2586.51	0.0003397	6.16	0.0000718	13.53	2767.83	1.38
	Hunt	0.0000348	4.91	0.0002135	78.53	0.0000103	0.19	0.0000022	0.41	84.03	0.04
	Tarrant	0.0007633	107.61	0.0046826	1722.01	0.0002262	4.10	0.0000478	9.01	1842.73	0.92
	Ellis	0.0010011	141.13	0.0061414	2258.47	0.0002966	5.37	0.0000627	11.82	2416.79	1.21
	Johnson	0.0001415	19.95	0.0008683	319.32	0.0000419	0.76	0.0000089	1.67	341.70	0.17
	Kaufman	0.0028327	399.34	0.0173774	6390.44	0.0008394	15.21	0.0001773	33.44	6838.43	3.42
	Parker	0.0006458	91.04	0.0039616	1456.84	0.0001914	3.47	0.0000404	7.62	1558.97	0.78
	Wise	0.0026775	377.45	0.0164249	6040.14	0.0007933	14.37	0.0001676	31.60	6463.56	3.23
San Antonio Area	Bexar	0.0155850	2197.06	0.0010511	386.53	0.0000508	0.92	0.1244678	23474.01	26058.53	13.03
	Comal	0.0004218	59.47	0.0000284	10.46	0.0000014	0.02	0.0033689	635.36	705.31	0.35
	Guadalupe	0.0025417	358.31	0.0001714	63.04	0.0000083	0.15	0.0202988	3828.26	4249.76	2.12
	Wilson	0.0001734	24.44	0.0000117	4.30	0.0000006	0.01	0.0013845	261.12	289.87	0.14
Austin Area	Bastrop	0.0020114	283.56	0.0001357	49.89	0.0000066	0.12	0.0160641	3029.62	3363.18	1.68
	Hays	0.0004548	64.12	0.0000307	11.28	0.0000015	0.03	0.0036324	685.05	760.47	0.38
	Travis	0.0037069	522.57	0.0002500	91.94	0.0000121	0.22	0.0296048	5583.31	6198.04	3.10
North East Texas Area	Rusk	0.0234887	3311.27	0.1440913	52988.67	0.0069599	126.10	0.0014701	277.25	56703.29	28.35
Corpus Christi Area	Nueces	0.0039261	553.48	0.0002648	97.37	0.0000128	0.23	0.0313555	5913.49	6564.57	3.28
	San Patricio	0.0065591	924.66	0.0004424	162.68	0.0000214	0.39	0.0523838	9879.32	10967.04	5.48
Victoria Area	Victoria	0.0013502	190.34	0.0000911	33.49	0.0000044	0.08	0.0107830	2033.61	2257.52	1.13
Other ERCOT counties	Anderson	0.0001010	14.23	0.0006194	227.76	0.0000299	0.54	0.0000063	1.19	243.73	0.12
	Angelina	0.0024008	338.44	0.0147275	5415.96	0.0007114	12.89	0.0001503	28.34	5795.63	2.90
	Atascosa	0.0055915	788.25	0.0003771	138.68	0.0000182	0.33	0.0446558	8421.86	9349.11	4.67
	Bell	0.0003222	45.42	0.0019766	726.87	0.0000955	1.73	0.0000202	3.80	777.83	0.39
	Bosque	0.0005680	80.08	0.0034846	1281.45	0.0001683	3.05	0.0000356	6.70	1371.28	0.69
	Brazos	0.0006415	90.44	0.0039355	1447.25	0.0001901	3.44	0.0000402	7.57	1548.70	0.77
	Calhoun	0.0088634	1249.50	0.0005978	219.83	0.0000289	0.52	0.0707865	13349.98	14819.83	7.41
	Cameron	0.0003811	53.72	0.0000257	9.45	0.0000012	0.02	0.0030433	573.94	637.14	0.32
	Cherokee	0.0003216	45.34	0.0019730	725.56	0.0000953	1.73	0.0000201	3.80	776.42	0.39
	Coke	0.0000135	1.90	0.0000826	30.37	0.0140226	254.06	0.0000008	0.16	286.49	0.14
	Colorado	0.0014171	199.77	0.0000956	35.15	0.0000046	0.08	0.0113173	2134.38	2369.38	1.18
	Ector	0.0000634	8.94	0.0003891	143.08	0.0660667	1197.00	0.0000040	0.75	1349.77	0.67
	Fayette	0.0145787	2055.19	0.0009832	361.57	0.0000475	0.86	0.1164306	21958.22	24375.85	12.19
	Freestone	0.0121950	1719.17	0.0748103	27511.00	0.0036135	65.47	0.0007632	143.94	29439.57	14.72
	Frio	0.0070162	989.10	0.0004732	174.01	0.0000229	0.41	0.0560343	10567.80	11731.32	5.87
	Goliad	0.0048476	683.38	0.0003269	120.23	0.0000158	0.29	0.0387148	7301.42	8105.31	4.05
	Grayson	0.0003586	50.55	0.0021996	808.88	0.0001062	1.92	0.0000224	4.23	865.58	0.43
	Grimes	0.0040938	577.12	0.0251136	9235.38	0.0012130	21.98	0.0002562	48.32	9882.80	4.94
	Hidalgo	0.0019872	280.15	0.0001340	49.29	0.0000065	0.12	0.0158708	2993.15	3322.70	1.66
	Hill	0.0004818	67.92	0.0029556	1086.89	0.0001428	2.59	0.0000302	5.69	1163.09	0.58
	Howard	0.0000104	1.47	0.0000639	23.49	0.0108444	196.48	0.0000007	0.12	221.56	0.11
	Lamar	0.0021680	305.63	0.0132996	4890.85	0.0006424	11.64	0.0001357	25.59	5233.71	2.62
	Limestone	0.0207580	2926.32	0.1273399	46828.46	0.0061507	111.44	0.0012992	245.02	50111.23	25.06
	Llano	0.0001816	25.60	0.0000122	4.50	0.0000006	0.01	0.0014501	273.47	303.58	0.15
	McLennan	0.0023590	332.55	0.0144710	5321.62	0.0006990	12.66	0.0001476	27.84	5694.68	2.85
	Milam	0.0070396	992.40	0.0004748	174.59	0.0000229	0.42	0.0562211	10603.02	11770.43	5.89
	Mitchell	0.0000196	2.77	0.0001204	44.29	0.0204490	370.50	0.0000012	0.23	417.78	0.21
	Nacogdoches	0.0001458	20.55	0.0008944	328.91	0.0000432	0.78	0.0000091	1.72	351.97	0.18
	Nolan	0.0000085	1.20	0.0000524	19.27	0.0088961	161.18	0.0000005	0.10	181.75	0.09
	Palo Pinto	0.0004954	69.84	0.0030391	1117.63	0.0001468	2.66	0.0000310	5.85	1195.97	0.60
	Pecos	0.0000002	0.02	0.0000011	0.39	0.0001806	3.27	0.0000000	0.00	3.69	0.00
	Potter	0.0004032	56.84	0.0024732	909.51	0.4199647	7608.95	0.0000252	4.76	8580.04	4.29
	Reagan	0.0000001	0.02	0.0000009	0.34	0.0001554	2.82	0.0000000	0.00	3.17	0.00
	Red River	0.0000376	5.30	0.0002305	84.76	0.0000111	0.20	0.0000024	0.44	90.71	0.05
	Robertson	0.0134304	1893.33	0.0823890	30298.02	0.0039795	72.10	0.0008406	158.53	32421.97	16.21
	Scurry	0.0000991	13.97	0.0006078	223.50	0.1032024	1869.83	0.0000062	1.17	2108.47	1.05
	Titus	0.0140204	1976.49	0.0860080	31628.89	0.0041543	75.27	0.0008775	165.49	33846.15	16.92
	Upton	0.0000001	0.02	0.0000008	0.29	0.0001352	2.45	0.0000000	0.00	2.76	0.00
	Ward	0.0000021	0.30	0.0000130	4.80	0.0022148	40.13	0.0000001	0.03	45.25	0.02
	Webb	0.0000283	3.99	0.0000019	0.70	0.0000001	0.00	0.0002259	42.60	47.29	0.02
	Wharton	0.0008796	124.00	0.0000593	21.81	0.0000029	0.05	0.0070246	1324.81	1470.68	0.74
	Wichita	0.0000013	0.18	0.0000079	2.92	0.0013464	24.39	0.0000001	0.02	27.51	0.01
	Wilbarger	0.0004088	57.63	0.0025077	922.20	0.4258276	7715.17	0.0000256	4.83	8699.83	4.35
	Wood	0.0000060	0.84	0.0000365	13.44	0.0000018	0.03	0.0000004	0.07	14.38	0.01
	Young	0.0000150	2.12	0.0000923	33.95	0.0156760	284.02	0.0000009	0.18	320.27	0.16
	Total	**0.4904222**	**69136.15**	**0.6972352**	**256403.84**	**1.1223498**	**20334.80**	**0.7248702**	**136706.90**	**482581.68**	**241.29**

Energy Savings by PCA (MWh)		140,973		367,744		18,118		188,595			

4.3 2017 Results for New Residential Construction (Single-family and Multi-family)

Table 18 presents the individual and combined annual electricity savings and NOx emissions reductions resulted from the new single-family and multi-family Construction in 2017. In addition, Table 18 includes the combined natural gas savings from the new Construction for both single-family and multi-family and the corresponding NOx emissions reductions[30].

The total NOx reductions from electricity and natural gas savings from total new single-family and multi-family Construction in 2017 are 326.56 tons NOx/year, including 66.69 tons NOx/year (20.42 %) from single-family residential electricity savings, 241.29 tons NOx/year (73.89 %) from multi-family residential electricity savings, and 18.58 tons NOx/year (5.69 %) from natural gas savings from both single-family and multi-family residences. Figure 9 through Figure 12 show the electricity savings and NOx reductions tabulated in Table 18. Figure 9 shows the annual electricity savings by county using a stacked bar chart and Figure 10 shows the spatial distribution of the electricity savings by county across the state. Figure 11 shows the annual NOx reductions by using a stacked bar chart and Figure 12 shows the spatial distribution of the NOx reductions by county across the state.

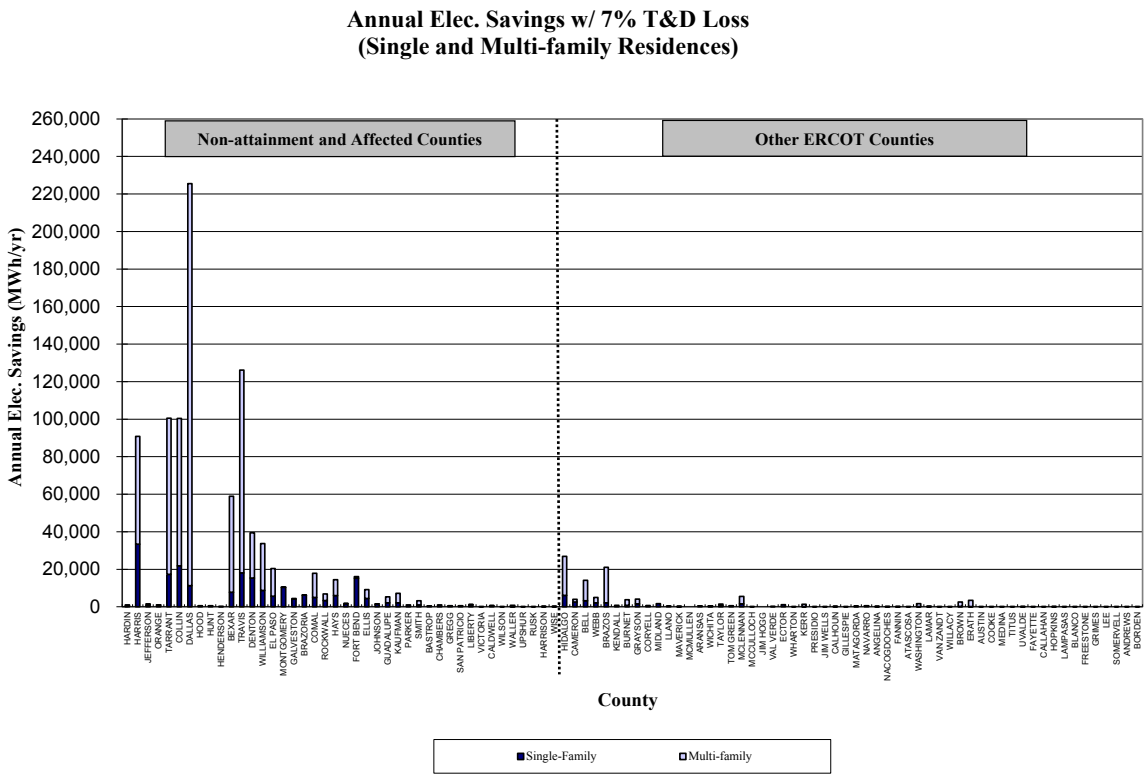
[30] 0.092 lb-NOx/MMBtu of emission rate was used for the calculation.

Table 18: 2017 Annual NOx Reductions from New Single-family and Multi-family Residences

	County	Electricity Savings and Resultant NOx Reductions (Single Family Houses)		Electricity Savings and Resultant NOx Reductions (Multifamily Houses)		Total Electricity Savings and Resultant NOx Reductions (Single and Multi-Family Houses)		Total Natural Gas Savings and Resultant NOx Reductions (Single and Multi-Family Houses)		Total Nox Reductions
		Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Annual Nox Reductions (Tons)
Non-attainment and Affected Counties	HARDIN	517.02		548.99		1,066.00	0.00	2,460.56	0.01	0.01
	HARRIS	33,418.96	5.04	57,427.84	8.24	90,846.80	13.29	221,340.51	1.02	14.30
	JEFFERSON	701.91		883.39		1,585.30	0.00	3,402.73	0.02	0.02
	ORANGE	904.04		157.21		1,061.25	0.00	3,887.34	0.02	0.02
	TARRANT	17,354.84	0.20	83,177.81	0.92	100,532.65	1.12	397,780.35	1.83	2.95
	COLLIN	21,817.73	0.03	78,588.06	0.13	100,405.79	0.16	411,021.41	1.89	2.05
	DALLAS	11,249.94	0.55	214,262.02	2.56	225,511.96	3.11	743,784.37	3.42	6.53
	HOOD	409.42	0.30	192.34	1.38	601.76	1.68	4,020.22	0.02	1.70
	HUNT	434.51	0.01	59.38	0.04	493.89	0.05	3,806.35	0.02	0.07
	HENDERSON	208.97	0.05	0.00	0.25	208.97	0.30	277.21	0.00	0.30
	BEXAR	7,744.82	3.73	51,202.22	13.03	58,947.03	16.76	252,722.37	1.16	17.92
	TRAVIS	18,095.17	0.89	108,027.18	3.10	126,122.35	3.99	555,048.10	2.55	6.54
	DENTON	15,311.69	0.40	24,135.10	1.88	39,446.80	2.28	195,859.39	0.90	3.18
	WILLIAMSON	8,743.39		24,912.88		33,656.27	0.00	182,190.13	0.84	0.84
	EL PASO	5,682.18		14,693.28		20,375.46	0.00	69,930.78	0.32	0.32
	MONTGOMERY	10,411.44	0.46	39.35	0.75	10,450.79	1.21	58,594.06	0.27	1.48
	GALVESTON	4,119.03	0.60	333.94	0.98	4,452.97	1.59	22,768.63	0.10	1.69
	BRAZORIA	6,157.90	2.55	58.93	4.17	6,216.83	6.73	33,782.84	0.16	6.88
	COMAL	4,963.29	0.10	12,857.96	0.35	17,821.24	0.45	99,267.91	0.46	0.91
	ROCKWALL	3,372.48		3,426.59		6,799.07	0.00	37,499.08	0.17	0.17
	HAYS	5,983.64	0.11	8,442.55	0.38	14,426.19	0.49	97,554.53	0.45	0.94
	NUECES	1,719.21	0.94	21.07	3.28	1,740.28	4.22	6,102.10	0.03	4.25
	FORT BEND	15,176.30	3.11	895.16	5.09	16,071.46	8.21	85,896.33	0.40	8.60
	ELLIS	4,455.85	0.26	4,719.62	1.21	9,175.47	1.47	51,712.81	0.24	1.71
	JOHNSON	1,373.83	0.04	147.95	0.17	1,521.78	0.21	11,982.56	0.06	0.26
	GUADALUPE	2,104.43	0.61	3,214.49	2.12	5,318.92	2.73	35,061.07	0.16	2.89
	KAUFMAN	2,074.49	0.74	5,110.09	3.42	7,184.57	4.16	32,029.10	0.15	4.30
	PARKER	1,068.26	0.17	0.00	0.78	1,068.26	0.95	8,637.96	0.04	0.99
	SMITH	1,038.27		2,174.16		3,212.43	0.00	(138.58)	(0.00)	(0.00)
	BASTROP	372.70	0.48	133.60	1.68	506.29	2.16	3,773.16	0.02	2.18
	CHAMBERS	975.15	0.81	0.00	1.33	975.15	2.14	4,134.72	0.02	2.16
	GREGG	359.38		218.84		578.21	0.00	190.79	0.00	0.00
	SAN PATRICIO	430.85	1.57	42.13	5.48	472.99	7.05	1,541.88	0.01	7.06
	LIBERTY	1,074.02		19.75		1,093.77	0.00	6,033.92	0.03	0.03
	VICTORIA	113.93	0.32	0.00	1.13	113.93	1.45	426.21	0.00	1.45
	CALDWELL	529.82		53.44		583.26	0.00	6,164.09	0.03	0.03
	WILSON	110.76	0.04	0.00	0.14	110.76	0.19	1,313.82	0.01	0.19
	WALLER	70.85		708.26		779.11	0.00	809.74	0.00	0.00
	UPSHUR	11.89		0.00		11.89	0.00	78.82	0.00	0.00
	RUSK	4.43	6.12	0.00	28.35	4.43	34.47	8.24	0.00	34.47
	HARRISON	97.22		170.45		267.68	0.00	3.17	0.00	0.00
	WISE	190.68	0.70	29.80	3.23	220.47	3.93	1,630.78	0.01	3.94
Other ERCOT Counties	HIDALGO	6,117.58	0.48	20,741.56	1.66	26,859.13	2.14	28,120.17	0.13	2.27
	CAMERON	2,582.62	0.09	1,374.99	0.32	3,957.61	0.41	9,984.46	0.05	0.46
	BELL	3,261.55	0.08	10,853.15	0.39	14,114.70	0.47	87,153.36	0.40	0.87
	WEBB	2,172.47	0.01	2,843.92	0.02	5,016.39	0.03	18,677.81	0.09	0.12
	BRAZOS	2,084.26	0.17	18,965.55	0.77	21,049.81	0.94	22,734.81	0.10	1.05
	KENDALL	808.35		0.00		808.35	0.00	5,407.25	0.02	0.02
	BURNET	777.75		2,943.52		3,721.27	0.00	18,499.27	0.09	0.09
	GRAYSON	1,523.07	0.09	2,627.40	0.43	4,150.47	0.53	20,603.97	0.09	0.62
	CORYELL	318.00		335.49		653.49	0.00	5,749.62	0.03	0.03
	MIDLAND	1,725.17		0.00		1,725.17	0.00	15,296.09	0.07	0.07
	LLANO	489.23	0.04	0.00	0.15	489.23	0.20	5,800.38	0.03	0.22
	MAVERICK	129.00		126.40		255.39	0.00	1,094.50	0.01	0.01
	MCMULLEN	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	ARANSAS	325.77		21.07		346.83	0.00	1,162.11	0.01	0.01
	WICHITA	255.15	0.00	220.48	0.01	475.63	0.02	3,606.52	0.02	0.03
	TAYLOR	673.87		763.79		1,437.66	0.00	9,174.84	0.04	0.04
	TOM GREEN	450.67		73.60		524.26	0.00	4,536.71	0.02	0.02
	MCLENNAN	1,563.50	0.61	4,009.13	2.85	5,572.63	3.46	37,240.78	0.17	3.63
	MCCULLOCH	2.34		0.00		2.34	0.00	22.18	0.00	0.00
	JIM HOGG	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	VAL VERDE	217.34		0.00		217.34	0.00	2,578.06	0.01	0.01
	ECTOR	1,115.35	0.22	0.00	0.67	1,115.35	0.89	9,889.19	0.05	0.94
	WHARTON	155.90	0.21	0.00	0.74	155.90	0.95	583.24	0.00	0.95
	KERR	83.63		1,284.45		1,368.07	0.00	5,040.17	0.02	0.02
	PRESIDIO	32.69		0.00		32.69	0.00	310.53	0.00	0.00
	JIM WELLS	29.42		0.00		29.42	0.00	104.31	0.00	0.00
	CALHOUN	127.92	2.12	122.37	7.41	250.29	9.53	521.42	0.00	9.53
	GILLESPIE	112.90		0.00		112.90	0.00	1,338.55	0.01	0.01
	MATAGORDA	281.82		122.37		404.20	0.00	1,097.18	0.01	0.01
	NAVARRO	507.58		117.42		625.00	0.00	7,587.66	0.03	0.03
	ANGELINA	104.12	0.63	65.35	2.90	169.47	3.52	161.98	0.00	3.52
	NACOGDOCHES	4.43	0.04	21.78	0.18	26.21	0.21	(2.34)	(0.00)	0.21
	FANNIN	70.89		59.38		130.27	0.00	770.18	0.00	0.00
	ATASCOSA	75.15	1.34	0.00	4.67	75.15	6.01	882.15	0.00	6.02
	WASHINGTON	163.36		1,465.70		1,629.05	0.00	1,769.82	0.01	0.01
	LAMAR	57.65	0.56	297.96	2.62	355.61	3.18	961.01	0.00	3.19
	VAN ZANDT	29.87		0.00		29.87	0.00	241.49	0.00	0.00
	WILLACY	22.67		0.00		22.67	0.00	84.57	0.00	0.00
	BROWN	297.62		2,247.79		2,545.41	0.00	12,733.83	0.06	0.06
	ERATH	92.11		3,303.37		3,395.48	0.00	12,371.81	0.06	0.06
	AUSTIN	66.92		0.00		66.92	0.00	376.45	0.00	0.00
	COOKE	160.08		0.00		160.08	0.00	1,336.68	0.01	0.01
	MEDINA	62.69		0.00		62.69	0.00	743.67	0.00	0.00
	TITUS	57.65	3.65	0.00	16.92	57.65	20.58	71.52	0.00	20.58
	UVALDE	41.80		27.01		68.81	0.00	580.64	0.00	0.00
	FAYETTE	17.71	3.49	0.00	12.19	17.71	15.68	99.65	0.00	15.68
	CALLAHAN	9.70		0.00		9.70	0.00	93.82	0.00	0.00
	HOPKINS	48.24		119.19		167.43	0.00	745.90	0.00	0.00
	LAMPASAS	67.27		0.00		67.27	0.00	946.42	0.00	0.00
	BLANCO	25.09		0.00		25.09	0.00	297.46	0.00	0.00
	FREESTONE	10.19	3.18	0.00	14.72	10.19	17.90	143.40	0.00	17.90
	GRIMES	94.47	1.07	0.00	4.94	94.47	6.01	531.46	0.00	6.01
	LEE	18.77		0.00		18.77	0.00	218.41	0.00	0.00
	SOMERVELL	31.84		0.00		31.84	0.00	267.35	0.00	0.00
	ANDREWS	40.81		0.00		40.81	0.00	361.80	0.00	0.00
	BORDEN	41.45		0.00		41.45	0.00	414.45	0.00	0.00

Table 16: 2017 Annual NOx Reductions from New Single-family and Multi-family Residences (Continued)

	County	Electricity Savings and Resultant NOx Reductions (Single Family Houses)		Electricity Savings and Resultant NOx Reductions (Multifamily Houses)		Total Electricity Savings and Resultant NOx Reductions (Single and Multi-Family Houses)		Total Natural Gas Savings and Resultant NOx Reductions (Single and Multi-Family Houses)		Total Nox Reductions
		Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Annual Nox Reductions (Tons)
Other ERCOT Counties	CHEROKEE	15.51	0.08	0.00	0.39	15.51	0.47	28.85	0.00	0.47
	DIMMIT	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	FALLS	2.04		0.00		2.04	0.00	28.68	0.00	0.00
	COLORADO	21.65	0.34	0.00	1.18	21.65	1.52	121.79	0.00	1.52
	FRIO	14.61	1.68	0.00	5.87	14.61	7.55	171.53	0.00	7.55
	MILAM	15.21	1.69	0.00	5.89	15.21	7.57	194.12	0.00	7.57
	JACKSON	9.99		652.66		662.66	0.00	266.03	0.00	0.00
	ANDERSON	31.02	0.03	0.00	0.12	31.02	0.15	57.71	0.00	0.15
	HILL	32.62	0.13	0.00	0.58	32.62	0.71	458.87	0.00	0.71
	CULBERSON	14.31		0.00		14.31	0.00	74.02	0.00	0.00
	MASON	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	POTTER	1,228.83	1.38	137.50	4.29	1,366.33	5.67	6,814.57	0.03	5.70
	PECOS	2.34	0.00	0.00	0.00	2.34	0.00	22.18	0.00	0.00
	RAINS	9.19		0.00		9.19	0.00	74.31	0.00	0.00
	LAVACA	18.06		0.00		18.06	0.00	68.36	0.00	0.00
	PALO PINTO	9.70	0.13	0.00	0.60	9.70	0.73	93.82	0.00	0.73
	KIMBLE	4.67		0.00		4.67	0.00	44.36	0.00	0.00
	MADISON	5.90		0.00		5.90	0.00	33.22	0.00	0.00
	ARCHER	17.86		0.00		17.86	0.00	193.38	0.00	0.00
	REFUGIO	19.99		0.00		19.99	0.00	74.77	0.00	0.00
	LIMESTONE	6.12	5.41	0.00	25.06	6.12	30.47	86.04	0.00	30.47
	CLAY	2.55		0.00		2.55	0.00	27.63	0.00	0.00
	BEE	15.99		0.00		15.99	0.00	59.82	0.00	0.00
	MARTIN	11.33		0.00		11.33	0.00	100.50	0.00	0.00
	GONZALES	31.35		0.00		31.35	0.00	371.84	0.00	0.00
	BURLESON	31.49		0.00		31.49	0.00	177.15	0.00	0.00
	KARNES	91.01		0.00		91.01	0.00	871.09	0.00	0.00
	KLEBERG	10.50		0.00		10.50	0.00	37.25	0.00	0.00
	BREWSTER	11.68		147.19		158.87	0.00	622.55	0.00	0.00
	WINKLER	0.00		2,256.94		2,256.94	0.00	8,020.83	0.04	0.04
	WOOD	23.78	0.00	29.72	0.01	53.50	0.01	246.30	0.00	0.01
	FRANKLIN	4.59		0.00		4.59	0.00	37.15	0.00	0.00
	YOUNG	9.70	0.05	0.00	0.16	9.70	0.21	93.82	0.00	0.21
	HOUSTON	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	SCURRY	17.45	0.34	0.00	1.05	17.45	1.39	174.50	0.00	1.39
	BOSQUE	16.31	0.15	0.00	0.69	16.31	0.83	229.44	0.00	0.83
	COMANCHE	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	BRISCOE	16.27		0.00		16.27	0.00	296.84	0.00	0.00
	CONCHO	2.34		0.00		2.34	0.00	22.18	0.00	0.00
	ZAVALA	2.05		0.00		2.05	0.00	16.69	0.00	0.00
	NOLAN	9.70	0.03	0.00	0.09	9.70	0.12	93.82	0.00	0.12
	BROOKS	8.37		0.00		8.37	0.00	32.50	0.00	0.00
	ROBERTSON	157.45	3.50	0.00	16.21	157.45	19.71	885.77	0.00	19.71
	LIVE OAK	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	HAMILTON	6.12		0.00		6.12	0.00	86.04	0.00	0.00
	JONES	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	REAGAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	WARD	9.07	0.01	0.00	0.02	9.07	0.03	80.40	0.00	0.03
	RED RIVER	0.00	0.01	0.00	0.05	0.00	0.06	0.00	0.00	0.06
	HASKELL	7.27		0.00		7.27	0.00	70.36	0.00	0.00
	HOWARD	63.48	0.04	0.00	0.11	63.48	0.15	562.80	0.00	0.15
	SAN SABA	0.00		26.76		26.76	0.00	84.35	0.00	0.00
	JACK	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	STEPHENS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	RUNNELS	9.34		0.00		9.34	0.00	88.72	0.00	0.00
	REEVES	9.07		0.00		9.07	0.00	80.40	0.00	0.00
	DE WITT	6.00		0.00		6.00	0.00	22.43	0.00	0.00
	CHILDRESS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	CROSBY	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	DAWSON	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	MITCHELL	0.00	0.07	0.00	0.21	0.00	0.28	0.00	0.00	0.28
	WILBARGER	7.65	1.40	0.00	4.35	7.65	5.75	82.88	0.00	5.75
	COLEMAN	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	UPTON	6.81	0.00	0.00	0.00	6.81	0.00	61.85	0.00	0.00
	COKE	0.00	0.05	0.00	0.14	0.00	0.19	0.00	0.00	0.19
	CROCKETT	44.37		0.00		44.37	0.00	421.43	0.00	0.00
	HARDEMAN	2.55		0.00		2.55	0.00	27.63	0.00	0.00
	BANDERA	2.47		0.00		2.47	0.00	16.54	0.00	0.00
	BAYLOR	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	COTTLE	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	CRANE	2.27		0.00		2.27	0.00	20.62	0.00	0.00
	DELTA	11.49		0.00		11.49	0.00	92.88	0.00	0.00
	DICKENS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	DUVAL	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	EASTLAND	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	EDWARDS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	FISHER	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	FOARD	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	GLASSCOCK	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	GOLIAD	8.00	1.16	0.00	4.05	8.00	5.21	29.91	0.00	5.21
	HALL	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	HUDSPETH	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	IRION	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	JEFF DAVIS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	KENEDY	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	KENT	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	KING	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	KINNEY	2.09		0.00		2.09	0.00	24.79	0.00	0.00
	KNOX	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	LA SALLE	4.10		0.00		4.10	0.00	33.37	0.00	0.00
	LEON	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	LOVING	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	MENARD	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	MILLS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	MONTAGUE	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	MOTLEY	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	REAL	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	SCHLEICHER	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	SHACKELFORD	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	STARR	0.00		25.94		25.94	0.00	6.63	0.00	0.00
	STERLING	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	STONEWALL	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	SUTTON	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TERRELL	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	THROCKMORTON	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	ZAPATA	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL	**242,747.75**	**66.69**	**779,516.70**	**241.29**	**1,022,264.45**	**307.98**	**4,038,728.58**	**18.58**	**326.56**



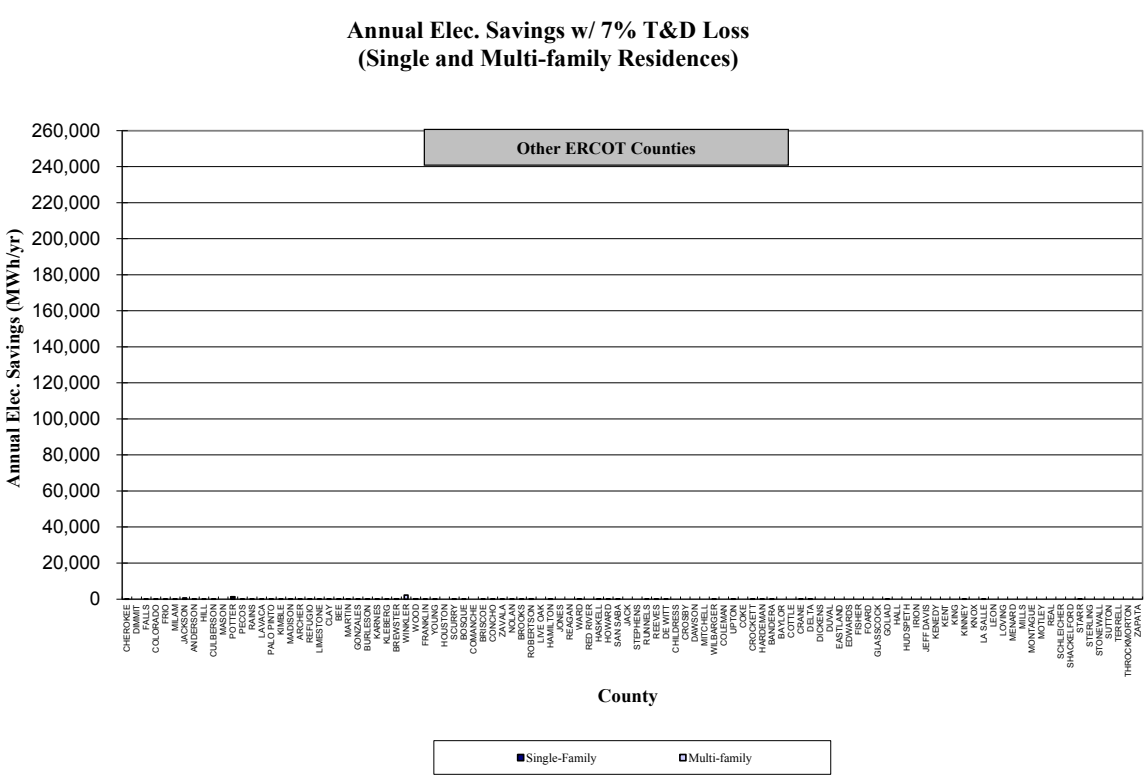


Figure 9: 2017 Annual Electricity Savings by County from New Single-family and Multi-family Residences

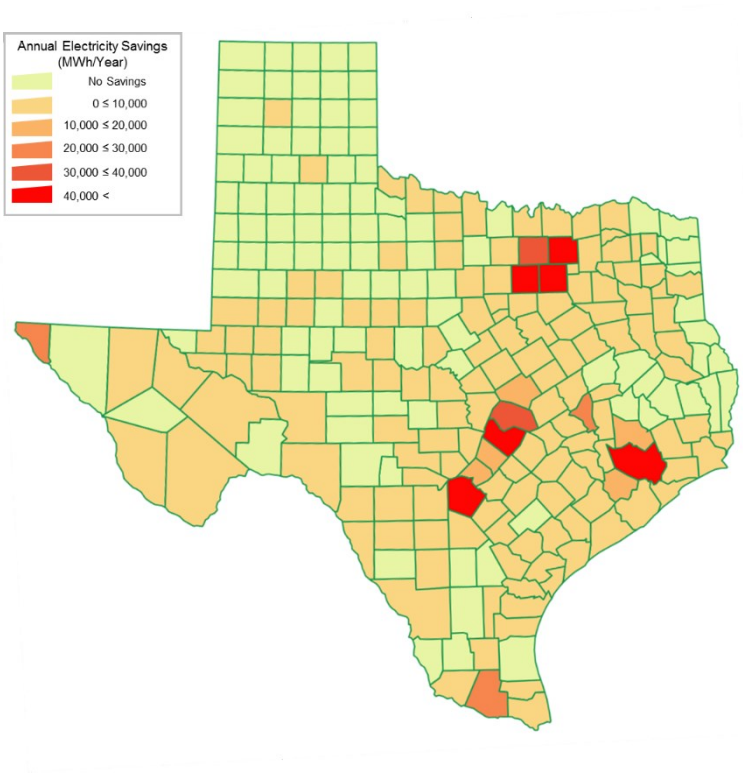
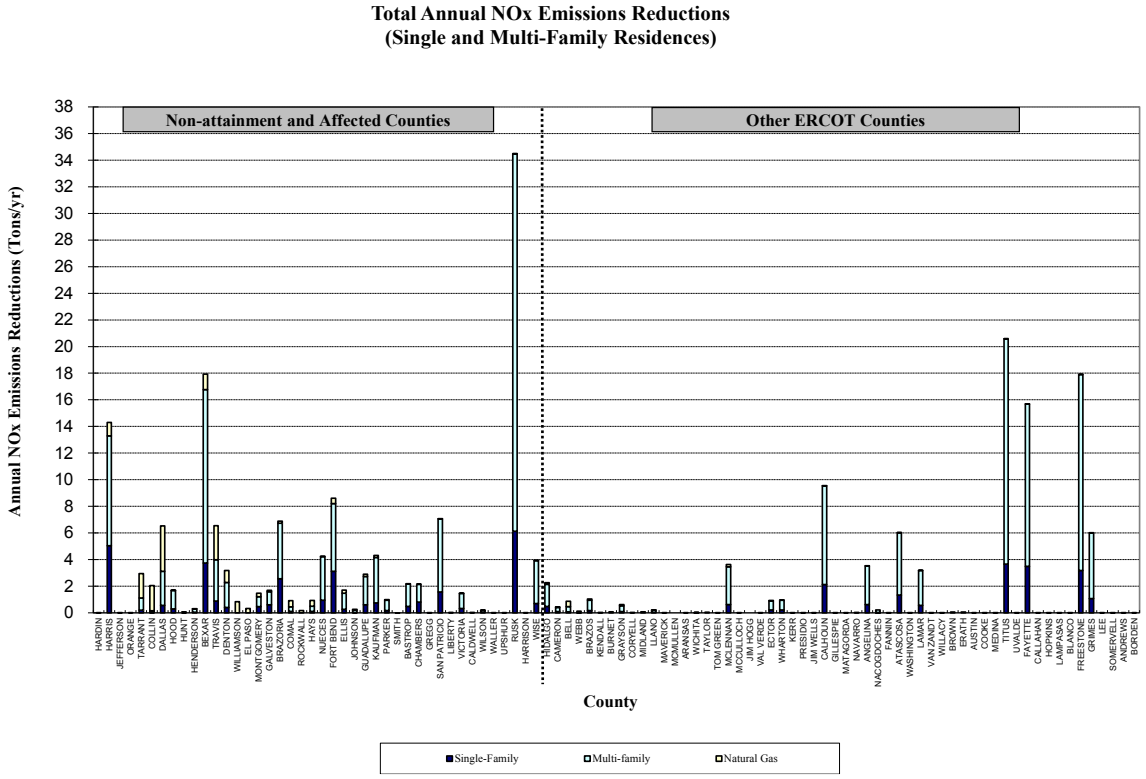


Figure 10: Map of 2017 Annual Electricity Savings by County from New Single-family and Multi-family Residences



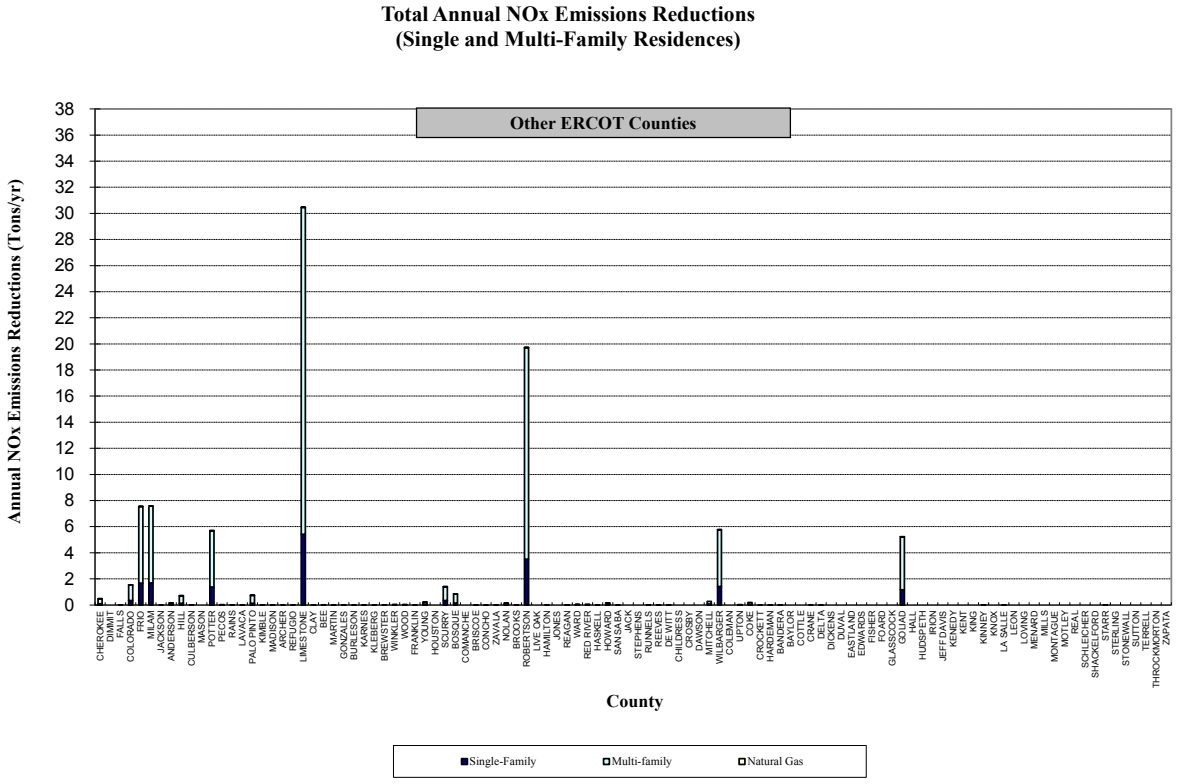


Figure 11: 2017 Annual NOx Reductions by County from New Single-family and Multi-family Residences

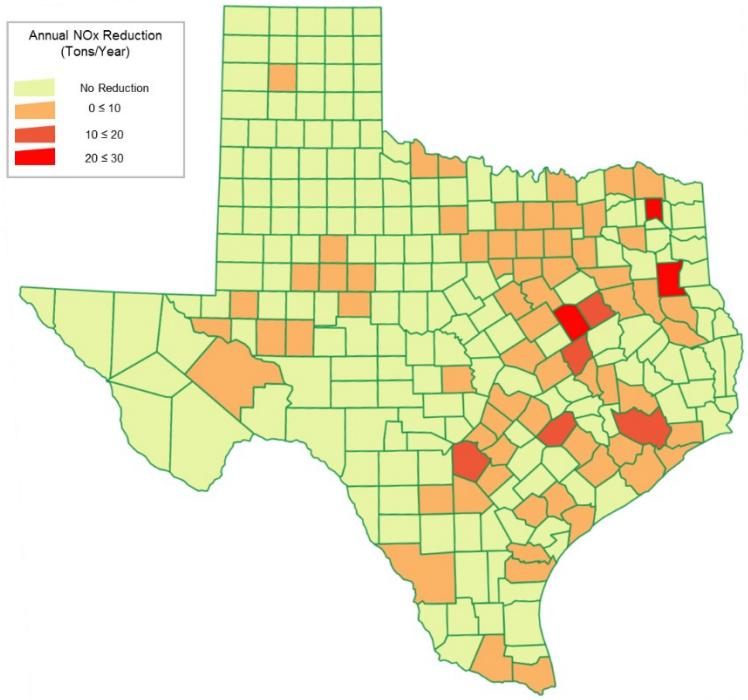


Figure 12: Map of 2017 Annual NOx Reductions by County from New Single-family and Multi-family Residences

4.4 2017 Results for Commercial Construction

This section reports the calculated energy savings and emissions reductions from new commercial construction in 2017 that were built to meet ASHRAE Standard 90.1-2013.

To determine the energy savings and emissions reductions from new commercial construction in all counties in the ERCOT region as well as the 42 non-attainment and affected counties, data from two sources (i.e., Dodge and USDOE) were merged into one analysis as shown in Figure 13 [31]. Beginning in the upper left of Figure 13, the Dodge database of the square footage of new commercial Construction per county in Texas (Dodge 2017) was categorized by the building types in the report published by the US Department of Energy (DOE) (USDOE 2014). This allowed for the new Construction to be tracked by county and building type. The next block in Figure 13 and Table 19 show the categories from the Dodge database and the DOE report. The Dodge "stores and restaurant" category had to be split into two categories to match the two DOE categories for "retail" and "food". To accomplish this, information published in the 2012 CBECS database by the US DOE's EIA was used to determine the percentages used to split the Dodge conditioned area for each county as shown in Table 20 (i.e., 21.33% for food and 78.67% for retail). As a result, six Dodge building types were categorized into seven DOE building types and the resultant square footage of new commercial construction by the seven DOE building types is shown in Figure 14 for all building types and in Figure 15 for each building type.

In the next step, the annual energy savings were calaulated. To accomplish this, this report used the resultant square footage and savings of the annual energy use intensity (EUI). The DOE report included the annual EUI values, which comply with the ASHRAE Standard 90.1-2007 and 2013, by seven building types (USDOE 2011). The annual energy use for each building type was calculated by multiplying the annual EUI value by the resultant square footage. Then, the annual energy savings were calculated by subtracting the annual energy use from ASHRAE

[31] The 2017 new commercial construction is estimated based on the 2016 Dodge database of the square footage of new commercial Construction per county in Texas

Standard 90.1-2007 to the annual energy use from ASHRAE Standard 90.1-2013. From Table 21 to Table 23 show the annual energy use calculated for new commercial Construction, by building type, for ASHRAE Standard 90.1-2007 and ASHRAE Standard 90.1-2013. Table 24 shows the county-wide annual electricity and natural gas savings by building type[32].

In the next calculation step, CL Zones were assigned to each county as shown in Table 25. In the case where more than one provider was shown in a county, a percentage of electricity use was allocated.

Table 27 shows the transformation of the annual county-wide electricity and natural gas savings, along with the associated 2017 NOx emissions reductions with 7% T&D losses[33]. Figure 16 shows the bar chart of the annual electricity savings for 2017. Figure 17 presents the NOx emissions reductions resulted from the electricity and natural gas savings. The total NOx reductions from electricity and natural gas savings from new commercial Construction in 2017 are calculated to be 95.16 tons NOx/year which represents 49.27 tons NOx/year from electricity savings and 45.89 tons NOx/year from natural gas savings.

[32] In this table (-) values are savings, (+) values are increased energy use.
[33] 0.092 lb-NOx/MMBtu of emission rate was used for the calculation.

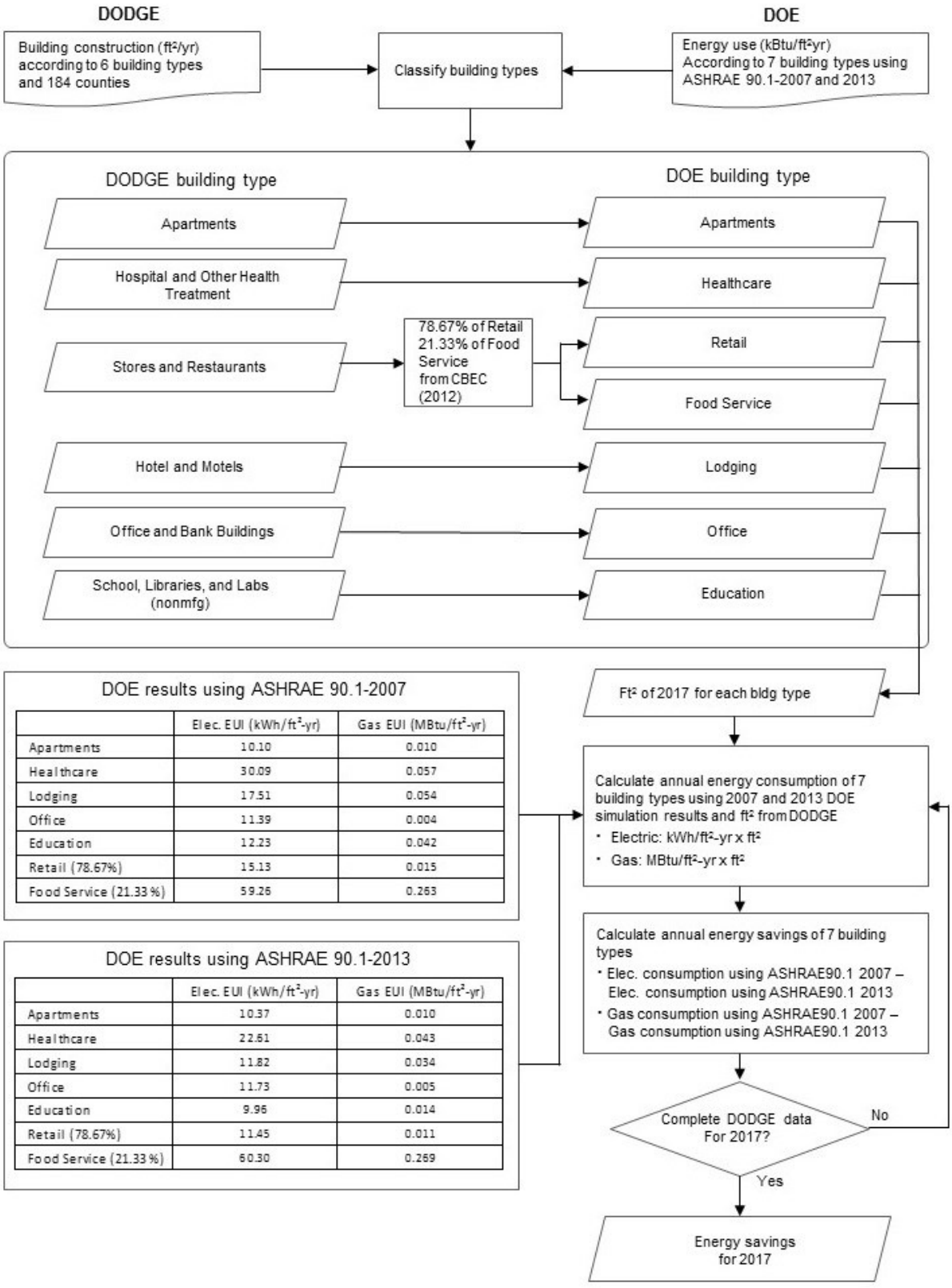


Figure 13: Calculation Method for 2017 Energy Savings from New Commercial Buildings

Table 19: Commercial Building Types in the US DOE Report and Dodge Database

No.	DOE Building Types	Dodge Building Types
1	Apartments	Apartments
2	Healthcare	Hospitals and Other Health Treatment
3	Lodging	Hotels and Motels
4	Office	Office and Bank Buildings
5	Education	Schools, Libraries, and Labs (nonmfg)
6	Retail	Stores and Restaurants
7	Food Service	

Table 20: Commercial Building Floor Area for Retail and Food Service Types from CBECS Database

		CBECS (2012)	
		Total Floor Area (million square feet)	% Distribution of Floor Area
Food	Food Sales	1,252	21.33
	Food Service	1,819	
Retail	Retail (Other Than Mall)	5,439	78.67
	Enclosed and Strip Malls	5,890	

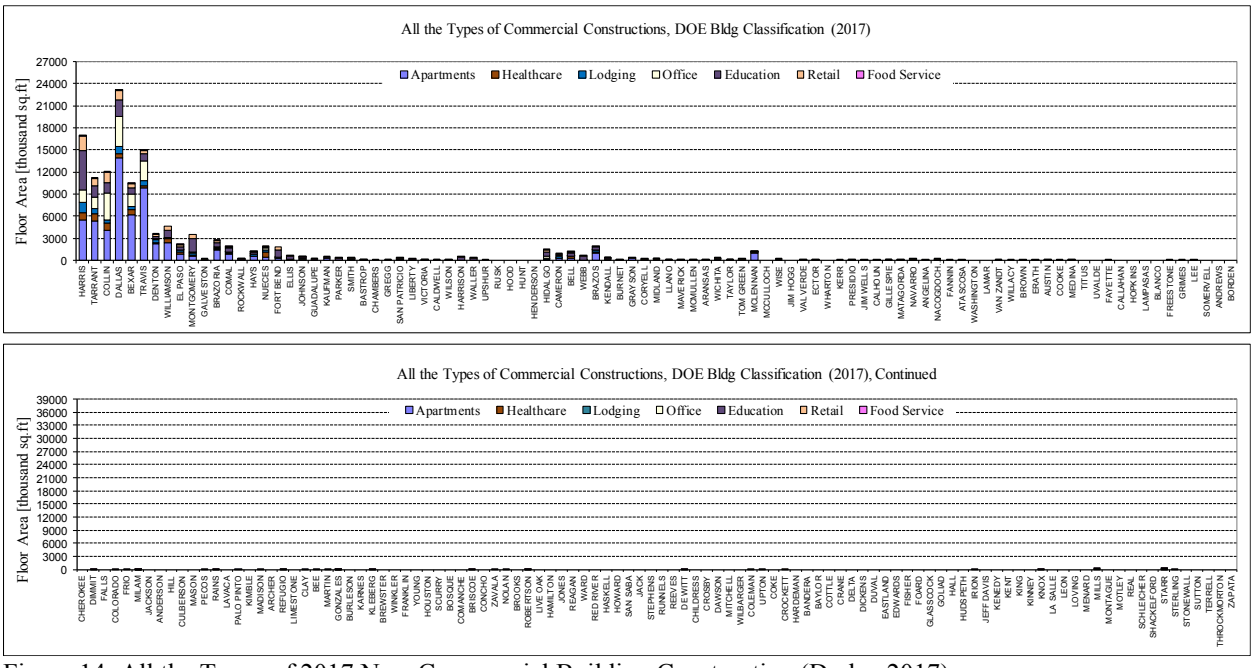
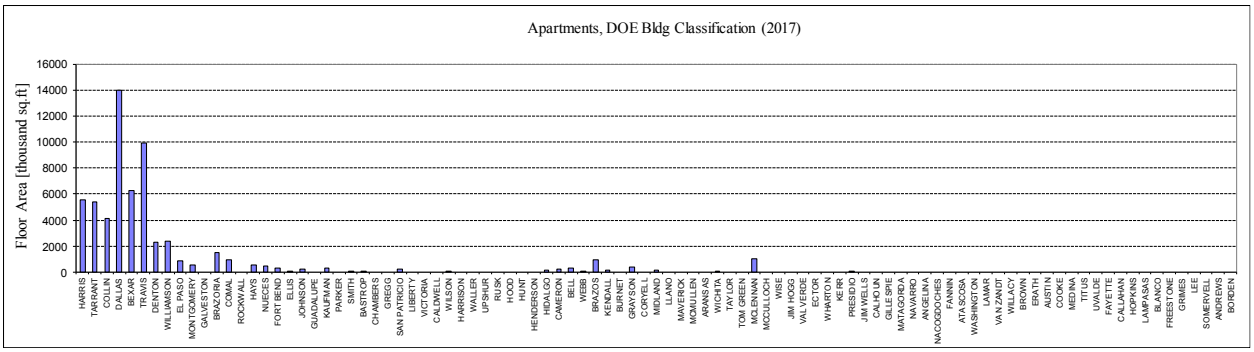
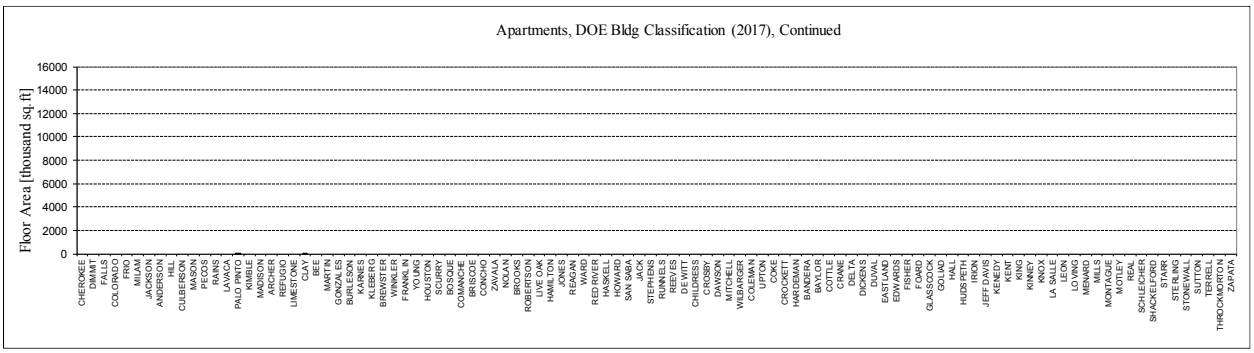
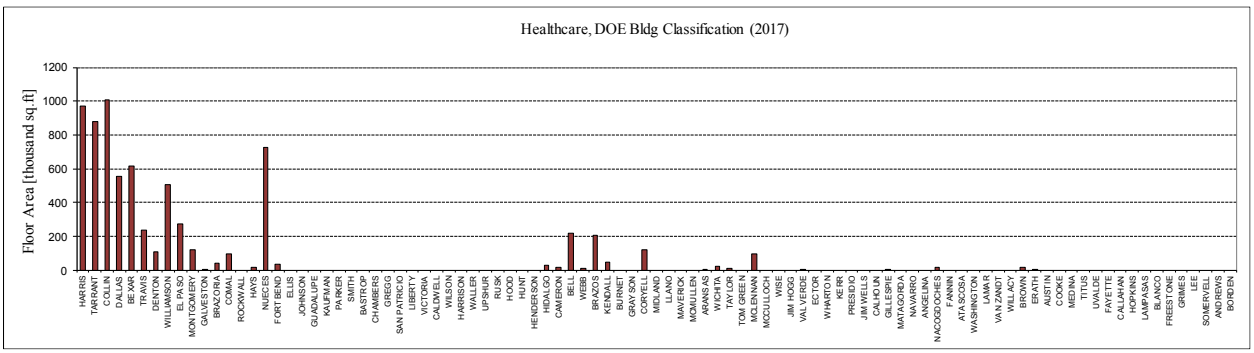


Figure 14: All the Types of 2017 New Commercial Building Construction (Dodge 2017)







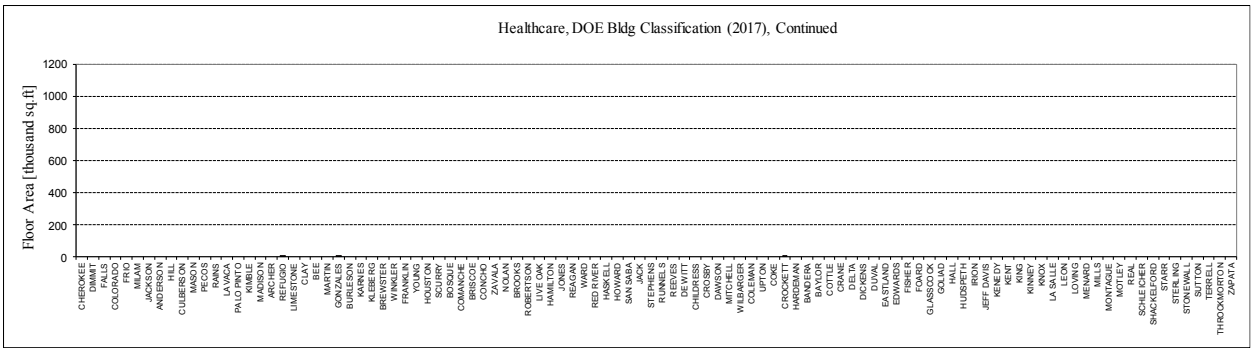
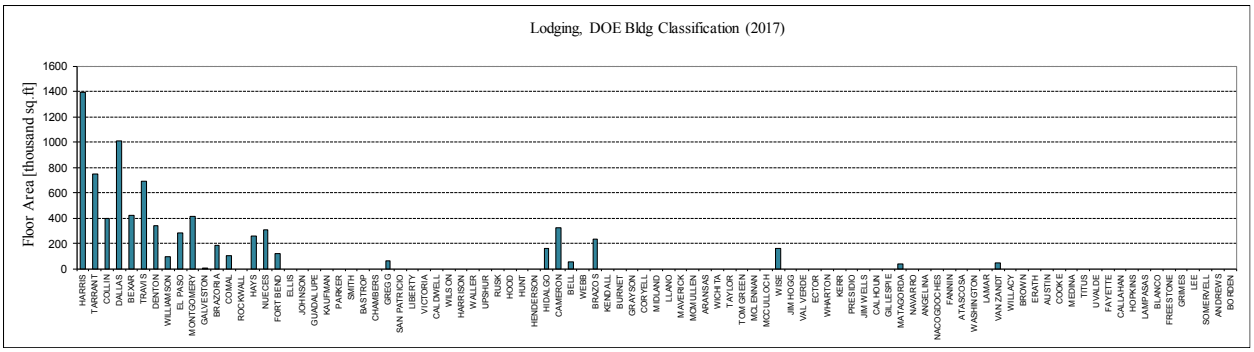
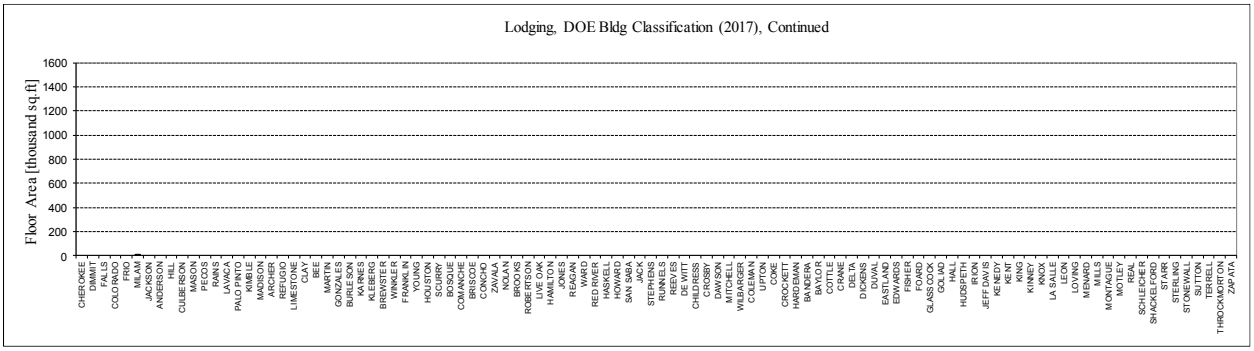
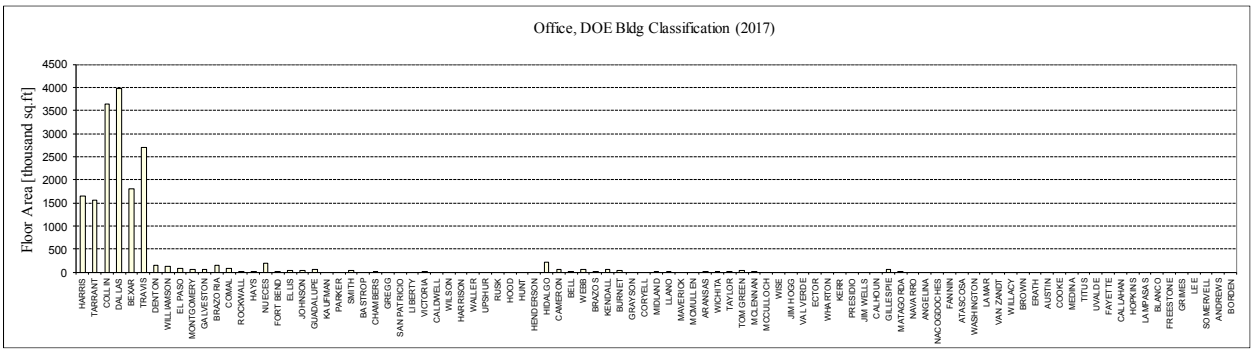


Figure 15: 2017 New Commercial Building Construction by Type (Dodge 2017)







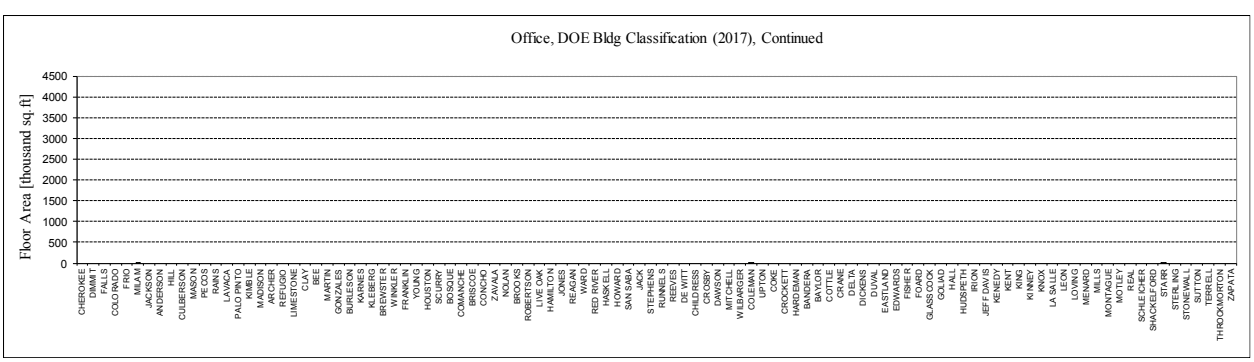
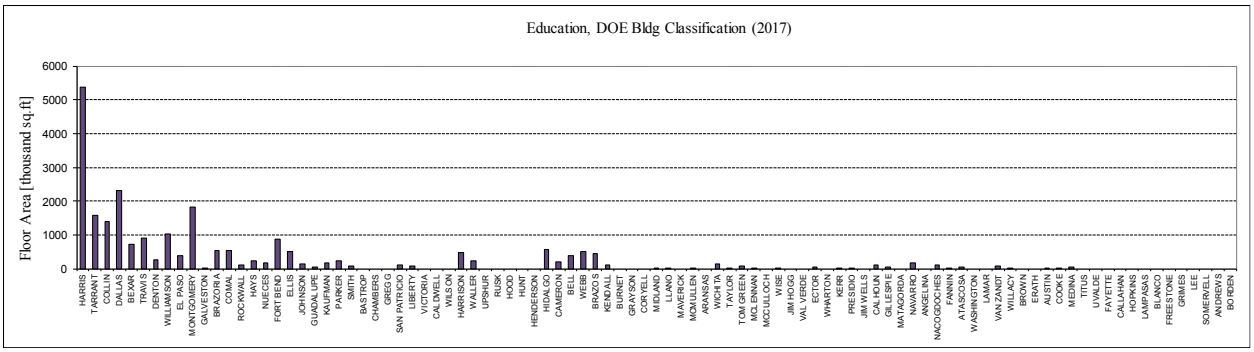
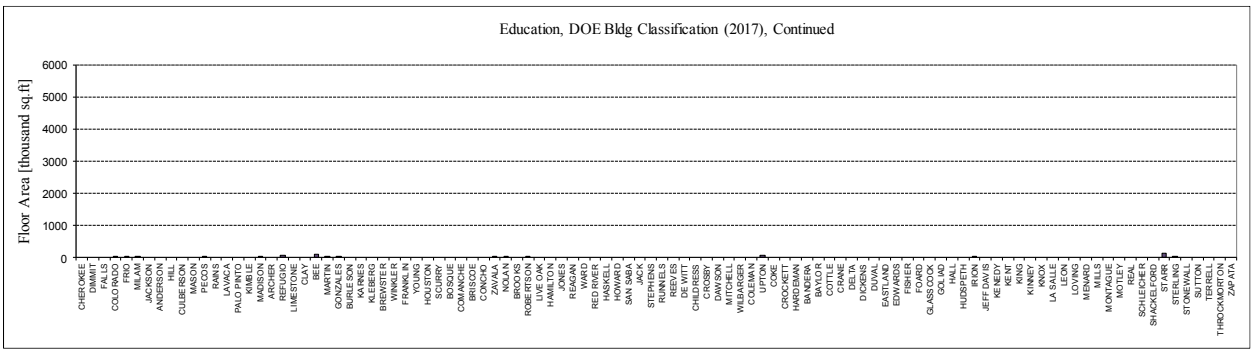
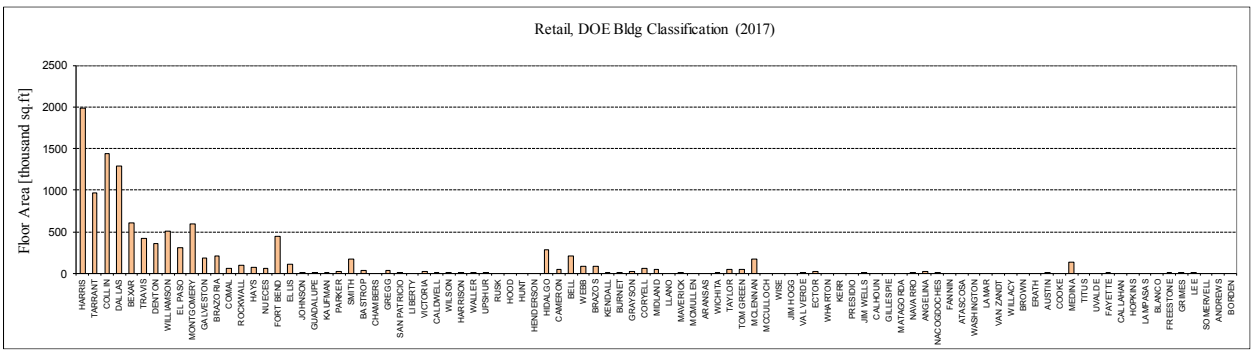


Figure 15: 2017 New Commercial Building Construction by Type (Dodge 2017) (Continued)







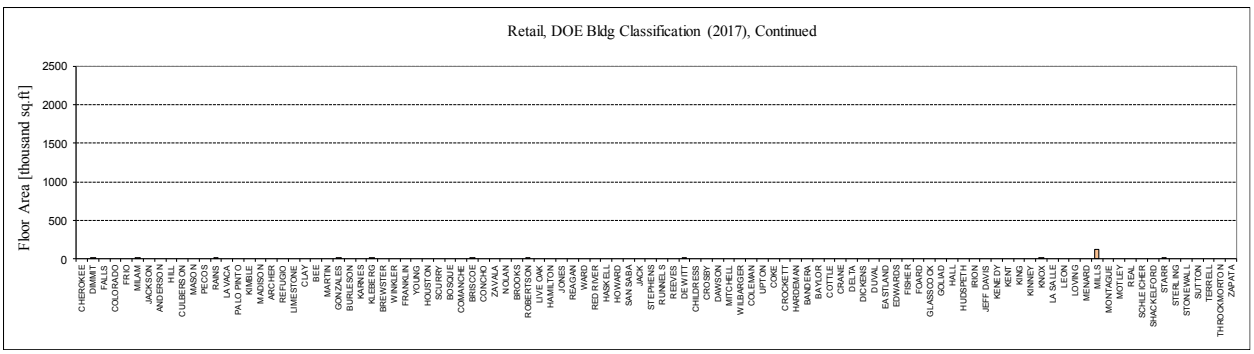


Figure 15: 2017 New Commercial Building Construction by Type (Dodge 2017) (Continued)

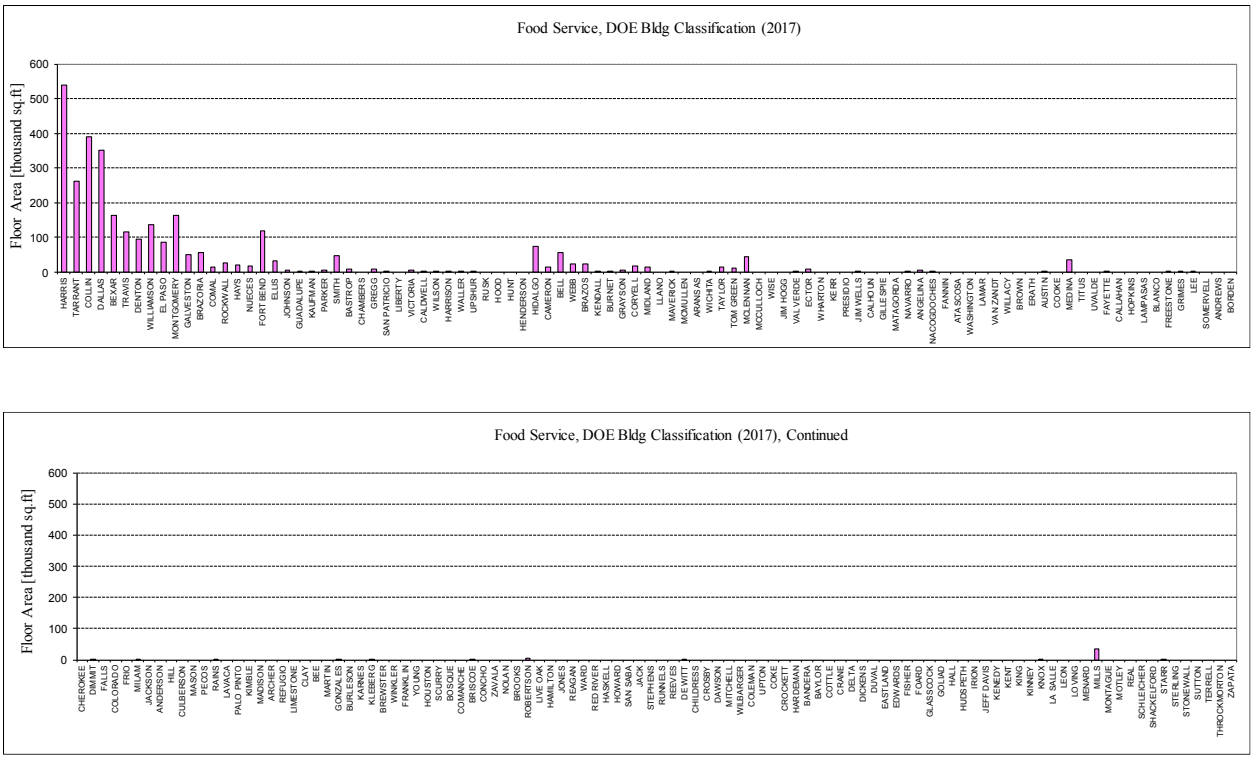


Figure 15: 2017 New Commercial Building Construction by Type (Dodge 2017) (Continued)

Table 21: Energy Use of ASHRAE Standard 90.1-2007 and 90.1-2013 Code-Compliant Apartment, Healthcare, and Lodging Building Types

Non-attainment Counties	Apartments				Healthcare				Lodging			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)
Brazoria	14950606	15356505	14438	14830	1188615	893063	2233	1683	3235722	2184870	10017	6313
Chambers	0	0	0	0	0	0	0	0	0	0	0	0
Collin	41479652	42605796	40057	41144	30220922	22706400	56767	42788	6882913	4647577	21308	13428
Dallas	141171559	145004272	136329	140031	16586450	12462180	31156	23483	17647642	11916288	54634	34429
Denton	23468857	24106020	22664	23279	3201739	2405617	6014	4533	5961923	4025693	18457	11631
El Paso	8541473	8773368	8249	8472	8239060	6190394	15476	11665	4886851	3299768	15129	9534
Ellis	841022	863855	812	834	0	0	0	0	0	0	0	0
Fort Bend	3221730	3309198	3111	3196	1035149	777756	1944	1466	2003066	1352538	6201	3908
Galveston	0	0	0	0	48146	36175	90	68	91048	61479	282	178
Harris	55813374	57328669	53899	55362	29236929	21967080	54918	41394	24374723	16458642	75460	47552
Johnson	2026328	2081341	1957	2010	0	0	0	0	0	0	0	0
Kaufman	3422647	3515569	3305	3395	0	0	0	0	0	0	0	0
Liberty	0	0	0	0	0	0	0	0	0	0	0	0
Montgomery	5365176	5510836	5181	5322	3632047	2728928	6822	5142	7152557	4829650	22143	13954
Parker	0	0	0	0	0	0	0	0	0	0	0	0
Rockwall	0	0	0	0	0	0	0	0	0	0	0	0
Tarrant	54764368	56251183	52886	54322	26411335	19844078	49611	37394	13067205	8823421	40454	25493
Waller	0	0	0	0	0	0	0	0	0	0	0	0
Wise	0	0	0	0	0	0	0	0	2754216	1859740	8527	5373
Affected Counties	Apartments				Healthcare				Lodging			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)
Bastrop	326111	334964	315	323	0	0	0	0	0	0	0	0
Bexar	63034250	64745587	60872	62525	18551427	13938560	34847	26266	7418698	5009357	22967	14473
Caldwell	0	0	0	0	0	0	0	0	0	0	0	0
Comal	9222973	9473370	8907	9148	2864714	2152394	5381	4056	1750932	1182289	5421	3416
Gregg	0	0	0	0	0	0	0	0	1015540	685727	3144	1981
Guadalupe	0	0	0	0	0	0	0	0	0	0	0	0
Harrison	0	0	0	0	0	0	0	0	0	0	0	0
Hays	5804365	5961949	5605	5757	496510	373051	933	703	4538415	3064492	14050	8854
Nueces	4462566	4583722	4310	4427	21819367	16393917	40985	30892	5347346	3610710	16554	10432
Rusk	0	0	0	0	0	0	0	0	0	0	0	0
San Patricio	1867816	1918526	1804	1853	0	0	0	0	0	0	0	0
Smith	959149	985189	926	951	0	0	0	0	0	0	0	0
Travis	100077586	102794625	96645	99269	7110628	5342549	13357	10067	12056917	8141240	37326	23522
Upshur	0	0	0	0	0	0	0	0	0	0	0	0
Victoria	0	0	0	0	0	0	0	0	0	0	0	0
Williamson	24218002	24875505	23387	24022	15232332	11444767	28612	21566	1680895	1134997	5204	3279
Wilson	232215	238519	224	230	0	0	0	0	0	0	0	0

Table 19: Energy Use of ASHRAE Standard 90.1-2007 and 90.1-2013 Code-Compliant Apartment, Healthcare, and Lodging Building Types (Continued)

Other ERCOT Counties	Apartments				Healthcare				Lodging			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)
ANDERSON	0	0	0	0	0	0	0	0	0	0	0	0
ANDREWS	0	0	0	0	0	0	0	0	0	0	0	0
ANGELINA	0	0	0	0	0	0	0	0	0	0	0	0
ARANSAS	0	0	0	0	105320	79132	198	149	0	0	0	0
ARCHER	0	0	0	0	0	0	0	0	0	0	0	0
ATASCOSA	0	0	0	0	0	0	0	0	0	0	0	0
AUSTIN	0	0	0	0	0	0	0	0	0	0	0	0
BANDERA	0	0	0	0	0	0	0	0	0	0	0	0
BAYLOR	0	0	0	0	0	0	0	0	0	0	0	0
BEE	0	0	0	0	0	0	0	0	0	0	0	0
BELL	3134902	3220013	3027	3110	6451624	4847408	12119	9134	875466	591144	2710	1708
BLANCO	0	0	0	0	0	0	0	0	0	0	0	0
BORDEN	0	0	0	0	0	0	0	0	0	0	0	0
BOSQUE	0	0	0	0	0	0	0	0	0	0	0	0
BRAZOS	9668220	9930706	9337	9590	6081498	4569315	11423	8610	4060411	2741728	12570	7921
BREWSTER	0	0	0	0	0	0	0	0	0	0	0	0
BRISCOE	0	0	0	0	0	0	0	0	0	0	0	0
BROOKS	0	0	0	0	0	0	0	0	0	0	0	0
BROWN	0	0	0	0	403226	302963	757	571	0	0	0	0
BURLESON	0	0	0	0	0	0	0	0	0	0	0	0
BURNET	0	0	0	0	0	0	0	0	0	0	0	0
CALHOUN	0	0	0	0	0	0	0	0	0	0	0	0
CALLAHAN	0	0	0	0	0	0	0	0	0	0	0	0
CAMERON	2497825	2565640	2412	2478	481464	361747	904	682	5667766	3827069	17546	11057
CHEROKEE	0	0	0	0	0	0	0	0	0	0	0	0
CHILDRESS	0	0	0	0	0	0	0	0	0	0	0	0
CLAY	673423	691706	650	668	0	0	0	0	0	0	0	0
COKE	0	0	0	0	0	0	0	0	0	0	0	0
COLEMAN	0	0	0	0	0	0	0	0	0	0	0	0
COLORADO	0	0	0	0	0	0	0	0	0	0	0	0
COMANCHE	0	0	0	0	0	0	0	0	0	0	0	0
CONCHO	0	0	0	0	0	0	0	0	0	0	0	0
COOKE	0	0	0	0	0	0	0	0	0	0	0	0
CORYELL	0	0	0	0	3610983	2713102	6783	5113	0	0	0	0
COTTLE	0	0	0	0	0	0	0	0	0	0	0	0
CRANE	0	0	0	0	0	0	0	0	0	0	0	0
CROCKETT	0	0	0	0	279851	210265	526	396	0	0	0	0
CROSBY	0	0	0	0	0	0	0	0	0	0	0	0
CULBERSON	0	0	0	0	0	0	0	0	0	0	0	0
DAWSON	0	0	0	0	0	0	0	0	0	0	0	0
DEWITT	0	0	0	0	0	0	0	0	0	0	0	0
DELTA	0	0	0	0	0	0	0	0	0	0	0	0
DICKENS	0	0	0	0	0	0	0	0	0	0	0	0
DIMMIT	0	0	0	0	0	0	0	0	0	0	0	0
DUVAL	0	0	0	0	0	0	0	0	0	0	0	0
EASTLAND	0	0	0	0	0	0	0	0	0	0	0	0
ECTOR	0	0	0	0	0	0	0	0	0	0	0	0
EDWARDS	0	0	0	0	0	0	0	0	0	0	0	0
ERATH	0	0	0	0	96293	72349	181	136	0	0	0	0
FALLS	0	0	0	0	0	0	0	0	0	0	0	0
FANNIN	0	0	0	0	0	0	0	0	0	0	0	0
FAYETTE	0	0	0	0	0	0	0	0	0	0	0	0
FISHER	0	0	0	0	0	0	0	0	0	0	0	0
FOARD	0	0	0	0	0	0	0	0	0	0	0	0
FRANKLIN	0	0	0	0	0	0	0	0	0	0	0	0
FREESTONE	0	0	0	0	0	0	0	0	0	0	0	0
FRIO	0	0	0	0	0	0	0	0	0	0	0	0
GILLESPIE	0	0	0	0	30092	22609	57	43	0	0	0	0
GLASSCOCK	0	0	0	0	0	0	0	0	0	0	0	0
GOLIAD	0	0	0	0	0	0	0	0	0	0	0	0
GONZALES	0	0	0	0	84256	63306	158	119	0	0	0	0
GRAYSON	3452936	3546681	3335	3425	0	0	0	0	0	0	0	0
GRIMES	0	0	0	0	0	0	0	0	0	0	0	0
HALL	0	0	0	0	0	0	0	0	0	0	0	0
HAMILTON	0	0	0	0	0	0	0	0	0	0	0	0
HARDEMAN	0	0	0	0	0	0	0	0	0	0	0	0
HASKELL	0	0	0	0	0	0	0	0	0	0	0	0
HENDERSON	484623	497780	468	481	947883	712189	1780	1342	0	0	0	0
HIDALGO	1686083	1731859	1628	1672	872654	655666	1639	1236	2817249	1902303	8722	5496
HILL	0	0	0	0	0	0	0	0	0	0	0	0
HOOD	0	0	0	0	0	0	0	0	0	0	0	0
HOPKINS	0	0	0	0	0	0	0	0	0	0	0	0
HOUSTON	0	0	0	0	0	0	0	0	0	0	0	0
HOWARD	0	0	0	0	0	0	0	0	0	0	0	0
HUDSPETH	0	0	0	0	0	0	0	0	0	0	0	0
HUNT	0	0	0	0	0	0	0	0	0	0	0	0
IRION	0	0	0	0	0	0	0	0	0	0	0	0
JACK	0	0	0	0	0	0	0	0	0	0	0	0
JACKSON	0	0	0	0	0	0	0	0	0	0	0	0
JEFF DAVIS	0	0	0	0	0	0	0	0	0	0	0	0
JIM HOGG	0	0	0	0	0	0	0	0	0	0	0	0

Table 19: Energy Use of ASHRAE Standard 90.1-2007 and 90.1-2013 Code-Compliant Apartment, Healthcare, and Lodging Building Types (Continued)

Other ERCOT Counties	Apartments				Healthcare				Lodging			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)
JIM WELLS	0	0	0	0	0	0	0	0	0	0	0	0
JONES	0	0	0	0	0	0	0	0	0	0	0	0
KARNES	0	0	0	0	0	0	0	0	0	0	0	0
KENDALL	1665890	1711118	1609	1652	1293936	972195	2431	1832	0	0	0	0
KENEDY	0	0	0	0	0	0	0	0	0	0	0	0
KENT	0	0	0	0	0	0	0	0	0	0	0	0
KERR	0	0	0	0	0	0	0	0	0	0	0	0
KIMBLE	0	0	0	0	0	0	0	0	0	0	0	0
KING	0	0	0	0	0	0	0	0	0	0	0	0
KINNEY	0	0	0	0	0	0	0	0	0	0	0	0
KLEBERG	0	0	0	0	0	0	0	0	0	0	0	0
KNOX	0	0	0	0	0	0	0	0	0	0	0	0
LA SALLE	0	0	0	0	0	0	0	0	0	0	0	0
LAMAR	0	0	0	0	0	0	0	0	0	0	0	0
LAMPASAS	0	0	0	0	0	0	0	0	0	0	0	0
LAVACA	0	0	0	0	0	0	0	0	0	0	0	0
LEE	0	0	0	0	0	0	0	0	0	0	0	0
LEON	0	0	0	0	0	0	0	0	0	0	0	0
LIMESTONE	0	0	0	0	0	0	0	0	0	0	0	0
LIVE OAK	0	0	0	0	0	0	0	0	0	0	0	0
LLANO	0	0	0	0	0	0	0	0	0	0	0	0
LOVING	0	0	0	0	0	0	0	0	0	0	0	0
MADISON	0	0	0	0	0	0	0	0	0	0	0	0
MARTIN	0	0	0	0	0	0	0	0	0	0	0	0
MASON	0	0	0	0	0	0	0	0	0	0	0	0
MATAGORDA	0	0	0	0	0	0	0	0	682863	461093	2114	1332
MAVERICK	0	0	0	0	0	0	0	0	0	0	0	0
MCCULLOCH	0	0	0	0	0	0	0	0	0	0	0	0
MCLENNAN	10060966	10334115	9716	9980	2888787	2170481	5426	4090	0	0	0	0
MCMULLEN	0	0	0	0	0	0	0	0	0	0	0	0
MEDINA	0	0	0	0	0	0	0	0	0	0	0	0
MENARD	0	0	0	0	0	0	0	0	0	0	0	0
MIDLAND	1625505	1669636	1570	1612	0	0	0	0	0	0	0	0
MILAM	0	0	0	0	0	0	0	0	131320	88672	407	256
MILLS	0	0	0	0	0	0	0	0	0	0	0	0
MITCHELL	0	0	0	0	0	0	0	0	0	0	0	0
MONTAGUE	0	0	0	0	0	0	0	0	0	0	0	0
MOTLEY	0	0	0	0	0	0	0	0	0	0	0	0
NACOGDOCHES	0	0	0	0	451373	339138	848	639	0	0	0	0
NAVARRO	0	0	0	0	0	0	0	0	0	0	0	0
NOLAN	0	0	0	0	0	0	0	0	0	0	0	0
PALO PINTO	805685	827559	778	799	0	0	0	0	0	0	0	0
PECOS	0	0	0	0	0	0	0	0	0	0	0	0
PRESIDIO	90867	93334	88	90	0	0	0	0	0	0	0	0
RAINS	0	0	0	0	0	0	0	0	0	0	0	0
REAGAN	0	0	0	0	0	0	0	0	0	0	0	0
REAL	0	0	0	0	0	0	0	0	0	0	0	0
RED RIVER	0	0	0	0	0	0	0	0	0	0	0	0
REEVES	0	0	0	0	0	0	0	0	0	0	0	0
REFUGIO	0	0	0	0	150458	113046	283	213	0	0	0	0
ROBERTSON	0	0	0	0	0	0	0	0	0	0	0	0
RUNNELS	0	0	0	0	0	0	0	0	0	0	0	0
SAN SABA	0	0	0	0	0	0	0	0	0	0	0	0
SCHLEICHER	0	0	0	0	0	0	0	0	0	0	0	0
SCURRY	0	0	0	0	0	0	0	0	0	0	0	0
SHACKELFORD	0	0	0	0	0	0	0	0	0	0	0	0
SOMERVELL	0	0	0	0	0	0	0	0	0	0	0	0
STARR	0	0	0	0	0	0	0	0	0	0	0	0
STEPHENS	0	0	0	0	0	0	0	0	0	0	0	0
STERLING	0	0	0	0	0	0	0	0	0	0	0	0
STONEWALL	0	0	0	0	0	0	0	0	0	0	0	0
SUTTON	0	0	0	0	0	0	0	0	0	0	0	0
TAYLOR	0	0	0	0	346053	260006	650	490	0	0	0	0
TERRELL	0	0	0	0	0	0	0	0	0	0	0	0
THROCKMORTON	0	0	0	0	0	0	0	0	0	0	0	0
TITUS	0	0	0	0	0	0	0	0	0	0	0	0
TOM GREEN	0	0	0	0	0	0	0	0	0	0	0	0
UPTON	0	0	0	0	0	0	0	0	0	0	0	0
UVALDE	0	0	0	0	0	0	0	0	0	0	0	0
VAL VERDE	0	0	0	0	75229	56523	141	107	0	0	0	0
VAN ZANDT	0	0	0	0	0	0	0	0	747648	504837	2315	1459
WARD	0	0	0	0	0	0	0	0	0	0	0	0
WASHINGTON	0	0	0	0	0	0	0	0	0	0	0	0
WEBB	35337	36296	34	35	186567	140177	350	264	0	0	0	0
WHARTON	0	0	0	0	0	0	0	0	0	0	0	0
WICHITA	1037900	1066078	1002	1030	692105	520011	1300	980	0	0	0	0
WILBARGER	0	0	0	0	0	0	0	0	0	0	0	0
WILLACY	0	0	0	0	0	0	0	0	0	0	0	0
WINKLER	0	0	0	0	0	0	0	0	0	0	0	0
YOUNG	0	0	0	0	0	0	0	0	0	0	0	0
ZAPATA	0	0	0	0	0	0	0	0	0	0	0	0
ZAVALA	0	0	0	0	0	0	0	0	0	0	0	0
Total	602191985	618541089	581537	597325	211405024	158838535	397100	299312	136849334	92405324	423661	266977

Table 22: Energy Use of ASHRAE Standard 90.1-2007 and 90.1-2013 Code-Compliant Office and Education Building Types

Non-attainment Counties	Office				Education			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)
Brazoria	1807501	1862265	688	750	6727873	5482809	22956	7679
Chambers	127561	131426	49	53	0	0	0	0
Collin	41450645	42706527	15787	17203	16899761	13772283	57664	19288
Dallas	45288879	46661052	17248	18796	28316238	23076021	96619	32318
Denton	1739164	1791858	662	722	3336428	2718987	11384	3808
El Paso	1043271	1074880	397	433	4671489	3806981	15940	5332
Ellis	392935	404840	150	163	6086017	4959736	20766	6946
Fort Bend	290430	299230	111	121	10594902	8634204	36151	12092
Galveston	829150	854271	316	344	366775	298899	1251	419
Harris	18893904	19466356	7196	7841	65781063	53607588	224454	75078
Johnson	445326	458819	170	185	1583245	1290249	5402	1807
Kaufman	0	0	0	0	2060052	1678818	7029	2351
Liberty	0	0	0	0	1075873	876771	3671	1228
Montgomery	761952	785038	290	316	22082289	17995730	75348	25203
Parker	0	0	0	0	2811940	2291561	9595	3209
Rockwall	35307	36377	13	15	1218915	993342	4159	1391
Tarrant	17831272	18371528	6791	7400	19238562	15678264	65645	21958
Waller	0	0	0	0	2986770	2434037	10191	3409
Wise	0	0	0	0	366775	298899	1251	419
Affected Counties	Office				Education			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)
Bastrop	0	0	0	0	0	0	0	0
Bexar	20488423	21109186	7803	8503	8875950	7233363	30286	10130
Caldwell	0	0	0	0	0	0	0	0
Comal	1023909	1054931	390	425	6593389	5373213	22498	7525
Gregg	0	0	0	0	0	0	0	0
Guadalupe	588833	606673	224	244	512262	417463	1748	585
Harrison	0	0	0	0	5760810	4694712	19657	6575
Hays	199315	205354	76	83	2752034	2242741	9390	3141
Nueces	2134377	2199045	813	886	1968358	1604093	6716	2247
Rusk	0	0	0	0	0	0	0	0
San Patricio	0	0	0	0	1260483	1027217	4301	1439
Smith	568332	585551	216	236	1020857	831936	3483	1165
Travis	30860765	31795792	11753	12808	11187854	9117425	38175	12769
Upshur	0	0	0	0	0	0	0	0
Victoria	100227	103264	38	42	0	0	0	0
Williamson	1458984	1503189	556	606	12628057	10291103	43089	14413
Wilson	0	0	0	0	0	0	0	0

Table 20: Energy Use of ASHRAE Standard 90.1-2007 and 90.1-2013 Code-Compliant Office and Education Building Types (Continued)

Other ERCOT Counties	Office				Education			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)
ANDERSON	0	0	0	0	0	0	0	0
ANDREWS	0	0	0	0	0	0	0	0
ANGELINA	0	0	0	0	0	0	0	0
ARANSAS	23918	24642	9	10	0	0	0	0
ARCHER	0	0	0	0	0	0	0	0
ATASCOSA	0	0	0	0	580727	473257	1982	663
AUSTIN	0	0	0	0	171162	139486	584	195
BANDERA	0	0	0	0	0	0	0	0
BAYLOR	0	0	0	0	0	0	0	0
BEE	0	0	0	0	1344841	1095964	4589	1535
BELL	282458	291016	108	117	4864657	3964401	16599	5552
BLANCO	0	0	0	0	0	0	0	0
BORDEN	0	0	0	0	0	0	0	0
BOSQUE	0	0	0	0	0	0	0	0
BRAZOS	153757	158416	59	64	5554193	4526332	18952	6339
BREWSTER	0	0	0	0	0	0	0	0
BRISCOE	0	0	0	0	0	0	0	0
BROOKS	0	0	0	0	0	0	0	0
BROWN	0	0	0	0	0	0	0	0
BURLESON	0	0	0	0	0	0	0	0
BURNET	375851	387238	143	156	0	0	0	0
CALHOUN	0	0	0	0	1198131	976404	4088	1367
CALLAHAN	0	0	0	0	0	0	0	0
CAMERON	728923	751008	278	303	2320462	1891036	7918	2648
CHEROKEE	0	0	0	0	0	0	0	0
CHILDRESS	0	0	0	0	0	0	0	0
CLAY	0	0	0	0	0	0	0	0
COKE	0	0	0	0	0	0	0	0
COLEMAN	97949	100917	37	41	0	0	0	0
COLORADO	0	0	0	0	184610	150446	630	211
COMANCHE	0	0	0	0	0	0	0	0
CONCHO	0	0	0	0	0	0	0	0
COOKE	0	0	0	0	97807	79706	334	112
CORYELL	0	0	0	0	0	0	0	0
COTTLE	0	0	0	0	0	0	0	0
CRANE	0	0	0	0	0	0	0	0
CROCKETT	0	0	0	0	0	0	0	0
CROSBY	0	0	0	0	0	0	0	0
CULBERSON	0	0	0	0	0	0	0	0
DAWSON	0	0	0	0	0	0	0	0
DEWITT	0	0	0	0	0	0	0	0
DELTA	0	0	0	0	0	0	0	0
DICKENS	0	0	0	0	0	0	0	0
DIMMIT	0	0	0	0	0	0	0	0
DUVAL	0	0	0	0	0	0	0	0
EASTLAND	0	0	0	0	0	0	0	0
ECTOR	0	0	0	0	712766	580861	2432	814
EDWARDS	0	0	0	0	0	0	0	0
ERATH	0	0	0	0	0	0	0	0
FALLS	0	0	0	0	0	0	0	0
FANNIN	0	0	0	0	264078	215207	901	301
FAYETTE	0	0	0	0	0	0	0	0
FISHER	0	0	0	0	0	0	0	0
FOARD	0	0	0	0	0	0	0	0
FRANKLIN	0	0	0	0	0	0	0	0
FREESTONE	0	0	0	0	0	0	0	0
FRIO	0	0	0	0	173607	141479	592	198
GILLESPIE	742590	765089	283	308	665085	542004	2269	759
GLASSCOCK	0	0	0	0	0	0	0	0
GOLIAD	0	0	0	0	0	0	0	0
GONZALES	0	0	0	0	134484	109596	459	153
GRAYSON	0	0	0	0	0	0	0	0
GRIMES	0	0	0	0	0	0	0	0
HALL	0	0	0	0	0	0	0	0
HAMILTON	0	0	0	0	0	0	0	0
HARDEMAN	0	0	0	0	0	0	0	0
HASKELL	0	0	0	0	0	0	0	0
HENDERSON	0	0	0	0	0	0	0	0
HIDALGO	2438474	2512356	929	1012	6921041	5640230	23616	7899
HILL	0	0	0	0	0	0	0	0
HOOD	0	0	0	0	122258	99633	417	140
HOPKINS	0	0	0	0	0	0	0	0
HOUSTON	0	0	0	0	0	0	0	0
HOWARD	0	0	0	0	0	0	0	0
HUDSPETH	0	0	0	0	0	0	0	0
HUNT	0	0	0	0	257965	210226	880	294
IRION	0	0	0	0	496369	404510	1694	567
JACK	0	0	0	0	0	0	0	0
JACKSON	0	0	0	0	0	0	0	0
JEFF DAVIS	0	0	0	0	0	0	0	0
JIM HOGG	0	0	0	0	0	0	0	0

Table 20: Energy Use of ASHRAE Standard 90.1-2007 and 90.1-2013 Code-Compliant Office and Education Building Types (Continued)

Other ERCOT Counties	Office				Education			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)
JIM WELLS	0	0	0	0	0	0	0	0
JONES	0	0	0	0	0	0	0	0
KARNES	0	0	0	0	0	0	0	0
KENDALL	650336	670040	248	270	1157786	943525	3951	1321
KENEDY	0	0	0	0	0	0	0	0
KENT	0	0	0	0	0	0	0	0
KERR	0	0	0	0	61129	49817	209	70
KIMBLE	0	0	0	0	0	0	0	0
KING	0	0	0	0	0	0	0	0
KINNEY	0	0	0	0	0	0	0	0
KLEBERG	0	0	0	0	0	0	0	0
KNOX	0	0	0	0	0	0	0	0
LA SALLE	0	0	0	0	0	0	0	0
LAMAR	0	0	0	0	0	0	0	0
LAMPASAS	0	0	0	0	0	0	0	0
LAVACA	0	0	0	0	0	0	0	0
LEE	0	0	0	0	0	0	0	0
LEON	0	0	0	0	0	0	0	0
LIMESTONE	0	0	0	0	0	0	0	0
LIVE OAK	0	0	0	0	0	0	0	0
LLANO	46697	48111	18	19	361884	294914	1235	413
LOVING	0	0	0	0	0	0	0	0
MADISON	0	0	0	0	751888	612744	2566	858
MARTIN	0	0	0	0	612514	499162	2090	699
MASON	0	0	0	0	0	0	0	0
MATAGORDA	61503	63366	23	26	0	0	0	0
MAVERICK	0	0	0	0	0	0	0	0
MCCULLOCH	0	0	0	0	0	0	0	0
MCLENNAN	41002	42244	16	17	202949	165391	692	232
MCMULLEN	0	0	0	0	42790	34872	146	49
MEDINA	0	0	0	0	544049	443367	1856	621
MENARD	0	0	0	0	0	0	0	0
MIDLAND	56947	58672	22	24	366775	298899	1251	419
MILAM	208426	214741	79	87	311759	254064	1064	356
MILLS	0	0	0	0	0	0	0	0
MITCHELL	0	0	0	0	0	0	0	0
MONTAGUE	0	0	0	0	0	0	0	0
MOTLEY	0	0	0	0	0	0	0	0
NACOGDOCHES	0	0	0	0	1137002	926588	3880	1298
NAVARRO	0	0	0	0	1931681	1574203	6591	2205
NOLAN	0	0	0	0	207839	169376	709	237
PALO PINTO	0	0	0	0	0	0	0	0
PECOS	0	0	0	0	317872	259046	1085	363
PRESIDIO	0	0	0	0	18339	14945	63	21
RAINS	0	0	0	0	0	0	0	0
REAGAN	0	0	0	0	0	0	0	0
REAL	0	0	0	0	0	0	0	0
RED RIVER	0	0	0	0	0	0	0	0
REEVES	0	0	0	0	0	0	0	0
REFUGIO	0	0	0	0	1132112	922602	3863	1292
ROBERTSON	0	0	0	0	199281	162402	680	227
RUNNELS	0	0	0	0	0	0	0	0
SAN SABA	0	0	0	0	0	0	0	0
SCHLEICHER	0	0	0	0	0	0	0	0
SCURRY	0	0	0	0	0	0	0	0
SHACKELFORD	0	0	0	0	0	0	0	0
SOMERVELL	0	0	0	0	0	0	0	0
STARR	60364	62193	23	25	1881555	1533353	6420	2147
STEPHENS	0	0	0	0	0	0	0	0
STERLING	0	0	0	0	50126	40850	171	57
STONEWALL	0	0	0	0	0	0	0	0
SUTTON	0	0	0	0	0	0	0	0
TAYLOR	17084	17602	7	7	311759	254064	1064	356
TERRELL	0	0	0	0	0	0	0	0
THROCKMORTON	0	0	0	0	0	0	0	0
TITUS	0	0	0	0	0	0	0	0
TOM GREEN	378129	389585	144	157	916937	747248	3129	1047
UPTON	0	0	0	0	1023302	833929	3492	1168
UVALDE	0	0	0	0	0	0	0	0
VAL VERDE	0	0	0	0	0	0	0	0
VAN ZANDT	0	0	0	0	794679	647615	2712	907
WARD	0	0	0	0	0	0	0	0
WASHINGTON	0	0	0	0	0	0	0	0
WEBB	646919	666519	246	268	6191159	5045420	21125	7066
WHARTON	0	0	0	0	0	0	0	0
WICHITA	23918	24642	9	10	1522115	1240432	5194	1737
WILBARGER	0	0	0	0	0	0	0	0
WILLACY	0	0	0	0	110032	89670	375	126
WINKLER	0	0	0	0	0	0	0	0
YOUNG	0	0	0	0	0	0	0	0
ZAPATA	0	0	0	0	0	0	0	0
ZAVALA	0	0	0	0	46458	37861	159	53
Total	195395702	201315850	74417	81095	297035028	242065582	1013525	339017

Table 23: Energy Use of ASHRAE Standard 90.1-2007 and 90.1-2013 Code-Compliant Retail and Food Service Building Types

Non-attainment Counties	Retail				Food Service			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)
Brazoria	3210388	2428451	3187	2429	3409039	3469011	15121	15457
Chambers	0	0	0	0	0	0	0	0
Collin	21700175	16414780	21542	16415	23042930	23448305	102207	104479
Dallas	19612292	14835432	19470	14836	20825854	21192226	92373	94427
Denton	5354218	4050120	5315	4050	5685524	5785545	25218	25779
El Paso	4755469	3597205	4721	3597	5049726	5138562	22398	22896
Ellis	1715302	1297515	1703	1298	1821441	1853484	8079	8259
Fort Bend	6707651	5073905	6659	5074	7122705	7248009	31593	32295
Galveston	2756863	2085388	2737	2085	2927451	2978951	12985	13273
Harris	30046945	22728573	29828	22729	31906179	32467478	141520	144666
Johnson	215454	162977	214	163	228786	232811	1015	1037
Kaufman	30949	23411	31	23	32864	33442	146	149
Liberty	0	0	0	0	0	0	0	0
Montgomery	9055032	6849547	8989	6850	9615336	9784490	42649	43597
Parker	269020	203496	267	204	285667	290692	1267	1295
Rockwall	1534368	1160650	1523	1161	1629311	1657974	7227	7387
Tarrant	14584232	11032029	14478	11032	15486669	15759113	68691	70218
Waller	95228	72034	95	72	101121	102900	449	458
Wise	0	0	0	0	0	0	0	0
Affected Counties	Retail				Food Service			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)
Bastrop	520185	393487	516	393	552373	562090	2450	2505
Bexar	9107407	6889165	9041	6889	9670952	9841085	42896	43849
Caldwell	108322	81939	108	82	115025	117049	510	522
Comal	813013	614991	807	615	863320	878508	3829	3914
Gregg	498759	377279	495	377	529621	538938	2349	2401
Guadalupe	202360	153073	201	153	214882	218662	953	974
Harrison	33330	25212	33	25	35392	36015	157	160
Hays	1089175	823891	1081	824	1156571	1176917	5130	5244
Nueces	985614	745553	978	746	1046602	1065014	4642	4745
Rusk	0	0	0	0	0	0	0	0
San Patricio	36901	27913	37	28	39184	39874	174	178
Smith	2678299	2025960	2659	2026	2844026	2894059	12615	12895
Travis	6399349	4840694	6353	4841	6795326	6914870	30141	30811
Upshur	83325	63030	83	63	88481	90037	392	401
Victoria	323777	244916	321	245	343811	349860	1525	1559
Williamson	7630177	5771736	7575	5772	8102314	8244851	35938	36737
Wilson	172601	130562	171	131	183282	186506	813	831

Table 21: Energy Use of ASHRAE Standard 90.1-2007 and 90.1-2013 Code-Compliant Retail and Food Service Building Types (Continued)

Other ERCOT Counties	Retail				Food Service			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)
ANDERSON	0	0	0	0	0	0	0	0
ANDREWS	0	0	0	0	0	0	0	0
ANGELINA	258307	195393	256	195	274291	279116	1217	1244
ARANSAS	0	0	0	0	0	0	0	0
ARCHER	0	0	0	0	0	0	0	0
ATASCOSA	0	0	0	0	0	0	0	0
AUSTIN	29759	22511	30	23	31600	32156	140	143
BANDERA	0	0	0	0	0	0	0	0
BAYLOR	0	0	0	0	0	0	0	0
BEE	0	0	0	0	0	0	0	0
BELL	3137776	2373525	3115	2374	3331934	3390550	14779	15107
BLANCO	0	0	0	0	0	0	0	0
BORDEN	0	0	0	0	0	0	0	0
BOSQUE	0	0	0	0	0	0	0	0
BRAZOS	1336769	1011179	1327	1011	1419485	1444457	6296	6436
BREWSTER	0	0	0	0	0	0	0	0
BRISCOE	108322	81939	108	82	115025	117049	510	522
BROOKS	0	0	0	0	0	0	0	0
BROWN	0	0	0	0	0	0	0	0
BURLESON	0	0	0	0	0	0	0	0
BURNET	52376	39619	52	40	55617	56595	247	252
CALHOUN	0	0	0	0	0	0	0	0
CALLAHAN	0	0	0	0	0	0	0	0
CAMERON	717784	542957	713	543	762199	775608	3381	3456
CHEROKEE	0	0	0	0	0	0	0	0
CHILDRESS	0	0	0	0	0	0	0	0
CLAY	0	0	0	0	0	0	0	0
COKE	0	0	0	0	0	0	0	0
COLEMAN	0	0	0	0	0	0	0	0
COLORADO	0	0	0	0	0	0	0	0
COMANCHE	0	0	0	0	0	0	0	0
CONCHO	0	0	0	0	0	0	0	0
COOKE	0	0	0	0	0	0	0	0
CORYELL	943952	714038	937	714	1002361	1019995	4446	4545
COTTLE	0	0	0	0	0	0	0	0
CRANE	0	0	0	0	0	0	0	0
CROCKETT	0	0	0	0	0	0	0	0
CROSBY	0	0	0	0	0	0	0	0
CULBERSON	0	0	0	0	0	0	0	0
DAWSON	0	0	0	0	0	0	0	0
DEWITT	104751	79238	104	79	111233	113190	493	504
DELTA	0	0	0	0	0	0	0	0
DICKENS	0	0	0	0	0	0	0	0
DIMMIT	85706	64831	85	65	91009	92610	404	413
DUVAL	0	0	0	0	0	0	0	0
EASTLAND	0	0	0	0	0	0	0	0
ECTOR	391627	296240	389	296	415860	423176	1845	1886
EDWARDS	0	0	0	0	0	0	0	0
ERATH	0	0	0	0	0	0	0	0
FALLS	0	0	0	0	0	0	0	0
FANNIN	0	0	0	0	0	0	0	0
FAYETTE	85706	64831	85	65	91009	92610	404	413
FISHER	0	0	0	0	0	0	0	0
FOARD	0	0	0	0	0	0	0	0
FRANKLIN	0	0	0	0	0	0	0	0
FREESTONE	108322	81939	108	82	115025	117049	510	522
FRIO	0	0	0	0	0	0	0	0
GILLESPIE	0	0	0	0	0	0	0	0
GLASSCOCK	0	0	0	0	0	0	0	0
GOLIAD	0	0	0	0	0	0	0	0
GONZALES	77373	58528	77	59	82161	83606	364	373
GRAYSON	258307	195393	256	195	274291	279116	1217	1244
GRIMES	108322	81939	108	82	115025	117049	510	522
HALL	0	0	0	0	0	0	0	0
HAMILTON	0	0	0	0	0	0	0	0
HARDEMAN	0	0	0	0	0	0	0	0
HASKELL	0	0	0	0	0	0	0	0
HENDERSON	89277	67532	89	68	94801	96469	420	430
HIDALGO	4206715	3182108	4176	3182	4467017	4545601	19813	20254
HILL	0	0	0	0	0	0	0	0
HOOD	103561	78337	103	78	109969	111904	488	499
HOPKINS	0	0	0	0	0	0	0	0
HOUSTON	0	0	0	0	0	0	0	0
HOWARD	0	0	0	0	0	0	0	0
HUDSPETH	0	0	0	0	0	0	0	0
HUNT	1504609	1138139	1494	1138	1597711	1625818	7087	7244
IRION	0	0	0	0	0	0	0	0
JACK	0	0	0	0	0	0	0	0
JACKSON	0	0	0	0	0	0	0	0
JEFF DAVIS	0	0	0	0	0	0	0	0
JIM HOGG	0	0	0	0	0	0	0	0

Table 21: Energy Use of ASHRAE Standard 90.1-2007 and 90.1-2013 Code-Compliant Retail and Food Service Building Types (Continued)

Other ERCOT Counties	Retail				Food Service			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)	2007 (Annual)	2013 (Annual)
JIM WELLS	179744	135964	178	136	190866	194223	847	865
JONES	0	0	0	0	0	0	0	0
KARNES	0	0	0	0	0	0	0	0
KENDALL	39282	29714	39	30	41712	42446	185	189
KENEDY	0	0	0	0	0	0	0	0
KENT	0	0	0	0	0	0	0	0
KERR	0	0	0	0	0	0	0	0
KIMBLE	0	0	0	0	0	0	0	0
KING	0	0	0	0	0	0	0	0
KINNEY	0	0	0	0	0	0	0	0
KLEBERG	14284	10805	14	11	15168	15435	67	69
KNOX	108322	81939	108	82	115025	117049	510	522
LA SALLE	0	0	0	0	0	0	0	0
LAMAR	0	0	0	0	0	0	0	0
LAMPASAS	0	0	0	0	0	0	0	0
LAVACA	0	0	0	0	0	0	0	0
LEE	83325	63030	83	63	88481	90037	392	401
LEON	0	0	0	0	0	0	0	0
LIMESTONE	0	0	0	0	0	0	0	0
LIVE OAK	0	0	0	0	0	0	0	0
LLANO	0	0	0	0	0	0	0	0
LOVING	0	0	0	0	0	0	0	0
MADISON	0	0	0	0	0	0	0	0
MARTIN	0	0	0	0	0	0	0	0
MASON	0	0	0	0	0	0	0	0
MATAGORDA	0	0	0	0	0	0	0	0
MAVERICK	38091	28814	38	29	40448	41160	179	183
MCCULLOCH	0	0	0	0	0	0	0	0
MCLENNAN	2503317	1893598	2485	1894	2658216	2704980	11791	12053
MCMULLEN	0	0	0	0	0	0	0	0
MEDINA	1970038	1490206	1956	1490	2091939	2128741	9279	9485
MENARD	0	0	0	0	0	0	0	0
MIDLAND	792777	599684	787	600	841832	856641	3734	3817
MILAM	46424	35117	46	35	49296	50164	219	224
MILLS	1904568	1440683	1891	1441	2022418	2057997	8970	9170
MITCHELL	0	0	0	0	0	0	0	0
MONTAGUE	0	0	0	0	0	0	0	0
MOTLEY	0	0	0	0	0	0	0	0
NACOGDOCHES	91657	69333	91	69	97329	99041	432	441
NAVARRO	44043	33316	44	33	46768	47591	207	212
NOLAN	0	0	0	0	0	0	0	0
PALO PINTO	0	0	0	0	0	0	0	0
PECOS	0	0	0	0	0	0	0	0
PRESIDIO	0	0	0	0	0	0	0	0
RAINS	85706	64831	85	65	91009	92610	404	413
REAGAN	0	0	0	0	0	0	0	0
REAL	0	0	0	0	0	0	0	0
RED RIVER	0	0	0	0	0	0	0	0
REEVES	0	0	0	0	0	0	0	0
REFUGIO	0	0	0	0	0	0	0	0
ROBERTSON	258307	195393	256	195	274291	279116	1217	1244
RUNNELS	0	0	0	0	0	0	0	0
SAN SABA	0	0	0	0	0	0	0	0
SCHLEICHER	0	0	0	0	0	0	0	0
SCURRY	0	0	0	0	0	0	0	0
SHACKELFORD	0	0	0	0	0	0	0	0
SOMERVELL	0	0	0	0	0	0	0	0
STARR	49995	37818	50	38	53088	54022	235	241
STEPHENS	0	0	0	0	0	0	0	0
STERLING	0	0	0	0	0	0	0	0
STONEWALL	0	0	0	0	0	0	0	0
SUTTON	0	0	0	0	0	0	0	0
TAYLOR	721355	545659	716	546	765991	779466	3398	3473
TERRELL	0	0	0	0	0	0	0	0
THROCKMORTON	0	0	0	0	0	0	0	0
TITUS	0	0	0	0	0	0	0	0
TOM GREEN	627317	474525	623	475	666134	677853	2955	3020
UPTON	0	0	0	0	0	0	0	0
UVALDE	0	0	0	0	0	0	0	0
VAL VERDE	30949	23411	31	23	32864	33442	146	149
VAN ZANDT	0	0	0	0	0	0	0	0
WARD	0	0	0	0	0	0	0	0
WASHINGTON	0	0	0	0	0	0	0	0
WEBB	1228447	929240	1220	929	1304460	1327408	5786	5915
WHARTON	0	0	0	0	0	0	0	0
WICHITA	46424	35117	46	35	49296	50164	219	224
WILBARGER	0	0	0	0	0	0	0	0
WILLACY	0	0	0	0	0	0	0	0
WINKLER	0	0	0	0	0	0	0	0
YOUNG	0	0	0	0	0	0	0	0
ZAPATA	0	0	0	0	0	0	0	0
ZAVALA	0	0	0	0	0	0	0	0
Total	176899872	133813324	175613	133817	187846019	191150635	833192	851713

Table 24: Annual Electricity and Natural Gas Savings from New Commercial Construction

Counties	Apartments		Healthcare		Lodging		Office		Education		Retail		Food Service		Total		Total*1.07 (T&D loss) for eGrid	
	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	MWh/yr	Therm/yr
Non-attainment Counties																		
(square feet in thousands)																		
BRAZORIA	405899	392	-295553	-550	-1050853	-3705	54764	62	-1245063	-15278	-781937	-759	59972	336	-2852770	-19501	3052	208659
CHAMBERS	0	0	0	0	0	0	3865	4	0	0	0	0	0	0	3865	4	-4	-47
COLLIN	1126144	1088	-7514522	-13979	-2235336	-7881	1255882	1416	-3127478	-38376	-5285395	-5127	405375	2272	-15375330	-60587	16452	648278
DALLAS	3832712	3701	-4124270	-7672	-5731354	-20205	1372174	1548	-5240217	-64301	-4776860	-4634	366372	2053	-14301444	-89510	15303	957755
DENTON	637164	615	-796122	-1481	-1936230	-6826	52694	59	-617441	-7576	-1304098	-1265	100021	561	-3864013	-15913	4134	170270
EL PASO	231895	224	-2048667	-3811	-1587083	-5595	31609	36	-864508	-10608	-1158264	-1124	88836	498	-5306182	-20380	5678	218070
ELLIS	22833	22	0	0	0	0	11905	13	-1126281	-13820	-417787	-405	32043	180	-1477287	-14010	1581	149911
FORT BEND	87468	84	-257393	-479	-650528	-2293	8800	10	-1960698	-24059	-1633746	-1585	125304	702	-4280794	-27619	4580	295526
GALVESTON	0	0	-11972	-22	-29569	-104	25122	28	-67876	-833	-671474	-651	51500	289	-704269	-1294	754	13843
HARRIS	1515295	1463	-7269849	-13524	-7916081	-27908	572452	646	-12173475	-149376	-7318372	-7099	561299	3146	-32028732	-192652	34271	2061372
JOHNSON	55013	53	0	0	0	0	13493	15	-292996	-3595	-52477	-51	4025	23	-272942	-3555	292	38041
KAUFMAN	92923	90	0	0	0	0	0	0	-381234	-4678	-7538	-7	578	3	-295272	-4592	316	49138
LIBERTY	0	0	0	0	0	0	0	0	-199102	-2443	0	0	0	0	-199102	-2443	213	26141
MONTGOMERY	145661	141	-903119	-1680	-2322907	-8189	23086	26	-4086559	-50145	-2205485	-2139	169155	948	-9180170	-61038	9823	653112
PARKER	0	0	0	0	0	0	0	0	-520379	-6385	-65524	-64	5025	28	-580877	-6421	622	68702
ROCKWALL	0	0	0	0	0	0	1070	1	-225573	-2768	-373718	-363	28663	161	-569558	-2969	609	31764
TARRANT	1486815	1436	-6567257	-12217	-4243784	-14961	540256	609	-3560297	-43687	-3552203	-3446	272444	1527	-15624025	-70739	16718	756904
WALLER	0	0	0	0	0	0	0	0	-552733	-6782	-23194	-22	1779	10	-574148	-6795	614	72705
WISE	0	0	0	0	-894476	-3153	0	0	-67876	-833	0	0	0	0	-962351	-3986	1030	42653
Affected Counties																		
(square feet in thousands)																		
BASTROP	8854	9	0	0	0	0	0	0	0	0	-126699	-123	9717	54	-108128	-60	116	641
BEXAR	1711337	1653	-4612868	-8581	-2409341	-8494	620763	700	-1642588	-20156	-2218242	-2152	170133	954	-8380805	-36076	8967	386015
CALDWELL	0	0	0	0	0	0	0	0	0	0	-26383	-26	2024	11	-24360	-14	26	152
COMAL	250397	242	-712320	-1325	-568643	-2005	31023	35	-1220176	-14972	-198021	-192	15188	85	-2402552	-18132	2571	194015
GREGG	0	0	0	0	-329813	-1163	0	0	0	0	-121480	-118	9317	52	-441976	-1228	473	13143
GUADALUPE	0	0	0	0	0	0	17841	20	-94799	-1163	-49288	-48	3780	21	-122466	-1170	131	12516
HARRISON	0	0	0	0	0	0	0	0	-1066098	-13082	-8118	-8	623	3	-1073594	-13086	1149	140021
HAYS	157585	152	-123459	-230	-1473923	-5196	6039	7	-509293	-6249	-265284	-257	20347	114	-2187989	-11660	2341	124757
NUECES	121156	117	-5425451	-10093	-1736636	-6122	64668	73	-364265	-4470	-240061	-233	18412	103	-7562177	-20625	8092	220684
RUSK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAN PATRICIO	50710	49	0	0	0	0	0	0	-233266	-2862	-8988	-9	689	4	-190854	-2818	204	30155
SMITH	26040	25	0	0	0	0	17219	19	-188920	-2318	-652339	-633	50033	280	-747967	-2626	800	28098
TRAVIS	2717039	2624	-1768079	-3289	-3915677	-13804	935027	1055	-2070430	-25405	-1558655	-1512	119544	670	-5541230	-39662	5929	424389
UPSHUR	0	0	0	0	0	0	0	0	0	0	-20295	-20	1557	9	-18738	-11	20	117
VICTORIA	0	0	0	0	0	0	3037	3	0	0	-78861	-76	6048	34	-69775	-39	75	419
WILLIAMSON	657502	635	-3787565	-7046	-545897	-1925	44205	50	-2336954	-28676	-1858441	-1803	142537	799	-7684613	-37965	8223	406229
WILSON	6304	6	0	0	0	0	0	0	0	0	-42040	-41	3224	18	-32511	-17	35	178

Note: A decrease in energy use is negative (i.e., savings); an increase in energy use is positive (i.e., more consumption)

Table 22: Annual Electricity and Natural Gas Savings from New Commercial Construction (Continued)

Counties	Apartments		Healthcare		Lodging		Office		Education		Retail		Food Service		Total		Total*1.07 (T&D loss) for eGrid	
	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	MWh/yr	Therm/yr
Other ERCOT Counties																		
(square feet in thousands)																		
ANDERSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANDREWS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANGELINA	0	0	0	0	0	0	0	0	0	0	-62914	-61	4825	27	-58089	-34	62	364
ARANSAS	0	0	-26188	-49	0	0	725	1	0	0	0	0	0	0	-25464	-48	27	513
ARCHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ATASCOSA	0	0	0	0	0	0	0	0	-107470	-1319	0	0	0	0	-107470	-1319	115	14110
AUSTIN	0	0	0	0	0	0	0	0	-31675	-389	-7248	-7	556	3	-38368	-393	41	4201
BANDERA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BAYLOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BEE	0	0	0	0	0	0	0	0	-248877	-3054	0	0	0	0	-248877	-3054	266	32676
BELL	85110	82	-1604215	-2984	-284322	-1002	8558	10	-900256	-11047	-764251	-741	58616	329	-3400760	-15354	3639	164291
BLANCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BORDEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BOSQUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BRAZOS	262486	253	-1512183	-2813	-1318683	-4649	4659	5	-1027862	-12612	-325590	-316	24972	140	-3892201	-19992	4165	213910
BREWSTER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BRISCOE	0	0	0	0	0	0	0	0	0	0	-26383	-26	2024	11	-24360	-14	26	152
BROOKS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BROWN	0	0	-100263	-187	0	0	0	0	0	0	0	0	0	0	-100263	-187	107	1996
BURLESON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BURNET	0	0	0	0	0	0	11388	13	0	0	-12757	-12	978	5	-391	6	0	-64
CALHOUN	0	0	0	0	0	0	0	0	-221727	-2721	0	0	0	0	-221727	-2721	237	29112
CALLAHAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMERON	67814	65	-119718	-223	-1840698	-6489	22085	25	-429426	-5269	-174827	-170	13409	75	-2461360	-11985	2634	128243
CHEROKEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHILDRESS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLAY	18283	18	0	0	0	0	0	0	0	0	0	0	0	0	18283	18	-20	-189
COKE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COLEMAN	0	0	0	0	0	0	2968	3	0	0	0	0	0	0	2968	3	-3	-36
COLORADO	0	0	0	0	0	0	0	0	-34164	-419	0	0	0	0	-34164	-419	37	4486
COMANCHE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CONCHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COOKE	0	0	0	0	0	0	0	0	-18100	-222	0	0	0	0	-18100	-222	19	2376
CORYELL	0	0	-897882	-1670	0	0	0	0	0	0	-229913	-223	17634	99	-1110161	-1794	1188	19201
COTTLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CRANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CROCKETT	0	0	-69586	-129	0	0	0	0	0	0	0	0	0	0	-69586	-129	74	1385
CROSBY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CULBERSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DAWSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEWITT	0	0	0	0	0	0	0	0	0	0	-25514	-25	1957	11	-23557	-14	25	147
DELTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DICKENS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIMMIT	0	0	0	0	0	0	0	0	0	0	-20875	-20	1601	9	-19274	-11	21	121
DUVAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EASTLAND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ECTOR	0	0	0	0	0	0	0	0	-131905	-1619	-95386	-93	7316	41	-219975	-1670	235	17870
EDWARDS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ERATH	0	0	-23944	-45	0	0	0	0	0	0	0	0	0	0	-23944	-45	26	477
FALLS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FANNIN	0	0	0	0	0	0	0	0	-48870	-600	0	0	0	0	-48870	-600	52	6416
FAYETTE	0	0	0	0	0	0	0	0	0	0	-20875	-20	1601	9	-19274	-11	21	121
FISHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FOARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRANKLIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FREESTONE	0	0	0	0	0	0	0	0	0	0	-26383	-26	2024	11	-24360	-14	26	152
FRIO	0	0	0	0	0	0	0	0	-32128	-394	0	0	0	0	-32128	-394	34	4218
GILLESPIE	0	0	-7482	-14	0	0	22499	25	-123081	-1510	0	0	0	0	-108064	-1499	116	16037
GLASSCOCK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOLIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GONZALES	0	0	-20951	-39	0	0	0	0	-24888	-305	-18845	-18	1445	8	-63238	-355	68	3794
GRAYSON	93745	91	0	0	0	0	0	0	0	0	-62914	-61	4825	27	35656	57	-38	-605
GRIMES	0	0	0	0	0	0	0	0	0	0	-26383	-26	2024	11	-24360	-14	26	152
HALL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAMILTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HARDEMAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HASKELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HENDERSON	13157	13	-235694	-438	0	0	0	0	0	0	-21745	-21	1668	9	-242614	-437	260	4681
HIDALGO	45776	44	-216988	-404	-914947	-3226	73882	83	-1280811	-15716	-1024607	-994	78584	440	-3239111	-19772	3466	211555
HILL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOOD	0	0	0	0	0	0	0	0	-22625	-278	-25224	-24	1935	11	-45914	-291	49	3116
HOPKINS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOUSTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOWARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HUDSPETH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HUNT	0	0	0	0	0	0	0	0	-47739	-586	-366469	-355	28107	158	-386101	-784	413	8386
IRION	0	0	0	0	0	0	0	0	-91858	-1127	0	0	0	0	-91858	-1127	98	12061
JACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JACKSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JEFF DAVIS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JIM HOGG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JIM WELLS	0	0	0	0	0	0	0	0	0	0	-43779	-42	3358	19	-40421	-24	43	253
JONES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KARNES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: A decrease in energy use is negative (i.e., savings); an increase in energy use is positive (i.e., more consumption)

Table 22: Annual Electricity and Natural Gas Savings from New Commercial Construction (Continued)

Counties	Apartments		Healthcare		Lodging		Office		Education		Retail		Food Service		Total		Total*1.07 (T&D loss) for eGrid	
	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	MWh/yr	Therm/yr
Other ERCOT Counties																		
(square feet in thousands)																		
KENDALL	45228	44	-321741	-599	0	0	19704	22	-214260	-2629	-9568	-9	734	4	-479903	-3167	513	33886
KENEDY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KERR	0	0	0	0	0	0	0	0	-11313	-139	0	0	0	0	-11313	-139	12	1485
KIMBLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KINNEY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KLEBERG	0	0	0	0	0	0	0	0	0	0	-3479	-3	267	1	-3212	-2	3	20
KNOX	0	0	0	0	0	0	0	0	0	0	-26383	-26	2024	11	-24360	-14	26	152
LA SALLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAMAR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAMPASAS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAVACA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LEE	0	0	0	0	0	0	0	0	0	0	-20295	-20	1557	9	-18738	-11	20	117
LEON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIMESTONE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIVE OAK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LLANO	0	0	0	0	0	0	1415	2	-66971	-822	0	0	0	0	-65556	-820	70	8776
LOVING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MADISON	0	0	0	0	0	0	0	0	-139145	-1707	0	0	0	0	-139145	-1707	149	18269
MARTIN	0	0	0	0	0	0	0	0	-113352	-1391	0	0	0	0	-113352	-1391	121	14883
MASON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MATAGORDA	0	0	0	0	-221771	-782	1863	2	0	0	0	0	0	0	-219907	-780	235	8343
MAVERICK	0	0	0	0	0	0	0	0	0	0	-9278	-9	712	4	-8566	-5	9	54
MCCULLOCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MCLENNAN	273148	264	-718305	-1336	0	0	1242	1	-37558	-461	-609719	-591	46764	262	-1044428	-1861	1118	19916
MCMULLEN	0	0	0	0	0	0	0	0	-7919	-97	0	0	0	0	-7919	-97	8	1040
MEDINA	0	0	0	0	0	0	0	0	-100682	-1235	-479831	-465	36802	206	-543712	-1495	582	15993
MENARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MIDLAND	44131	43	0	0	0	0	1725	2	-67876	-833	-193092	-187	14810	83	-200301	-893	214	9551
MILAM	0	0	0	0	-42648	-150	6315	7	-57694	-708	-11307	-11	867	5	-104467	-857	112	9173
MILLS	0	0	0	0	0	0	0	0	0	0	-463885	-450	35579	199	-428307	-251	458	2681
MITCHELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MONTAGUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MOTLEY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NACOGDOCHES	0	0	-112235	-209	0	0	0	0	-210414	-2582	-22324	-22	1712	10	-343262	-2803	367	29989
NAVARRO	0	0	0	0	0	0	0	0	-357478	-4386	-10727	-10	823	5	-367382	-4392	393	46997
NOLAN	0	0	0	0	0	0	0	0	-38463	-472	0	0	0	0	-38463	-472	41	5050
PALO PINTO	21874	21	0	0	0	0	0	0	0	0	0	0	0	0	21874	21	-23	-226
PECOS	0	0	0	0	0	0	0	0	-58825	-722	0	0	0	0	-58825	-722	63	7724
PRESIDIO	2467	2	0	0	0	0	0	0	-3394	-42	0	0	0	0	-927	-39	1	420
RAINS	0	0	0	0	0	0	0	0	0	0	-20875	-20	1601	9	-19274	-11	21	121
REAGAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RED RIVER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REEVES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REFUGIO	0	0	-37412	-70	0	0	0	0	-209509	-2571	0	0	0	0	-246921	-2640	264	28252
ROBERTSON	0	0	0	0	0	0	0	0	-36879	-453	-62914	-61	4825	27	-94968	-487	102	5206
RUNNELS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAN SABA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCHLEICHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCURRY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHACKELFORD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOMERVELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STARR	0	0	0	0	0	0	1829	2	-348201	-4273	-12177	-12	934	5	-357616	-4277	383	45766
STEPHENS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STERLING	0	0	0	0	0	0	0	0	-9276	-114	0	0	0	0	-9276	-114	10	1218
STONEWALL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUTTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TAYLOR	0	0	-86047	-160	0	0	518	1	-57694	-708	-175697	-170	13475	76	-305445	-962	327	10297
TERRELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
THROCKMORTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TITUS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOM GREEN	0	0	0	0	0	0	11457	13	-169689	-2082	-152792	-148	11719	66	-299306	-2152	320	23024
UPTON	0	0	0	0	0	0	0	0	-189373	-2324	0	0	0	0	-189373	-2324	203	24864
UVALDE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VAL VERDE	0	0	-18706	-35	0	0	0	0	0	0	-7538	-7	578	3	-25666	-39	27	416
VAN ZANDT	0	0	0	0	-242811	-856	0	0	-147064	-1805	0	0	0	0	-389874	-2661	417	28468
WARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WASHINGTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WEBB	959	1	-46391	-86	0	0	19601	22	-1145739	-14059	-299206	-290	22948	129	-1447827	-14284	1549	152837
WHARTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WICHITA	28178	27	-172094	-320	0	0	725	1	-281683	-3456	-11307	-11	867	5	-435314	-3755	466	40175
WILBARGER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WILLACY	0	0	0	0	0	0	0	0	-20363	-250	0	0	0	0	-20363	-250	22	2674
WINKLER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
YOUNG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZAPATA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZAVALA	0	0	0	0	0	0	0	0	-8598	-105	0	0	0	0	-8598	-105	9	1129
Total	16349104	15788	-52566489	-97788	-44444010	-156684	5920148	6677	-54969446	-674508	-43086548	-41796	3304617	18521	-169492624	-929789	181357	9948746

Note: A decrease in energy use is negative (i.e., savings); an increase in energy use is positive (i.e., more consumption)

Table 25: 2017 Totalized Annual Electricity Savings by CL Zone from New Commercial Construction

CL Zone	Total Electricity Savings by CL Zone (MWh) 2017-TRY 2008
Houston (H)	64,969
North (N)	55,069
West (W)	3,664
South (S)	33,438
Total	157,141

Table 26: 2017 Annual NOx Reductions from New Commercial Construction Using 2016 eGRID

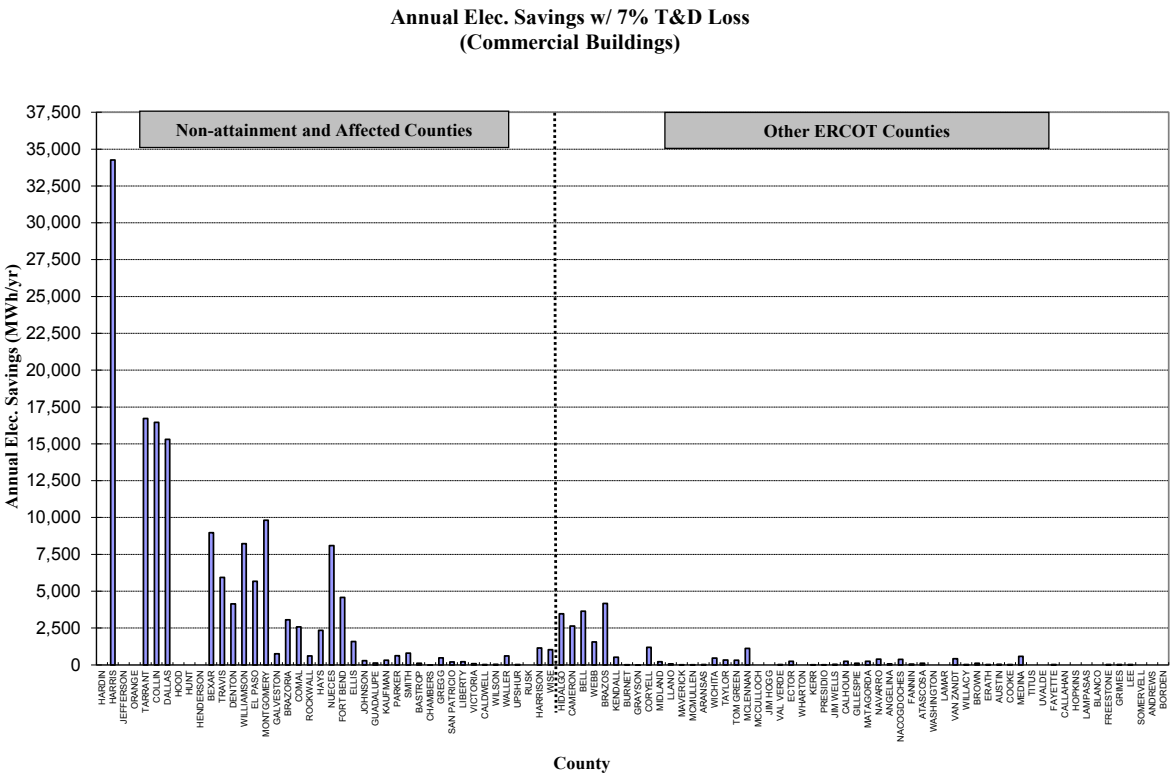
Area	County	H	NOx Reductions (lbs)	N	NOx Reductions (lbs)	W	NOx Reductions (lbs/year)	S	NOx Reductions (lbs)	Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
Houston-Galveston Area	Brazoria	0.0584658	3798.48	0.0000074	0.41	0.0000004	0.00	0.0005477	18.32	3817.20	1.91
	Chambers	0.0186322	1210.52	0.0000024	0.13	0.0000001	0.00	0.0001746	5.84	1216.48	0.61
	Fort Bend	0.0713459	4635.29	0.0000091	0.50	0.0000004	0.00	0.0006684	22.35	4658.14	2.33
	Galveston	0.0137868	895.71	0.0000017	0.10	0.0000001	0.00	0.0001292	4.32	900.13	0.45
	Harris	0.1154764	7502.41	0.0000147	0.81	0.0000007	0.00	0.0010818	36.17	7539.39	3.77
	Montgomery	0.0105050	682.50	0.0000013	0.07	0.0000001	0.00	0.0000984	3.29	685.87	0.34
Dallas/ Fort Worth Area	Collin	0.0001062	6.90	0.0006516	35.88	0.0000315	0.12	0.0000066	0.22	43.12	0.02
	Dallas	0.0021209	137.79	0.0130108	716.49	0.0006284	2.30	0.0001327	4.44	861.03	0.43
	Denton	0.0015536	100.93	0.0095304	524.83	0.0004603	1.69	0.0000972	3.25	630.70	0.32
	Henderson	0.0002047	13.30	0.0012557	69.15	0.0000607	0.22	0.0000128	0.43	83.10	0.04
	Hood	0.0011465	74.49	0.0070335	387.33	0.0003397	1.24	0.0000718	2.40	465.46	0.23
	Hunt	0.0000348	2.26	0.0002135	11.76	0.0000103	0.04	0.0000022	0.07	14.13	0.01
	Tarrant	0.0007633	49.59	0.0046826	257.87	0.0002262	0.83	0.0000478	1.60	309.89	0.15
	Ellis	0.0010011	65.04	0.0061414	338.20	0.0002966	1.09	0.0000627	2.10	406.43	0.20
	Johnson	0.0001415	9.20	0.0008683	47.82	0.0000419	0.15	0.0000089	0.30	57.46	0.03
	Kaufman	0.0028327	184.04	0.0173774	956.96	0.0008394	3.08	0.0001773	5.93	1150.01	0.58
	Parker	0.0006458	41.96	0.0039616	218.16	0.0001914	0.70	0.0000404	1.35	262.17	0.13
	Wise	0.0026775	173.95	0.0164249	904.51	0.0007933	2.91	0.0001676	5.60	1086.97	0.54
San Antonio Area	Bexar	0.0155850	1012.55	0.0010511	57.88	0.0000508	0.19	0.1244678	4161.97	5232.58	2.62
	Comal	0.0004218	27.41	0.0000284	1.57	0.0000014	0.01	0.0033689	112.65	141.63	0.07
	Guadalupe	0.0025417	165.13	0.0001714	9.44	0.0000083	0.03	0.0202988	678.75	853.36	0.43
	Wilson	0.0001734	11.26	0.0000117	0.64	0.0000006	0.00	0.0013845	46.30	58.21	0.03
Austin Area	Bastrop	0.0020114	130.68	0.0001357	7.47	0.0000066	0.02	0.0160641	537.15	675.33	0.34
	Hays	0.0004548	29.55	0.0000307	1.69	0.0000015	0.01	0.0036324	121.46	152.70	0.08
	Travis	0.0037069	240.84	0.0002500	13.77	0.0000121	0.04	0.0296048	989.93	1244.57	0.62
	Rusk	0.0234887	1526.04	0.1440913	7935.01	0.0069599	25.50	0.0014701	49.16	9535.71	4.77
Corpus Christi Area	Nueces	0.0039261	255.08	0.0002648	14.58	0.0000128	0.05	0.0313555	1048.47	1318.17	0.66
	San Patricio	0.0065591	426.14	0.0004424	24.36	0.0000214	0.08	0.0523838	1751.61	2202.19	1.10
Victoria Area	Victoria	0.0013502	87.72	0.0000911	5.01	0.0000044	0.02	0.0107830	360.56	453.31	0.23
Other ERCOT counties	Anderson	0.0001010	6.56	0.0006194	34.11	0.0000299	0.11	0.0000063	0.21	40.99	0.02
	Angelina	0.0024008	155.98	0.0147275	811.04	0.0007114	2.61	0.0001503	5.02	974.64	0.49
	Atascosa	0.0055915	363.28	0.0003771	20.77	0.0000182	0.07	0.0446558	1493.20	1877.31	0.94
	Bell	0.0003222	20.93	0.0019766	108.85	0.0000955	0.35	0.0000202	0.67	130.81	0.07
	Bosque	0.0005680	36.90	0.0034846	191.90	0.0001683	0.62	0.0000356	1.19	230.61	0.12
	Brazos	0.0006415	41.68	0.0039355	216.72	0.0001901	0.70	0.0000402	1.34	260.44	0.13
	Calhoun	0.0088634	575.85	0.0005978	32.92	0.0000289	0.11	0.0707865	2366.96	2975.84	1.49
	Cameron	0.0003811	24.76	0.0000257	1.42	0.0000012	0.00	0.0030433	101.76	127.94	0.06
	Cherokee	0.0003216	20.90	0.0019730	108.65	0.0000953	0.35	0.0000201	0.67	130.57	0.07
	Coke	0.0000135	0.87	0.0000826	4.55	0.0140226	51.38	0.0000008	0.03	56.83	0.03
	Colorado	0.0014171	92.07	0.0000956	5.26	0.0000046	0.02	0.0113173	378.43	475.77	0.24
	Ector	0.0000634	4.12	0.0003891	21.43	0.0660667	242.08	0.0000040	0.13	267.76	0.13
	Fayette	0.0145787	947.16	0.0009832	54.15	0.0000475	0.17	0.1164306	3893.21	4894.70	2.45
	Freestone	0.0121950	792.30	0.0748103	4119.75	0.0036135	13.24	0.0007632	25.52	4950.81	2.48
	Frio	0.0070162	455.84	0.0004732	26.06	0.0000229	0.08	0.0560343	1873.68	2355.66	1.18
	Goliad	0.0048476	314.95	0.0003269	18.00	0.0000158	0.06	0.0387148	1294.55	1627.56	0.81
	Grayson	0.0003586	23.30	0.0021996	121.13	0.0001062	0.39	0.0000224	0.75	145.56	0.07
	Grimes	0.0040938	265.97	0.0251136	1382.99	0.0012130	4.44	0.0002562	8.57	1661.98	0.83
	Hidalgo	0.0019872	129.11	0.0001340	7.38	0.0000065	0.02	0.0158708	530.69	667.20	0.33
	Hill	0.0004818	31.30	0.0029556	162.76	0.0001428	0.52	0.0000302	1.01	195.59	0.10
	Howard	0.0000104	0.68	0.0000639	3.52	0.0108444	39.74	0.0000007	0.02	43.95	0.02
	Lamar	0.0021680	140.85	0.0132996	732.40	0.0006424	2.35	0.0001357	4.54	880.14	0.44
	Limestone	0.0207580	1348.63	0.1273399	7012.52	0.0061507	22.54	0.0012992	43.44	8427.13	4.21
	Llano	0.0001816	11.80	0.0000122	0.67	0.0000006	0.00	0.0014501	48.49	60.96	0.03
	McLennan	0.0023590	153.26	0.0144710	796.91	0.0006990	2.56	0.0001476	4.94	957.67	0.48
	Milam	0.0070396	457.36	0.0004748	26.15	0.0000229	0.08	0.0562211	1879.93	2363.52	1.18
	Mitchell	0.0000196	1.28	0.0001204	6.63	0.0204490	74.93	0.0000012	0.04	82.88	0.04
	Nacogdoches	0.0001458	9.47	0.0008944	49.25	0.0000432	0.16	0.0000091	0.31	59.19	0.03
	Nolan	0.0000085	0.55	0.0000524	2.89	0.0088961	32.60	0.0000005	0.02	36.05	0.02
	Palo Pinto	0.0004954	32.19	0.0030391	167.36	0.0001468	0.54	0.0000310	1.04	201.13	0.10
	Pecos	0.0000002	0.01	0.0000011	0.06	0.0001806	0.66	0.0000000	0.00	0.73	0.00
	Potter	0.0004032	26.19	0.0024732	136.20	0.4199647	1538.85	0.0000252	0.84	1702.08	0.85
	Reagan	0.0000001	0.01	0.0000009	0.05	0.0001554	0.57	0.0000000	0.00	0.63	0.00
	Red River	0.0000376	2.44	0.0002305	12.69	0.0000111	0.04	0.0000024	0.08	15.25	0.01
	Robertson	0.0134304	872.57	0.0823890	4537.10	0.0039795	14.58	0.0008406	28.11	5452.36	2.73
	Scurry	0.0000991	6.44	0.0006078	33.47	0.1032024	378.16	0.0000062	0.21	418.27	0.21
	Titus	0.0140204	910.89	0.0860080	4736.40	0.0041543	15.22	0.0008775	29.34	5691.86	2.85
	Upton	0.0000001	0.01	0.0000008	0.04	0.0001352	0.50	0.0000000	0.00	0.55	0.00
	Ward	0.0000021	0.14	0.0000130	0.72	0.0022148	8.12	0.0000001	0.00	8.98	0.00
	Webb	0.0000283	1.84	0.0000019	0.11	0.0000001	0.00	0.0002259	7.55	9.50	0.00
	Wharton	0.0008796	57.15	0.0000593	3.27	0.0000029	0.01	0.0070246	234.89	295.31	0.15
	Wichita	0.0000013	0.08	0.0000079	0.44	0.0013464	4.93	0.0000001	0.00	5.46	0.00
	Wilbarger	0.0004088	26.56	0.0025077	138.10	0.4258276	1560.33	0.0000256	0.86	1725.84	0.86
	Wood	0.0000060	0.39	0.0000365	2.01	0.0000018	0.01	0.0000004	0.01	2.42	0.00
	Young	0.0000150	0.98	0.0000923	5.08	0.0156760	57.44	0.0000009	0.03	63.53	0.03
	Total	**0.4904222**	**31862.35**	**0.6972352**	**38396.25**	**1.1223498**	**4112.55**	**0.7248702**	**24238.27**	**98609.41**	**49.30**
Energy Savings by PCA (MWh)		64,969		55,069		3,664		33,438			

Table 27: 2017 Annual Electricity and Natural Gas Savings and NOx Reductions from New Commercial Construction

	County	Electricity Savings and Resultant NOx Reductions (Commercial)		Total Natural Gas Savings and Resultant NOx Reductions (Commercial)		Total Nox Reductions
		Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Annual Nox Reductions (Tons)
Non-attainment and Affected Counties	HARDIN	0.00		0.00	0.00	0.00
	HARRIS	34,270.74	3.77	2,061,372.19	9.48	13.25
	JEFFERSON	0.00		0.00	0.00	0.00
	ORANGE	0.00		0.00	0.00	0.00
	TARRANT	16,717.71	0.15	756,904.12	3.48	3.64
	COLLIN	16,451.60	0.02	648,277.67	2.98	3.00
	DALLAS	15,302.54	0.43	957,755.30	4.41	4.84
	HOOD	0.00	0.23	0.00	0.00	0.23
	HUNT	0.00	0.01	0.00	0.00	0.01
	HENDERSON	0.00	0.04	0.00	0.00	0.04
	BEXAR	8,967.46	2.62	386,014.87	1.78	4.39
	TRAVIS	5,929.12	0.62	424,388.51	1.95	2.57
	DENTON	4,134.49	0.32	170,270.50	0.78	1.10
	WILLIAMSON	8,222.54		406,229.17	1.87	1.87
	EL PASO	5,677.61		218,069.62	1.00	1.00
	MONTGOMERY	9,822.78	0.34	653,111.83	3.00	3.35
	GALVESTON	753.57	0.45	13,843.44	0.06	0.51
	BRAZORIA	3,052.46	1.91	208,658.94	0.96	2.87
	COMAL	2,570.73	0.07	194,015.30	0.89	0.96
	ROCKWALL	609.43		31,763.89	0.15	0.15
	HAYS	2,341.15	0.08	124,756.80	0.57	0.65
	NUECES	8,091.53	0.66	220,684.04	1.02	1.67
	FORT BEND	4,580.45	2.33	295,526.33	1.36	3.69
	ELLIS	1,580.70	0.20	149,910.75	0.69	0.89
	JOHNSON	292.05	0.03	38,041.06	0.17	0.20
	GUADALUPE	131.04	0.43	12,516.32	0.06	0.48
	KAUFMAN	315.94	0.58	49,137.70	0.23	0.80
	PARKER	621.54	0.13	68,702.10	0.32	0.45
	SMITH	800.32		28,098.02	0.13	0.13
	BASTROP	115.70	0.34	640.84	0.00	0.34
	CHAMBERS	(4.14)	0.61	(46.64)	(0.00)	0.61
	GREGG	472.91		13,143.39	0.06	0.06
	SAN PATRICIO	204.21	1.10	30,154.66	0.14	1.24
	LIBERTY	213.04		26,141.11	0.12	0.12
	VICTORIA	74.66	0.23	419.17	0.00	0.23
	CALDWELL	26.07		152.50	0.00	0.00
	WILSON	34.79	0.03	177.85	0.00	0.03
	WALLER	614.34		72,705.36	0.33	0.33
	UPSHUR	20.05		117.31	0.00	0.00
	RUSK	0.00	4.77	0.00	0.00	4.77
	HARRISON	1,148.75		140,020.71	0.64	0.64
	WISE	1,029.72	0.54	42,653.22	0.20	0.74
Other ERCOT Counties	HIDALGO	3,465.85	0.33	211,555.07	0.97	1.31
	CAMERON	2,633.66	0.06	128,242.78	0.59	0.65
	BELL	3,638.81	0.07	164,291.02	0.76	0.82
	WEBB	1,549.18	0.00	152,836.60	0.70	0.71
	BRAZOS	4,164.66	0.13	213,910.23	0.98	1.11
	KENDALL	513.50		33,885.79	0.16	0.16
	BURNET	0.42		(63.69)	(0.00)	(0.00)
	GRAYSON	(38.15)	0.07	(605.02)	(0.00)	0.07
	CORYELL	1,187.87		19,201.14	0.09	0.09
	MIDLAND	214.32		9,551.00	0.04	0.04
	LLANO	70.14	0.03	8,775.85	0.04	0.07
	MAVERICK	9.17		53.63	0.00	0.00
	MCMULLEN	8.47		1,039.70	0.00	0.00
	ARANSAS	27.25		512.53	0.00	0.00
	WICHITA	465.79	0.00	40,174.69	0.18	0.19
	TAYLOR	326.83		10,297.03	0.05	0.05
	TOM GREEN	320.26		23,024.24	0.11	0.11
	MCLENNAN	1,117.54	0.48	19,915.73	0.09	0.57
	MCCULLOCH	0.00		0.00	0.00	0.00
	JIM HOGG	0.00		0.00	0.00	0.00
	VAL VERDE	27.46		415.91	0.00	0.00
	ECTOR	235.37	0.13	17,869.83	0.08	0.22
	WHARTON	0.00	0.15	0.00	0.00	0.15
	KERR	12.10		1,485.29	0.01	0.01
	PRESIDIO	0.99		420.10	0.00	0.00
	JIM WELLS	43.25		253.05	0.00	0.00
	CALHOUN	237.25	1.49	29,111.70	0.13	1.62
	GILLESPIE	115.63		16,037.37	0.07	0.07
	MATAGORDA	235.30		8,343.17	0.04	0.04
	NAVARRO	393.10		46,997.19	0.22	0.22
	ANGELINA	62.16	0.49	363.65	0.00	0.49
	NACOGDOCHES	367.29	0.03	29,989.47	0.14	0.17
	FANNIN	52.29		6,416.46	0.03	0.03
	ATASCOSA	114.99	0.94	14,110.26	0.06	1.00
	WASHINGTON	0.00		0.00	0.00	0.00
	LAMAR	0.00	0.44	0.00	0.00	0.44
	VAN ZANDT	417.17		28,468.10	0.13	0.13
	WILLACY	21.79		2,673.52	0.01	0.01
	BROWN	107.28		1,995.73	0.01	0.01
	ERATH	25.62		476.59	0.00	0.00
	AUSTIN	41.05		4,200.71	0.02	0.02
	COOKE	19.37		2,376.46	0.01	0.01
	MEDINA	581.77		15,992.54	0.07	0.07
	TITUS	0.00	2.85	0.00	0.00	2.85
	UVALDE	0.00		0.00	0.00	0.00
	FAYETTE	20.62	2.45	120.66	0.00	2.45
	CALLAHAN	0.00		0.00	0.00	0.00
	HOPKINS	0.00		0.00	0.00	0.00
	LAMPASAS	0.00		0.00	0.00	0.00
	BLANCO	0.00		0.00	0.00	0.00
	FREESTONE	26.07	2.48	152.50	0.00	2.48
	GRIMES	26.07	0.83	152.50	0.00	0.83
	LEE	20.05		117.31	0.00	0.00
	SOMERVELL	0.00		0.00	0.00	0.00
	ANDREWS	0.00		0.00	0.00	0.00
	BORDEN	0.00		0.00	0.00	0.00

Table 25: 2017 Annual Electricity and Natural Gas Savings and NOx Reductions from New Commercial Construction (Continued)

	County	Electricity Savings and Resultant NOx Reductions (Commercial)		Total Natural Gas Savings and Resultant NOx Reductions (Commercial)		Total Nox Reductions
		Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Annual Nox Reductions (Tons)
Other ERCOT Counties	CHEROKEE	0.00	0.07	0.00	0.00	0.07
	DIMMIT	20.62		120.66	0.00	0.00
	FALLS	0.00		0.00	0.00	0.00
	COLORADO	36.56	0.24	4,485.58	0.02	0.26
	FRIO	34.38	1.18	4,218.23	0.02	1.20
	MILAM	111.78	1.18	9,172.91	0.04	1.22
	JACKSON	0.00		0.00	0.00	0.00
	ANDERSON	0.00	0.02	0.00	0.00	0.02
	HILL	0.00	0.10	0.00	0.00	0.10
	CULBERSON	0.00		0.00	0.00	0.00
	MASON	0.00		0.00	0.00	0.00
	POTTER	3.63	0.85	445.59	0.00	0.85
	PECOS	62.94	0.00	7,723.51	0.04	0.04
	RAINS	20.62		120.66	0.00	0.00
	LAVACA	0.00		0.00	0.00	0.00
	PALO PINTO	(23.40)	0.10	(226.02)	(0.00)	0.10
	KIMBLE	0.00		0.00	0.00	0.00
	MADISON	148.88		18,269.07	0.08	0.08
	ARCHER	0.00		0.00	0.00	0.00
	REFUGIO	264.21		28,252.26	0.13	0.13
	LIMESTONE	0.00	4.21	0.00	0.00	4.21
	CLAY	(19.56)		(188.92)	(0.00)	(0.00)
	BEE	266.30		32,676.39	0.15	0.15
	MARTIN	121.29		14,882.61	0.07	0.07
	GONZALES	67.66		3,793.59	0.02	0.02
	BURLESON	0.00		0.00	0.00	0.00
	KARNES	0.00		0.00	0.00	0.00
	KLEBERG	3.44		20.11	0.00	0.00
	BREWSTER	0.00		0.00	0.00	0.00
	WINKLER	0.00		0.00	0.00	0.00
	WOOD	1,029.72	0.00	42,653.22	0.20	0.20
	FRANKLIN	0.00		0.00	0.00	0.00
	YOUNG	0.00		0.00	0.00	0.00
	HOUSTON	0.00		0.00	0.00	0.00
	SCURRY	0.00	0.21	0.00	0.00	0.21
	BOSQUE	0.00	0.12	0.00	0.00	0.12
	COMANCHE	0.00		0.00	0.00	0.00
	BRISCOE	26.07		152.50	0.00	0.00
	CONCHO	0.00		0.00	0.00	0.00
	ZAVALA	9.20		1,128.82	0.01	0.01
	NOLAN	41.16	0.02	5,049.99	0.02	0.04
	BROOKS	0.00		0.00	0.00	0.00
	ROBERTSON	101.62	2.73	5,205.70	0.02	2.75
	LIVE OAK	0.00		0.00	0.00	0.00
	HAMILTON	0.00		0.00	0.00	0.00
	JONES	0.00		0.00	0.00	0.00
	REAGAN	0.00	0.00	0.00	0.00	0.00
	WARD	0.00	0.00	0.00	0.00	0.00
	RED RIVER	0.00	0.01	0.00	0.00	0.01
	HASKELL	0.00		0.00	0.00	0.00
	HOWARD	0.00	0.02	0.00	0.00	0.02
	SAN SABA	0.00		0.00	0.00	0.00
	JACK	0.00		0.00	0.00	0.00
	STEPHENS	0.00		0.00	0.00	0.00
	RUNNELS	0.00		0.00	0.00	0.00
	REEVES	0.00		0.00	0.00	0.00
	DEWITT	25.21		147.47	0.00	0.00
	CHILDRESS	0.00		0.00	0.00	0.00
	CROSBY	0.00		0.00	0.00	0.00
	DAWSON	0.00		0.00	0.00	0.00
	MITCHELL	0.00	0.04	0.00	0.00	0.04
	WILBARGER	0.00	0.86	0.00	0.00	0.86
	COLEMAN	(3.18)		(35.81)	(0.00)	(0.00)
	UPTON	202.63	0.00	24,863.76	0.11	0.11
	COKE	0.00	0.03	0.00	0.00	0.03
	CROCKETT	74.46		1,385.10	0.01	0.01
	HARDEMAN	0.00		0.00	0.00	0.00
	BANDERA	0.00		0.00	0.00	0.00
	BAYLOR	0.00		0.00	0.00	0.00
	COTTLE	0.00		0.00	0.00	0.00
	CRANE	0.00		0.00	0.00	0.00
	DELTA	0.00		0.00	0.00	0.00
	DICKENS	0.00		0.00	0.00	0.00
	DUVAL	0.00		0.00	0.00	0.00
	EASTLAND	0.00		0.00	0.00	0.00
	EDWARDS	0.00		0.00	0.00	0.00
	FISHER	0.00		0.00	0.00	0.00
	FOARD	0.00		0.00	0.00	0.00
	GLASSCOCK	0.00		0.00	0.00	0.00
	GOLIAD	0.00	0.81	0.00	0.00	0.81
	HALL	0.00		0.00	0.00	0.00
	HUDSPETH	0.00		0.00	0.00	0.00
	IRION	98.29		12,060.56	0.06	0.06
	JEFF DAVIS	0.00		0.00	0.00	0.00
	KENEDY	0.00		0.00	0.00	0.00
	KENT	0.00		0.00	0.00	0.00
	KING	0.00		0.00	0.00	0.00
	KINNEY	0.00		0.00	0.00	0.00
	KNOX	26.07		152.50	0.00	0.00
	LA SALLE	0.00		0.00	0.00	0.00
	LEON	0.00		0.00	0.00	0.00
	LOVING	0.00		0.00	0.00	0.00
	MENARD	0.00		0.00	0.00	0.00
	MILLS	458.29		2,681.28	0.01	0.01
	MONTAGUE	0.00		0.00	0.00	0.00
	MOTLEY	0.00		0.00	0.00	0.00
	REAL	0.00		0.00	0.00	0.00
	SCHLEICHER	0.00		0.00	0.00	0.00
	SHACKELFORD	0.00		0.00	0.00	0.00
	STARR	382.65		45,765.56	0.21	0.21
	STERLING	9.93		1,217.94	0.01	0.01
	STONEWALL	0.00		0.00	0.00	0.00
	SUTTON	0.00		0.00	0.00	0.00
	TERRELL	0.00		0.00	0.00	0.00
	THROCKMORTON	0.00		0.00	0.00	0.00
	ZAPATA	0.00		0.00	0.00	0.00
	TOTAL	**181,668.60**	**49.27**	**9,975,661.10**	**45.89**	**95.16**



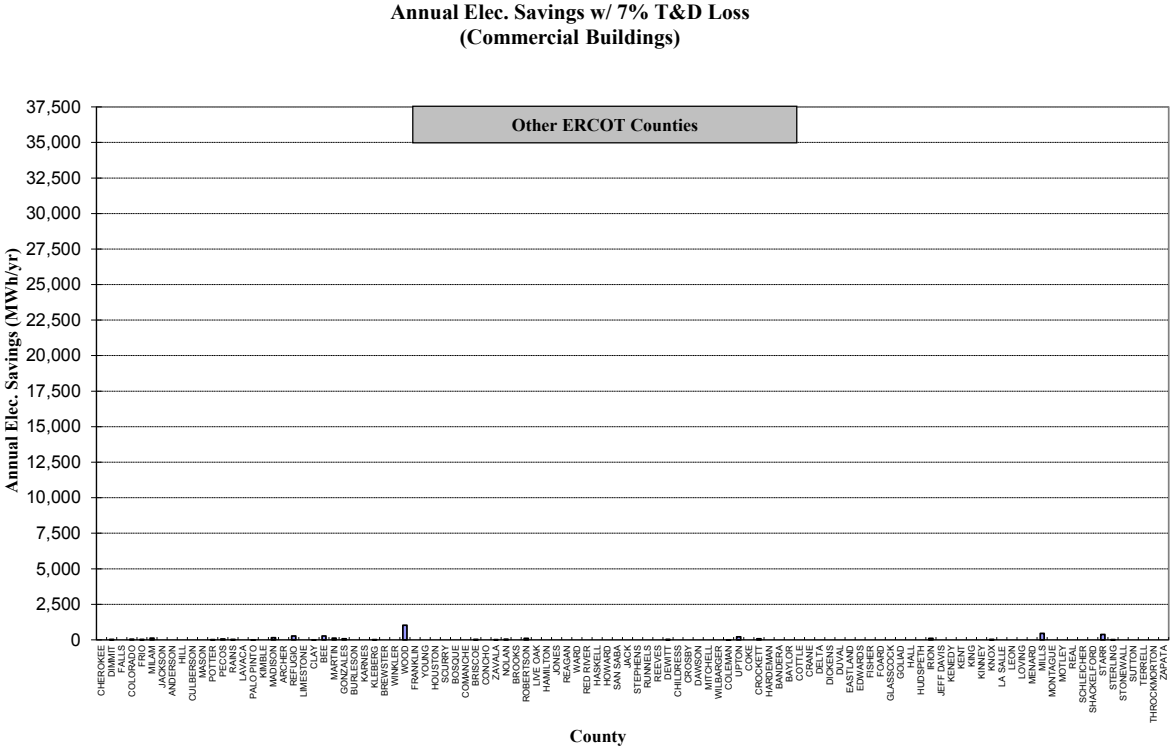
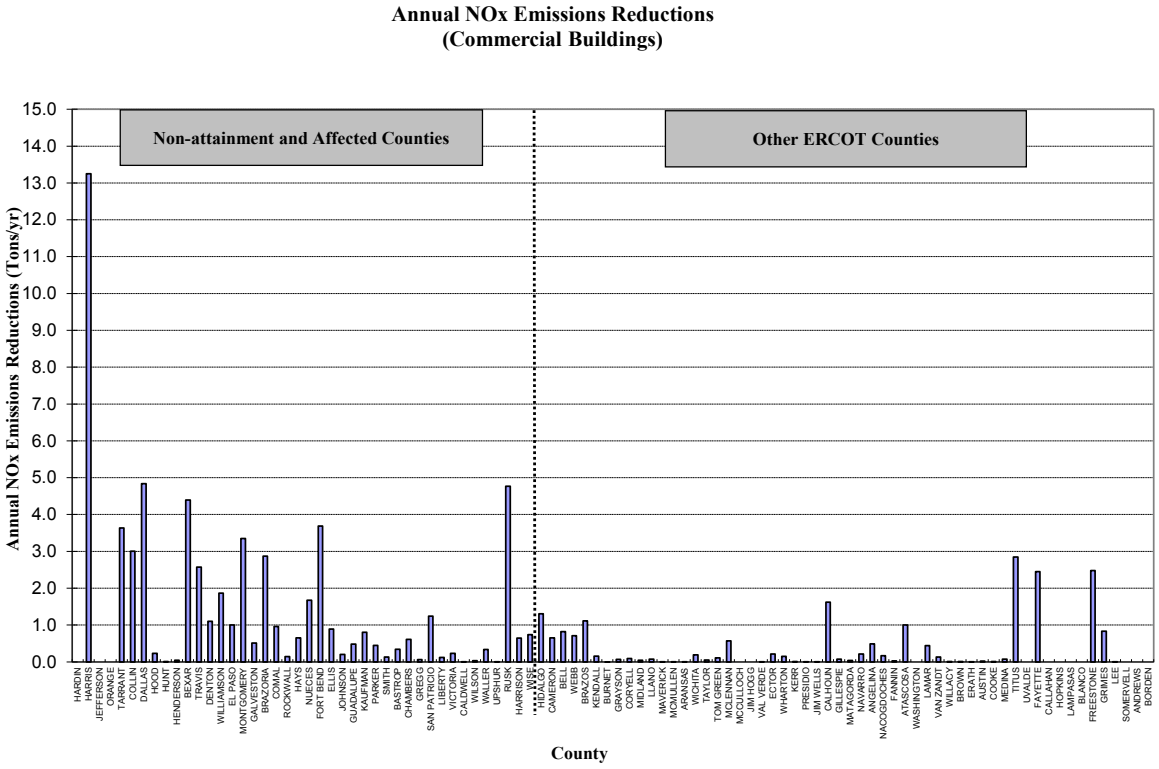


Figure 16: 2017 Annual Electricity Savings by County from New Commercial Construction



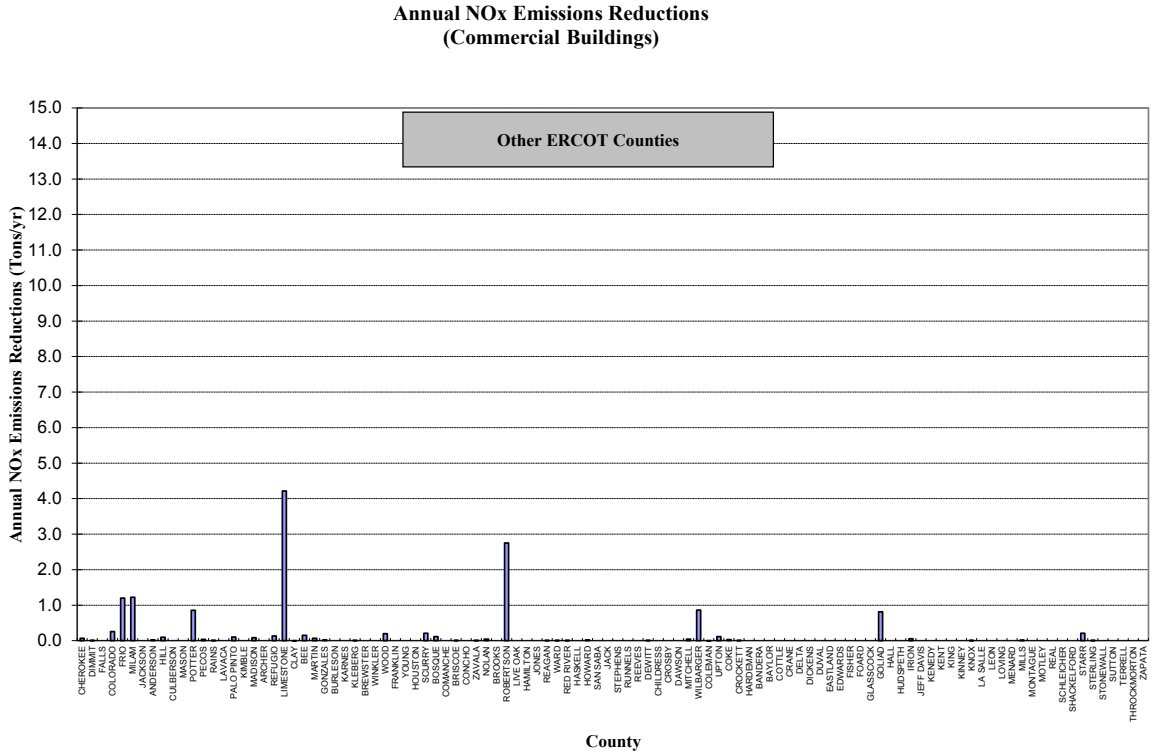


Figure 17: 2017 Annual NOx Reductions by County from New Commercial Construction

4.5 2017 Results for New Residential (Single-family and Multi-family) and Commercial Construction

Figure 18 shows the bar chart and Figure 19 shows the spatial distribution of the 2017 annual electricity savings, and Figure 20 shows the bar chart and Figure 21 shows the spatial distribution of the 2017 annual NOx reductions for new residential and commercial Construction, respectively. In general the significant increase in the annual NOx emissions reduction shown in Figure 20, compared to the previous report is due to the higher energy savings. As shown in Table 28, the total annual electricity savings in 2017 resulted in 1,203,933.05 MWh/yr which includes 242,747.75 MWh/yr (i.e., 20.16 %) for single-family buildings, 779,516.70 MWh/yr (i.e., 64.75 %) for multi-family buildings, and 181,668.60 MWh/yr (i.e., 15.09 %) for new commercial buildings. In addition, the total annual natural gas savings from new residential and commercial Construction in 2017 resulted in 1,401,438.97 MMBtu[34] (14,014,389.67 therms).

The total NOx reductions[35] from electricity and natural gas savings from new residential (single-family and multi-family) and commercial Construction in 2017 resulted in 421.72 tons NOx/year which represents 357.26 tons NOx/year from electricity savings and 64.47 tons NOx/year from natural gas savings.

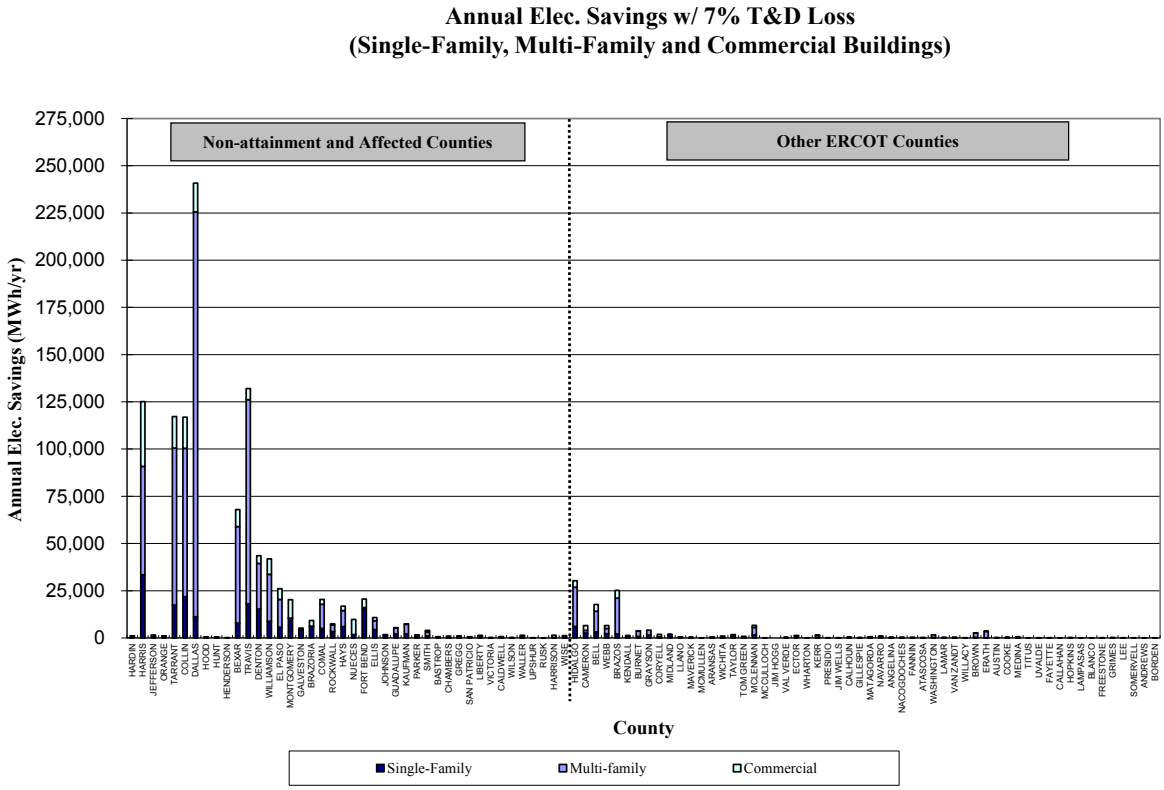
[34] 1 Therm = 0.10 MMBtu, source from www.eia.gov/tools/faqs/faq.cfm?id=45&t=8
[35] 0.092 lb-NOx/MMBtu of emission rate was used for the calculation.

Table 28: 2017 Annual NOx Reductions from New Residential and Commercial Construction

	County	Electricity Savings and Resultant NOx Reductions (Single Family Houses)		Electricity Savings and Resultant NOx Reductions (Multifamily Houses)		Electricity Savings and Resultant NOx Reductions (Commercial Buildings)		Total Electricity Savings and Resultant NOx Reductions (SF, MF and Commecial Buildings)		Total Natural Gas Savings and Resultant NOx Reductions (Single and Multi-Family Houses)		Total Natural Gas Savings and Resultant NOx Reductions (SF, MF and Commecial Buildings)		Total Nox Reductions
		Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Annual Nox Reductions (Tons)
Non-attainment and Affected Counties	HARDIN	517.02		548.99		0.00	0.00	1,066.00	0.00	2,460.56	0.01	2,460.56	0.01	0.01
	HARRIS	33,418.96	5.04	57,427.84	8.24	34,270.74	3.77	125,117.54	17.05	221,340.51	1.02	2,282,712.70	10.50	27.56
	JEFFERSON	701.91		883.39		0.00	0.00	1,585.30	0.00	3,402.73	0.02	3,402.73	0.02	0.02
	ORANGE	904.04		157.21		0.00	0.00	1,061.25	0.00	3,887.34	0.02	3,887.34	0.02	0.02
	TARRANT	17,354.84	0.20	83,177.81	0.92	16,717.71	0.15	117,250.36	1.28	397,780.35	1.83	1,154,684.48	5.31	6.59
	COLLIN	21,817.73	0.03	78,588.06	0.13	16,451.60	0.02	116,857.39	0.18	411,021.41	1.89	1,059,299.08	4.87	5.05
	DALLAS	11,249.94	0.55	214,262.02	2.56	15,302.54	0.43	240,814.51	3.54	743,784.37	3.42	1,701,539.67	7.83	11.37
	HOOD	409.42	0.30	192.34	1.38	0.00	0.23	601.76	1.92	4,020.22	0.02	4,020.22	0.02	1.93
	HUNT	434.51	0.01	59.38	0.04	0.00	0.01	493.89	0.06	3,806.35	0.02	3,806.35	0.02	0.08
	HENDERSON	208.97	0.05	0.00	0.25	0.00	0.04	208.97	0.34	277.21	0.00	277.21	0.00	0.34
	BEXAR	7,744.82	3.73	51,202.22	13.03	8,967.46	2.62	67,914.49	19.38	252,722.37	1.16	638,737.24	2.94	22.31
	TRAVIS	18,095.17	0.89	108,027.18	3.10	5,929.12	0.62	132,051.47	4.61	555,048.10	2.55	979,436.61	4.51	9.11
	DENTON	15,311.69	0.40	24,135.10	1.88	4,134.49	0.32	43,581.29	2.60	195,859.39	0.90	366,129.89	1.68	4.28
	WILLIAMSON	8,743.39		24,912.88		8,222.54		41,878.80	0.00	182,190.13	0.84	588,419.30	2.71	2.71
	EL PASO	5,682.18		14,693.28		5,677.61		26,053.07	0.00	69,930.78	0.32	288,000.39	1.32	1.32
	MONTGOMERY	10,411.44	0.46	39.35	0.75	9,822.78	0.34	20,273.57	1.55	58,594.06	0.27	711,705.90	3.27	4.83
	GALVESTON	4,119.03	0.60	333.94	0.98	753.57	0.45	5,206.54	2.04	22,768.63	0.10	36,612.07	0.17	2.20
	BRAZORIA	6,157.90	2.55	58.93	4.17	3,052.46	1.91	9,269.30	8.63	33,782.84	0.16	242,441.78	1.12	9.75
	COMAL	4,963.29	0.10	12,857.96	0.35	2,570.73	0.07	20,391.97	0.52	99,267.91	0.46	293,283.21	1.35	1.87
	ROCKWALL	3,372.48		3,426.59		609.43		7,408.49	0.00	37,499.08	0.17	69,262.97	0.32	0.32
	HAYS	5,983.64	0.11	8,442.55	0.38	2,341.15	0.08	16,767.34	0.57	97,554.53	0.45	222,311.33	1.02	1.59
	NUECES	1,719.21	0.94	21.07	3.28	8,091.53	0.66	9,831.81	4.88	6,102.10	0.03	226,786.14	1.04	5.92
	FORT BEND	15,176.30	3.11	895.16	5.09	4,580.45	2.33	20,651.91	10.54	85,896.33	0.40	381,422.66	1.75	12.29
	ELLIS	4,455.85	0.26	4,719.62	1.21	1,580.70	0.20	10,756.17	1.67	51,712.81	0.24	201,623.56	0.93	2.60
	JOHNSON	1,373.83	0.04	147.95	0.17	292.05	0.03	1,813.83	0.24	11,982.56	0.06	50,023.62	0.23	0.47
	GUADALUPE	2,104.43	0.61	3,214.49	2.12	131.04	0.43	5,449.96	3.16	35,061.07	0.16	47,577.38	0.22	3.38
	KAUFMAN	2,074.49	0.74	5,110.09	3.42	315.94	0.58	7,500.51	4.73	32,029.10	0.15	81,166.79	0.37	5.11
	PARKER	1,068.26	0.17	0.00	0.78	621.54	0.13	1,689.80	1.08	8,637.96	0.04	77,340.06	0.36	1.43
	SMITH	1,038.27		2,174.16		800.32	0.00	4,012.75	0.00	(138.58)	(0.00)	27,959.44	0.13	0.13
	BASTROP	372.70	0.48	133.60	1.68	115.70	0.34	621.99	2.50	3,773.16	0.02	4,414.00	0.02	2.52
	CHAMBERS	975.15	0.81	0.00	1.33	(4.14)	0.61	971.02	2.75	4,134.72	0.02	4,088.08	0.02	2.77
	GREGG	359.38		218.84		472.91		1,051.13	0.00	190.79	0.00	13,334.18	0.06	0.06
	SAN PATRICIO	430.85	1.57	42.13	5.48	204.21	1.10	677.20	8.15	1,541.88	0.01	31,696.53	0.15	8.30
	LIBERTY	1,074.02		19.75		213.04		1,306.81	0.00	6,033.92	0.03	32,175.04	0.15	0.15
	VICTORIA	113.93	0.32	0.00	1.13	74.66	0.23	188.59	1.68	426.21	0.00	845.38	0.00	1.68
	CALDWELL	529.82		53.44		26.07	0.00	609.32	0.00	6,164.09	0.03	6,316.59	0.03	0.03
	WILSON	110.76	0.04	0.00	0.14	34.79	0.03	145.55	0.22	1,313.82	0.01	1,491.67	0.01	0.22
	WALLER	70.85		708.26		614.34	0.00	1,393.45	0.00	809.74	0.00	73,515.10	0.34	0.34
	UPSHUR	11.89		0.00		20.05		31.94	0.00	78.82	0.00	196.12	0.00	0.00
	RUSK	4.43	6.12	0.00	28.35	0.00	4.77	4.43	39.24	8.24	0.00	8.24	0.00	39.24
	HARRISON	97.22		170.45		1,148.75		1,416.42	0.00	3.17	0.00	140,023.88	0.64	0.64
	WISE	190.68	0.70	29.80	3.23	1,029.72	0.54	1,250.19	4.47	1,630.78	0.01	44,284.00	0.20	4.68
	HIDALGO	6,117.58	0.48	20,741.56	1.66	3,465.85	0.33	30,324.98	2.47	28,120.17	0.13	239,675.24	1.10	3.57
	CAMERON	2,582.62	0.09	1,374.99	0.32	2,633.66	0.06	6,591.27	0.47	9,984.46	0.05	138,227.24	0.64	1.11
	BELL	3,261.55	0.08	10,853.15	0.39	3,638.81	0.07	17,753.51	0.54	87,153.36	0.40	251,444.39	1.16	1.69
	WEBB	2,172.47	0.01	2,843.92	0.02	1,549.18	0.00	6,565.56	0.04	18,677.81	0.09	171,514.41	0.79	0.82
	BRAZOS	2,084.26	0.17	18,965.55	0.77	4,164.66	0.13	25,214.46	1.07	22,734.81	0.10	236,645.04	1.09	2.16
	KENDALL	808.35		0.00		513.50	0.00	1,321.85	0.00	5,407.25	0.02	39,293.04	0.18	0.18
	BURNET	777.75		2,943.52		0.42	0.00	3,721.69	0.00	18,499.27	0.09	18,435.58	0.08	0.08
	GRAYSON	1,523.07	0.09	2,627.40	0.43	(38.15)	0.07	4,112.32	0.60	20,603.97	0.09	19,998.95	0.09	0.69
	CORYELL	318.00		335.49		1,187.87	0.00	1,841.36	0.00	5,749.62	0.03	24,950.76	0.11	0.11
	MIDLAND	1,725.17		0.00		214.32	0.00	1,939.49	0.00	15,296.09	0.07	24,847.09	0.11	0.11
	LLANO	489.23	0.04	0.00	0.15	70.14	0.03	559.37	0.23	5,800.38	0.03	14,576.22	0.07	0.29
	MAVERICK	129.00		126.40		9.17	0.00	264.56	0.00	1,094.50	0.01	1,148.13	0.01	0.01
	MCMULLEN	0.00		0.00		8.47	0.00	8.47	0.00	0.00	0.00	1,039.70	0.00	0.00
	ARANSAS	325.77		21.07		27.25	0.00	374.08	0.00	1,162.11	0.01	1,674.64	0.01	0.01
	WICHITA	255.15	0.00	220.48	0.01	465.79	0.00	941.41	0.02	3,606.52	0.02	43,781.21	0.20	0.22
	TAYLOR	673.87		763.79		326.83	0.00	1,764.48	0.00	9,174.84	0.04	19,471.86	0.09	0.09
	TOM GREEN	450.67		73.60		320.26	0.00	844.52	0.00	4,536.71	0.02	27,560.95	0.13	0.13
	MCLENNAN	1,563.50	0.61	4,009.13	2.85	1,117.54	0.48	6,690.17	3.94	37,240.78	0.17	57,156.51	0.26	4.20
	MCCULLOCH	2.34		0.00		0.00	0.00	2.34	0.00	22.18	0.00	22.18	0.00	0.00
	JIM HOGG	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VAL VERDE	217.34		0.00		27.46	0.00	244.80	0.00	2,578.06	0.01	2,993.97	0.01	0.01
	ECTOR	1,115.35	0.22	0.00	0.67	235.37	0.13	1,350.73	1.03	9,889.19	0.05	27,759.02	0.13	1.15
	WHARTON	155.90	0.21	0.00	0.74	0.00	0.15	155.90	1.09	583.24	0.00	583.24	0.00	1.10
	KERR	83.63		1,284.45		12.10	0.00	1,380.18	0.00	5,040.17	0.02	6,525.46	0.03	0.03
	PRESIDIO	32.69		0.00		0.99	0.00	33.68	0.00	310.53	0.00	730.63	0.00	0.00
	JIM WELLS	29.42		0.00		43.25	0.00	72.68	0.00	104.31	0.00	357.36	0.00	0.00
	CALHOUN	127.92	2.12	122.37	7.41	237.25	1.49	487.54	11.02	521.42	0.00	29,633.12	0.14	11.16
	GILLESPIE	112.90		0.00		115.63	0.00	228.53	0.00	1,338.55	0.01	17,375.92	0.08	0.08
	MATAGORDA	281.82		122.37		235.30	0.00	639.50	0.00	1,097.18	0.01	9,440.35	0.04	0.04
	NAVARRO	507.58		117.42		393.10	0.00	1,018.10	0.00	7,587.66	0.03	54,584.85	0.25	0.25
	ANGELINA	104.12	0.63	65.35	2.90	62.16	0.49	231.62	4.01	161.98	0.00	525.63	0.00	4.01
	NACOGDOCHES	4.43	0.04	21.78	0.18	367.29	0.03	393.50	0.24	(2.34)	(0.00)	29,987.13	0.14	0.38
	FANNIN	70.89		59.38		52.29	0.00	182.56	0.00	770.18	0.00	7,186.64	0.03	0.03
	ATASCOSA	75.15	1.34	0.00	4.67	114.99	0.94	190.14	6.95	882.15	0.00	14,992.41	0.07	7.02
	WASHINGTON	163.36		1,465.70		0.00	0.00	1,629.05	0.00	1,769.82	0.01	1,769.82	0.01	0.01
	LAMAR	57.65	0.56	297.96	2.62	0.00	0.44	355.61	3.62	961.01	0.00	961.01	0.00	3.63
	VAN ZANDT	29.87		0.00		417.17	0.00	447.03	0.00	241.49	0.00	28,709.59	0.13	0.13
	WILLACY	22.67		0.00		21.79	0.00	44.46	0.00	84.57	0.00	2,758.10	0.01	0.01
	BROWN	297.62		2,247.79		107.28	0.00	2,652.69	0.00	12,733.83	0.06	14,729.56	0.07	0.07
	ERATH	92.11		3,303.37		25.62	0.00	3,421.10	0.00	12,371.81	0.06	12,848.40	0.06	0.06
	AUSTIN	66.92		0.00		41.05	0.00	107.97	0.00	376.45	0.00	4,577.16	0.02	0.02
	COOKE	160.08		0.00		19.37	0.00	179.45	0.00	1,336.68	0.01	3,713.14	0.02	0.02
	MEDINA	62.69		0.00		581.77	0.00	644.47	0.00	743.67	0.00	16,736.21	0.08	0.08
	TITUS	57.65	3.65	0.00	16.92	0.00	2.85	57.65	23.42	71.52	0.00	71.52	0.00	23.42
	UVALDE	41.80		27.01		0.00	0.00	68.81	0.00	580.64	0.00	580.64	0.00	0.00
	FAYETTE	17.71	3.49	0.00	12.19	20.62	2.45	38.34	18.13	99.65	0.00	220.31	0.00	18.13
	CALLAHAN	9.70		0.00		0.00	0.00	9.70	0.00	93.82	0.00	93.82	0.00	0.00
	HOPKINS	48.24		119.19		0.00	0.00	167.43	0.00	745.90	0.00	745.90	0.00	0.00
	LAMPASAS	67.27		0.00		0.00	0.00	67.27	0.00	946.42	0.00	946.42	0.00	0.00
	BLANCO	25.09		0.00		0.00	0.00	25.09	0.00	297.46	0.00	297.46	0.00	0.00
	FREESTONE	10.19	3.18	0.00	14.72	26.07	2.48	36.26	20.37	143.40	0.00	295.90	0.00	20.37
	GRIMES	94.47	1.07	0.00	4.94	26.07	0.83	120.54	6.84	531.46	0.00	683.96	0.00	6.84
	LEE	18.77		0.00		20.05	0.00	38.82	0.00	218.41	0.00	335.72	0.00	0.00
	SOMERVELL	31.84		0.00		0.00	0.00	31.84	0.00	267.35	0.00	267.35	0.00	0.00
	ANDREWS	40.81		0.00		0.00	0.00	40.81	0.00	361.80	0.00	361.80	0.00	0.00
	BORDEN	41.45		0.00		0.00	0.00	41.45	0.00	414.45	0.00	414.45	0.00	0.00

Table 26: 2017 Annual NOx Reductions from New Residential and Commercial Construction (Continued)

	County	Electricity Savings and Resultant NOx Reductions (Single Family Houses)		Electricity Savings and Resultant NOx Reductions (Multifamily Houses)		Electricity Savings and Resultant NOx Reductions (Commercial Buildings)		Total Electricity Savings and Resultant NOx Reductions (SF, MF and Commecial Buildings)		Total Natural Gas Savings and Resultant NOx Reductions (Single and Multi-Family Houses)		Total Natural Gas Savings and Resultant NOx Reductions (SF, MF and Commecial Buildings)		Total Nox Reductions
		Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Annual Nox Reductions (Tons)
Other ERCOT Counties	CHEROKEE	15.51	0.08	0.00	0.39	0.00	0.07	15.51	0.54	28.85	0.00	28.85	0.00	0.54
	DIMMIT	0.00		0.00		20.62	0.00	20.62	0.00	0.00	0.00	120.66	0.00	0.00
	FALLS	2.04		0.00		0.00	0.00	2.04	0.00	28.68	0.00	28.68	0.00	0.00
	COLORADO	21.65	0.34	0.00	1.18	36.56	0.24	58.20	1.76	121.79	0.00	4,607.37	0.02	1.78
	FRIO	14.61	1.68	0.00	5.87	34.38	1.18	48.99	8.72	171.53	0.00	4,389.75	0.02	8.74
	MILAM	15.21	1.69	0.00	5.89	111.78	1.18	126.99	8.75	194.12	0.00	9,367.03	0.04	8.80
	JACKSON	9.99		652.66		0.00	0.00	662.66	0.00	266.03	0.00	266.03	0.00	0.00
	ANDERSON	31.02	0.03	0.00	0.12	0.00	0.02	31.02	0.17	57.71	0.00	57.71	0.00	0.17
	HILL	32.62	0.13	0.00	0.58	0.00	0.10	32.62	0.80	458.87	0.00	458.87	0.00	0.81
	CULBERSON	14.31		0.00		0.00	0.00	14.31	0.00	74.02	0.00	74.02	0.00	0.00
	MASON	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	POTTER	1,228.83	1.38	137.50	4.29	3.63	0.85	1,369.96	6.52	6,814.57	0.03	7,260.16	0.03	6.56
	PECOS	2.34	0.00	0.00	0.00	62.94	0.00	65.28	0.00	22.18	0.00	7,745.69	0.04	0.04
	RAINS	9.19		0.00		20.62	0.00	29.81	0.00	74.31	0.00	194.96	0.00	0.00
	LAVACA	18.06		0.00		0.00	0.00	18.06	0.00	68.36	0.00	68.36	0.00	0.00
	PALO PINTO	9.70	0.13	0.00	0.60	(23.40)	0.10	(13.71)	0.83	93.82	0.00	(132.20)	(0.00)	0.83
	KIMBLE	4.67		0.00		0.00	0.00	4.67	0.00	44.36	0.00	44.36	0.00	0.00
	MADISON	5.90		0.00		148.88	0.00	154.79	0.00	33.22	0.00	18,302.29	0.08	0.08
	ARCHER	17.86		0.00		0.00	0.00	17.86	0.00	193.38	0.00	193.38	0.00	0.00
	REFUGIO	19.99		0.00		264.21	0.00	284.19	0.00	74.77	0.00	28,327.03	0.13	0.13
	LIMESTONE	6.12	5.41	0.00	25.06	0.00	4.21	6.12	34.68	86.04	0.00	86.04	0.00	34.68
	CLAY	2.55		0.00		(19.56)	0.00	(17.01)	0.00	27.63	0.00	(161.29)	(0.00)	(0.00)
	BEE	15.99		0.00		266.30	0.00	282.29	0.00	59.82	0.00	32,736.21	0.15	0.15
	MARTIN	11.33		0.00		121.29	0.00	132.62	0.00	100.50	0.00	14,983.11	0.07	0.07
	GONZALES	31.35		0.00		67.66	0.00	99.01	0.00	371.84	0.00	4,165.42	0.02	0.02
	BURLESON	31.49		0.00		0.00	0.00	31.49	0.00	177.15	0.00	177.15	0.00	0.00
	KARNES	91.01		0.00		0.00	0.00	91.01	0.00	871.09	0.00	871.09	0.00	0.00
	KLEBERG	10.50		0.00		3.44	0.00	13.94	0.00	37.25	0.00	57.36	0.00	0.00
	BREWSTER	11.68		147.19		0.00	0.00	158.87	0.00	622.55	0.00	622.55	0.00	0.00
	WINKLER	0.00		2,256.94		0.00	0.00	2,256.94	0.00	8,020.83	0.04	8,020.83	0.04	0.04
	WOOD	23.78	0.00	29.72	0.01	1,029.72	0.00	1,083.21	0.01	246.30	0.00	42,899.52	0.20	0.21
	FRANKLIN	4.59		0.00		0.00	0.00	4.59	0.00	37.15	0.00	37.15	0.00	0.00
	YOUNG	9.70	0.05	0.00	0.16	0.00	0.00	9.70	0.21	93.82	0.00	93.82	0.00	0.21
	HOUSTON	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SCURRY	17.45	0.34	0.00	1.05	0.00	0.21	17.45	1.60	174.50	0.00	174.50	0.00	1.60
	BOSQUE	16.31	0.15	0.00	0.69	0.00	0.12	16.31	0.95	229.44	0.00	229.44	0.00	0.95
	COMANCHE	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	BRISCOE	16.27		0.00		26.07	0.00	42.34	0.00	296.84	0.00	449.33	0.00	0.00
	CONCHO	2.34		0.00		0.00	0.00	2.34	0.00	22.18	0.00	22.18	0.00	0.00
	ZAVALA	2.05		0.00		9.20	0.00	11.25	0.00	16.69	0.00	1,145.51	0.01	0.01
	NOLAN	9.70	0.03	0.00	0.09	41.16	0.02	50.85	0.14	93.82	0.00	5,143.81	0.02	0.16
	BROOKS	8.37		0.00		0.00	0.00	8.37	0.00	32.50	0.00	32.50	0.00	0.00
	ROBERTSON	157.45	3.50	0.00	16.21	101.62	2.73	259.07	22.44	885.77	0.00	6,091.46	0.03	22.47
	LIVE OAK	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	HAMILTON	6.12		0.00		0.00	0.00	6.12	0.00	86.04	0.00	86.04	0.00	0.00
	JONES	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	REAGAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	WARD	9.07	0.01	0.00	0.02	0.00	0.00	9.07	0.03	80.40	0.00	80.40	0.00	0.03
	RED RIVER	0.00	0.01	0.00	0.05	0.00	0.01	0.00	0.06	0.00	0.00	0.00	0.00	0.06
	HASKELL	7.27		0.00		0.00	0.00	7.27	0.00	70.36	0.00	70.36	0.00	0.00
	HOWARD	63.48	0.04	0.00	0.11	0.00	0.02	63.48	0.17	562.80	0.00	562.80	0.00	0.17
	SAN SABA	0.00		26.76		0.00	0.00	26.76	0.00	84.35	0.00	84.35	0.00	0.00
	JACK	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	STEPHENS	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RUNNELS	9.34		0.00		0.00	0.00	9.34	0.00	88.72	0.00	88.72	0.00	0.00
	REEVES	9.07		0.00		0.00	0.00	9.07	0.00	80.40	0.00	80.40	0.00	0.00
	DE WITT	6.00		0.00		25.21	0.00	31.20	0.00	22.43	0.00	169.90	0.00	0.00
	CHILDRESS	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CROSBY	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	DAWSON	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MITCHELL	0.00	0.07	0.00	0.21	0.00	0.04	0.00	0.32	0.00	0.00	0.00	0.00	0.32
	WILBARGER	7.65	1.40	0.00	4.35	0.00	0.86	7.65	6.62	82.88	0.00	82.88	0.00	6.62
	COLEMAN	0.00		0.00		(3.18)	0.00	(3.18)	0.00	0.00	0.00	(35.81)	(0.00)	(0.00)
	UPTON	6.81	0.00	0.00	0.00	202.63	0.00	209.44	0.00	61.85	0.00	24,925.62	0.11	0.12
	COKE	0.00	0.05	0.00	0.14	0.00	0.03	0.00	0.22	0.00	0.00	0.00	0.00	0.22
	CROCKETT	44.37		0.00		74.46	0.00	118.82	0.00	421.43	0.00	1,806.53	0.01	0.01
	HARDEMAN	2.55		0.00		0.00	0.00	2.55	0.00	27.63	0.00	27.63	0.00	0.00
	BANDERA	2.47		0.00		0.00	0.00	2.47	0.00	16.54	0.00	16.54	0.00	0.00
	BAYLOR	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	COTTLE	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CRANE	2.27		0.00		0.00	0.00	2.27	0.00	20.62	0.00	20.62	0.00	0.00
	DELTA	11.49		0.00		0.00	0.00	11.49	0.00	92.88	0.00	92.88	0.00	0.00
	DICKENS	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	DUVAL	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	EASTLAND	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	EDWARDS	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	FISHER	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	FOARD	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GLASSCOCK	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GOLIAD	8.00	1.16	0.00	4.05	0.00	0.81	8.00	6.03	29.91	0.00	29.91	0.00	6.03
	HALL	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	HUDSPETH	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	IRION	0.00		0.00		98.29	0.00	98.29	0.00	0.00	0.00	12,060.56	0.06	0.06
	JEFF DAVIS	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	KENEDY	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	KENT	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	KING	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	KINNEY	2.09		0.00		0.00	0.00	2.09	0.00	24.79	0.00	24.79	0.00	0.00
	KNOX	0.00		0.00		26.07	0.00	26.07	0.00	0.00	0.00	152.50	0.00	0.00
	LA SALLE	4.10		0.00		0.00	0.00	4.10	0.00	33.37	0.00	33.37	0.00	0.00
	LEON	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	LOVING	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MENARD	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MILLS	0.00		0.00		458.29	0.00	458.29	0.00	0.00	0.00	2,681.28	0.01	0.01
	MONTAGUE	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MOTLEY	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	REAL	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SCHLEICHER	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SHACKELFORD	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	STARR	0.00		25.94		382.65	0.00	408.59	0.00	6.63	0.00	45,772.19	0.21	0.21
	STERLING	0.00		0.00		9.93	0.00	9.93	0.00	0.00	0.00	1,217.94	0.01	0.01
	STONEWALL	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SUTTON	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TERRELL	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	THROCKMORTON	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	ZAPATA	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TOTAL	**242,747.75**	**66.69**	**779,516.70**	**241.29**	**181,668.60**	**49.27**	**1,203,933.05**	**357.26**	**4,038,728.58**	**18.58**	**14,014,389.67**	**64.47**	**421.72**



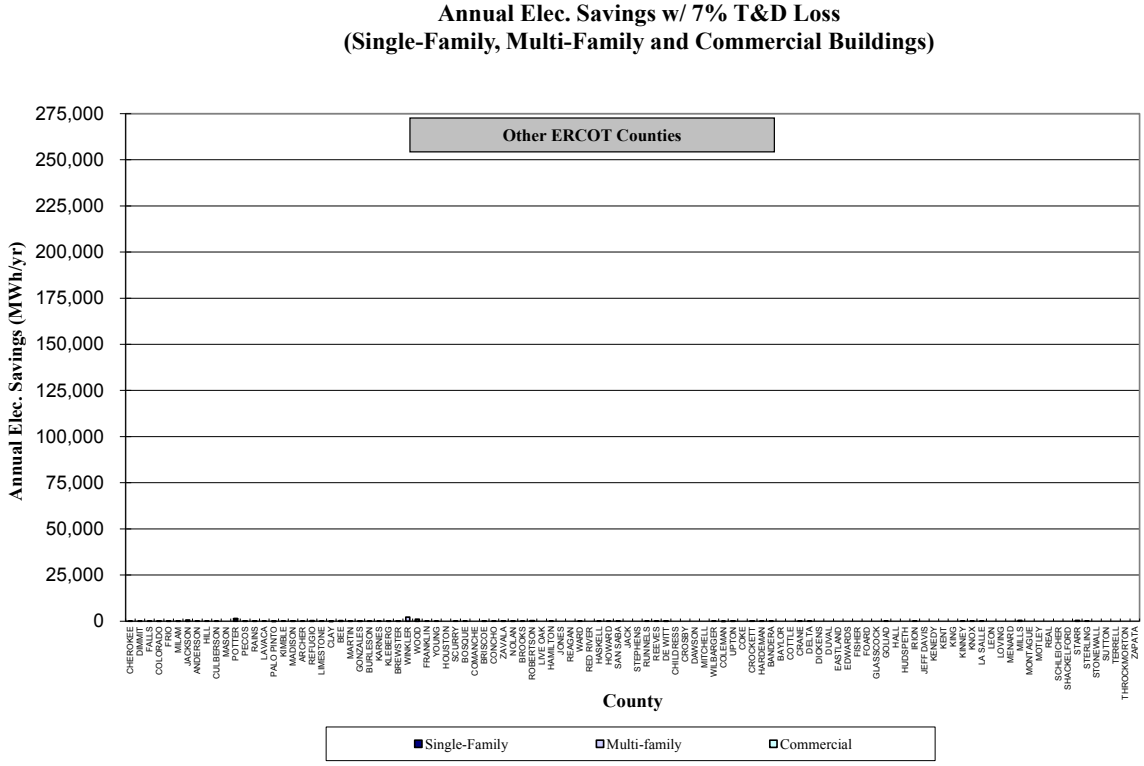


Figure 18: 2017 Annual Electricity Savings by County from New Residential and Commercial Construction

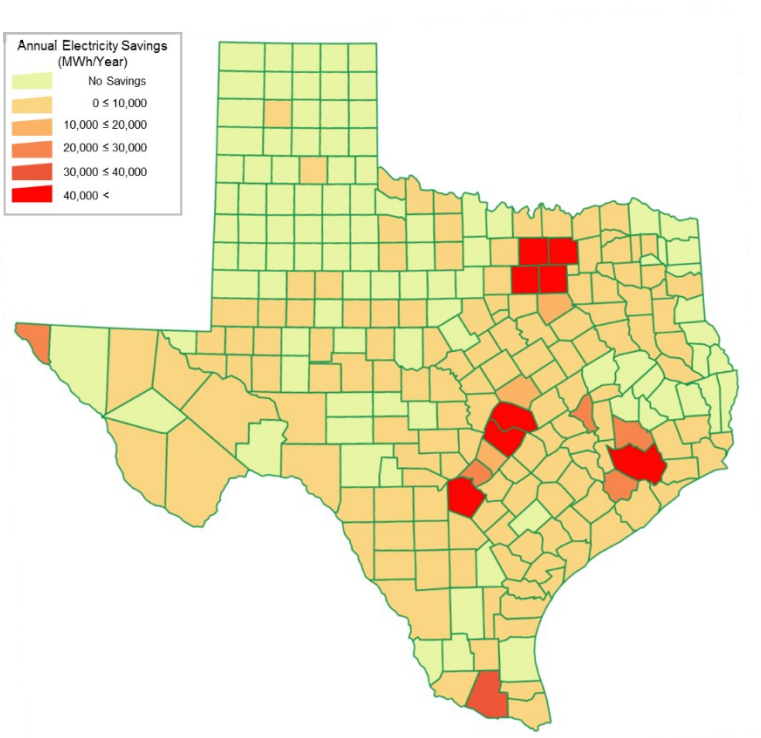


Figure 19: Map of 2017 Annual Electricity Savings by County from New Residential and Commercial Construction

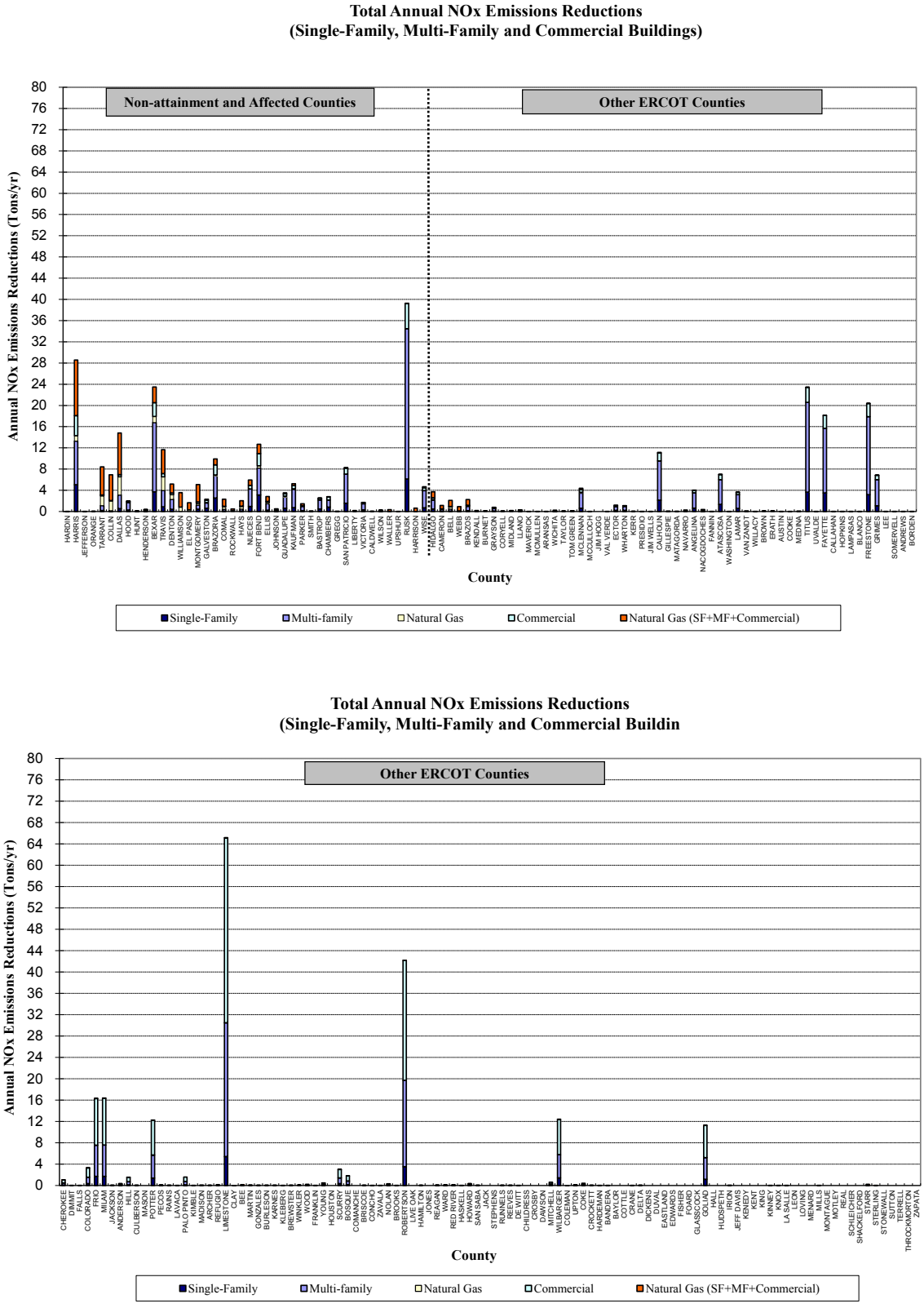


Figure 20: 2017 Annual NOx Reductions by County from New Residential and Commercial Construction

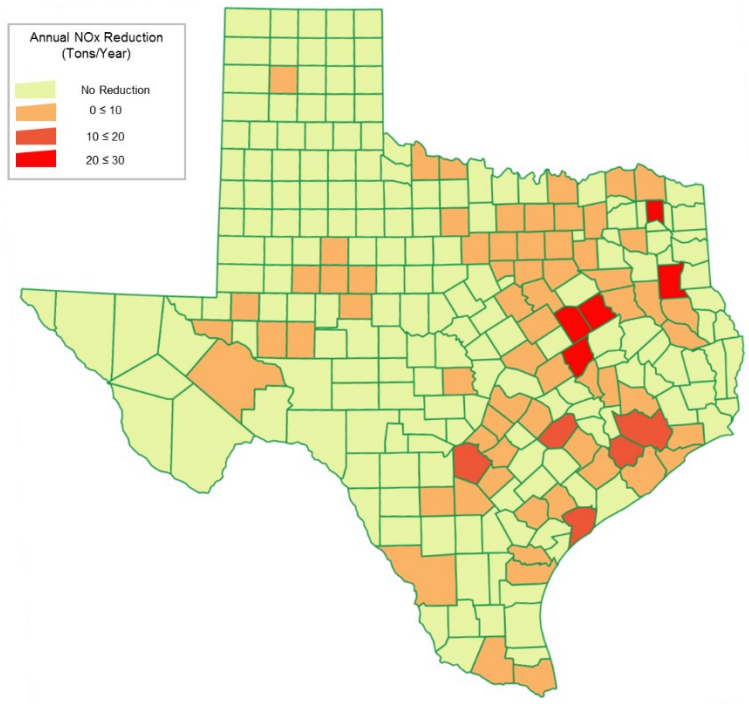


Figure 21: Map of 2017 Annual NOx Reductions by County from New Residential and Commercial Construction

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

5.1 Background

In January 2005, the Laboratory was asked by the Texas Commission on Environmental Quality (TCEQ) to develop a method by which the NOx emissions reductions from the energy-efficiency programs from multiple Texas State Agencies working under Senate Bill 5 and Senate Bill 7 could be reported in a uniform format to allow the TCEQ to consider the combined savings for Texas' State Implementation Plan (SIP) planning purposes. This required that the analysis should include the integrated savings estimation from all projects projected through 2022 for both the annual and Ozone Season Day (OSD) NOx reductions. The NOx emissions reductions from all these programs were calculated using estimated emissions factors for 2016 from the US Environmental Protection Agency (US EPA) eGRID database, which had been specially prepared for this purpose. The different programs included in this 2017 integrated analysis are:

- ESL Single-family new construction
- ESL Multi-family new construction
- ESL Commercial new construction
- PUC Senate Bill 7 Program
- SECO Senate Bill 5 Program
- Electricity generated by renewables in Texas (ERCOT)
- SEER 13 upgrades to Single-family and Multi-family residences

The Laboratory's single-family and multi-family programs include the energy savings attained by constructing new residences in Texas. The baseline to estimate energy savings uses the published data on residential construction characteristics by the 2008 National Association of Home Builders (NAHB 2008) based on the 2006 IECC building code (2006 ICC). Annual electricity savings (MWh) are obtained from the Laboratory's Annual Reports to the TCEQ (Haberl et al., 2002 - 2017).

The Laboratory's commercial program includes the energy savings attained by constructing new commercial buildings in Texas, including office, apartment, healthcare, education, retail, food and lodging as defined by Dodge building type (Dodge 2011). Energy savings were estimated from code compliant buildings (ASHRAE Standard 90.1-2013) against pre-code buildings (ASHRAE Standard 90.1-2007) using EUI in the USDOE report and constructed square footage in Dodge data (Dodge 2017).

The Public Utility Commission of Texas (PUC) Senate Bill 7 program includes the energy efficiency programs implemented by electric utilities under the Public Utility Regulatory Act §39.905. The PUC regulated energy efficiency program was adopted pursuant to 1999 legislation (SB 7) and subsequent legislation in 2001 (SB 5), 2007 (HB 3693), and 2011 (SB 1125). The energy efficiency measures include high efficiency HVAC equipment, variable speed drives, increased insulation levels, infiltration reduction, duct sealing, Energy Star Homes, etc. Annual electricity savings claimed by the utilities were reported for the different programs completed in the years 2001 through 2017.

The Texas State Energy Conservation Office (SECO) funds energy-efficiency programs that are directed towards school districts, government agencies, city and county governments, private industries and residential energy consumers. For the 2017 reporting year SECO submitted annual energy savings values for projects funded by SECO and by Energy Service projects.

The *Electric Reliability Council of Texas (ERCOT) electricity production from currently installed green power generation* in Texas is reported. Actual measured electricity productions for 2001 through 2017 were included. For projections to 2022, the annual growth factor was estimated using the last six years installed power capacity.

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

5.2 Description of the Analysis Method

Annual and Ozone Season Period (OSP) NOx emissions reductions were calculated for 2017 and integrated from 2009 to 2022 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 29 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 renewables, an annual degradation factor of 2% was used for ESL Single-family, Multi-family, and Commercial programs and an annual degradation factor of 5% was used for all other programs . The value of the 5% degradation factor was taken from a study by Kats et al. (1996).

Transmission and distribution loss: This factor adjusts the reported savings to account for the loss in energy resulting from the transmission and distribution of the power from the electricity producers to the electricity consumers. For this calculation, the energy savings reported at the consumer level are increased by 7% to give credit for the actual power produced that is lost in the transmission and distribution system on its way to the customer. In the case of electricity generated by renewables, the T&D losses were assumed to cancel out since renewable energy is displacing power produced by conventional power plants; therefore, there is no net increase or decrease in T&D losses.

Initial discount factor: This factor was used to discount the reported savings for any inaccuracies in the assumptions and methods employed in the calculation procedures. For the Laboratory's Single, Multi-family and Commercial program, the discount factor was assumed to be 20%. For PUC's Senate Bill 7 program, the discount factor was taken as 10%. For the savings in the SECO program, the discount factor was 60%. For the electricity from renewables, the discount factor was taken as 5%. In addition, the discount factor for SEER 13 single-family and SEER 13 multi-family program was 20%.

Growth factor: The growth factors shown in Table 25 were used to account for several different factors. Growth factors for single-family (4.1%), multi-family residential (6.1%), and commercial (5.3%) construction are projections based on the average growth rate for these housing types from recent U.S. Census data for Texas. Growth factor for renewable energy (8.5%) is a linear projection based on the installed renewable power generation capacity for 2009 through 2017 from the Public Utility Commission of Texas. No growth was assumed for PUC programs, SECO, and SEER 13 entries.

Figure 22 shows the overall information flow that was used to calculate the NOx emissions savings from the annual and OSP electricity savings (MWh) from all programs. For the Laboratory's single-family and multi-family code-implementation programs, the annual and OSP were calculated from DOE-2 hourly simulation models[36]. The base case is taken as the average characteristics of single- and multi-family residences for Texas published by the National Association of Home Builders for 2008 (NAHB 2008) and 2006 IECC. The annual electricity savings from PUC's energy efficiency programs were calculated using PUC approved demand savings calculations or tables or industry accepted measurement and verification methods (PUC 2018). The OSP consumption is the average daily consumption for the period between July 15 and September 15.

The SECO electricity savings were submitted as annual savings by project[37]. A description of the measures completed for the project was also submitted for information purposes. The electricity production from renewables farms in Texas was from the actual on-site metered data measured at 15-minute intervals except non-utility scale solar photovoltaic (PV) projects.

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 29. These include evaluation across programs, evaluation

[36] These values are based on a performance analysis as defined by Chapter 4 of IECC 2006. This analysis is discussed in the Laboratory's annual reports to the TCEQ.
[37] 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.

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

5.3 Calculation Procedure

The electricity savings in this report was estimated based on the baseline year of 2008. In addition, the emissions estimation throughout this report was updated to the 2016 eGrid database, which is applied to the four different Competitive Load (CL) zones: Houston, North, West, and South. For all the programs, except renewable projects, the corresponding OSP emissions reductions were calculated using an annual daily average. The OSP emissions reductions from the electricity generated by renewables except non-utility scale solar PV projects were estimated by actual measured data.

ESL Single-family and Multi-family. The calculation of the annual electricity savings reported for the years 2002 through 2017 included the savings from code-compliant new housing in all 36 non-attainment and affected counties as reported in the Laboratory's annual report submitted by the Laboratory to the Texas Commission of Environmental Quality (TCEQ). From 2009 to 2017, based on year 2008, the annual electricity savings were calculated for new residential construction in all the counties in ERCOT region, which includes the 42 non-attainment and affected counties. These savings were then tabulated by county and program. Using the calculated values through 2017, savings were then projected to 2022 by incorporating the different adjustment factors mentioned above.

In these calculations, it was assumed that the same amount of electricity savings from the code-complaint construction would be achieved for each year after 2017 through 2022[38]. The projected energy savings through 2022, according to county, were then divided into the CL zones in the 2016 eGRID. To determine which CL zone was to be used, or in counties with multiple CL zone, the allocation to each CL zone by county was obtained from CL zone's listing published in the Laboratory's 2010 annual report[39].

For the 2017 annual NOx emissions calculations, the US EPA's 2016 eGRID were used. An example of the eGRID spreadsheet is given in the Table 30. The total electricity savings for each CL zone were used to calculate the NOx emissions reductions for each of the different counties using the emissions factors contained in eGRID. Similar calculations were performed for each year for which the analysis was required.

ESL-Commercial Buildings. The annual electricity savings for 2004 through 2017 for commercial buildings were obtained from the annual reports for 2004 through 2017 submitted by the Laboratory to TCEQ . From 2009 to 2017, based on year 2008, the annual electricity savings were also calculated for new commercial construction by county. Using the calculated savings through 2017, savings were then projected to 2022 by incorporating the different adjustment factors mentioned above . In the projected annual electricity savings, it was assumed that the same 2017 amount of electricity savings would be achieved for each year through 2022. Similarly to the single family calculations, the projected energy saving numbers through 2022, by county, were allocated into the appropriate CL zones.

PUC-Senate Bill 7. For the PUC Senate Bill 7 program savings, the annual electricity savings for 2001 through 2017 were obtained from the Public Utility Commission of Texas. Using these values savings were projected through 2022 by incorporating the different adjustment factors mentioned above. Similar savings were assumed for each year after 2017 until 2022. The 2016 annual eGRID was also used to calculate the NOx emissions savings for the PUC-Senate Bill 7 program. The total electricity savings for each CL zone were used to calculate the NOx emissions reductions for each county using the emissions factors contained in the US EPA's eGRID spreadsheet. The integrated NOx emissions reductions for each county were then calculated.

SECO Savings. The annual electricity consumption reported by political subdivisions for 13 counties (38 entities) through 2017 were obtained from the State Energy Conservation Office (SECO). Using the reported consumption,

[38] This would include the appropriate discount and degradation factors for each year.
[39] Haberl et al., 2010, pp. 265.

the annual and OSP electricity savings resulted from energy conservation projects were then calculated. To achieve this, the annual energy use intensity (EUI) for each county was estimated and the county's energy savings for each year against the baseline year of 2008 were then calculated . In addition, the savings through 2022 were projected using the different adjustment factors mentioned above. In a similar fashion to the previous programs, it was assumed that the same amount of electricity savings will be achieved for each year through 2022. The 2016 annual eGRID was also used to calculate the NOx emissions savings for the SECO program.

Electricity Generated by Renewables. The measured and estimated electricity production from renewables in Texas for 2008 through 2017 was obtained from reports of Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP) - Technical Report (2009-2010) for 2008 through 2009 data and Statewide Air Emissions Calculations from Wind and Other Renewables (2011-2018) for 2010 through 2017 data. Using the reported numbers for 2017, savings through 2022 were projected incorporating the different adjustment factors mentioned above. The 2010 eGRID was used for the period of 2008 through 2016 and 2016 eGRID was then used for the period of 2017 through 2022 to calculate the NOx emissions reductions for the electricity generated by renewables in Texas. The total electricity savings for each CL zone were used to calculate the NOx emissions reductions 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 OSP electricity savings from the replacement of the air conditioning units by air conditioners with an efficiency of SEER 13 in existing residences needed to be calculated. In this analysis, it was assumed that an equal number of existing houses had their air conditioners replaced, as reported for 2006, by the air conditioner manufacturers. This replacement rate continued until all the existing air conditioner stock was replaced with SEER 13 air conditioners.

In the 2017 report to the TCEQ, the annual and OSP electricity savings for all the counties in ERCOT region as well as the 42 non-attainment and affected counties were calculated. Using the numbers for 2008, the savings after 2008 until 2022 were projected by incorporating the appropriate adjustment factors[40]. The total electricity savings for each CL zone were used to calculate the NOx emissions reductions for each of the different county using the emissions factors contained in the 2016 eGRID. Integrated NOx emissions reductions for each county by ozone non-attainment and affected counties were also calculated.

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

5.4 Results

The total integrated annual and OSP electricity savings for all the different programs in the integrated format were calculated for 2009 through 2022 as shown in Table 31, using the adjustment factors shown in Table 29. Annual and OSP NOx emissions reductions from the electricity savings (presented in Table 31) for all the programs in the integrated format were shown in Table 32.

In 2017, the total integrated annual savings from all programs are 56,457,081 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction are 4,034,136 MWh/year (7.1% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program are 3,844,949 MWh/year (6.8%),
- Savings from SECO's Senate Bill 5 program are 1,275,938 MWh/year (2.3%),
- Electricity savings from renewable power generation are 47,055,032 MWh/year (83.3%), and
- Savings from residential air conditioner retrofits[41] are 247,025 MWh/year (0.4%).

In 2017, the total integrated OSP savings from all programs are 123,280 MWh/day, which would be a 5,137 MW average hourly load reduction during the OSP. The integrated OSP electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction are 11,052 MWh/day (9.0%),
- Savings from the PUC's Senate Bill 7 programs are 10,534 MWh/day (8.5%),
- Savings from SECO's Senate Bill 5 program are 3,496 MWh/day (2.8%),
- Electricity savings from renewable power generation are 96,446 MWh/day (78.2%), and
- Savings from residential air conditioner retrofits are 1,752 MWh/day (1.4%).

By 2022, the total integrated annual savings from all programs will be 87,687,961 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction will be 9,380,917 MWh/year (10.7% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program will be 5,332,467 MWh/year (6.1%),
- Savings from SECO's Senate Bill 5 program will be 2,028,819 MWh/year (2.3%),
- Electricity savings from renewable power generation will be 70,754,614 MWh/year (80.7%), and
- Savings from residential air conditioner retrofits will be 191,143 MWh/year (0.2%).

By 2022, the total integrated OSP savings from all programs will be 192,246 MWh/day, which would be a 8,010 MW average hourly load reduction during the OSP. The integrated OSP electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction will be 25,701 MWh/day (13.4%),
- Savings from the PUC's Senate Bill 7 programs will be 14,609 MWh/day (7.6%),
- Savings from SECO's Senate Bill 5 program will be 5,558 MWh/day (2.9%),
- Electricity savings from renewable power generation will be 145,021 MWh/day (75.4%), and
- Savings from residential air conditioner retrofits will be 1,356 MWh/day (0.7%).

In 2017 (Table 32), the total integrated annual NOx emissions reductions from all programs are 27,065 tons-NOx/year. The integrated annual NOx emissions reductions from all the different programs are:

- NOx emissions reductions from code-compliant residential and commercial construction are 1,213 tons-NOx/year (4.5% of the total NOx savings),
- NOx emissions reductions from the PUC's Senate Bill 7 programs are 1,326 tons-NOx/year (4.9%),
- NOx emissions reductions from SECO's Senate Bill 5 program are 400 tons-NOx/year (1.5%),
- NOx emissions reductions from renewable power generation are 24,054 tons-NOx/year (88.9%), and
- NOx emissions reductions from residential air conditioner retrofits are 72 tons-NOx/year (0.3%).

[41] 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.

In 2017, the total integrated OSP NOx emissions reductions from all programs are 59.00 tons-NOx/day. The integrated OSP NOx emissions reductions from all the different programs are:

- NOx emissions reductions from code-compliant residential and commercial construction are 3.36 tons-NOx/day (5.7%),
- NOx emissions reductions from the PUC's Senate Bill 7 programs are 3.75 tons-NOx/day (6.4 %),
- NOx emissions reductions from SECO's Senate Bill 5 program are 1.12 tons-NOx/day (1.9%),
- NOx emissions reductions from renewable power generation are 50.25 tons-NOx/day (85.2%), and
- NOx emissions reductions from residential air conditioner retrofits are 0.52 tons-NOx/day (0.9%).

By 2022, the total integrated annual NOx emissions reductions from all programs will be 41,612 tons-NOx/year. The integrated annual NOx emissions reductions from all the different programs are:

- NOx emissions reductions from code-compliant residential and commercial construction will be 2,891 tons-NOx/year (6.9% of the total NOx savings),
- NOx emissions reductions from the PUC's Senate Bill 7 programs will be 1,833 tons-NOx/year (4.4%),
- NOx emissions reductions from SECO's Senate Bill 5 program will be 665 tons-NOx/year (1.6%),
- NOx emissions reductions from renewable power generation will be 36,169 tons-NOx/year (86.9%), and
- NOx emissions reductions from residential air conditioner retrofits will be 55 tons-NOx/year (0.1%).

By 2022, the total integrated OSP NOx emissions reductions from all programs will be 91.00 tons-NOx/day. The integrated OSP NOx emissions reductions from all the different programs are:

- NOx emissions reductions from code-compliant residential and commercial construction will be 7.99 tons-NOx/day (8.8%),
- NOx emissions reductions from the PUC's Senate Bill 7 programs will be 5.19 tons-NOx/day (5.7%),
- NOx emissions reductions from SECO's Senate Bill 5 program will be 1.85 tons-NOx/day (2.0%),
- NOx emissions reductions from renewable power generation will be 75.57 tons-NOx/day (83.0%), and
- NOx emissions reductions from residential air conditioner retrofits will be 0.40 tons-NOx/day (0.4%).

Table 29: Final Adjustment Factors used for the Calculation of the Annual and OSP NOx Savings for the Different Programs

	ESL-Single Family	ESL-Multifamily	ESL-Commercial	PUC (SB7)	SECO	Renewables-ERCOT	SEER13 Single Family	SEER13 Multi Family
Annual Degradation Factor	2.0%	2.0%	2.0%	5.0%	5.0%	0.0%	5.0%	5.0%
T&D Loss	7.0%	7.0%	7.0%	7.0%	7.0%	0.0%	7.0%	7.0%
Initial Discount Factor	20.0%	20.0%	20.0%	10.0%	60.0%	5.0%	20.0%	20.0%
Growth Factor	4.1%	6.1%	5.3%	0.0%	0.0%	8.5%	N.A.	N.A.
Weather Normalized	Yes	Yes	Yes	No	No	No	Yes	Yes

Note: For Renewables-ERCOT, the OSP energy consumption is the average daily consumption of the measured data in the months of July, August and September.

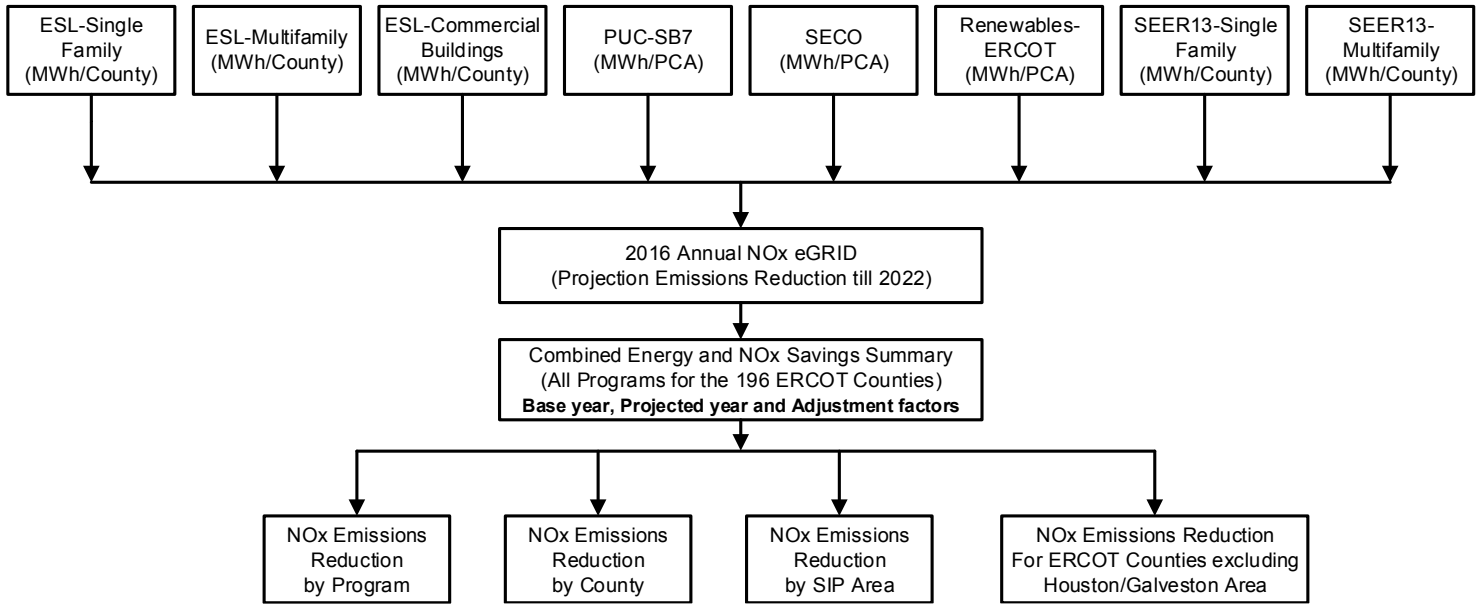


Figure 22: Process Flow Diagram of the NOx Emissions Reduction Calculations

Table 30: Example of NOx Emissions Reduction Calculations using 2016 eGRID

Area	County	CL Zones								Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
		H		N		W		S			
Houston-Galveston Area	Brazoria	0.0568294	257.8981	0.0000072	0.0469	0.0000003	0.0006	0.0005324	0.9138	258.86	0.13
	Chambers	0.0246685	111.9486	0.0000031	0.0204	0.0000002	0.0003	0.0002311	0.3966	112.37	0.06
	Fort Bend	0.0916210	415.7866	0.0000116	0.0757	0.0000006	0.0010	0.0008584	1.4732	417.34	0.21
	Galveston	0.0118565	53.8064	0.0000015	0.0098	0.0000001	0.0001	0.0001111	0.1906	54.01	0.03
	Harris	0.1083409	491.6634	0.0000137	0.0895	0.0000007	0.0012	0.0010150	1.7420	493.50	0.25
	Liberty	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Montgomery	0.0093310	42.3453	0.0000012	0.0077	0.0000001	0.0001	0.0000874	0.1500	42.50	0.02
	Waller	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
Beaumont/ Port Arthur Area	Hardin	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Jefferson	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Orange	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
Dallas/ Fort Worth Area	Collin	0.0000368	0.1670	0.0002257	1.4690	0.0000109	0.0201	0.0000023	0.0040	1.66	0.00
	Dallas	0.0019990	9.0715	0.0122626	79.8167	0.0005923	1.0935	0.0001251	0.2147	90.20	0.05
	Denton	0.0012011	5.4508	0.0073682	47.9593	0.0003559	0.6570	0.0000752	0.1290	54.20	0.03
	Tarrant	0.0007589	3.4440	0.0046556	30.3029	0.0002249	0.4151	0.0000475	0.0815	34.24	0.02
	Ellis	0.0011262	5.1108	0.0069087	44.9682	0.0003337	0.6161	0.0000705	0.1210	50.82	0.03
	Johnson	0.0002237	1.0151	0.0013721	8.9311	0.0000663	0.1224	0.0000140	0.0240	10.09	0.01
	Kaufman	0.0025504	11.5741	0.0156455	101.8360	0.0007557	1.3951	0.0001596	0.2740	115.08	0.06
	Parker	0.0004992	2.2653	0.0030622	19.9314	0.0001479	0.2731	0.0000312	0.0536	22.52	0.01
	Rockwall	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Henderson	0.0002092	0.9495	0.0012835	8.3545	0.0000620	0.1145	0.0000131	0.0225	9.44	0.00
	Hood	0.0017809	8.0818	0.0109248	71.1087	0.0005277	0.9742	0.0001115	0.1913	80.36	0.04
	Hunt	0.0000552	0.2506	0.0003387	2.2048	0.0000164	0.0302	0.0000035	0.0059	2.49	0.00
	Wise	0.0026648	12.0931	0.0163471	106.4023	0.0007896	1.4577	0.0001668	0.2862	120.24	0.06
El Paso Area	El Paso	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
San Antonio Area	Bexar	0.0173770	78.8587	0.0011719	7.6281	0.0000566	0.1045	0.1387790	238.1853	324.78	0.16
	Comal	0.0003148	1.4286	0.0000212	0.1382	0.0000010	0.0019	0.0025142	4.3151	5.88	0.00
	Guadalupe	0.0025314	11.4879	0.0001707	1.1112	0.0000082	0.0152	0.0202169	34.6981	47.31	0.02
	Wilson	0.0001491	0.6765	0.0000101	0.0654	0.0000005	0.0009	0.0011905	2.0433	2.79	0.00
Austin Area	Bastrop	0.0023093	10.4800	0.0001557	1.0137	0.0000075	0.0139	0.0184432	31.6538	43.16	0.02
	Caldwell	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Hays	0.0004586	2.0812	0.0000309	0.2013	0.0000015	0.0028	0.0036626	6.2861	8.57	0.00
	Travis	0.0034963	15.8665	0.0002358	1.5348	0.0000114	0.0210	0.0279226	47.9234	65.35	0.03
	Williamson	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
North East Texas Area	Gregg	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Harrison	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Rusk	0.0241170	109.4455	0.1479453	962.9693	0.0071460	13.1925	0.0015094	2.5906	1088.20	0.54
	Smith	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Upshur	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
Corpus Christi Area	Nueces	0.0037957	17.2252	0.0002560	1.6662	0.0000124	0.0228	0.0303137	52.0272	70.94	0.04
	San Patricio	0.0057420	26.0577	0.0003873	2.5206	0.0000187	0.0345	0.0458575	78.7048	107.32	0.05
Victoria Area	Victoria	0.0013919	6.3165	0.0000939	0.6110	0.0000045	0.0084	0.0111160	19.0784	26.01	0.01
Other ERCOT counties	Anderson	0.0000896	0.4068	0.0005499	3.5795	0.0000266	0.0490	0.0000056	0.0096	4.04	0.00
	Andrews	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Angelina	0.0020918	9.4927	0.0128320	83.5230	0.0006198	1.1443	0.0001309	0.2247	94.38	0.05
	Atascosa	0.0053556	24.3042	0.0003612	2.3510	0.0000174	0.0322	0.0427716	73.4085	100.10	0.05
	Bell	0.0003279	1.4879	0.0020113	13.0915	0.0000971	0.1794	0.0000205	0.0352	14.79	0.01
	Bosque	0.0005396	2.4486	0.0033099	21.5443	0.0001599	0.2952	0.0000338	0.0580	24.35	0.01
	Brazos	0.0006180	2.8044	0.0037909	24.6749	0.0001831	0.3380	0.0000387	0.0664	27.88	0.01
	Calhoun	0.0074943	34.0099	0.0005054	3.2898	0.0000244	0.0451	0.0598521	102.7236	140.07	0.07
	Cameron	0.0003272	1.4847	0.0000221	0.1436	0.0000011	0.0020	0.0026129	4.4844	6.11	0.00
	Cherokee	0.0003928	1.7825	0.0024096	15.6840	0.0001164	0.2149	0.0000246	0.0422	17.72	0.01
	Coke	0.0000132	0.0597	0.0000807	0.5255	0.0137102	25.3108	0.0000008	0.0014	25.90	0.01
	Coleman	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Colorado	0.0018297	8.3032	0.0001234	0.8032	0.0000060	0.0110	0.0146124	25.0791	34.20	0.02
	Crockett	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Ector	0.0000665	0.3018	0.0004080	2.6556	0.0692797	127.8998	0.0000042	0.0071	130.86	0.07
	Fannin	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Fayette	0.0142622	64.7235	0.0009619	6.2608	0.0000465	0.0858	0.1139033	195.4913	266.56	0.13
	Freestone	0.0119736	54.3374	0.0734517	478.0936	0.0035478	6.5498	0.0007494	1.2862	540.27	0.27
	Frio	0.0075616	34.3153	0.0005100	3.3194	0.0000246	0.0455	0.0603896	103.6462	141.33	0.07
	Goliad	0.0055754	25.3016	0.0003760	2.4475	0.0000182	0.0335	0.0445268	76.4210	104.20	0.05
	Grayson	0.0003196	1.4503	0.0019605	12.7610	0.0000947	0.1748	0.0000200	0.0343	14.42	0.01
	Grimes	0.0044394	20.1467	0.0272337	177.2627	0.0013154	2.4285	0.0002778	0.4769	200.31	0.10
	Hardeman	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Haskell	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Hidalgo	0.0015064	6.8361	0.0001016	0.6613	0.0000049	0.0091	0.0120304	20.6478	28.15	0.01
	Hill	0.0004153	1.8847	0.0025477	16.5829	0.0001231	0.2272	0.0000260	0.0446	18.74	0.01
	Howard	0.0000147	0.0669	0.0000904	0.5886	0.0153564	28.3501	0.0000009	0.0016	29.01	0.01
	Jack	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Jones	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Lamar	0.0020634	9.3641	0.0126581	82.3913	0.0006114	1.1287	0.0001291	0.2216	93.11	0.05
	Limestone	0.0203491	92.3465	0.1248314	812.5216	0.0060296	11.1314	0.0012736	2.1858	918.19	0.46
	Llano	0.0001567	0.7112	0.0000106	0.0688	0.0000005	0.0009	0.0012515	2.1480	2.93	0.00
	McLennan	0.0034688	15.7416	0.0212790	138.5042	0.0010278	1.8975	0.0002171	0.3726	156.52	0.08
	Milam	0.0065761	29.8431	0.0004435	2.8868	0.0000214	0.0395	0.0525191	90.1381	122.91	0.06
	Mitchell	0.0000167	0.0758	0.0001024	0.6666	0.0173890	32.1025	0.0000010	0.0018	32.85	0.02
	Nacogdoches	0.0001939	0.8797	0.0011892	7.7405	0.0000574	0.1060	0.0000121	0.0208	8.75	0.00
	Nolan	0.0000074	0.0335	0.0000452	0.2945	0.0076822	14.1825	0.0000005	0.0008	14.51	0.01
	Palo Pinto	0.0007026	3.1887	0.0043104	28.0561	0.0002082	0.3844	0.0000440	0.0755	31.70	0.02
	Pecos	0.0000003	0.0012	0.0000016	0.0107	0.0002780	0.5133	0.0000000	0.0000	0.53	0.00
	Potter	0.0003904	1.7718	0.0023951	15.5896	0.4067024	750.8286	0.0000244	0.0419	768.23	0.38
	Presidio	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Reagan	0.0000002	0.0011	0.0000015	0.0099	0.0002570	0.4744	0.0000000	0.0000	0.49	0.00
	Red River	0.0000354	0.1605	0.0002170	1.4125	0.0000105	0.0194	0.0000022	0.0038	1.60	0.00
	Robertson	0.0123366	55.9850	0.0756789	492.5903	0.0036554	6.7484	0.0007721	1.3252	556.65	0.28
	Scurry	0.0000851	0.3860	0.0005218	3.3965	0.0886072	163.5811	0.0000053	0.0091	167.37	0.08
	Taylor	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Titus	0.0153000	69.4333	0.0938579	610.9167	0.0045335	8.3695	0.0009576	1.6435	690.36	0.35
	Tom Green	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Upton	0.0000002	0.0010	0.0000014	0.0092	0.0002401	0.4433	0.0000000	0.0000	0.45	0.00
	Ward	0.0000015	0.0067	0.0000091	0.0591	0.0015429	2.8483	0.0000001	0.0002	2.91	0.00
	Webb	0.0000329	0.1493	0.0000022	0.0144	0.0000001	0.0002	0.0002628	0.4511	0.62	0.00
	Wharton	0.0008579	3.8932	0.0000579	0.3766	0.0000028	0.0052	0.0068515	11.7592	16.03	0.01
	Wichita	0.0000021	0.0094	0.0000127	0.0826	0.0021547	3.9779	0.0000001	0.0002	4.07	0.00
	Wilbarger	0.0005125	2.3257	0.0031439	20.4633	0.5338477	985.5563	0.0000321	0.0550	1008.40	0.50
	Wood	0.0000083	0.0377	0.0000509	0.3316	0.0000025	0.0045	0.0000005	0.0009	0.37	0.00
	Young	0.0000249	0.1128	0.0001525	0.9924	0.0258899	47.7963	0.0000016	0.0027	48.90	0.02
	Total	**0.5057727**	**2295.2545155**	**0.7055240**	**4592.2240670**	**1.2166789**	**2246.1566175**	**0.7215719**	**1238.4281709**	10372.06	**4.45**
Energy Savings (MWh)		4,538		6,509		1,846		1,716			

Table 31: Annual and OSP Electricity Savings for the Different Programs (Base Year 2008)

PROGRAM	ANNUAL (MWh)														
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ESL-Single Family	0	25,031	47,000	74,109	153,562	215,164	275,535	360,010	533,473	722,595	916,125	1,114,311	1,317,411	1,525,690	1,739,422
ESL-Multifamily	0	50,784	108,018	200,414	332,835	527,292	774,578	1,225,617	1,856,682	2,472,527	3,115,886	3,788,639	4,492,777	5,230,406	6,003,760
ESL-Commercial	0	0	24,066	83,255	119,422	247,952	400,015	559,947	696,924	839,015	986,534	1,139,810	1,299,190	1,465,038	1,637,735
PUC (SB7)	0	538,841	976,984	1,437,883	1,831,318	2,267,414	2,675,295	3,079,759	3,498,867	3,844,949	4,173,727	4,486,067	4,782,789	5,064,675	5,332,467
SECO	0	71,910	154,786	347,175	508,375	705,060	1,004,828	1,005,713	1,100,775	1,275,938	1,442,344	1,600,428	1,750,609	1,893,281	2,028,819
Renewables-ERCOT	0	3,454,992	8,351,369	12,158,649	13,392,752	17,028,343	18,753,002	20,883,590	34,193,486	47,055,032	51,054,710	55,394,360	60,102,881	65,211,626	70,754,614
SEER13-Single Family	0	343,330	326,163	309,855	294,362	279,644	265,662	252,379	239,760	227,772	216,383	205,564	195,286	185,522	176,246
SEER13-Multi Family	0	29,021	27,569	26,191	24,881	23,637	22,456	21,333	20,266	19,253	18,290	17,376	16,507	15,682	14,897
Total Annual (MWh)	**0**	**4,513,907**	**10,015,955**	**14,637,531**	**16,657,507**	**21,294,506**	**24,171,371**	**27,388,349**	**42,140,233**	**56,457,081**	**61,923,999**	**67,746,556**	**73,957,450**	**80,591,919**	**87,687,961**

PROGRAM	OZONE SEASON PERIOD - OSP (MWh/day)														
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ESL-Single Family	0	69	129	203	421	589	755	986	1,462	1,980	2,510	3,053	3,609	4,180	4,766
ESL-Multifamily	0	139	296	549	912	1,445	2,122	3,358	5,087	6,774	8,537	10,380	12,309	14,330	0
ESL-Commercial	0	0	66	228	327	679	1,096	1,534	1,909	2,299	2,703	3,123	3,559	4,014	4,487
PUC (SB7)	0	1,476	2,677	3,939	5,017	6,212	7,330	8,438	9,586	10,534	11,435	12,291	13,104	13,876	14,609
SECO	0	197	424	951	1,393	1,932	2,753	2,755	3,016	3,496	3,952	4,385	4,796	5,187	5,558
Renewables-ERCOT	0	15,037	26,234	30,736	32,528	31,695	46,338	63,604	86,957	96,446	104,644	113,538	123,189	133,660	145,021
SEER13-Single Family	0	2,445	2,323	2,207	2,097	1,992	1,892	1,798	1,708	1,622	1,541	1,464	1,391	1,321	1,255
SEER13-Multi Family	0	195	186	176	167	159	151	144	136	130	123	117	111	106	100
Total OSP (MWh)	**0**	**19,559**	**32,334**	**38,990**	**42,862**	**44,703**	**62,436**	**82,617**	**109,861**	**123,280**	**135,444**	**148,350**	**162,069**	**176,674**	**175,797**

Table 32: Annual and OSP NOx Emissions Reduction Values for the Different Programs (Base Year 2008)

PROGRAM	ANNUAL (in tons NOx)														
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ESL-Single Family	0	3	8	15	34	50	65	86	129	206	263	320	379	440	502
ESL-Multifamily	0	4	19	43	77	127	190	305	468	810	1,028	1,256	1,494	1,744	2,006
ESL-Commercial	0	0	5	16	22	47	79	114	141	197	232	267	304	343	383
PUC (SB7)	0	135	246	362	460	567	669	770	874	1,326	1,438	1,545	1,646	1,742	1,833
SECO	0	19	43	92	133	183	264	265	294	400	458	514	567	617	665
Renewables-ERCOT	0	951	2,645	3,258	3,561	4,693	5,116	5,683	9,360	24,054	26,098	28,317	30,724	33,335	36,169
SEER13-Single Family	0	81	77	73	69	66	62	59	56	66	63	60	57	54	51
SEER13-Multi Family	0	7	6	6	6	6	5	5	5	6	5	5	5	5	4
Total Annual (Tons NOx)	**0**	**1,199**	**3,048**	**3,864**	**4,363**	**5,738**	**6,451**	**7,287**	**11,328**	**27,065**	**29,585**	**32,283**	**35,175**	**38,279**	**41,612**

PROGRAM	OZONE SEASON PERIOD - OSP (in tons NOx/day)														
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ESL-Single Family	0.00	0.01	0.02	0.04	0.09	0.14	0.18	0.24	0.35	0.57	0.73	0.89	1.05	1.22	1.39
ESL-Multifamily	0.00	0.01	0.05	0.12	0.21	0.35	0.52	0.83	1.28	2.24	2.84	3.47	4.13	4.82	5.54
ESL-Commercial	0.00	0.00	0.01	0.04	0.06	0.13	0.22	0.31	0.39	0.54	0.64	0.74	0.84	0.94	1.05
PUC (SB7)	0.00	0.37	0.67	0.99	1.26	1.55	1.83	2.11	2.39	3.75	4.07	4.37	4.65	4.93	5.19
SECO	0.00	0.05	0.12	0.25	0.37	0.50	0.72	0.73	0.81	1.12	1.28	1.44	1.58	1.72	1.85
Renewables-ERCOT	0.00	4.15	7.53	8.42	8.91	9.03	12.87	17.55	24.11	50.25	54.53	59.16	64.19	69.65	75.57
SEER13-Single Family	0.00	0.57	0.54	0.51	0.49	0.46	0.44	0.42	0.40	0.48	0.46	0.44	0.41	0.39	0.37
SEER13-Multi Family	0.00	0.05	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.04	0.04	0.03	0.03	0.03	0.03
Total OSP (Tons NOx)	**0.00**	**5.20**	**8.99**	**10.41**	**11.42**	**12.20**	**16.82**	**22.22**	**29.76**	**59.00**	**64.58**	**70.53**	**76.90**	**83.71**	**91.00**

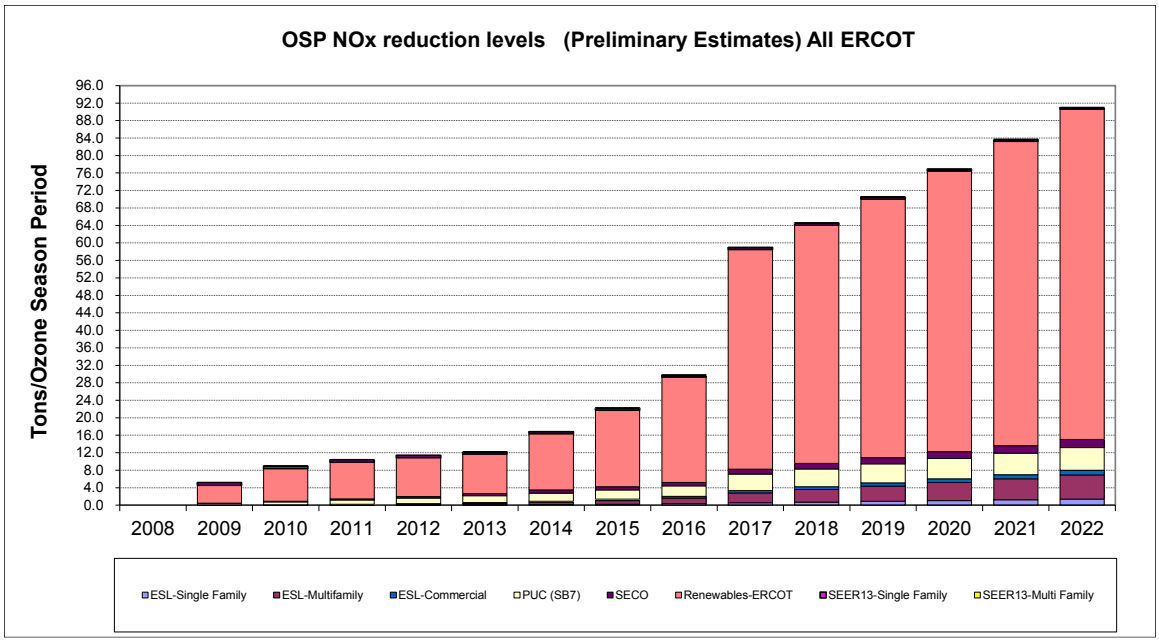


Figure 23: Integrated OSP NOx Emissions Reduction Projections through 2022 (Base Year 2008)

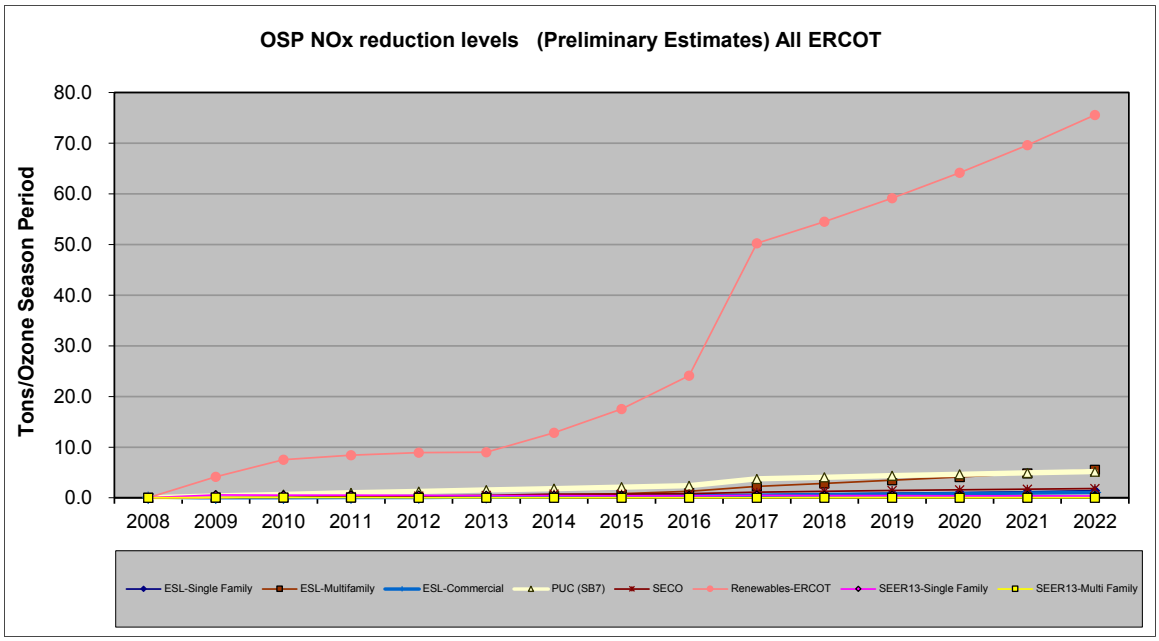


Figure 24: Integrated OSP Individual Programs NOx Emissions Reduction Projections through 2022 (Base Year 2008)

6 2017 Year Activities of Energy Systems Laboratory (ESL) for Texas Emissions Reduction Plan

6.1 IC3 Texas Building Registry (TBR)

6.1.1 Background

In 2008, the 81st Texas Legislature amended the Texas Administrative Code (TAC .§388.008, 2009) to develop a Registry of Above-Code homes. The ESL built the first version of the Registry in 2009. This preliminary version allowed to provide basic metrics on usage of the ESL's above code calculators, *IC3*[42] and *TCV*[43]. By running reports against the calculator's databases, the ESL could determine calculator usage by month for Texas' Cities and Counties. These reports allowed a better understanding of how builders were adopting the calculators across the State, which helped to improve the calculators. In 2017, the reports continued and numbers where gathered. Figure 25 shows the projects issued each month from January to December 2017. The projects are differentiated by the basic types, IECC performance path and ERI path. Figure 26 shows the cumulative users and projects through 2017. The data are only valid for IC3 version 4, and so the counts begin from September 2015. The largest adopter of the IC3 software was the North Central Texas Council of Governments (NCTCOG) area, closely followed by the Austin-San Antonio corridor, see Figure 27. Only counties with at least 10 new projects in 2017 are included in the chart. Figure 28 shows the certifications issued bssy city in 2017. Only those cities with at least 30 new projects are shown on the chart.

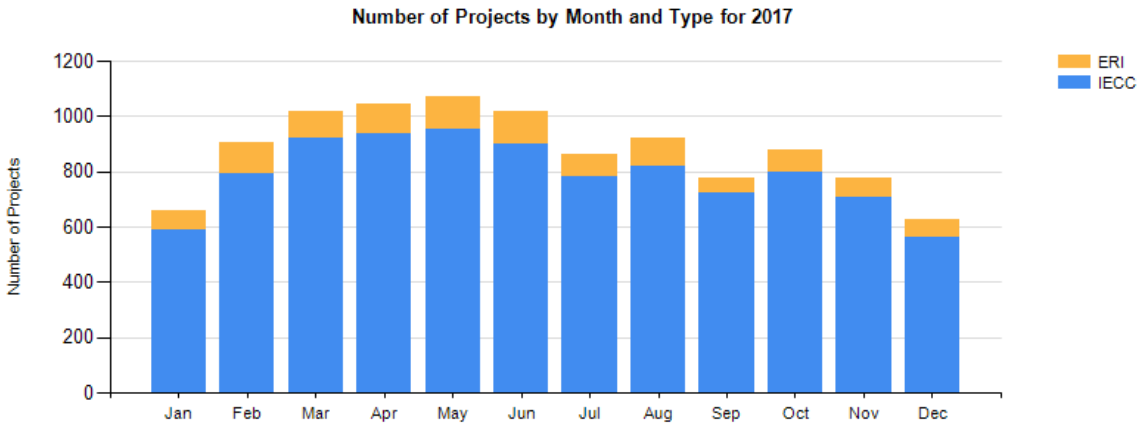


Figure 25: *IC3* 2017 Certificates and Projects

[42] International Code Compliance Calculator, a web based, above code calculator for single family, detached, new construction in Texas.
[43] Texas Climate Vision, a web based, above code calculator for single family, detached, new construction in Austin Energy's service area.

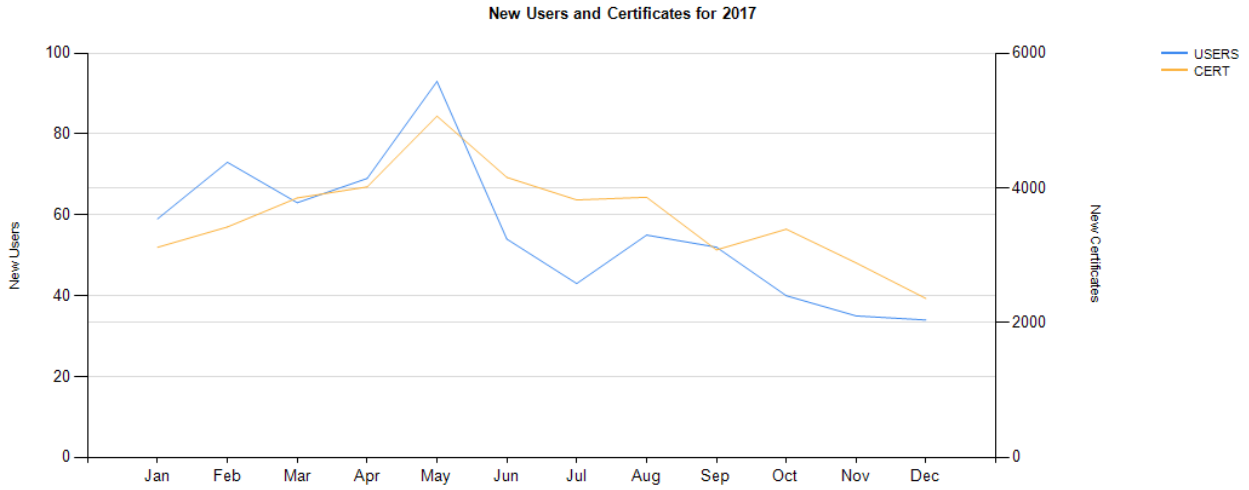


Figure 26: *IC3* 2017 Active Users and Certificates

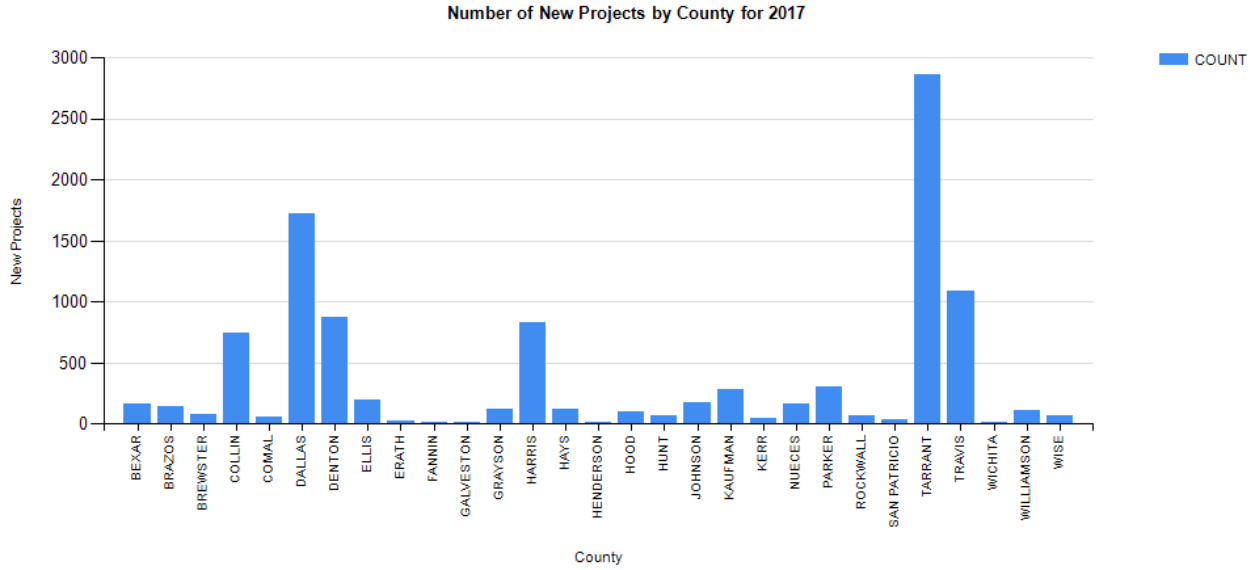


Figure 27: *IC3* 2017 Certificates – Counties with at least 10 Certificates

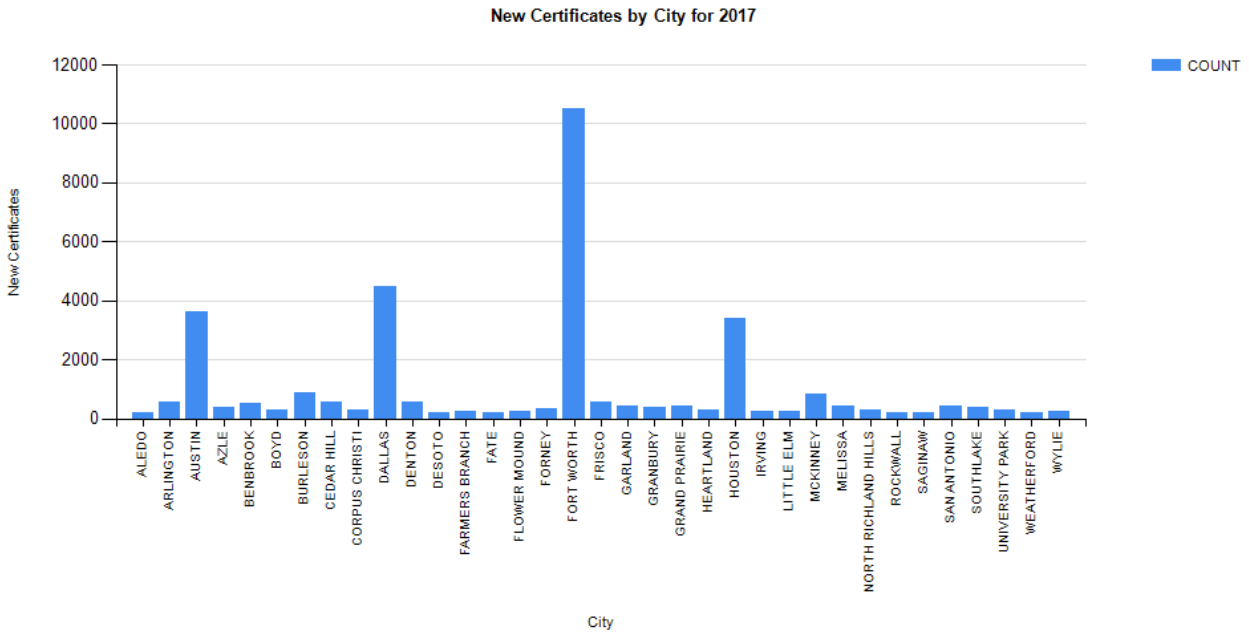


Figure 28: *IC3* 2017 Certificates – Cities with at least 200 Certificates

6.1.2 Texas Building Registry Current Version

As illustrated below and in the "*Report on the Development of the Format for a Texas Residential Registry* (Gilman, et al., 2008), the underlying database was optimized for supporting the *IC3* and *TCV* calculators and therefore needed a transformation to allow for seamless reporting. Consequently, the ESL has been steadily adding reporting capability and has been making software changes to reflect the new reporting requirements and analysis capabilities.

The underlying technology of the *IC3* and *TCV* calculators is *Microsoft SQL Server 2016*. This product offers reporting capabilities through various tools.

Figure 29 shows the "layout" of the IC3 (v3.x and above) and TCV[44] (v1.1) databases. It gives a rough overview of the different tables (called "entities") found in the *IC3* database. The center entity is the project, which is the center of the *IC3* software's abstraction of a house. The other tables include floors, walls, electrical, and systems.

[44] The *TCV* v1.1 database has different fields due to the built-in inspection module and the fact it was completed two years earlier than the described *IC3* v3.6.

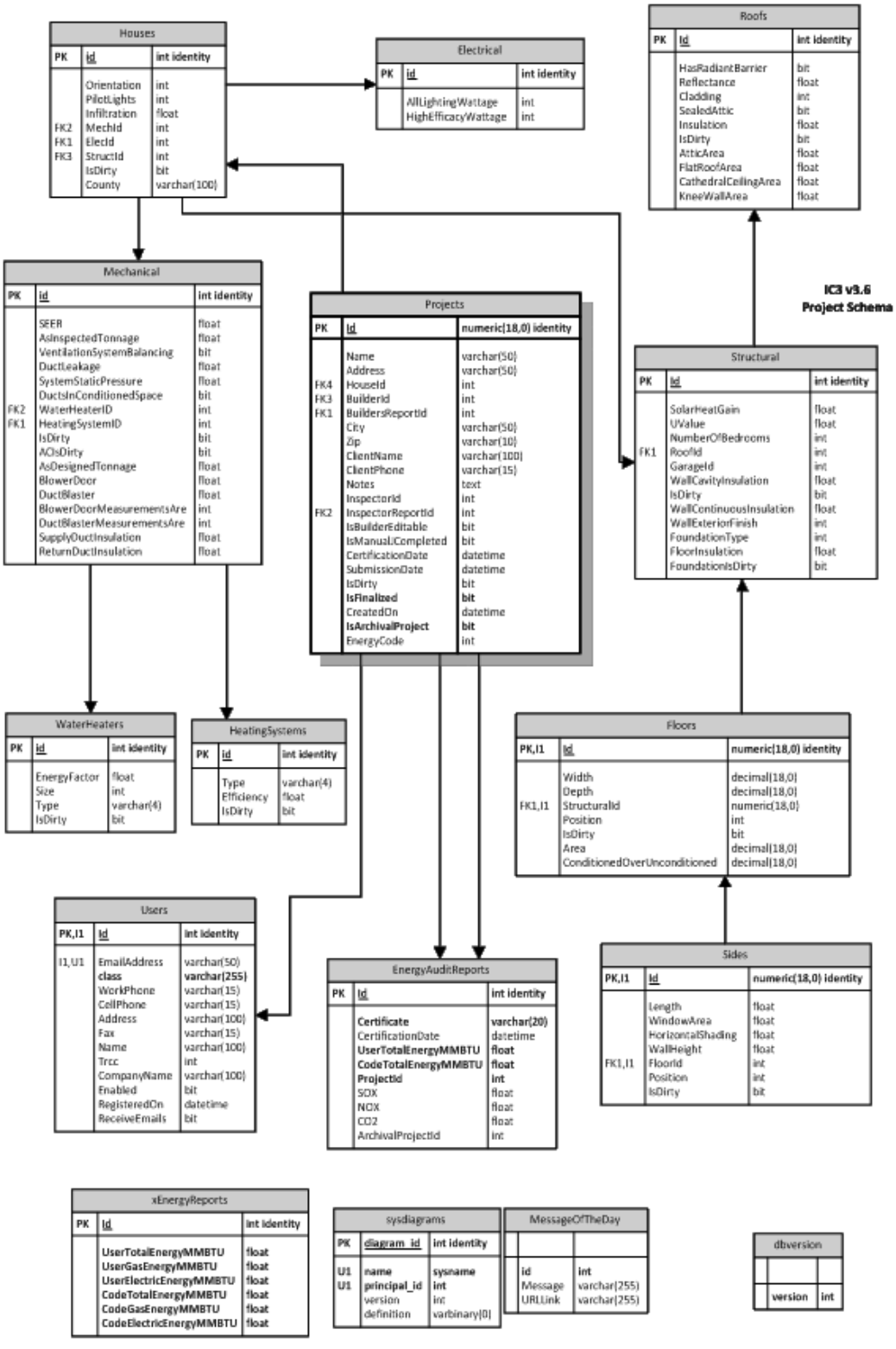


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Figure 29: Database Schema

6.1.3 Usage Reports

Figure 26 in Section 6.1.1 shows the correlation between users and their successful projects (i.e. those that generate certificates). The graph shows that users were generating more projects, and were doing so at a much faster rate than the rate of adding new users.

Figure 30 shows where the usage was using Counties as the grouping entity. The North Central Texas Council of Governments (NCTCOG) led the way in usage during 2017.

County Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ARANSAS	0	0	0	0	0	0	0	0	0	0	0	6
ATASCOSA	0	0	0	0	8	0	0	0	0	4	0	0
BEXAR	79	77	103	80	63	30	12	47	4	9	0	0
BRAZORIA	5	2	0	0	0	0	0	0	0	0	0	0
BRAZOS	0	1	0	0	1	3	3	0	0	0	0	0
BREWSTER	0	6	9	0	0	0	0	0	0	0	0	0
BURNET	0	0	3	0	0	0	0	0	0	1	0	0
CALDWELL	0	1	0	0	0	0	0	0	0	0	0	0
CHEROKEE	0	0	0	0	0	0	0	0	0	8	0	0
COLLIN	223	278	444	214	214	115	255	128	147	212	170	211
COMAL	12	0	0	0	0	0	0	4	1	73	5	0
COOKE	0	0	0	19	0	0	0	28	0	0	0	0
DALLAS	797	634	656	536	954	877	718	801	753	432	370	317
DENTON	237	195	263	280	392	500	251	186	223	225	242	175
ELLIS	18	26	48	50	113	27	51	98	35	40	42	70
ERATH	0	0	0	0	7	46	9	0	0	0	0	0
FANNIN	0	0	0	0	0	20	0	0	15	13	0	2
FORT BEND	0	1	0	0	0	0	0	23	12	0	0	0
GALVESTON	3	0	0	2	3	1	0	1	1	1	0	1
GRAYSON	12	17	53	14	22	14	36	12	20	0	38	15
HARDIN	0	5	0	0	0	0	0	1	0	0	0	0
HARRIS	370	329	197	339	405	296	218	140	196	551	294	255
HAYS	20	44	70	0	2	0	0	0	0	0	0	0
HENDERSON	8	3	0	0	2	0	2	10	24	43	1	0
HIDALGO	0	0	0	0	0	0	9	0	0	0	0	0
HOOD	2	47	49	41	71	21	41	22	13	45	54	2
HUNT	14	26	5	28	4	5	4	5	6	3	7	2
JEFFERSON	9	31	0	0	0	0	0	3	5	5	0	0
JOHNSON	37	58	34	84	71	141	38	152	82	13	10	48
KAUFMAN	13	28	50	138	183	66	113	52	84	115	33	24
KERR	7	4	4	17	24	28	10	23	24	3	7	18

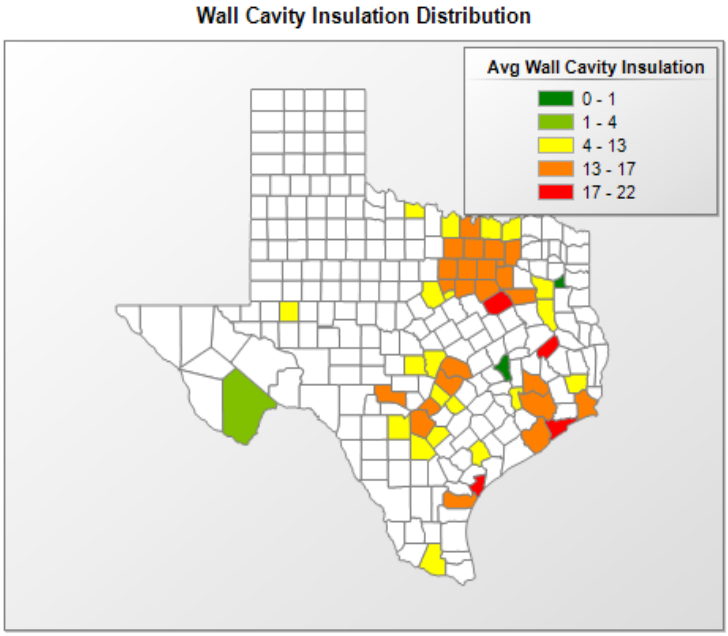
Figure 30: Counties Generating IC3 Certificates in 2017

County Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
LLANO	0	2	1	0	0	1	5	3	4	0	0	0
MEDINA	0	0	0	0	0	0	0	0	0	2	0	0
MIDLAND	0	4	0	0	0	0	0	0	0	0	0	0
MONTGOMERY	0	3	0	0	2	1	1	1	0	0	0	1
NAVARRO	0	3	0	0	1	0	0	0	0	0	0	0
NUECES	40	24	20	22	26	37	23	15	19	20	20	15
PALO PINTO	0	0	0	0	0	0	1	3	0	0	15	14
PARKER	31	51	87	75	119	113	20	96	74	94	101	127
ROCKWALL	16	191	62	60	35	23	57	31	41	23	14	10
SAN PATRICIO	3	8	5	4	6	5	9	2	0	2	6	5
SMITH	7	0	0	0	0	0	3	0	0	0	0	0
SOMERVELL	0	17	0	0	0	0	0	0	0	0	0	0
TARRANT	778	1140	1367	1700	1612	1008	1314	1534	1091	1129	1163	785
TRAVIS	263	83	257	232	632	737	521	431	114	256	291	205
VAN ZANDT	0	0	0	0	0	0	0	0	0	0	0	6
VICTORIA	0	0	0	0	1	0	0	0	0	0	0	0
WALLER	0	0	0	0	0	0	0	0	0	0	3	0
WICHITA	15	0	9	0	0	0	0	0	5	0	0	3
WILLIAMSON	40	54	37	25	0	0	0	4	11	15	1	0
WILSON	0	0	0	0	0	0	0	0	0	0	0	2
WISE	59	27	18	54	92	41	97	5	76	50	0	39

Figure 29: Counties Generating IC3 Certificates in 2017 (Continued)

6.1.4 Parameter Reports

A unique and valuable use of the Registry is to look at building trends across the state. This report shows the yearly average wall cavity insulation distribution in Texas for 2017. Green, Yellow-green, Yellow, Orange, and Red in the figure show the relevant insulation values.

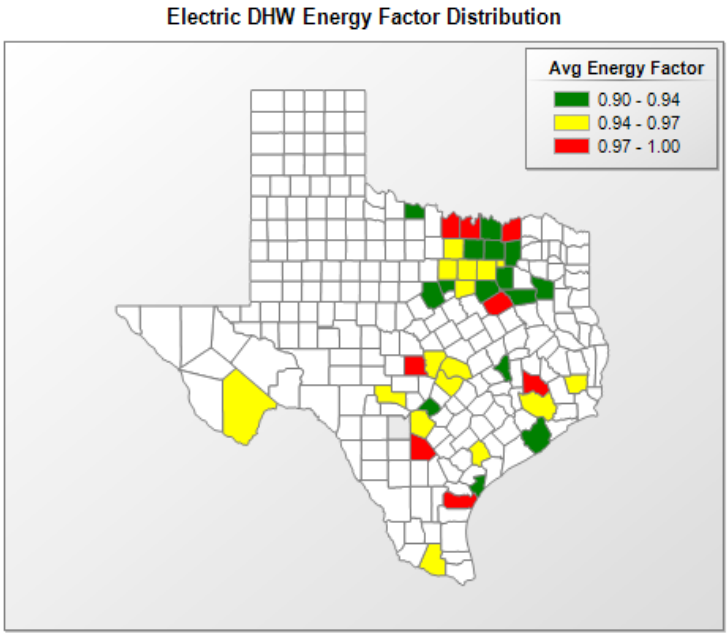


County	Avg Wall Insulation	House Count
Aransas	19.0	1
Atascosa	6.5	2
Bexar	16.4	169
Brazoria	16.0	2
Brazos	1.0	144
Brewster	1.3	75
Burnet	10.7	3
Caldwell	13.0	1
Cherokee	13.0	1
Collin	15.4	748
Comal	15.0	57
Cooke	13.7	3
Dallas	14.4	1715
Denton	14.3	872
El paso	19.0	1
Ellis	13.5	196
Erath	12.4	21
Fannin	13.0	10
Fort bend	17.3	3
Galveston	17.2	10
Grayson	13.0	123
Gregg	0.0	1
Hardin	13.0	1
Harris	16.3	825
Hays	13.0	121
Henderson	14.8	16
Hidalgo	13.0	1
Hood	15.3	99

County	Avg Wall Insulation	House Count
Hunt	13.2	65
Jefferson	13.5	4
Johnson	14.6	179
Kaufman	13.1	279
Kerr	15.8	46
Llano	12.5	6
Medina	13.0	1
Midland	13.0	1
Montague	13.0	1
Montgomery	14.4	8
Navarro	17.5	2
Nueces	14.7	168
Palo pinto	13.0	4
Parker	14.5	300
Rockwall	15.2	68
San patricio	14.7	33
Smith	13.0	3
Somervell	13.0	1
Tarrant	13.7	2831
Travis	15.4	1061
Trinity	22.0	1
Van zandt	13.0	1
Victoria	13.0	1
Waller	13.0	2
Wichita	11.4	11
Williamson	14.7	114
Wilson	13.0	1
Wise	14.2	67

Figure 31: Yearly Average Wall Cavity Insulation Distribution by County in 2017

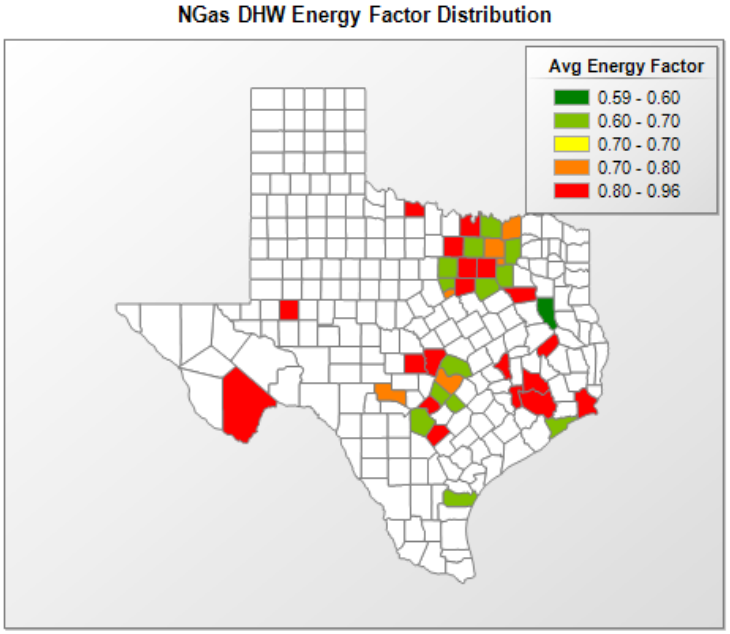
This report shows water heater efficiencies across Texas in 2017.



County	Avg Energy Factor	House Count
Aransas	0.9	1
Atascosa	0.5	2
Bexar	0.6	12
Brazoria	0.9	2
Brazos	0.0	141
Brewster	0.0	71
Burnet	0.5	2
Collin	0.9	152
Comal	0.9	56
Cooke	0.5	2
Dallas	0.9	847
Denton	0.9	337
Ellis	0.9	124
Erath	0.9	21
Fannin	1.0	8
Fort bend	0.9	1
Galveston	0.0	1
Grayson	0.9	75
Gregg	0.0	1
Hardin	0.9	1
Harris	0.5	65
Hays	0.0	1
Henderson	0.9	13
Hidalgo	0.9	1

County	Avg Energy Factor	House Count
Hood	0.9	88
Hunt	0.9	59
Jefferson	0.0	1
Johnson	0.9	147
Kaufman	0.9	155
Kerr	0.9	34
Llano	0.7	3
Medina	0.9	1
Montague	1.0	1
Montgomery	1.0	2
Navarro	1.0	2
Nueces	1.0	18
Palo pinto	0.9	3
Parker	0.9	174
Rockwall	0.9	20
San patricio	1.0	32
Smith	0.9	3
Tarrant	0.9	1558
Travis	0.7	180
Van zandt	0.9	1
Victoria	0.9	1
Wichita	0.3	7
Williamson	0.9	27
Wise	0.9	62

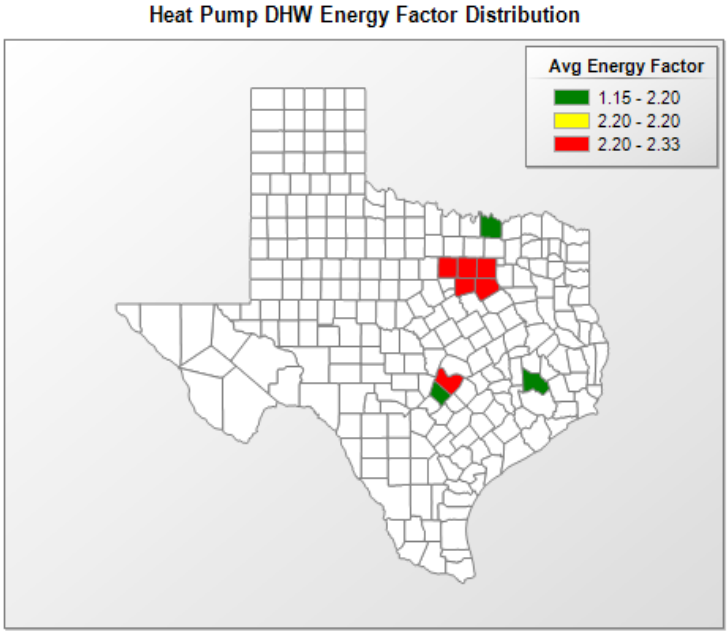
Figure 32: Yearly Average Water Heater Energy Factor Distribution by County in 2017



County	Avg Energy Factor	House Count
Bexar	0.7	157
Brazos	0.9	3
Brewster	0.6	4
Burnet	1.0	1
Caldwell	0.6	1
Cherokee	0.6	1
Collin	0.8	596
Comal	0.9	1
Cooke	0.8	1
Dallas	0.8	864
Denton	0.7	535
El paso	0.6	1
Ellis	0.7	71
Fannin	0.8	2
Fort bend	0.9	2
Galveston	0.7	9
Grayson	0.7	46
Harris	0.8	760
Hays	0.6	118
Henderson	0.9	3
Hood	0.7	11
Hunt	0.7	6

County	Avg Energy Factor	House Count
Jefferson	0.9	3
Johnson	0.9	31
Kaufman	0.6	124
Kerr	0.7	12
Llano	0.8	3
Midland	0.8	1
Montgomery	0.9	5
Nueces	0.7	150
Palo pinto	0.8	1
Parker	0.6	125
Rockwall	0.7	48
San patricio	0.7	1
Somervell	0.8	1
Tarrant	0.8	1259
Travis	0.7	837
Trinity	0.9	1
Waller	0.9	2
Wichita	0.8	4
Williamson	0.6	87
Wilson	0.9	1
Wise	0.9	5

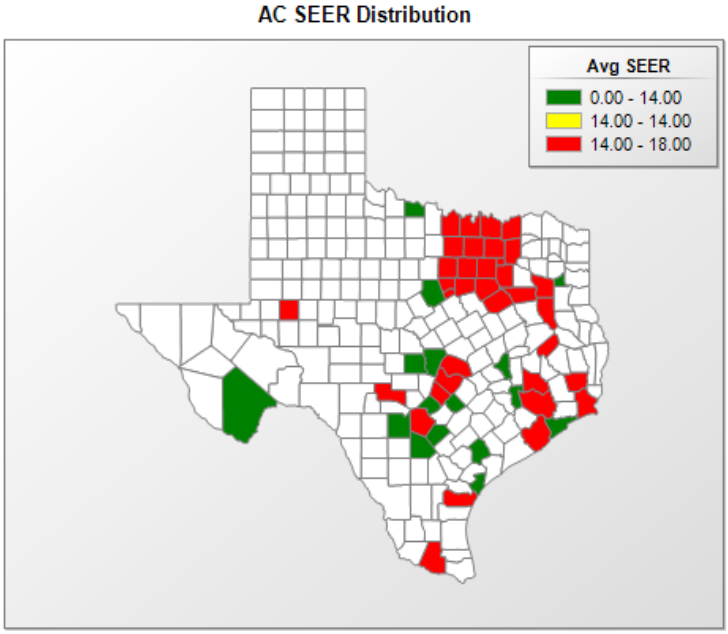
Figure 33: Yearly Average Water Heater Energy Factor Distribution by County in 2017



County	Avg Energy Factor	House Count
Dallas	2.2	4
Ellis	2.3	1
Grayson	2.2	2
Hays	1.1	2
Johnson	2.3	1
Montgomery	2.0	1
Parker	2.3	1
Tarrant	2.2	14
Travis	2.3	44

Figure 34: Yearly Average Water Heater Energy Factor Distribution for in 2017

This report shows the average A/C SEER across Texas in 2017. The efficiency (and sizing) of air conditioning is a vital component of energy efficiency in Texas.

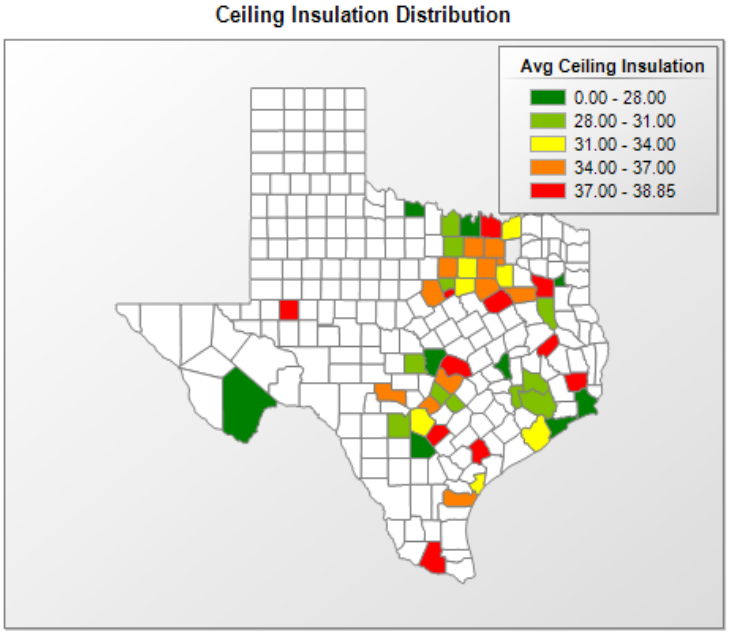


County	Avg A/C SEER	House Count
Aransas	14.0	1
Atascosa	7.0	2
Bexar	15.2	169
Brazoria	15.0	2
Brazos	0.5	144
Brewster	1.2	75
Burnet	9.3	3
Caldwell	14.0	1
Cherokee	18.0	1
Collin	15.0	748
Comal	13.8	57
Cooke	14.3	3
Dallas	14.2	1715
Denton	14.7	872
El Paso	14.0	1
Ellis	14.2	196
Erath	13.9	21
Fannin	14.1	10
Fort bend	16.3	3
Galveston	14.0	10
Grayson	14.6	123
Gregg	0.0	1
Hardin	16.0	1
Harris	14.6	825
Hays	14.3	121
Henderson	14.2	16
Hidalgo	15.0	1
Hood	14.7	99

County	Avg A/C SEER	House Count
Hunt	14.1	65
Jefferson	14.8	4
Johnson	14.5	179
Kaufman	14.1	279
Kerr	14.7	46
Llano	12.8	6
Medina	14.0	1
Midland	18.0	1
Montague	15.0	1
Montgomery	14.8	8
Navarro	15.0	2
Nueces	15.8	168
Palo pinto	16.0	4
Parker	15.0	300
Rockwall	14.4	68
San Patricio	16.0	33
Smith	14.7	3
Somervell	16.0	1
Tarrant	14.2	2831
Travis	15.5	1061
Trinity	18.0	1
Van Zandt	14.0	1
Victoria	14.0	1
Waller	14.0	2
Wichita	7.9	11
Williamson	14.5	114
Wilson	14.0	1
Wise	14.4	67

Figure 35: Average A/C SEER across Counties in 2017

This report shows the average ceiling insulation across Texas in 2017.

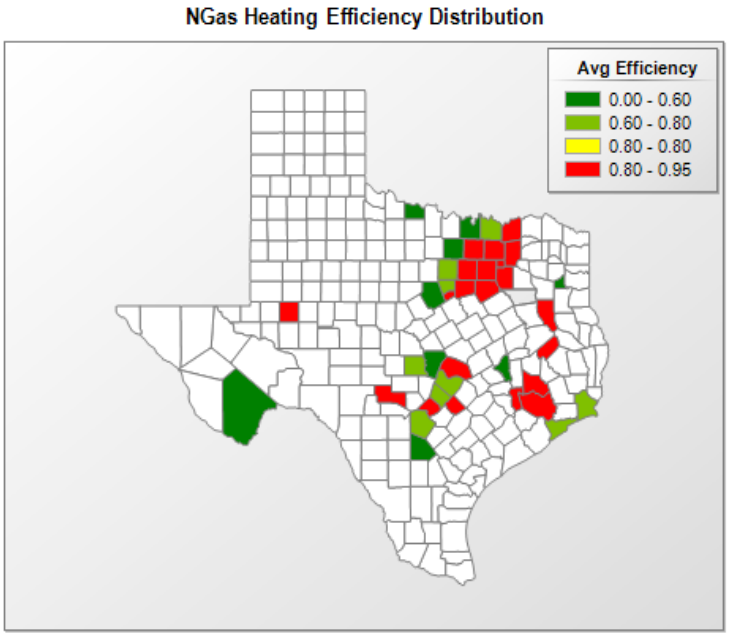


County	Avg Ceiling Insulation	House Count
Aransas	33.0	1
Atascosa	24.0	2
Bexar	33.5	169
Brazoria	34.0	2
Brazos	1.1	144
Brewster	1.9	75
Burnet	25.3	3
Caldwell	30.0	1
Cherokee	30.0	1
Collin	35.8	748
Comal	36.9	57
Cooke	20.0	3
Dallas	34.8	1715
Denton	34.3	872
El Paso	38.0	1
Ellis	34.3	196
Erath	36.2	21
Fannin	33.0	10
Fort bend	31.0	3
Galveston	27.0	10
Grayson	37.3	123
Gregg	0.0	1
Hardin	38.0	1
Harris	28.9	825
Hays	29.7	121
Henderson	34.6	16
Hidalgo	38.0	1
Hood	29.7	99

County	Avg Ceiling Insulation	House Count
Hunt	38.8	65
Jefferson	24.5	4
Johnson	32.1	179
Kaufman	31.7	279
Kerr	34.2	46
Llano	28.3	6
Medina	30.0	1
Midland	38.0	1
Montague	30.0	1
Montgomery	29.0	8
Navarro	38.0	2
Nueces	35.3	168
Palo pinto	33.3	4
Parker	35.7	300
Rockwall	35.5	68
San Patricio	35.8	33
Smith	38.0	3
Somervell	38.0	1
Tarrant	32.9	2830
Travis	34.9	1061
Trinity	38.0	1
Van Zandt	30.0	1
Victoria	38.0	1
Waller	30.0	2
Wichita	17.1	10
Williamson	37.7	114
Wilson	38.0	1
Wise	30.9	67

Figure 36: Average Ceiling Insulation across Counties in 2017

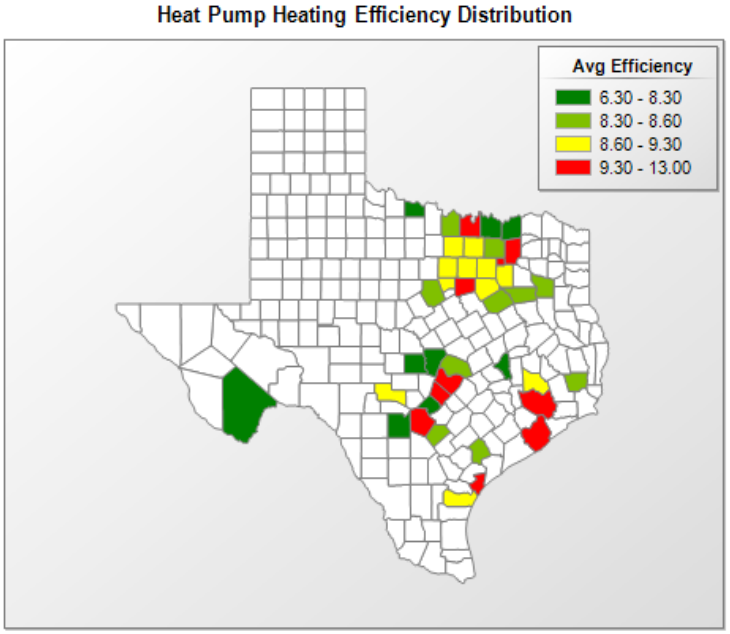
This report shows the average heating efficiency across Texas in 2017.



County	Avg NGas Efficiency	House Count
Atascosa	0.0	1
Bexar	0.8	145
Brazos	0.0	139
Brewster	0.0	72
Burnet	0.5	2
Caldwell	0.8	1
Cherokee	0.8	1
Collin	0.9	604
Comal	0.9	56
Cooke	0.0	1
Dallas	0.9	923
Denton	0.8	548
El Paso	0.8	1
Ellis	0.8	70
Erath	0.0	1
Fannin	0.8	3
Fort bend	0.9	2
Galveston	0.7	10
Grayson	0.8	64
Gregg	0.0	1
Harris	0.9	790

County	Avg NGas Efficiency	House Count
Hays	0.8	120
Henderson	1.0	4
Hood	0.7	11
Hunt	0.8	6
Jefferson	0.6	4
Johnson	0.9	22
Kaufman	0.8	123
Kerr	0.8	20
Llano	0.7	4
Midland	0.8	1
Montgomery	0.8	6
Parker	0.8	155
Rockwall	0.8	48
Somervell	0.9	1
Tarrant	0.9	1398
Travis	0.8	852
Trinity	0.9	1
Waller	0.8	2
Wichita	0.5	7
Williamson	0.8	103
Wise	0.5	8

Figure 37: Average Heating Efficiency across Counties in 2017

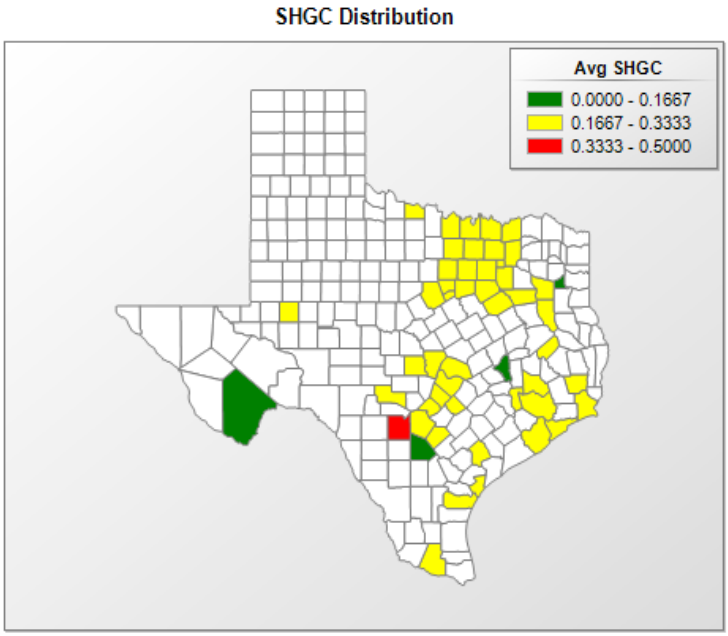


County	Avg Heat Pump Efficiency	House Count
Aransas	10.0	1
Bexar	9.4	24
Brazoria	11.3	2
Brazos	6.8	3
Brewster	7.0	3
Burnet	8.2	1
Collin	8.5	144
Comal	8.2	1
Cooke	10.0	2
Dallas	8.8	789
Denton	8.7	324
Ellis	8.7	126
Erath	8.4	20
Fannin	8.2	7
Fort bend	13.0	1
Grayson	8.2	59
Hardin	8.5	1
Harris	10.7	33
Hays	13.0	1
Henderson	8.3	12
Hood	9.3	88
Hunt	11.2	59

County	Avg Heat Pump Efficiency	House Count
Johnson	10.4	156
Kaufman	8.7	156
Kerr	8.7	26
Llano	8.2	1
Medina	8.2	1
Montague	8.5	1
Montgomery	9.1	2
Navarro	8.6	2
Nueces	8.7	168
Palo pinto	8.6	4
Parker	8.9	145
Rockwall	9.8	20
San Patricio	8.7	33
Smith	8.4	3
Tarrant	9.1	1431
Travis	9.9	209
Van Zandt	8.2	1
Victoria	8.5	1
Wichita	6.3	4
Williamson	8.5	11
Wilson	8.5	1
Wise	8.7	59

Figure 38: Average Heat Pump Heating Efficiency across Counties in 2017

This report shows the average SHGC across Texas in 2017.

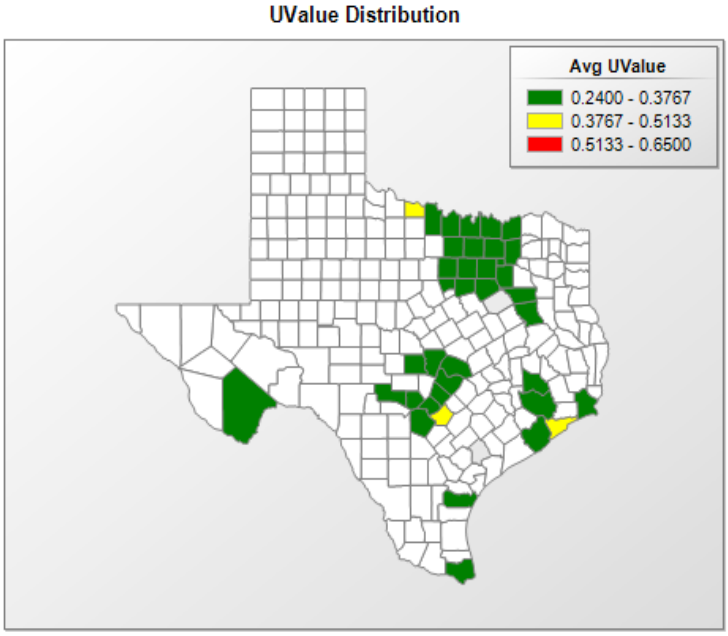


County	Avg SHGC	House Count
Aransas	0.30	1
Atascosa	0.21	1
Bexar	0.23	167
Brazoria	0.24	2
Brazos	0.28	9
Brewster	0.29	6
Burnet	0.29	2
Caldwell	0.27	1
Cherokee	0.22	1
Collin	0.23	747
Comal	0.24	57
Cooke	0.27	3
Dallas	0.24	1664
Denton	0.24	863
El paso	0.34	1
Ellis	0.23	195
Erath	0.23	20
Fannin	0.23	10
Fort bend	0.29	3
Galveston	0.30	10
Grayson	0.24	121
Hardin	0.25	1
Harris	0.29	807
Hays	0.22	119
Henderson	0.24	16
Hidalgo	0.21	1
Hood	0.28	98
Hunt	0.20	65

County	Avg SHGC	House Count
Jefferson	0.23	3
Johnson	0.24	179
Kaufman	0.24	279
Kerr	0.25	46
Llano	0.25	5
Medina	0.50	1
Midland	0.30	1
Montague	0.22	1
Montgomery	0.29	7
Navarro	0.25	2
Nueces	0.22	168
Palo pinto	0.27	4
Parker	0.24	297
Rockwall	0.24	68
San patricio	0.22	33
Smith	0.23	3
Somervell	0.27	1
Tarrant	0.25	2746
Travis	0.23	1030
Trinity	0.20	1
Van zandt	0.25	1
Victoria	0.25	1
Waller	0.32	2
Wichita	0.29	9
Williamson	0.22	114
Wilson	0.20	1
Wise	0.25	66

Figure 39: Average SHGC across Counties in 2017

This report shows the average U Factor acorss Texas is 2017. The U Factor applies to the heat transfer of a window caused by temperature, no direct solar radiation.



County	Avg U-value	House Count
Anderson	0.28	5
Bexar	0.32	506
Brazoria	0.35	1
Brewster	0.32	17
Burnet	0.35	4
Cameron	0.30	1
Clay	0.32	1
Collin	0.33	265
Comal	0.35	19
Cooke	0.35	6
Dallas	0.32	469
Denton	0.34	220
El paso	0.25	1
Ellis	0.33	86
Fannin	0.30	1
Fort bend	0.32	4
Galveston	0.38	3
Grayson	0.34	27
Guadalupe	0.48	2
Harris	0.34	284
Hays	0.36	85
Henderson	0.35	1
Hood	0.33	13

County	Avg U-value	House Count
Hunt	0.31	12
Jefferson	0.35	1
Johnson	0.35	20
Kaufman	0.34	124
Kendall	0.33	1
Kerr	0.33	4
Llano	0.27	4
Mclennan	0.25	1
Montague	0.30	1
Montgomery	0.30	3
Navarro	0.24	2
Nueces	0.33	58
Palo pinto	0.30	1
Parker	0.35	47
Rockwall	0.32	65
San patricio	0.32	11
Tarrant	0.33	667
Travis	0.34	328
Van zandt	0.35	1
Victoria	0.65	1
Wichita	0.38	3
Williamson	0.35	65
Wise	0.35	6

Figure 40: Average U Factor across Counties for Single-Family Homes in 2017

6.2 IC3 Enhancements

IC3 is continuously being enhanced since 2009 released Version 3.5.2 to 2017 released Version 4.3.1. Numerous enhancements have been made and are detailed out in section 6.2.1 and section 6.2.2.

6.2.1 History of IC3 version 3 Enhancements

Most of the enhancements that are being added to IC3 in the recent years are summarized next:

In Version 3.5.2 (November 2009)

- Three code choices: IECC 2009, IECC 2006 (with Houston Amendments) and IECC 2000/2001.
- Duct insulation values
- Improved input of overhang values to allow for just inches

In Version 3.6.1 (December 2009)

- Foundations
- Opt out of emails
- Copy a project
- Moved orientation from Floors tab to Project Information

In Version 3.6.2 (April 2010)

- Fixed defect in 2nd Floor, Back Window issue
- Reference A\C tonnage matches the proposed A\C tonnage.
- Updated model
- Updated illustrations

In Version 3.7.x (June 2010)

- Simple multi-family code compliance
- Updated model
  a. Floor Insulation R-Value
  b. Four foundation types
- Updated illustrations
- Updated manual

In Version 3.8.x (September 2010)

- Fixed default of Multi-family Units to be “Ducts in Conditioned Space” to YES
- Fixed wrong IECC code version on certificate
- Enhanced input screens by moving several fields from Units to Floor
- Plans

In Version 3.9.x (October 2010)

- Added slab insulation
- Updated the manual

In Version 3.10 (September 2011)

- Three IECC 2009 compliant reports (i.e. energy, inspection list, and certificate)
- Paging enhancements on “My Page” to help organize large quantities of projects.
- Multi-family usability increased with Plan/Unit information being displayed on pages.
- Elimination of flash animation (so we will become iPad compatible).

- Updated/expanded help text.
- Updated illustrations.
- Tweaked min/max values on duct insulation, water heaters.

In Version 3.11 (December 2011)

- Added support for IECC 2009 Austin Amendments

In version 3.12.x (January 2012)

- Deprecated 2000/2001 and 2006 Houston Code.
- Added a button to generate Energy Report w/ a signature line. The original energy report still exists
- Improvements in the algorithm
- Help images/ text updated
- Updated manual

In version 3.13.x (August 2013)

- Added Manual J.
- Added 2009 NCTCOG code. This is the 2012 IECC w/ NCTCOG amendments. It is slightly less stringent than the base 2012 code and is optimized for climate zone 3.

In version 3.14.x (March 2015)

- Added 2012 AE Code.
- Added heat-pump water heater option
- Added sealed attic option.
- Revised energy report to make it clearer

6.2.2 History of IC3 version 4 Enhancements

Version 4.0 (June 2015)

- Initial release
- Originally has only 2015 IECC single-family

Version 4.0.1 (July 2015)

- The original version (4.0) printed the logged in user's name, phone number, and email address in the builder's fields on the certificate and energy report. These can now be overridden on a project-by-project basis. The new input fields on the left side of the screen are now the values that will be printed on the certificate and energy reports.
- The project notes will now appear on the Energy Report. Due to spacing issues, only the first 60 characters will be printed. If the project notes are longer, they will be truncated in the energy report.
- On a user's main user screen (the one immediately after login that lists all of your projects), a button has been added to the top: 'Edit User Information'. This button allows you to edit the logged in user's contact information that you entered when registering on the site.
- On a user's main user screen (the one immediately after login that lists all of your projects), a button has been added to the top: 'Import Project from IC3 version 3.x '. Several users have requested the ability to 'import' projects from the old version of IC3. This is now possible. o Users will be prompted to enter their IC3 version 3.x credentials and the select a project to import. Only single-family project import is available at this time.
    - The user will be prompted for a new project name, project address, and orientation (just as when you are copying an existing project from version 4.x).
    - Aside from these fields, the project is copied without alteration except that the code is changed to IECC 2015. Of course, there is no guarantee that a project that passes 2009 or 2012 will still pass 2015 without some modifications.
- Some rounding issues on the energy Report have been fixed.

In version 4.0.2 (April 2016)

- Clean up of some error messages
- Revised attic model to give better results
- Webpage will now check that the house meets the minimum fresh air standards as given by the IRC and will post an error message upon submission if it does not meet the minimum standards.

In version 4.1 (September 2016)

- Added ERI calculation mode

In version 4.1.1 (September 2016)

- Some bug fixes

In version 4.1.2 (October 2016)

- Altered appliance energy calculation for ERI

In version 4.2 (October 2016)

- Added NCTCOG 2015 IECC amendment to list of codes

In version 4.3 (March 2017)

- Added 2015 Austin Energy Ammendments to list of codes
- Altered the duct model to improve accuracy

In version 4.3.1 (July 2017)

- Added NCTCOG 2015 ERI amendment to list of codes

6.2.3 Changes in Single-Family Input File

There have been two major version changes according to the changes in the Single-Family Input file since the 2012 annual simulations. Table 33 presents the summarized description of the changes in Single-Family Input file since the 2012 annual simulation.

Table 33: Changes in Single-Family Input file

BDL Version	Description	Date Modified
4.01.08	BDL used for the 2012 annual report.	03/10/2011
4.01.09	Added sensible and latent components for equipment heat gain.	07/31/2013
4.01.10	Added special construction for knee wall. Corrected plywood layers for floor. Corrected construction for floor-over-ambient conditions. Added heat-pump water heater module. Corrected layers for cathedral ceiling.	08/27/2013 10/20/2013 12/11/2013
4.01.11	Added option to include attic volume in conditioned space in case of sealed attic. Added option for roof insulation to go over roof studs.	05/29/2014 04/09/2014

Added sensible and latent components for equipment heat gain
In order to incorporate the HERS Index calculations in IC3, it became necessary to elaborate the input for lighting, equipment and occupants[45]. Equipment loads were now divided into sensible and latent components. Two new parameters were added in Version 4.01.09 to incorporate the sensible and latent components of the equipment load.

Added special construction for knee wall
In BDL Version 4.01.10 specifications were added to represent knee wall construction. Previous versions of the BDL did not have a separate entry for knee wall construction. Specifications for exterior wall construction was used to represent construction for knee walls.

Corrected plywood layers for floor
In BDL Version 4.01.10 specifications for floor construction was modified to better account for standard practice. Previous versions of the BDL had thinner layer of plywood specified. The current version specifies a more appropriate thickness of plywood used in the construction of floors, which include floors over basements and crawl spaces.

Corrected construction for floor over ambient
In BDL Version 4.01.10 specifications for floor-over-ambient construction was created. Previous versions of the BDL used specifications for ceiling insulation for floor-over-ambient conditions. The current version appropriately incorporates floor insulation in floor-over-ambient construction. The specification in the BDL limits the thickness of floor insulation to the thickness of floor studs input in the model.

Added heat-pump water heater module
In BDL Version 4.01.10 specifications for heat-pump water heaters were added. These specifications include the addition of the heat-pump option as an option available in the BDL to be modeled as a DHW type. When the heat-pump option is selected, several inputs are now modified by the software team. These includevalues for energy input

[45] It should be noted that loads from occupants were included in the loads for equipment.

ratio (DHW-EIR) and heat rate (DHW-HEAT-RATE). The equation for converting EF to COP is adopted from the specifications in EnergyGauge USA (Version 3.1.02).

$$\text{DHW-EIR} = 1/\text{COP} = 0.781/(\text{EF})$$

The heat rate values of 7,700 Btu/hr are adopted from EnergyGauge regardless of the size of the tank[46].
In addition, the curves used for energy input ratio as a function of part load ratio are the same curves that are used for heat pump space heating obtained from Henderson et al. (2000)[47].

Corrected layers for cathedral ceiling
In BDL Version 4.01.10 specifications for cathedral ceiling were added to the BDL. The modification included providing a separate entry in the BDL for cathedral ceiling insulation that is restricted size of ceiling stud. Previous versions of the BDL used ceiling insulation for cathedral ceilings.

Added option to include attic volume in conditioned space in case of sealed attic
In BDL Version 4.01.11 modifications were made to include attic volume in conditioned space in the case of sealed attic was simulated. The modifications were made to 'ROOM' space conditions.

[46] Email correspondence with Jeff Myron, EnergyGauge Technical Support (10/18/2013).
[47] Henderson, H., D. Parker, Huang, Y. (2000). Improving DOE-2's RESYS Routine: User Defined Functions to Provide More Accurate Part Load Energy Use and Humidity Predictions. Presented at the 2000 ACEEE Summer Study on Energy Efficiency in Buildings, Pacific Grove, CA.

6.3 Laboratory's TERP Web Site "esl.tamu.edu/terp"

Since the fall of 2001, the Laboratory has maintained a TERP webpage, where information is provided to builders, code officials, the design community and homeowners about TERP. In 2017, the Laboratory redesigned its website to make navigation easier. On the navigation bar is a tab that links to the TERP homepage (Figure 41). The homepage contains the following items:

- Texas Emissions Reduction Program
- Texas Work
  - TERP Objectives
  - TERP Elements
  - ESL's TERP Responsibilities
  - The CATEE Conference
- National Work
  - National Center of Excellence on Displaced Emission Reductions (CEDER)
  - Our Work
    - EPA Recognizes ESL and Dallas Partners

The TERP tab also contains a dropdown menu which provides links to the following sections

- History
- Code Compliance Calculator
  - IC3
    - City Amendments to the State Energy Code
      - City of Austin
      - City of Houston
      - North Central Texas COG
    - Resources
      - What's New in This Version?
      - IC3 Version 3.14 Manual
      - IC3 Version 4.0 Release Notes
      - RESNET Validation Report
      - FBI IC3 Unit
      - Aggregate Reports from IC3
    - FAQs
- Data
  - Texas Building Registry
    - IC3 Usage
    - IC3 House Construction
  - Weather
- Letters and Reports
  - Legislative Documents
  - EPA/CEDER Work
  - Builders Information
  - Reports – listed by year from 2002-2017
  - Presentations
- Workshops
  - IC3
  - IECC Residential

  - IECC Commercial
  - ASHRAE
- TERP Links
  - eCalc Emissions & Energy Calculator
  - International Code Compliance Calculator (ICCC)
  - Public Utility Commission of Texas (PUC)
  - U.S. Department of Energy (DOE)
  - Texas State Energy Conservation Office (SECO)
  - U.S. Environmental Protection Agency (EPA)
  - International Code Council (ICC)
  - American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - North Central Texas Council of Governments (NCTCOG)
  - Alamo Area Council of Governments (AACOG)
  - Circle of Ten

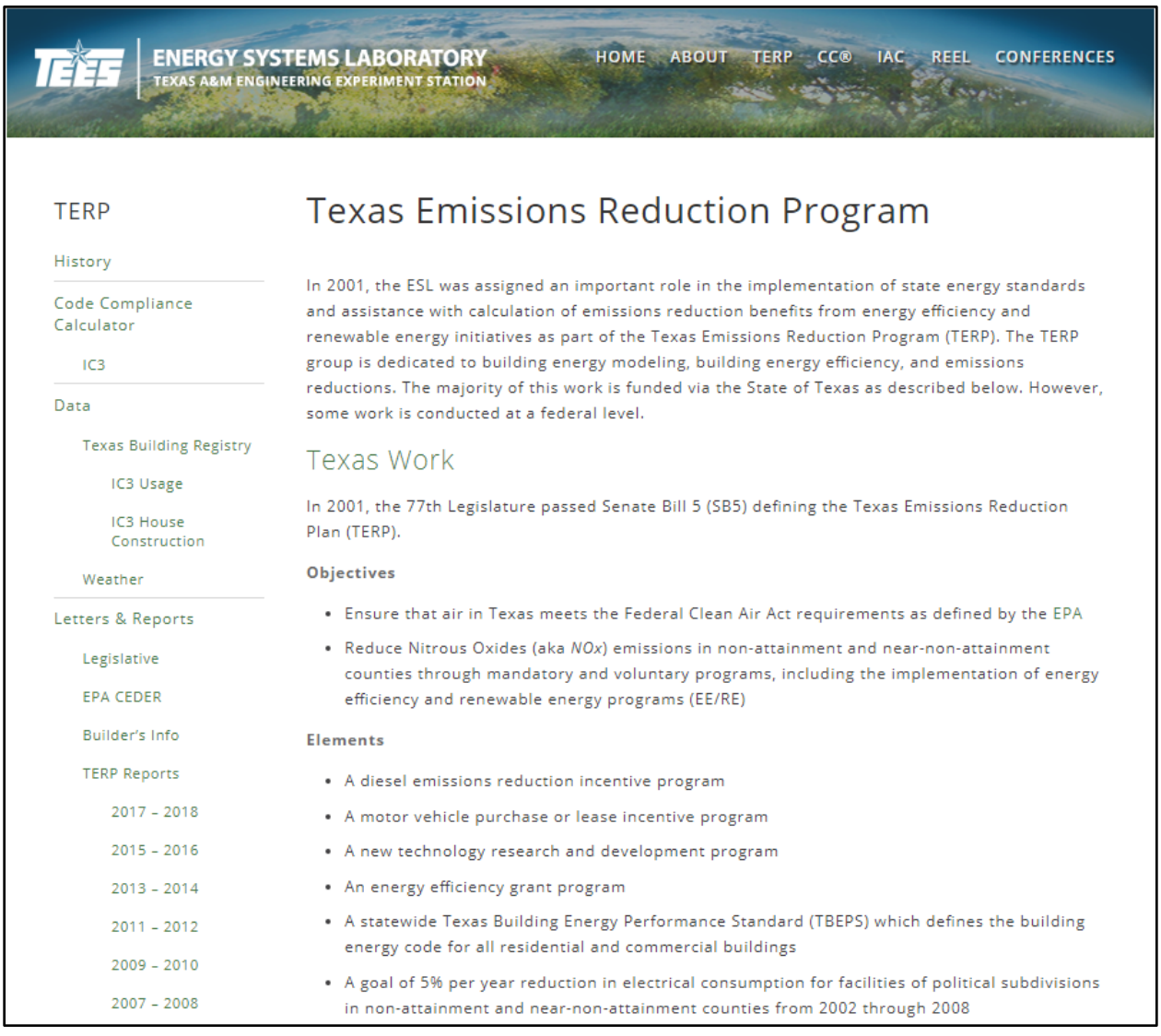


Figure 41. TERP Home Page

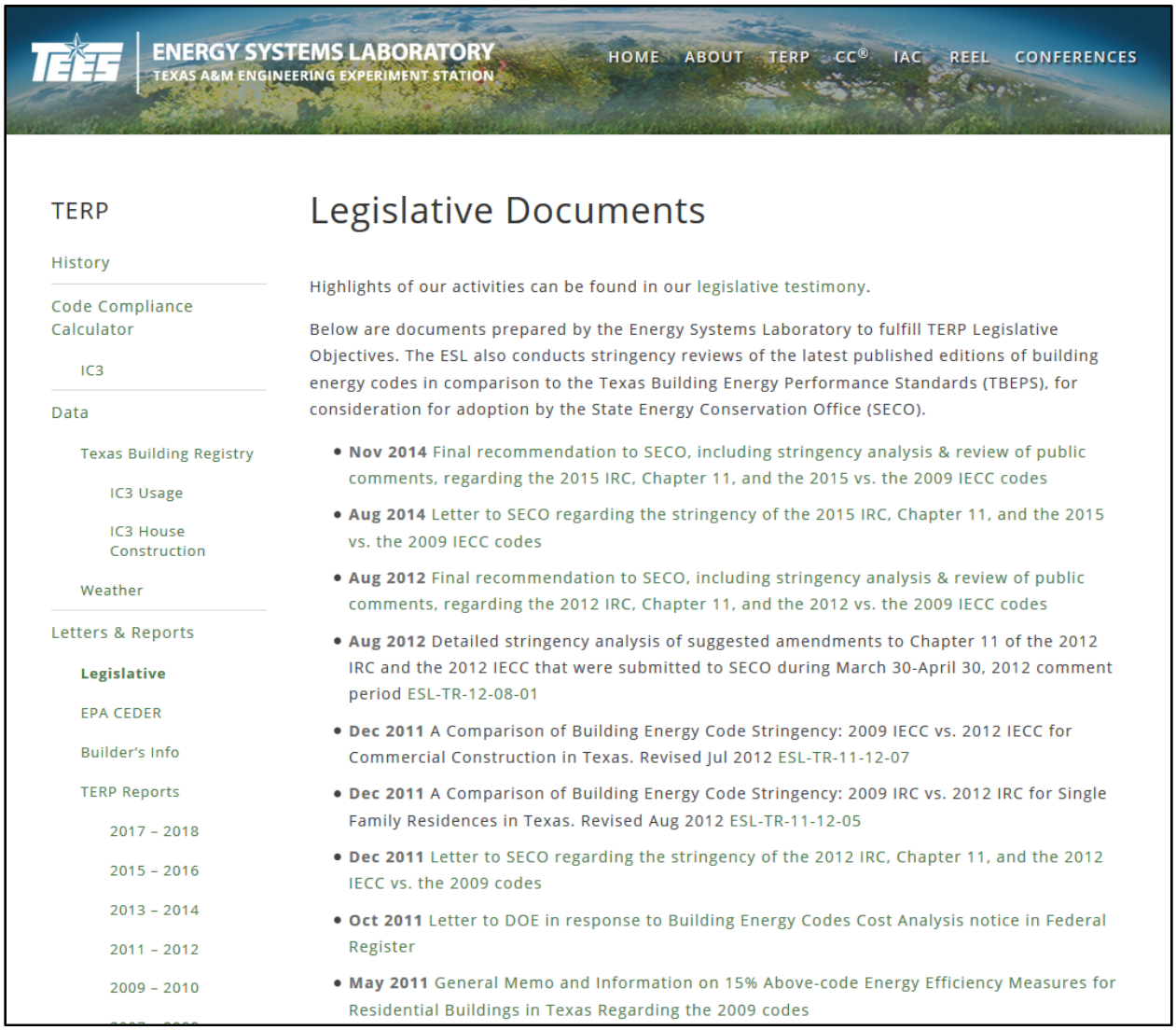


Figure 42: TERP –Letters and Reports

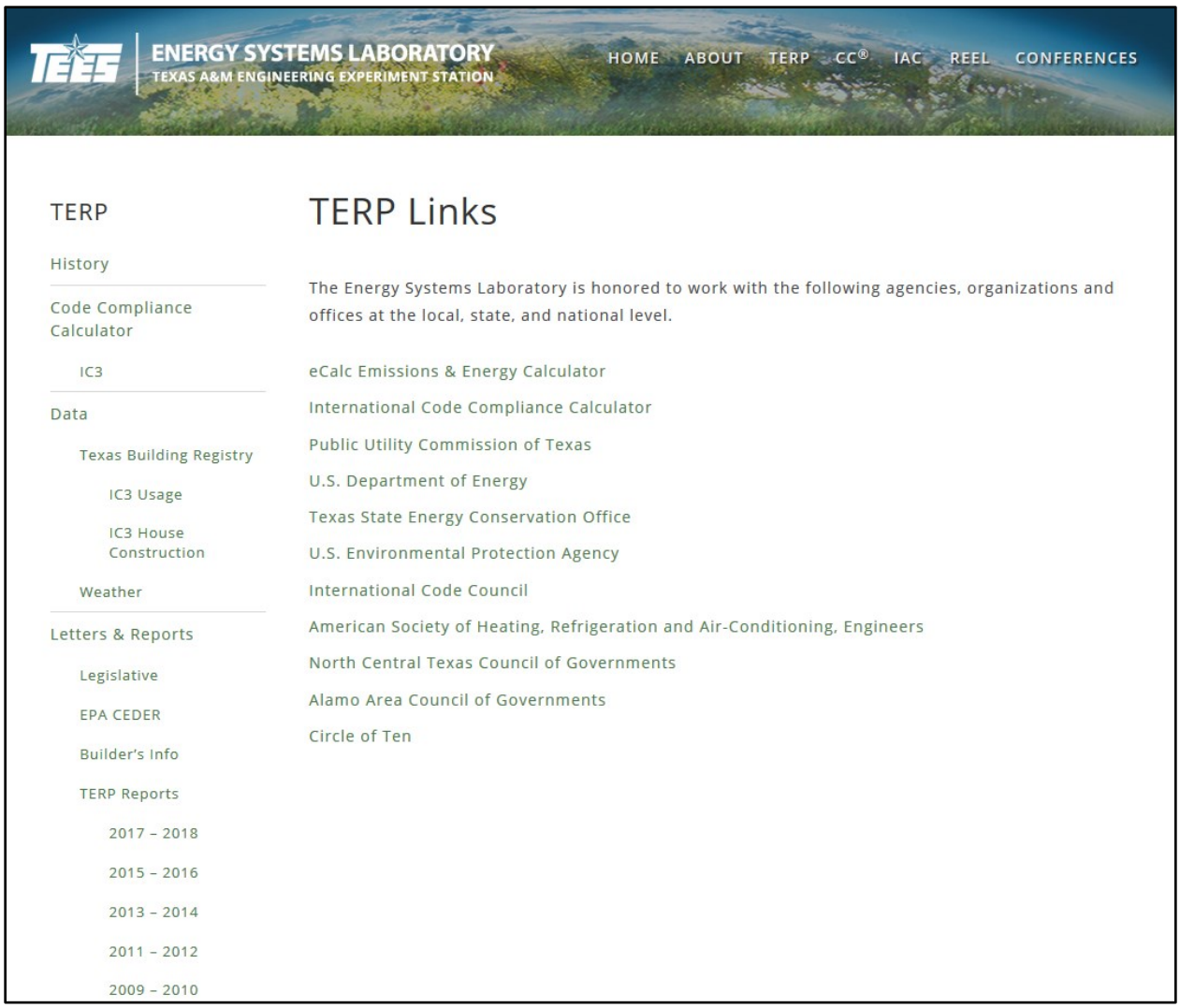


Figure 43: TERP Links

In addition, the Energy Systems Lab. (ESL) also hosted the Texas Energy Summit (previously Clear Air Through Energy Efficiency Conference (CATEE)). The Texas Energy Summit website and information are linked in the menu of the Conference tab in the ESL website.

6.4 Activities of Technical Transfer

6.4.1 Technical Assistance to the TCEQ

The Laboratory received dozens of calls per week from code officials, builders, home owners and municipal officials regarding the building code and emissions calculations. A complete file of these transactions is maintained at the Laboratory.

The Laboratory provides technical assistance to the TCEQ, the PUC, SECO and ERCOT, as well as Stakeholders participating in a number of conferences and presentations. In 2011, the Laboratory continued to work closely with the TCEQ to develop an integrated emissions calculation, which provided the TCEQ with a creditable NOx emissions reduction from energy efficiency and renewable energy (EE/RE) programs reported to the TCEQ in 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, and 2016 by the Laboratory, PUC, SECO, and Renewables-ERCOT.

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

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

6.4.2 Code Training

Section 388.009 of HB 3235 requires the Laboratory to develop and administer a state-wide training program for municipal building inspectors who seek to become code-certified inspectors. To accomplish this, the Laboratory originally developed the Energy Code Workshops which were based on the 2006 International Energy Conservation Code (IECC) as published by the International Code Council (ICC) for residential and commercial buildings, with amendments. Since then, the Laboratory has updated the workshops to the 2015 IECC, and developed 2018 code workshops.

6.4.3 ASHRAE Summer Conference Standards Committee Activities in Long Beach, California, June 20 to June 24, 2017

The following sections are the minutes and transactions of Standards Committee activities at the ASHRAE Summer Conference in Long Beach, California, June 20 to June 24, 2017

ASHRAE

ASHRAE SSPC 90.1 MEETING DRAFT AGENDA
ASHRAE Annual Meeting, Long Beach, CA
June 20-24- 2017

Full Committee meetings at the Long Beach Renaissance Hotel (Bixby 4/5)

Notes:

- Full Committee meetings will start promptly at times noted.
- This meeting is open to observation by interested parties.
- Subcommittee meeting rooms are at end of agenda
- All sessions are open to the public.
- The agenda order shown may not be followed
- Material for Project Committee members is posted on the Committee Only FTP site

Full Committee Saturday, June 24, 2017 ..... 8 AM to Noon PDT

1) Introductions

a) Sign-in and Quorum Determination (Ferguson) –

b) Introductions of members and guests (Erbe) – all members and guests introduced themselves.

c) ASHRAE Code of Ethics

ASHRAE Code Of Ethics

(Approved by ASHRAE Board of Directors January 30, 2013)

1.140.001.1 As members of ASHRAE or participants in ASHRAE committees, we pledge to act with honesty, fairness, courtesy, competence, integrity and respect for others in our conduct.

A. Efforts of the Society, its members, and its bodies shall be directed at all times to enhancing the public health, safety and welfare.

B. Members and organized bodies of the Society shall be good stewards of the world's resources including energy, natural, human and financial resources.

C. Our products and services shall be offered only in areas where our competence and expertise can satisfy the public need.

D. We shall act with care and competence in all activities, using and developing up-to-date knowledge and skills.

E. We shall avoid real or perceived conflicts of interest whenever possible, and disclose them to affected parties when they do exist.

F. The confidentiality of business affairs, proprietary information, intellectual property, procedures, and restricted Society discussions and materials shall be respected.

G. Each member is expected and encouraged to be committed to the code of ethics of his or her own professional or trade association in their nation and area of work.

ASHRAE SSPC 90.1 MEETING DRAFT AGENDA
ASHRAE Annual Meeting, Long Beach, CA
June 20-24- 2017

9) **Subcommittee Reports and Actions** – (unresolved objections = negative voters with reason or unresolved commenter)

a) Envelope
- Text modifications to section A9
- Response and proposed addendum to CMP 90.1-16-12-0005-001 Hetzel – door definition
- Thermal Bridging Presentation (Humble)
- Air Leakage - tentative

b) Lighting
- Addendum EH (from 2013) – parking lot lighting –
- Addendum ei (from 2013) – two comments from two commenters - historic building definition– if responses are available –
- Functional testing addition to Alterations requirements –
- New interior and exterior space types –

c) ECB –
- Denson Interpretation 1 response
- Denson Interpretation 2 response

d) Format & Compliance
- Compliance paths/mandatory provisions/flowcharts – Action Items assigned at Atlanta Interim – review

  Ferguson do document compare to make sure text wasn't accidentally removed without strikethrough, or added without underline. To be completed by 4/26 (complete)

  Ferguson to Organize section numbers in section 4. To be completed by 4/26 (complete)

  Mechanical (primary) and F&C Action item clean up and confirm section 6 compliance paths. **Status update**

  Lighting subcommittee action item Lighting subcommittee needs to confirm compliance paths. **Status update**

  Lighting subcommittee (primary) and F&C action item: Another addendum modifies Section 9.2.2 (addendum bg), and we need to show how it all gets merged together before it comes up to SSPC vote per standard work. **Status update**

  ECB needs to determine what's required for compliance in Appendix G and what's required for beyond code stuff. (complete)

  ECB needs to look at final sentence in Appendix G and how it applies to a and applies to b. How do we do this better? (complete)

ASHRAE SSPC 90.1 MEETING DRAFT AGENDA
ASHRAE Annual Meeting, Long Beach, CA
June 20-24- 2017

Full Committee Sunday, June 25, 2017 ..... 9 AM to Noon PDT

1) **Introductions**
   a) Sign-in and Quorum Determination (ASHRAE Staff)
   b) Introductions of members and guests (Erbe)
2) **Announcements** (Erbe)
   a) Bias and Conflict Forms
3) **Subcommittee Reports**
   a) Lighting
   b) Mechanical
   c) ECB
   d) Envelope
   e) Format & Compliance
4) **Continuous Maintenance Proposals Status updates –** Hermans
5) **Interpretations - Status updates –** Hermans
6) **Update on Standard Work** – Lord
7) **Commissioning WG update** – Hart
8) **Public time to address SSPC (30 minutes).** Persons wishing to address the Project Committee should contact the Chair (Drake Erbe – drakeerbe@airxchange.com) by NOON June 17.

End of Full Committee Meeting..... Noon

ASHRAE SSPC 90.1 MEETING DRAFT AGENDA
ASHRAE Annual Meeting, Long Beach, CA
June 20-24- 2017

All meetings at the Renaissance (Room assignments, SC times are tentative check with SC chair for final schedule)

Project Committee (Bixby 4/5)

- Saturday: 8 AM – Noon
- Sunday: 9 AM – Noon
- Monday: 8 AM – Noon

ECB – (Wilmore)

- Friday: 3 pm – 8 pm
- Saturday: 1 pm – 5 pm
- Sunday: 1 pm – 4 pm

Lighting (Broadlind 1)

Friday: 9 am – 10 pm
Saturday: 1 pm – 7 pm
Sunday: 1 pm – 8 pm

Envelope (different rooms each day)

- Friday: 9 am – 10 pm (Broadlind 2)
- Saturday: 1 pm – 8 pm (Bixby 2)
- Sunday: 1 pm – 8 pm (Bixby 3)

Mechanical (different rooms each day)

Friday: 9 am – 10 pm (Bixby 2)
Saturday: 1 pm – 7 pm (Bixby 4/5)
Sunday: 1 pm – 8 pm (Bixby 4/5)

Envelope Working Groups (different rooms each day)

- Friday: 4 pm - 6 pm (Broadlind 2)
- Saturday: 4 pm – 6 pm (Bixby 3)

Format & Compliance (different rooms each day)

- Friday: 5 pm – 10 pm (Tichenor)
- Saturday: 1 pm – 5 pm (Ebell)
- Sunday: 4 pm – 7 pm (Wilmore)

ASHRAE SSPC 90.2
Long Beach, CA
June 26 (Renaissance – Broadlind 1) and 27 (Renaissance – Bixby 2), 2017
Draft Agenda

If you would like to participate remotely please contact Theresa Weston by email: theresa.a.weston@dupont.com. She will send connection information to you.

1 - Call to Order

2 - Welcome and Introductions

3 - Sign–in and Quorum Determination (20 PCVM which requires 11 members for a quorum)

No.	Member	Position	06/26	Guests	Affiliation	06/26
1	Theresa Weston	CHAIR				
2	Jeff Inks	Vice Chair				
3	Wes Davis	PCVM				
4	Scott Campbell	PRI ORG/PCA				
4A	David Shepherd	ALT ORG/PCA				
5	Isaac Elnecave	PCVM				
6	Philip Fairey	PCVM				
7	David Goldstein	PCVM				
8	Michael Jouaneh	PCVM				
9	Michael Lubliner	PCVM				
10	Chris Mathis	PCVM				
11	Merle McBride	PCVM				
12	Harry Misuriello	PRI ORG/ACEEE				
13	Jerry Phelan	PCVM				
14	Steve Rosenstock	PRI ORG/EEI				
14A	Chuck Foster	ALT ORG/EEI				
15	Loren Ross	PRI ORG/AWC				
15A	Sam Francis	ALT ORG/AWC				
16	Amy Schmidt	PCVM				
17	Wayne Stoppelmoor	PCVM				
18	Bruce Sweicicki	PCVM				
19	Martha VanGeem	PCVM				
20	Richard Watson	PCVM				
	Armin Hauer	NVM				
	Bertrand Poirier	PSVM - Mechanical				
	Max Sherman	Consultant				
	Jerry White	Consultant				
	Jonathan Humble	Consultant				
	Robert Bean	SSPC 55 Liaison				
	Dru Crawley	SPLS Liaison				
	Keith Emerson	TC 7.6 Liaison				
	Steve Ferguson	Staff Liaison				
	Mark Lien	IES Staff Liaison				

SSPC 90.2 2017 Annual Meeting Draft Agenda

7	David Goldstein	PCVM				
8	Michael Jouaneh	PCVM				
9	Michael Lubliner	PCVM				
10	Chris Mathis	PCVM				
11	Merle McBride	PCVM				
12	Harry Misuriello	PRI ORG/ACEEE				
13	Jerry Phelan	PCVM				
14	Steve Rosenstock	PRI ORG/EEI				
14A	Chuck Foster	ALT ORG/EEI				
15	Loren Ross	PRI ORG/AWC				
15A	Sam Francis	ALT ORG/AWC				
16	Amy Schmidt	PCVM				
17	Wayne Stoppelmoor	PCVM				
18	Bruce Sweicicki	PCVM				
19	Martha VanGeem	PCVM				
20	Richard Watson	PCVM				
	Armin Hauer	NVM				
	Bertrand Poirier	PSVM - Mechanical				
	Max Sherman	Consultant				
	Jerry White	Consultant				
	Jonathan Humble	Consultant				
	Robert Bean	SSPC 55 Liaison				
	Dru Crawley	SPLS Liaison				
	Keith Emerson	TC 7.6 Liaison				
	Steve Ferguson	Staff Liaison				
	Mark Lien	IES Staff Liaison				

10 – Subcommittee Reports – Further Discussion of Public Review Comments referred to subcommittees:

- Envelope Subcommittee Report (Merle McBride)
- Mechanical Subcommittee Report (Michael Lubliner)
- Lighting Subcommittee Report (Michael Jouaneh)

11 – Continuation of Public Review Comment Discussion – Public Review Comments referred to topic TaskGroups:

- ERI Task Group
- Simulation / Modeling Task Group
- Existing Buildings Task Group
- ON-Site Energy Production Task Group

12 -- Old Business

13 – New Business

14 – Next Meetings:

- Webinar schedule

16– Adjourn

SSPC 90.2 2017 Annual Meeting Draft Agenda

Transparency of Appendix K	Table	Table K1	16	2	New - Submitted	Envelope Subcommittee
Various comments on 90.2R Draft	General	General	13	1	New - Submitted	Envelope Subcommittee

Pending Comments Related to units, general definitions and thermal comfort:

Title	Section Type	Section ID	Commenter	Comment	Topic
Conversion correction in 6.4.3	Clause	6.4.3	4	27	Units
Update proper IP SI conversions in Normative Appendix B	Clause	Appendix B	4	46	Units
formats, conventions, style	General	General	1	2	General ? PDF attachment
Section 6.4 Title	Clause	6.4	15	2	Format
3.2. Abbreviations and Acronyms	General	3.2 Abbreviations	7	5	Format
Chapters 4	Clause	Formatting	5	14	Format
Draft Contains Multiple Section and Table Reference Errors	General	General	8	4	Format
Incomplete Document	General	General	17	1	Format
Normative Reference Standards	Clause	Normative Reference	5	3	Format
Section 4.1	Clause	Section 4.1.1	5	8	Format
Table of Contents, and related chapters	Clause	Table of contents	5	2	Format

SSPC 90.2 2017 Annual Meeting Draft Agenda

ASHRAE/ICC/IES/USGBC SSPC 189.1,
Standard for High-Performance Green Buildings
Except Low-Rise Residential Buildings
June 27 and 28, 2017
Long Beach, CA

Tuesday 6/27/17 (8:00 a.m. to 10:00 a.m.) Renaissance Hotel, Pike 3

1. **Call to order**

2. **ASHRAE Code of Ethics Commitment**
   In this and all other ASHRAE meetings, we will act with honesty, fairness, courtesy, competence, integrity and respect for others, and we shall avoid all real or perceived conflicts of interests. (See full Code of Ethics: https://www.ashrae.org/about-ashrae/ashrae-code-of-ethics.)

3. **Logistics**
   - Bias/conflict announcement
   - Voting members: Balaras, Boldt, Conrad, Crawley, Cross, Dolin, Edelson, Eley, Floyd, Francis, Gitlin, Gress, Horn, Lawrence, Leslie, Lord, Mason, McBride, McGuire, McHugh, Paliaga, Pape, Persily, Rainey, Rosenstock, Ross-Bain, Schoen, Setty, Sovocool, Stanke, Stoppelmoor, Sullens, Taber, VanGeem, West, Whittet, Winters, Zhang
   - Guest Introductions

4. **Review agenda – Persily**

5. **Review of Action Items – Persily**

6. **Chair's Reminders and Remarks**
   - Requests for posting of ASTM standards to WG chairs by 7/1/17.
   - Include ASHRAE copyright on all working drafts 2017.
   - Do not to distribute draft addenda outside of committee, member contact information, or nay other internal committee documents, e.g. input from designated reviewers.
   - Do not communicate with committee members during letter ballots.

7. **Approval of Meeting Minutes**
   - 2/28/17, 3/28/17, 4/25/17, 5/30/17 and 6/6/17 pending

8. **Membership - Schoen**

9. **Requests for Interpretation (RFI) status: None pending**

10. **CMP status (submission date)**
    - 17-12-0001/001, Brooks (wood in Section 9) assigned to WG 9 (dated 1/24/17)

11. **Addenda Status Update**
    a. Approved for publication (25 addenda): by (moisture infiltration control); ce (peak demand), a (DCV outdoor sensors), b (peak demand), c (reference Standard 202), d (lighting control factors), e (institutional tuning), f (flush volume), g (HVAC moisture control), i (vegetative roofs), j (prohibited development), k (opaque envelope), L (Section 9 Title and Scope), m (walkways/bike paths), n (Table 7.5.2a footnote), o (TPS), p (bottle filling stations), q (climate zone 0), s (section 6 all mandatory), t (reverse osmosis), u (water softeners), x (energy performance option B), y (occupant survey), z (parking lighting) and ab (kitchen hood SI).

14. Working group reports
- **WG9**
  - *ak publication (LCA)

15. Informative appendix to reference Standard 189.3

16. New Business

Wednesday 6/28/17 (8:00 a.m. to Noon): Renaissance Hotel, Pike 3

17. Call to order

18. Logistics – Staff
- Bias/conflict announcement
- Voting members: Balaras, Boldt, Conrad, Crawley, Cross, Dolin, Edelson, Eley, Floyd, Francis, Gitlin, Gress, Horn, Lawrence, Leslie, Lord, Mason, McBride, McGuire, McHugh, Paliaga, Pape, Persily, Rainey, Rosenstock, Ross-Bain, Schoen, Setty, Sovocool, Stanke, Stoppelmoor, Sullens, Taber, VanGeem, West, Whittet, Winters, Zhang)
- Guest Introductions

19. Working Group Reports
- **WG 5**
  - *Publication of addendum az (biodiverse planting exceptions)
- **WG 6**
  - *Publication of addendum ay (dual plumbing)
  - *Publication of addendum bf (cooling towers)
- **WG 7**
- **WG 7.5**
  - *Publication of addendum ar (zEPI)
  - *Publication of addendum cl (Table 7.5.2A update)
- **WG 8**
  - *Publication of addendum as (acoustics)
  - *Publication of addendum aw (glare)
- **WG 9**
- **WG 10**
  - *Publication of addendum aq (commissioning)

20. New Business

21. Future Meetings
- **Scheduled web meetings: July 25, August 29 and September 26**

22. Adjournment

6.4.4 Other Meetings

6.4.4.1 North Central Texas Council Government (NCTCG) Meetings from 2017

The following pages are meeting notes, agendas, and summaries from the NCTCG meetings from 2017

North Central Texas Council of Governments

AGENDA

Energy and Green Advisory Board (EGAB)
Monday, January 23, 2017
9:00 AM – 12:00 PM William J. Pitstick Executive Board Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden, City of Dallas
Vice Chair: Vacant

1. **Welcome and Introductions.**

DISCUSSION

2. **Discuss and formulate direction on Energy Systems Laboratory's (ESL) response of November 28, 2016.**
3. **Discussion and direction regarding "Air Leakage" protocol testing for multi-family projects.**
4. **Update on RESNET processes as they relate to HERS rating and formulas.**
5. **Discussion and direction regarding "Air Leakage" sampling testing for multi-family projects.**
6. **Discussion of stakeholder's options in regard to support for ESL.**
7. **Discussion of future requests from NCTCOG EGAB to ESL.**

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

8. **Future Agenda Items.** EGAB members and NCTCOG staff may suggest future agenda items.
9. **Roundtable Topics/Other Business.** EGAB members and NCTCOG staff may share additional items of interest as time allows.
10. **Schedule for the Next Meeting.** To be determined.
11. **Adjournment.**

If you have any questions regarding the meeting or agenda items, please contact Cassidy Campbell at (817) 608-2368 or ccampbell@nctcog.org.

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Asher Hallman by phone at (817) 695-3231 or by email at a.hallman@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

616 Six Flags Drive, Centerpoint Two
P.O. Box 5888, Arlington, Texas 76005-5888
(817) 640-3300 FAX: 817-608-2372
www.nctcog.org

North Central Texas Council of Governments

AGENDA

Regional Codes Coordinating Committee
Monday, April 24, 2017
9:30 AM, Regional Forum Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: David Kerr, City of Plano
Vice-Chair: Jack Thompson, Town of Westover Hills

1. **Welcome and Introductions.**

ACTION ITEMS/PRESENTATIONS

2. **Summary of the January 31, 2017 Meeting.** The January 31, 2017 draft meeting summary is available online for your review and consideration.

3. **Presentation by Jerry Daniel, Chief Electrical Inspector, Texas Department of Licensing and Regulations.** Mr. Daniel will be presenting the State of Texas' position on the 2017 National Electrical Code.

4. **Approval of the 2017 National Electrical Code Regional Recommended Amendments** (Gary Jones). The Electrical Advisory Board (EAB) has completed the review of the 2017 National Electrical Code and has developed regional recommended amendments for which the EAB will be seeking approval from the Regional Codes Coordinating Committee (RCCC).

5. **Guidance for Air Leakage Protocol** (Ed Dryden) - The Energy and Green Advisory Board (EGAB) will present the "NCTCOG Approved Methodology for Establishing Code Compliant Multifamily Residences Based on Measured Total Air Leakage Results Guidance for Code Officials, Raters, and Builders" for approval from the RCCC.

6. **RCCC Work Program Update and Code Adoption Survey Results** – NCTCOG will present the proposed Work Program to the RCCC for approval. The results of the code adoption survey will also be presented for discussion related to the priorities included in the proposed Work Program.

7. **Approval of Advisory Board Members for Appointment** (Ed Dryden) - The Energy and Green Advisory Board will seek approval for the appointment of Steven McPherson, Senior Plans Examiner, City of Mansfield.

DISCUSSION

8. **Building Code Requirements** (Bruce Rachel) – Mr. Rachel will discuss requirements for elevators to have two-way communication devices for individuals with temporary and/or permanent disabilities.

616 Six Flags Drive, Centerpoint Two
P.O. Box 5888, Arlington, Texas 76005-5888
(817) 640-3300 FAX: 817-608-2372
www.nctcog.org

9. **Standards for Electronic Plan Submittal** (Jim Olk) – The RCCC will discuss whether or not to establish a subcommittee to review and make a recommendation regarding standards for electronic plan submittal.

10. **2015 International Residential Code (IRC) Section 313** (Bob Morgan) – Mr. Morgan will discuss the deletion of Section 313 from the 2015 IRC as recommended by the 2015 NCTCOG amendments to the IRC and the possibility of replacing it in the 2018 code review.

11. **FY2018 RCCC Reappointments and Appointments.** In May, committee members with expiring terms will receive notification that his/her term is expiring and will be provided with reappointment/nomination forms. NCTCOG will also request nominations for Chair and Vice Chair. The individuals nominated for appointment and reappointment will be brought to the RCCC for approval at the July 19, 2017 meeting.

12. **Legislative Update** – NCTCOG will provide a matrix of bills relevant to building codes filed in the current legislative session.

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

13. **Future Agenda Items**. The committee can request future agenda items.

14. **Roundtable Topics/Other Business**. RCCC members and NCTCOG may share additional items of interest as time allows.

15. **Schedule for the Next RCCC Meeting**. The next meeting date is scheduled for Wednesday, July 19, 2017.

16. **Adjournment**.

If you have any questions regarding the meeting or agenda items, please contact Cassidy Campbell by phone at (817) 608-2368, or by email at ccampbell@nctcog.org.

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Brian Geck by phone at (817) 608-2361 or by email at bgeck@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

616 Six Flags Drive, Centerpoint Two
P.O. Box 5888, Arlington, Texas 76005-5888
(817) 640-3300 FAX: 817-608-2372
www.nctcog.org

North Central Texas Council of Governments

AGENDA

Energy and Green Advisory Board
Wednesday, May 17, 2017
9:00 AM – 12:00 PM William J. Pitstick Executive Board Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden, City of Dallas
Vice Chair: Vacant

1. **Welcome and Introductions.**

DISCUSSION

2. **Discussion and Development of a regional policy for sampling of multi-family projects in regard to Air Changes Per Hour (Section R402.4.1.2 Testing)**

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

3. **Future Agenda Items**. EGAB members and NCTCOG staff may suggest future agenda items.
4. **Roundtable Topics/Other Business**. EGAB members and NCTCOG staff may share additional items of interest as time allows.
5. **Schedule for the Next Meeting**. To be determined.
6. **Adjournment.**

If you have any questions regarding the meeting or agenda items, please contact Cassidy Campbell at (817) 608-2368 or ccampbell@nctcog.org.

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Brian Geck by phone at (817) 608-2361 or by email at bgeck@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

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www.nctcog.org

6.4.4.2 State Agency Energy Advisory Group (SAEAG)

The following pages are meeting notes, agendas, and summaries from the SAEAG meetings from 2017.

SAEAG MEETING

State Agency Energy Advisory Group

Wednesday, January 18, 2017
9:00 a.m. – 10:30 a.m.
Office of the Attorney General
William Clements Building
NW Corner of 15th and Lavaca
12th Floor Large Conference Room by Receptionist Area
Austin, Texas 78701

AGENDA

9:00 am OAG Rate Case Update (not open to the public)

9:15 am SECO Update: Implementing HB51(82R – 2011)

Relating to energy efficiency standards for certain buildings and to high-performance design, construction, and renovation standards for certain buildings and facilities of institutions of higher education.

9:30 am Sam Houston Central Plant Commissioning Project, Wendell Cook, Texas Facilities Commission

10:30 am Questions and General Discussion

Attending by Webinar

Register here to attend by webinar. After registering, you will receive a confirmation email containing information about joining the webinar.

If you are attending in person, be sure to bring a picture I.D. to gain entry to the Clements Building.

You may pre-register to obtain unescorted clearance (you will still need to bring a picture I.D.) to our floor by emailing or calling before our meeting is scheduled nancy.villarreal@oag.texas.gov [512-475-4164] or colleen.minor@oag.texas.gov [512-475-4157].

State Agency Energy Advisory Group

LBJ Office Building- 111 E. 17th Street, Austin
April 19, 2017

Agenda

9:30am	Introductions
9:40am	OAG Rate Case Update (not open to the public)
10:00am	SECO Update
10:15am	Open Forum for Discussion of Current Projects, Concerns or Issues
10:30am	Austin Green Business Leader Program, Andee Chamberlain (TPWD) and Marc Coudert (City of Austin- Office of Sustainability)

SAEAG MEETING

State Agency Energy Advisory Group

Wednesday, September 20, 2017
9:00 a.m. – 11:00 a.m.
Office of the Attorney General
William Clements Building
NW Corner of 15th and Lavaca
12th Floor Large Conference Room by Receptionist Area
Austin, Texas 78701

AGENDA

9:00 am	OAG Rate Case Update (not open to the public)
9:15 am	SECO Update
9:30 am	Karen Blaney, SPEER to present on "Texas 2030 Districts: Measuring City Core Progress on Energy and Water Efficiency"
10:30 am	Questions and General Discussion

Attending by Webinar

Register at https://attendee.gotowebinar.com/rt/1280879751890586369 to attend by webinar. After registering, you will receive a confirmation email containing information about joining the webinar.

If you are attending in person, be sure to bring a picture I.D. to gain entry to the Clements Building.

You may pre-register to obtain unescorted clearance (you will still need to bring a picture I.D.) to our floor by emailing or calling before our meeting is scheduled nancy.villarreal@oag.texas.gov [512-475-4164] or colleen.minor@oag.texas.gov [512-475-4157].

SAEAG MEETING

State Agency Energy Advisory Group

Wednesday, August 17, 2016
9:00 a.m. – 11:00 a.m.
Office of the Attorney General
William Clements Building
NW Corner of 15th and Lavaca
12th Floor Large Conference Room by Receptionist Area
Austin, Texas 78701

AGENDA

9:00 a.m. – 9:15 a.m.	Introductions
9:15 a.m. – 9:45 a.m.	Case Update from OAG
9:45 a.m. – 10:00 a.m.	BREAK
10:00 a.m. – 11:00 a.m.	Energy Reporting Requirements for State Agencies and Universities, presented by Alison Huxel, SECO

Webinar Registration: https://attendee.gotowebinar.com/rt/7495588846236999171

If you are attending in person, be sure to bring a picture I.D. to gain entry to the Clements Building.

You may pre-register to obtain unescorted clearance (you will still need to bring a picture I.D.) to our floor by emailing or calling before our meeting is scheduled nancy.villarreal@texasattorneygeneral.gov [512-475-4164] or colleen.minor@texasattorneygeneral.gov [512-475-4157].

State Agency Energy Advisory Group

LBJ Office Building- 111 E. 17th Street, Austin

September 21, 2016

AGENDA

9:00– 9:15 am Case Update from OAG (not open to public)

9:15– 9:30 am SECO Update

9:30– 10:30 am Presentation on Eproject Builder by Elizabeth Stuart, Lawrence Berkeley National Laboratory

10:30– 10:45 am Questions and General discussion

6.4.4.3 The Blue Bonnet Chapter Association Meetings from 2017

The following pages are meeting notes, agendas, and summaries from the Blue Bonnet Chapter Association meetings from 2017.

BLUEBONNET CHAPTER ICC
OFFICER INSTALLATION ANNUAL BANQUET

SPARE TIME TEXAS
January 14, 2017
5434 Loop 205, Temple TX
5:00pm-9:00pm

Agenda:

5:00pm -7:00pm-Family Bowling (Shoe rental included)

7:15pm-8:00 pm-Dinner and door prizes

8:00pm-9:00 pm-Chapters Business

-Call to order

-New Members

-Approve/disapprove minutes

-Treasurer report

-Old Business

-New Business

-Annual training in Harker Heights.

-Speaker: Cyndi Lewis, International Code Council
Government Relations, Regional Manager

-Officer installation

-Member of the year presentation

-Adjourn

BLUE BONNET CHAPTER ASSOCIATION

AGENDA

MEETING DATE: **Wed, February 15, 2017**

TIME: **6:30 p.m. – 8:00 p.m.**

LOCATION: **Rosa's Café & Tortilla Factory, 1110 E CTE Killeen, TX 76541**

1. **CALL TO ORDER**
   A. Mike Beard, Chapter President
      Prayer / Pledge

2. **NEW MEMBERS:**

3. **GUEST SPEAKER:**

4. **APPROVE/ DISAPPROVE MINUTES:**

5. **TREASURER REPORT**

6. **OLD BUSINESS:**

   A. Vote on amendments to Bylaws

7. **NEW BUSINESS:**

   A. Please turn in old board binders
   B. Annual training update
   C. Vote on annual training expenses
   D. Vote on cost of RTIC Cooler for annual training raffle
   E. Taxes/ Vote on expenses for filing taxes
   F. Discuss benefits of QuickBooks
   G. Vote on holding off on scholarships to take on other expenses
   H. Discuss new meeting locations- Next 3 months Killeen, Oxbow for the following 3 months, etc.

8. **50/50 RAFFLE:**

9. **ADJOURN**

PLEASE CHECK OUT OUR WEB SITE AT www.bluebonneticc.com
FOR MEETING DATES/ EVENTS / TRAINING

BLUE BONNET CHAPTER ASSOCIATION

AGENDA

MEETING DATE: Wed, March ~~01~~ 15, 2017

TIME: 6:30 p.m. – 8:00 p.m.

LOCATION: Plate Factory, 2801 S Interstate Hwy 35, Belton, TX 76513

1. **CALL TO ORDER**
   A. Mike Beard, Chapter President
      Prayer / Pledge

2. **NEW MEMBERS:**

3. **GUEST SPEAKER:** **Andy Severy with Simpson Strong Tie**

4. **APPROVE/ DISAPPROVE MINUTES:**

5. **TREASURER REPORT**

6. **OLD BUSINESS:**
   A. Annual training/ getting information out
   B. Quick books software
   C. Audit
   D. Appointment of Committees (Education, Annual Banquet, Financial Review)

7. **NEW BUSINESS:**
   A. Update on RTIC cups
   B. Cooler raffle

8. **50/50 RAFFLE:**

9. **ADJOURN**

PLEASE CHECK OUT OUR WEB SITE AT www.bluebonneticc.com
FOR MEETING DATES/ EVENTS / TRAINING

BLUE BONNET CHAPTER ASSOCIATION

AGENDA

MEETING DATE: **Wed, April 19, 2017**

TIME: **6:30 p.m. – 8:00 p.m.**

LOCATION: **Rosa's Café & Tortilla Factory, 1110 E CTE Killeen, TX 76541**

1. **CALL TO ORDER**
   A. Mike Beard, Chapter President
      Prayer / Pledge

2. **NEW MEMBERS:**

3. **GUEST SPEAKER:** **Shirley Ellis, ICC Board and ESL updates**

4. **APPROVE/ DISAPPROVE MINUTES:**

5. **TREASURER REPORT**

6. **OLD BUSINESS:**
   A. Quick books software- use it for a year
   B. Internal financial review after 1 year
   C. Appointment of Committees (Education, Annual Banquet, Financial Review)- need volunteers by next meeting

7. **NEW BUSINESS:**
   A. Take payments on site with PayPal
   B. Annual training recap

8. **50/50 RAFFLE:**

9. **ADJOURN**

PLEASE CHECK OUT OUR WEB SITE AT www.bluebonneticc.com
FOR MEETING DATES/ EVENTS / TRAINING

BLUE BONNET CHAPTER ASSOCIATION

AGENDA

MEETING DATE: **Wed, June 21, 2017**

TIME: **6:30 p.m. – 8:00 p.m.**

LOCATION: **Rudy's - 5621 E Central Texas Expressway Killeen, TX 76543**

1. **CALL TO ORDER**
   A. Mike Beard, Chapter President
   Prayer / Pledge

2. **NEW MEMBERS:**

3. **GUEST SPEAKER:** **Tracey Herring- TCEQ**

4. **APPROVE/ DISAPPROVE MINUTES:**

5. **TREASURER REPORT**

6. **OLD BUSINESS:**
   A. Bobby- TSTC graduation recap
   B. Summer picnic- postpone?
   C. If Mike Olsen is present- Annual meeting update
   D. Mechanical/Electrical training- October- Bill McGovern (speaker) would cost us $1000 per day – We will discuss this further at the next meeting
   E. 1 hr. Legal Code Updates – August 16th at CJ's BBQ in College Station
   F. November time frame – Plumbing CEU's in Killeen or Harker Heights (James Walls)

7. **NEW BUSINESS:**
   A. Guest speaker for the 1 hour legal updates class also does other additional training for code enforcement. Hotel and meal reimbursement is the only fee. Waco has more information on this.
   B. The next meeting will be in Waco- need location.

8. **50/50 RAFFLE:**

9. **ADJOURN**

PLEASE CHECK OUT OUR WEB SITE AT www.bluebonneticc.com
FOR MEETING DATES/ EVENTS / TRAINING

BLUE BONNET CHAPTER ASSOCIATION

AGENDA

MEETING DATE: **Wed, September 20, 2017**

TIME: **6:30 p.m. – 8:00 p.m.**

LOCATION: **Rancher's Steakhouse, 107 Highway 36 Bypass N, Gatesville, TX 76528**

1. **CALL TO ORDER**
   A. Mike Beard, Chapter President
      Prayer / Pledge

2. **NEW MEMBERS:**

3. **RECOGNITION:**

4. **GUEST SPEAKER:** **Gas Line Safety- Atmos Representative**

5. **APPROVE/ DISAPPROVE MINUTES:**

6. **TREASURER REPORT**

7. **OLD BUSINESS:**
   A. Annual banquet update- Mike Olsen
   B. TSTC October meeting and meal deadline- Bobby Horner
   C. Electrical Inspector class will be in April at Micro conference
   D. Board of Director appointment committee – Appoint and vote.
      1. Ashlie Tolliver
      2. Charles Simpson
      3. Vacant
      4. Vacant
      5. Vacant

8. **NEW BUSINESS:**
   A. Donation to Hurricane Relief- $300.00
   B. New cups are in!!

9. **50/50 RAFFLE:**
10. **ADJOURN:**

PLEASE CHECK OUT OUR WEB SITE AT www.bluebonneticc.com
FOR MEETING DATES/ EVENTS / TRAINING

6.4.4.4 2017 Building Official of Texas Annual Conference

2017 Building Official of Texas Annual Conference
Career Development Day – August 9, 2017
Schedule of Events

BOAT
BUILDING OFFICIALS ASSOCIATION OF TEXAS

TIME	TOPIC
8:00	**Registration / Introduction of Mentors** Van Tran
8:00 – 8:45	**Welcome and Opening Remarks (Networking Breakfast)** BOAT President
9:00 – 10:15	**Classroom Education** Professional Development – TDLR, TSBPE, Internship Program, BOAT Membership Pools & Spas – Why the code needs to be adopted and review – the Pros and Cons Susan Hilaski, Association of Pools and Spa Professional
10:15 – 10:45	**Break / Exhibit Hall – Networking Session**
10:45 – 12:00	**Group Discussion / Conference Tour with Exhibitors**
12:00 – 1:00	**Lunch**
1:00 – 1:30	**Transportation to Rockwall Building Inspections Department** 385 S Goliad St, Rockwall, TX 75087
1:30 – 4:00	**Training at the City of Rockwall's Building Inspections Department**
1:30 – 1:45	**Welcome / Overview of Building Inspections Department (Council Chamber)**
1:45 – 2:30	**Concurrent Training**
Group 1	**Development Process and Inspections (Council Chamber)** Inspectors visit the site during different construction phases to determine the structure is built safely and according to plan. If something does not comply, the code official issues orders to have the builder correct the problem. When the project is complete, the inspector issues a certificate of occupancy. (Source: ICC – Careers in Code Enforcement)
Group 2	**Permitting and Plan Review Division (Lower level)** Permit Technicians are responsible for providing information and assistance to internal and external customers regarding permits and other building construction related activities. (Source: Job Description – City of Georgetown, TX) After a property owner submits an application for permission to construct or remodel a building, plan reviewers check the construction plans for code compliance. The code official grants a permit so construction can begin. (Source: ICC – Careers in Code Enforcement)
2:45 – 3:30	**Training**
Group 1	**Permitting and Plan Review Division (Lower level)**
Group 2	**Development Process and Inspections (Council Chamber)**
3:30 – 4:00	**Round Table Discussion at Council Chamber and Wrap up** **Survey Feedback**

BOAT

BUILDING OFFICIALS ASSOCIATION OF TEXAS

BOAT Business Meeting
August 10, 2017
4:15 pm – 5:15 pm
Hilton Rockwall Lakefront, Rockwall, Texas

1) Call to Order:

2) Roll Call:

3) Approval of Agenda:

4) Financial report

5) Bpi report status

6) ICC Vice President - Jay Elbettar

6) Resolutions

7) Election of officers/board

8) Other Business:

9) Adjournment

10) Pictures:

BOAT
BUILDING OFFICIALS ASSOCIATION OF TEXAS

BOAT Banquet
August 10, 2017
6:00 pm – 9:00 pm
Hilton Rockwall Lakefront, Rockwall, Texas

1) Welcome

2) Benediction

3) Dinner

4) City awards and scholarships

5) President farewell address

6) Installation of board

Jay Elbettar - ICC Vice President
Shirley Ellis - ICC Board of Director

8) Passing of gavel

9) Elected President address

10) Adjournment

8:00 pm -9:00pm Boat ride on Lake Ray Hubbard

BOAT BUILDING OFFICIALS ASSOCIATION OF TEXAS

TUESDAY WEDNESDAY THURSDAY FRIDAY

All events will be held at the Hilton Dallas/Rockwall Lakefront unless otherwise noted.
Speakers and sessions are subject to change.

Tuesday, August 8, 2017

1:00–4:00 p.m.
BOAT Board Meeting (closed)

2:00–4:30 p.m.
Registration

5:15–6:15 p.m.
Buses leave hotel for Shenaniganz

5:30–8:30 p.m.
Welcome Reception
Greet old friends and make some new ones with light refreshments at this year's Texas Shoot-Out location – Shenaniganz.
Meritage Systems, Reception Sponsor

Texas Shoot-Out
Dinner, bowling and a chance to try Shenaniganz go carts, lazer tag, or other games. What else do you need? (Complimentary for **all conference attendees!**)
Avolve Software Corporation, Title Sponsor | Selectron Technologies, Dinner Sponsor

8:30–9:30 p.m.
Buses leave Shenaniganz for hotel

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Wednesday, August 9, 2017

7:00 a.m.–5:00 p.m.
Registration

7:30–8:45 a.m.
Networking Buffet Breakfast with Exhibitors
Opening Remarks and Welcome
Omega Flex, Inc., Breakfast Sponsor

8:45 a.m.
Nominating Committee Meeting

9:00–10:15 a.m. | **CONCURRENT SESSIONS**

Track 1
Management & Legal

This track will cover what is required when taking the Certified Building Official Management and Legal exam to become a certified building official with the International Code Council (ICC). This course is for those hoping to earn a CBO certification or for individuals that currently have the certification and wish to enhance their knowledge and strengthen their skills. Part 1 of 8.
Speaker: Tim Ryan, ICC Instructor

Track 2
Professional development – What you need to know from TDLR, TSBPE, and BOAT
This session will go over State of Texas programs from the Texas Department of Licensing and Regulation and the Texas State Board of Plumbing Examiners and how it will affect the building departments within the state. We will also discuss the newly formed BOAT internship program and how it works.
Speakers: Representatives from TDLR, TSBPE and BOAT

10:15-10:45 a.m.
Refreshment Break with Exhibitors
Viega Plumbing & Heating Systems, Break Sponsor

10:45 a.m.–Noon | CONCURRENT SESSIONS

Track 1
Management & Legal
Continued – Part 2 of 8
Speaker: Tim Ryan, ICC Instructor

Track 2
Elimination of Architectural Barriers
Discussion of the Public Right of Way Accessibility Guidelines (PROWAG) and AB Rule 68.102.
Speaker: Robert Posey, Program Director, Texas Department of Licensing and Regulation

Noon–1:15 p.m.
Networking Lunch
Air King, Lunch Sponsor

1:30–2:45 p.m. | CONCURRENT SESSIONS

Track 1
Management & Legal
Continued – Part 3 of 8
Speaker: Tim Ryan, ICC Instructor

Track 2
Inspector Skills
This session addresses the necessary soft skills for success as an inspector—those non-technical traits and behaviors that enhance an inspector's ability to interact with others and to successfully carry out their job duties. This includes not only people skills such as effective communication, diplomacy, and customer service; but also skills for problem solving, professionalism, integrity, and time management. In addition to a solid understanding of the technical provisions of the codes, developing appropriate soft skills are essential in pursuing the goal of safe, healthy, and durable buildings for the community. Developed specifically for construction inspectors in all disciplines, the topics covered are equally important to all employees of public service agencies including permit technicians, plan reviewers, managers, building officials, and fire code officials. The information is also beneficial for developing policies and procedures to promote consistent and fair inspection practices while improving communications and public relations. Part 1 of 2.
Speaker: Steve Van Note, CBO, Managing Director of Product Development, International Code Council

2:45–3:15 p.m.Refreshment Break with Exhibitors
Viega Plumbing & Heating Systems, Break Sponsor

3:30–4:45 p.m. | CONCURRENT SESSIONS

Track 1
Management & Legal
Continued – Part 4 of 8
Speaker: Tim Ryan, ICC Instructor

Track 2
Inspector Skills
Continued – Part 2 of 2
Speaker: Steve Van Note, CBO, Managing Director of Product Development, International Code Council

4:45 p.m.
Free evening in Rockwall
Check out things to do in Rockwall and the restaurants right near the hotel.

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Thursday, August 10, 2017

7:30 a.m.–4:00 p.m.
Registration

7:30–8:30 a.m.
Networking Breakfast with Exhibitors

8:45–10:00 a.m. | CONCURRENT SESSIONS

Track 1
Track 1
Management & Legal
Continued – Part 5 of 8
Speaker: Tim Ryan, ICC Instructor

Track 2
The Do's and Don't's of Floodplain Code Compliance
This session will go over the description of floods and floodplains and the potential hazards to buildings. You'll also learn the difference between wet flood and dry flood proofing techniques and acceptable applications; the role of flood openings in flood events to ensure resilient structures; identify regulations, codes,

and standards as they relate to sustaining foundations in flood hazard areas; and analyze the role of building compliance in securing lowering flood insurance rates and what mitigation solutions are available.
Speaker: **Paul Abrams**, National Sales Manager, Smart Vent Productions

10:00–10:30 a.m.
Refreshment Break with Exhibitors
e-PlanSoft, Break Sponsor

10:30–11:45 a.m. | CONCURRENT SESSIONS

Track 1
Track 1
Management & Legal
Continued – Part 6 of 8
Speaker: Tim Ryan, ICC Instructor

Track 2
Two Sessions in One!
Protect Citizens from the Top! Re-Roofing Inspections Can be a Life Saver
This class will provide you with critical information on the importance of performing inspections on re-roofing projects. This interactive program will illustrate common problems which can lead to illness and even death. The instructor will provide you with steps you can take to enhance or develop a robust re-roofing program in your community. The president of Roofing Contractors Association of Texas will be on hand to answer questions on how they can assist your community.
Speaker: **Scott McDonald, CBO**, Director of Strategic Initiatives, City of Amarillo

Pools and Spas
This session will go over why the International Pool and Spa Code needs to be adopted and review the pros and cons of adopting the code.
Speaker: **Jana Auringer**, Pebble Technology International

Noon–1:00 p.m.
Networking Lunch
Marwin Company, Lunch Sponsor

1:15–2:30 p.m. | CONCURRENT SESSIONS

Track 1
Track 1
Management & Legal
Continued – Part 7 of 8
Speaker: **Tim Ryan**, ICC Instructor

Track 2
Round Tables
Get and share information. Each round table discussion will last fifteen minutes. When the bell rings, move to a new table or stay for more. Topics will include:

- **FLASH** – This table explores residential building codes in Texas, incorporating input and survey responses from building officials, leaders, and industry experts. We'll review the residential code system, with a background of the removal of the Texas Residential Construction Commission, and the impact of natural disasters within the state. Survey responses regarding the feasibility of residential building code improvements and additional considerations for the Texas system will also be discussed. Discussion led by: **Mike Rimoldi**
- **High Wind Construction Provisions** – This presentation covers damage assessments from the December 26, 2015, tornado near Dallas, Texas, and how tornadoes are assessed and American Planning Association's (APA) recommendations for High Wind Design. The recommendations contribute to improved overall performance of the structure and focus on the structural shell as well as good connection details to tie together exterior walls, roofs and floors. Discussion led by: **Asma Momin**, American Planning Association
- **Storm Shelters – ICC 500 Impact on Schools** – The presentation covers the 2015 International Building Code storm shelters requirements for E ccupancies and a brief overview of the applicable sections of the ICC 500 Standard for the Design and Construction of Storm Shelters. Discussion led by: **Ben Harris, PE,** Huckabee
- **IAS Accreditation (AC251)** – Where do we start and how do we get to the finish line? Using Best Practices and the benefits of accreditation for all size jurisdictions and how IAS accreditation and ISO BCEGS work together.

Discussion led by: **Rick Herzberger, CBO,** Chief Building Official, City of McKinney

2:30–3:00 p.m.
Refreshment Break with Exhibitors
e-PlanSoft, Break Sponsor

3:00–4:00 p.m. | CONCURRENT SESSIONS

Track 1
Management & Legal
Continued – Part 8 of 8
Speaker: Tim Ryan, ICC Instructor

Track 2

Round Table/Open Forum
Get and share information. Each round table discussion will last fifteen minutes. When the bell rings, move to a new table or stay for more. Topics will include:

- **Update on Code Enforcement Transition to Texas Department of Licensing and Regulation** – This table will discuss TDLR's plans for implementation on their code enforcement program as it becomes their authority on September 2017. Discussion led by: **David Gonzales,** Program Director, Texas Department of Licensing and Regulation
- **ISO BCEGS – Do's and Don'ts of ISO** – How building departments can obtain "good" grades from ISO's Building Code Effectiveness Grading Schedule (BCEGS) program, with an "overview" of the questionnaire and what areas carry the most weight with regard to points. Discussion led by: **Dean Shattuck, CFPS, CHCM,** Sr. Field Representative (BCEGS)
- **Permit Techs** – Permit techs and their importance within a building department. Discussion led by: **Samantha Morrow,** North Texas Chapter of Permit Techs and City of Garland
- **Legislative Updates** – A brief discussion on 2017 legislative bills affecting cities and building departments. Discussion led by: **Randall Childers,** Building Official, City of Waco; **Jim Olk,** Building Official, City or Garland

4:15–5:15 p.m.
BOAT Business Meeting

6:00–9:00 p.m.
BOAT Awards Dinner and Cruise
Civil Systems, Award Dinner Sponsor
Huber Engineered Woods, Cruise Sponsor

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Friday, August 11, 2017

8:00–9:30 a.m.
BOAT Presidential Address, Cracker Barrel, and Continental Breakfast

10:00 a.m.
Jackson Plumlee Annual Golf Outing
Buffalo Creek Golf Club
624 Country Club Dr.
Rockwall TX 75032
972-771-4003
Simpson Strong-Tie, Title Sponsor | **CSA Group**, Lunch Sponsor

Search

6.4.4.5 Clean Air Through Energy Efficiency (CATEE 2017)

The Clean Air Through Energy Efficiency (CATEE) Conference is a premiere educational conference and business exhibition connecting public and private decision makers and thought leaders. Its purpose is to help communities improve decisions that determine the energy and water intensity of the built environment, learn from examples and seek alternative renewable energy sources – and reduce related emissions. CATEE is hosted by the Energy Systems Laboratory (ESL) of the Texas A&M Engineering Experiment Station (TEES).
The following pages are conference program and list of sponsors from the CATEE 2017.

CATEE 2017 Program

Monday, Nov. 13		
Registration & Information Desk Open	8:00 a.m. –	5:00 p.m.
Workshop: **Continuous Commissioning® Workshop**	8:00 a.m. –	12:00 p.m.
Workshop: **Communicating Energy Efficiency: The Role of Communication in a Successful Energy Management Program**	8:00 a.m. –	12:00 p.m.
Workshop: **TX-PACE Service Provider Training**	1:00 p.m. –	5:00 p.m.
Workshop: **Technology Driving Energy Efficiency in the Built Environment**	1:00 p.m. –	5:00 p.m.
Tour: **UT Dallas – Campus Transformations in Sustainability**	1:00 p.m. –	5:00 p.m.
New Professionals Meet & Greet	5:30 p.m. –	7:00 p.m.
CATEE Steering Committee Dinner	7:00 p.m. –	9:00 p.m.

Tuesday, Nov. 14		
Registration & Information Desk Open	7:30 a.m. –	5:00 p.m.
Business Expo Open	7:30 a.m. –	7:30 p.m.
Continental Breakfast & Flash Sales/Technology Presentations	7:30 a.m. –	8:30 a.m.
Opening General Session • **Welcome** – Betin Santos, *CATEE Executive Director* • **Welcome** – Kayci Prince, *Council Member Place 4, City of Plano* • **Texas – A Reservoir of Energy Efficiency** – Dub Taylor, *Director, State Energy Conservation Office* • **Keynote: "Texas Leads the Nation in Economic Electric Savings Potential"** – Danielle Sass Byrnett, *Senior Policy Advisor, DOE*	8:30 a.m. –	10:00 a.m.
Expo Networking Break & Flash Sales/Technology Presentations	10:00 a.m. –	10:30 a.m.

Concurrent Sessions 10:30 a.m. – 11:45 a.m.

- **Texas Bets Big with Alternative Fuels**
  - Panel Chair – Heather Ball, *Executive Director, Texas Natural Gas Foundation*
  - Speaker – Representative Jason Isaac, *Texas House of Representatives*
  - **Are We There Yet? The Current State and Impact of Alternative Fuels**– Lori Pampell Clark, *Program Manager, North Central Texas Council of Governments*
  - **Advances in Alternative Fuel Vehicle Technology** – Michael Ross, *Sr. Program Manager, Southwest Research Institute*

- **Overview of Renewable Energy in Texas**
  - Moderator – Ross Pumfrey, *Consultant, Texas Solar Energy Society*
  - **The Future of Utility-Scale Renewable Energy in Texas: Cheaper, Cleaner Energy** – Scott D. Deatherage, *Managing Member, S Deatherage Law, PLLC*
  - **Roadmap to Developing Geothermal Energy in Texas** – Joseph Batir, *Research Geologist, SMU Geothermal Laboratory*
  - **100% Renewable Cities in Texas** – Neil McAndrews, *Senior Principal, Enterprise Risk Consulting LLC*

- **Commercial Property Assessed Clean Energy: TX-PACE 101**
  - **Commercial Property Assessed Clean Energy (TX-PACE) Financing: 101** – Bridget Branch, *Regional Program Manager, Texas PACE Authority*
  - Speaker: Marina Badoian-Kriticos, *Program Advisor, Texas PACE Authority*

State of the State – Lunch Presentation – Dr. Jeff Haberl, *Energy Systems Laboratory* 11:45 a.m. – 1:00 p.m.

Concurrent Sessions 1:00 p.m. – 2:15 p.m.

- **Overview of Texas Utilities' Energy Efficiency Programs**
  - Moderator – Jeff Reed, *Senior Program Manager, Oncor*
  - Speaker – Scot Arey, *Owner, Solar CenTex*
  - Speaker – Chris Gage, *Mascot Mechanical*
  - **Bearwall Energy Efficient Solutions – Manuel Sovero, *Operations Manager, Bearwall Energy Solutions***

- **A Deeper Understanding of High Performance Buildings in Texas: 2030 Districts in Texas**
  - **Groundbreaking High-Performance Building Districts** – Salima Moolji, *Executive Director, Dallas 2030 District*
  - **High Performance Buildings** – Dan McLaughlin, *Director of Sales, Facility Solutions Group*
  - Speaker – Jacob Steiner, *Regional Manager, Healthy Buildings*
  - Speaker – Anthony Martin, *Business Solutions Account Manager, Trane*
  - Speaker – Mary Hart, *Principal, Corgan*

- **Energy Codes Texas Style**
  - **Energy Codes Texas Style** – Fred Yebra, *Energy Codes Engineer, State Energy Conservation Office*
  - **Third Party Energy Inspections & Overview of a Third Party Inspection Program** – Jason Vandever, *Energy Code Program Manager, SPEER*
  - **Energy Code Software – Details That Matter** – Shirley Ellis, *Energy Codes Specialist, Energy Systems Laboratory*

Expo Networking Break & Flash Sales/Technology Presentations	2:15 p.m. – 2:45 p.m.

Concurrent Sessions	2:45 p.m. – 3:45 p.m.

- **Engaging the Community with Successful Air Quality Outreach Strategies**
  - Panel Chair – Betin Santos, *CATEE Executive Director*
  - **City of Plano Air Quality Initiatives** – Alex Pharmakis, *Sustainability Coordinator, City of Plano*
  - **Air North Texas: A Clean Air Campaign for North Central Texas** – Whitney Vandiver, *Communications Coordinator, North Central Texas Council of Governments*

- **Distributed Generation – Solar Energy for Communities, Homes, and Businesses**
  - Moderator – Lissa Magel, *Chair, North Texas Renewable Energy Group*
  - **Status and Trends in Distributed Renewables** – Larry Howe, *Board Member, Texas Solar Energy Society*
  - **How Local Governments Can Optimize Rooftop Solar** – Derica Peters, *Senior Environment & Development Planner, North Central Texas Council of Governments*
  - **Talking to a Prospective Solar Installer** – Mohammed Abdalla, *Founder, Good Faith Energy*
  - **Community Solar in the Lone Star State** – Katherine Searcy, P.E., *Principal, Cation Consultants PLLC*

- **Educational Facilities – The Life Cycle of an Energy Management Program**
  - Panel Chair – Jennifer DuPlessis, *Executive Director Of Operations, Wylie ISD*
  - **The Beginning** – Marcia Coker, *Facilities Manager, Wylie ISD*
  - **Growing the Program** – Danny Helm, *Energy Manager, Arlington ISD*
  - **Continued Evolution** – Joshua Minor, *Director of Maintenance & Operations, Hurst-Euless-Bedford ISD*

Expo Networking Break & Flash Sales/Technology Presentations	3:45 p.m. –	4:15 p.m.

- **Texas Legislative Roundtable – Clean Energy and Air Quality Policy**
  - Moderator: Elizabeth Pearsall Lippincott, *Executive Director, Texas Clean Energy Coalition*
  - Speaker: Representative Jason Isaac, *Texas House of Representatives*
  - Speaker: Diane Rath, *Executive Director, Alamo Area Council of Governments (AACOG)*
  - Speaker: Commissioner Theresa Daniel, *Dallas County Commissioner District 1*
  - Adrian Shelley, *Director, Texas Office, Public Citizen*

4:15 p.m. – 5:30 p.m.

Evening Reception	5:30 p.m. –	7:30 p.m.

Wednesday, Nov. 15		
Registration & Information Desk Open	7:30 a.m. –	3:45 p.m.
Business Expo Open	7:30 a.m. –	3:45 p.m.
Continental Breakfast & Flash Sales/Technology Presentations	7:30 a.m. –	8:30 a.m.

• **Hurricane Response Roundtable – Resiliency and Future Systems Planning**
  • Moderator: Kate Zerrenner, *Senior Manager – Energy-Water Initiatives, Environmental Defense Fund (EDF)*
  • Speaker: Gavin Dillingham, Ph.D., *Program Director, Clean Energy Policy, HARC*
  • Speaker: Charlene Heydinger, *President, Texas PACE Authority*
  • Speaker: Lynn Crawford, *Market Leader Energy and Utilities, Affiliated Engineers, Inc. (AEI)*
  • Speaker: Shirley Ellis, *Energy Codes Specialist, TAMU Energy Systems Laboratory*
	8:30 a.m. –	9:45 a.m.

Expo Networking Break & Flash Sales/Technology Presentations	9:45 a.m. –	10:15 a.m.

Concurrent Sessions 10:15 a.m. – 11:30 a.m.

- **Local Governments Take the Lead on Carbon and GHGs**
  - Panel Chair: Jesse Dillard, *Senior Engineer, City of Dallas – Dept. of Transportation*
  - **Dallas/Fort Worth International Airport – 1st Carbon Neutral Airport in North America**– Jerry Dennis, *Energy Manager, DFW International Airport*
  - **Municipal Tracking and Reporting of GHGs** – Jonathan Gregory, *Conservation Program Coordinator, City of Denton*
  - Speaker: Kevin Overton, *Senior Environmental Coordinator, City of Dallas (Office of Environmental Quality)*
  - **Citizen Driven Policy Efforts: The Lewisville 2025 Plan** – Mendie White, *Sustainability Manager, City of Lewisville*

- **Malcolm Verdict Memorial Student Poster Competition**

- **TX-PACE in Practice: Texas Case Studies**
  - Moderator: Jonathon Blackburn, *Managing Director, Texas PACE Authority*
  - Speaker: Jennifer Smith, *Executive Director, Congregation Beth Israel*
  - Speaker: Joshua Kagan, *Vice President – Business Development, Clean Fund*
  - Speaker: Tommy Deavenport, *Chief Operating Officer, Petros PACE Finance*
  - Speaker: Kevin Spath, *Manager (Business Development), City of Dallas, Office of Economic Development*

CATEE 2017 Awards Luncheon 11:30 a.m. – 1:00 p.m.
Betin Santos, CATEE Exec. Director

Concurrent Sessions 1:15 p.m. – 2:30 p.m.

- **Energy Water Nexus Roundtable for Local Governments**
  - Moderator: Kate Zerrenner, *Senior Manager – Energy-Water Initiatives, Environmental Defense Fund (EDF)*
  - **Technical and Economic Potential of Purifying Brackish Groundwater on Texas State Lands Using Integrated Renewables and Desalination Facilities** – Sam Aminfard, *Graduate Research Assistant, The University of Texas at Austin*
  - Tamara Cook, *Senior Program Manager, North Central Texas Council of Governments (NCTCOG)*
  - Saleem Khan, PE, CEO, *Texas Energy Engineering Services, Inc.(TEESI)*

- **Microgrids: Pathways to Sustainability and Resiliency**
  - Panel Chair: Gavin Dillingham, Ph.D., *Program Director, Clean Energy Policy, HARC*
  - **Micro-Grids Introduction** – Cliff Braddock, *METCO Engineering*
  - **Hurricane Harvey vs. UTMB Galveston – Lynn Crawford, *Market Leader Energy and Utilities, Affiliated Engineers, Inc. (AEI)***
  - **Optimizing Microgrids for Resilience – Carlos Gamarra, PE, *HARC***

- **Educational Facilities – Keeping Energy Top of Mind When Construction is King**
  - Panel Chair: Jennifer DuPlessis, *Executive Director Of Operations, Wylie ISD*
  - **Energy Modeling** – Mike Brown, *Sustainability Manager/Energy Modeler, The Beck Group*
  - **Incorporating Sustainability** – Jim Scrivner, *Division Director, Irving ISD*
  - **Ensuring Efficiency is Present Through Construction** – Brandon Boyter, *Executive Director of Facilities, Allen ISD*

Expo Networking Break & Flash Sales/Technology Presentations	2:30 p.m.	–	2:45 p.m.
Concurrent Sessions	2:45 p.m.	–	3:45 p.m.

- **Educational Facilities: The Bleeding Edge – Dilemmas in Implementing Energy Projects in School Systems**
  - Panel Chair: Jennifer DuPlessis, *Executive Director Of Operations, Wylie ISD*
  - **Challenges Implementing an Exterior LED Lighting Program** – Jennifer Malaniuk, *Energy Manager/Analyst, Richardson ISD*
  - **Demand Response and Response to Energy Savings Initiatives** – Victor Melton, *Carrollton-Farmers Branch ISD*
  - **Building a Case for Owning the Utility Budget** – Charles Ashby, *Energy Manager, Northwest ISD*

- **Everything You Wanted To Know About Financing Energy Efficiency Projects**
  - Panel Chair: Stephen Ross, *Program Specialist, State Energy Conservation Office (SECO)*
  - **Texas Emission Reduction Plan (TERP)** – Jessica Fleming, *Program Coordinator, Texas Commission on Environmental Quality*
  - **LoanSTAR Revolving Loan Fund** – Eddy Trevino, *Manager, State Energy Conservation Office (SECO)*
  - **Using Dollars to Make Sense: How to Finance An Energy Project** – Quinn Tolbert, *Sales Director, McKinstry*

- **How TX-PACE Will Transform Your Community**
  - Panel Chair: Charlene Heydinger, *President, Texas PACE Authority*
  - Speaker: Kevin Spath, *Manager (Business Development), Office of Economic Development, City of Dallas*
  - Speaker: Gavin Dillingham, *Program Director, Clean Energy Policy, HARC*
  - The Benefits of PACE in Plano – Yarcus Lewis, *LEED AP Sustainability Projects Manager, City of Plano*
  - Speaker: David Gabrielson, *Executive Director, PACENation*
  - Andrew Freeman, *Economic Development Manager, City of Amarillo*

CATEE 2017 – Texas Energy Summit Closing Remarks 3:45 p.m. – 4:15 p.m.

6.4.4.6 Other

The following pages are meeting notes, agendas, and summaries from the multiple meetings from 2017.

Texas Clean Air Working Group and TERP stakeholders meeting
(followed by a VW Settlement subcommittee meeting)

Time: **10:00 am-11:45, Thursday, January 19, 2017**
Location: **Texas Conference of Urban Counties Building**, 2st floor conference room.
500 West 13th Street, Austin, TX 78701

If unable to attend in person, please call in to the following conference call number; room number (pin), **1-800-510-5860; 085482** and state your name.

If you need to mute your line (due to static or other background noise), you may push the # (Pound) symbol at any time. This will turn the mute feature on and off.

Draft Agenda for meeting:

- Introductions
- Moment of silence in honor of Michael Vasquez
- Welcome Co-chair Commissioner Daniel
- Brief updates from EPA, TCEQ and Regions
  - Comment period for proposal for nonattainment area classifications and SIP requirements for the 2015 ozone standard has been extended to 2/13/17. www.epa.gov/ozone-pollution/implementation-2015-national-ambient-air-quality-standards-naaqs-ozone-state
- TERP Educational Briefings for Legislators (see below)
  - Members Lounge, Jan 26 at 12noon-1pm and Feb 2 at 8:30am-9:30am
    - Limited Seating so please don't attend unless you are speaking or are technical expert/resource....
  - Please invite members and staff
  - Who will help with handouts
- Updates and resolutions from subcommittees:
  - LIRAP – vote of approval
  - Transport – vote of approval
  - TERP tune-up – update
- Letter to Lt Gov., Gov. and Speaker
- Draft TERP talking points/handouts. Please take from these, edit them, and add to them to educate legislators about TERP.
- Legislative update:
  - Bills you are tracking?
    - TERP/alt fuels for gov. fleets Senate bill similar to last session's
  - Committee info?
- Next meetings?
- Adjourn (VW Settlement subcommittee to follow. No TERP tuneup meeting.)

Updated notes from the last meeting can be found at https://www.dropbox.com/s/snoxvr32csjs2ln/TCAWG-TERP%20stk%20meeting%20notes%20from%202016Dec15.docx?dl=0
Past notes and handouts are at
https://www.dropbox.com/sh/z89himi7dubeyc5/AAC5TSAsPc7sWGUnM0kEewuka?dl=0

State Agency Energy Advisory Group

LBJ Office Building- 111 E. 17th Street, Austin
April 19, 2017

Agenda

9:30am	Introductions
9:40am	OAG Rate Case Update (not open to the public)
10:00am	SECO Update
10:15am	Open Forum for Discussion of Current Projects, Concerns or Issues
10:30am	Austin Green Business Leader Program, Andee Chamberlain (TPWD) and Marc Coudert (City of Austin- Office of Sustainability)

Texas Energy Code Compliance Collaborative
June 15, 2017

1:30 PM – 3:30 PM
Hyatt Place North-central
7522 N. IH 35
Austin, TX

Agenda

1.	Introductions	All
2.	State Update	SECO
3.	Regional News	All
4.	Adoption Status	SPEER
5.	Legislation Affecting Buildings	SPEER
6.	2018 IECC Development	SPEER
7.	NCTCOG Amendments	ESL
8.	Field Study Update	SPEER
9.	New Business	
10.	Adjourn	

NOTICE OF MEETING

North Texas Chapter
International Code Council

Will Hold a Regular Meeting on:

Friday September 22, 2017
11:30 a.m.

Construction Education Foundation
1401 W Royal Lane (Use E 14th St w/GPS)
Irving/DFW Airport, Texas 75063

Catered Lunch - $15.00 per person (Meal is optional)

PROGRAM

1. Welcome – Call to Order – IR
   Recognition of honorary members, introductions and welcome all members present
2. Approval of July 21, 2017 Chapter Meeting Minutes – SA
3. Speaker – Asma Momin, APA – IR
   Topic: Advanced Framing for Wood Construction
4. ICC Representative Updates/Announcements – IR/KS
5. Chapter's Upcoming Events & Updates – EW/JO
   Topic: ICC 2017 ABM & Hurricane Harvey Affected Areas Update.
6. Professional Member's Update/Announcements – PJ
7. Employee of the Month – EW
8. Door Prizes – IR/EW
9. Adjournment

RCMA 2017 Fall Meeting

Schedule of Events*

Time	Monday, October 16
12:00pm – 1:00pm	**RCMA Lunch** -Welcome and Introductions -Working Sessions Overview
1:00pm – 3:00pm	**RCMA Committee Working Sessions:** -Technical Affairs Committee -Government Affairs Committee -Reflective Roof Coatings Institute -Communications, Education, & Membership Committee
3:00pm – 3:30pm	**Break**
3:30pm – 5:00pm	**RCMA Committee Working Sessions (Continued):** -Technical Affairs Committee -Government Affairs Committee -Reflective Roof Coatings Institute -Communications, Education, & Membership Committee
5:30pm – 7:00pm	**RCMA Welcome Reception**

Time	Tuesday, October 17
7:30am – 8:30am	**RCMA Breakfast**
8:30am – 8:45am	**RCMA President's Update** -John Stubblefield, Polyglass, USA, Inc.
8:45am – 9:30am	**RCMA Government Affairs Committee Report-Out** -Greg Johnson, Sherwin-Williams & Will Lorenz, General Coatings
9:30am – 10:15am	**RCMA Technical Affairs Committee Report-Out** -Ryan Blad, 838 Coatings & Jason Smith, Garland Company
10:15am – 10:45am	**Break**
10:45am – 11:30am	**RCMA Communications, Education & Membership Committee Report-Out** -Matt Lendzinski, Dow Chemical Company & Scott Gayle, American WeatherStar

11:30am – 12:00pm	**RCMA Reflective Roof Coatings Institute Report-Out** -Tim Leonard, 838 Coatings, Josh Poole, Tremco Inc.
12:00pm – 1:30pm	**RCMA Lunch**
1:30pm – 2:30pm	**RCMA Codes and Standards Outlook** -Mike Fischer, Vice President of Codes and Regulatory Compliance, Kellen
2:30pm – 3:15pm	**ASTM Processes and Participation on Committee D08** -Joe Hugo, Manager, ASTM International
3:15 – 3:30pm	**Break**
3:30 – 4:15pm	**Texas Energy Code and Cool Roofing Issues** -Shirley Ellis, Energy Codes Specialist, Texas A&M Engineering Experiment Station
4:15pm – 5:00pm	**Green Construction and Roofing Outlook in Texas** -Jonathan Kraatz, Executive Director, USGBC Texas Chapter *(Invited)*

	[illegible]
7:30am – 8:30am	RCMA Breakfast
8:30am – 11:00am	RCMA Board of Directors Meeting

*The RCMA 2017 Fall Meeting schedule of events will include working group-style sessions, which will provide an open forum for dialogues about current and future RCMA committee projects. The sessions will provide valuable time for RCMA members and staff to work together to shape the association's programs and initiatives going into 2018.

Texas Energy Code Compliance Collaborative
Wednesday October 25, 2017

1:30-3:30 PM
Hyatt Place Austin-North Central
7522 N. Interstate Hwy 35
Austin, TX 78752

Agenda:

1.	Welcome and Introductions	All
2.	State Update	SECO
3.	Regional Updates	All
4.	Legislative Update	SPEER
5.	Field Study Update	SPEER
6.	2018 IECC Development	SPEER
7.	CATEE and other Ed Opps	ESL
8.	New Business	
9.	Adjourn	

6.4.5 Papers, Theses, etc.

6.4.5.1 Theses and Dissertations.

The following theses and dissertations were published in 2017 incorporating work related to the Texas Emissions Reduction Plan (TERP).

- Sukjoon Oh, "Quantifying the Electricity Savings from the Use of Home Automation Devices in A Residence,"PhD., Department of Architecture, December 2017.

  This study quantifies the electricity savings to homeowners when they install and use Home Automation Devices (HADs), which are also called Internet of Things (IoT), in a residence. To accomplish this study, new analysis methods were developed that have built on and enhanced the features of existing energy analysis methods. Several existing methods, including forward, inverse, and calibrated simulation approaches, were combined to analyze the electricity savings from the installation and use of HADs. This study found that few of the previous studies about HADs that were reviewed developed methods for specifically quantifying the weather-normalized, hourly electricity savings from the use of HADs. The review of the literature did find that homeowners using HADs wanted to use them automatically, without changing their lifestyle or experiencing discomfort, when turning-on or turning-off devices. Therefore, this study developed new, non-intrusive methods to help quantify the electricity savings to homeowners from the use of HADs using a combination of Smart Meter (SM) data and the corresponding weather data to analyze the weather-normalized savings from residences equipped with HADs.

  First, a non-intrusive method was developed to automatically detect and quantify potential electricity savings of HADs using hourly electricity use data recorded by a SM (i.e., Level 0 Analysis) before the retrofit. To accomplish this, both an event detection process and an energy quantification process were developed. Second, a calibrated building energy simulation model (i.e., Level I Analysis) was developed for the case- study residence to analyze selected HAD usage scenarios to better quantify the potential electricity savings to the homeowner from the use of the HADs. The calibrated simulation model was used to simulate different scenarios of thermostatically-controlled and non-thermostatically-controlled HADs. Third, a HAD was installed in the case-study house to quantify the before/after actual electricity savings from the use of the HADs (i.e., Level II Analysis). Specifically, in the case-study house, a wireless HAD thermostat with occupancy sensors was installed.

  The results showed that the annual electricity savings resulted from Level 0 Analysis, Level I Analysis, and Level II Analysis were 987.8 kWh (8.3 %), 2,961.7 kWh (25.2 %), and 5,208.4 kWh (43.6 %), respectively. Differences in the savings between the three methods can be attributed to the assumptions made for each analysis as well as the limitations in the three methods. Using the Level II Analysis savings, when the costs of the new thermostat ($249) with the seven motion sensors ($237), including the installation fee ($100), were considered, the simple payback period was 1.0 year. Thermal comfort was also analyzed. The analysis showed no significant degradation of thermal comfort from the electricity savings during occupied hours. Finally, this study provides recommendations to help improve future quantification methods and reduce the uncertainty in predicting the electricity savings for residences equipped with HADs using hourly or sub-hourly electricity use data recorded by a SM.

6.4.5.2 Papers

6.4.5.2.1 Published Papers in 2017

The following papers were published in 2017 incorporating work related to the Texas Emissions Reduction Plan (TERP).

- Do, S.; Haberl, J.S., 2017. "Development of a Ground-coupled Heat Pump System Simulation Model Using G-function Approximation for a Residential Code-compliant Tool." Building Simulation.

  This study develops a ground-coupled heat pump (GCHP) simulation model for a residential code-compliant simulation tool. To achieve this, this study proposed the g-function approximation method using polynomial curve-fitting equations. In addition, the residential air-source heat pump (ASHP) simulation model (i.e., RESYS in DOE-2.1e) was modified to include a vertical ground heat exchanger module. To check validity of the new GCHP system model, this study compared the simulation results against the results from the other simulation tools. The results between the programs showed good agreement within 5.3% differences for the annual total site energy use. Using the developed GCHP simulation model, the energy savings for a code-compliant residential building in Houston and Dallas were evaluated in comparison with the ASHP system, and the resultant annual energy savings were about 10% to 15% in the total site energy use and 30% to 40% in the heating plus cooling energy use.

  Link: https://link.springer.com/article/10.1007/s12273-017-0368-x

- Do, S.; Shin, M.; Baltazar, J.; Kim, J. 2017. "Energy Benefits from Semi-transparent BIPV Window and Daylight-dimming Systems for IECC Code-Compliance Residential Buildings in Hot and Humid Climates", Solar Energy..

  Interest in semi-transparent solar cell window systems, also called building integrated photovoltaic (BIPV) windows, has increased worldwide because the windows generate electricity and also provide natural light transmission. This study evaluates the potential energy benefits of integrating semi-transparent solar cell windows and daylight-dimming systems for a 2009 International Energy Conservation Code (IECC) code-compliant residential building in a hot and humid climate. This study used whole-building energy simulation models, a DOE-2.1e BIPV window module created for this study, and an existing daylight-dimming system module. Based on the simulation results, peak demand, energy use, and electricity production from each orientation (east-, west-, south-, and north-facing) were all analyzed. The south-facing window showed the greatest potential to generate electric power and reduce cooling loads/use, whereas the east-facing window resulted in the largest annual lighting energy savings. As compared to the code-compliant base-case model, the BIPV windows showed great potential for energy savings: about 12–21% in annual energy use, and 14–26% in peak cooling demand. In addition, the parametric study varying the window-to-wall ratio (WWR) with the BIPV window resulted that the larger BIPV window provided more savings in annual total energy use.

  Link: https://www.sciencedirect.com/science/article/pii/S0038092X17305364

- Kim, H.; Haberl, J. 2017. "Field Test of the ASHRAE/CIBSE/USGBC Performance Measurement Protocols: Part I - Intermediate Level Protocols", Science and Technology for the Built Environment.

  The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)/Chartered Institution of Building Services Engineers (CIBSE)/U.S. Green Building Council (USGBC) performance measurement protocols provide a standardized set of protocols for measuring and comparing the operational performance of occupied commercial buildings. The

ASHRAE performance measurement protocols has been developed at three levels of cost/accuracy, Basic (Indicative), Intermediate (Diagnostic), and Advanced (Investigative), for the following six performance categories: energy use, water use, thermal comfort, indoor air quality, lighting, and acoustics. This article presents the results of an effort to develop and apply a field test to evaluate the Intermediate level of the performance measurement protocols energy protocols in a case-study office building in Central Texas. The data collected include multi-year monthly whole-building electricity use, electric demand, and natural gas data for the total and major end uses of the case-study building, as well as coincident on-site weather data. The data collected were then analyzed to calculate the corresponding performance metrics based on the Intermediate level of the performance measurement protocols energy protocols and compared with the appropriate benchmarks. The problems and issues with implementing the performance measurement protocols Intermediate level energy protocols in a case-study building were noted throughout the entire research process. The evaluation revealed five issues, for each of which recommendations were developed to improve the current version of the performance measurement protocols. The results for the performance measurement protocols Basic level applications, including all six areas, were reported in Kim and Haberl (2012a Kim, H., and J. Haberl. 2012b. Field-test of the new ASHRAE/CIBSE/USGBC performance measurement protocols: Intermediate and Advanced level indoor environmental quality protocols.

Link: https://www.tandfonline.com/doi/abs/10.1080/23744731.2017.1368836

- Kim, H.; Haberl, J. 2017. "Field Test of the ASHRAE/CIBSE/USGBC Performance Measurement Protocols: Part II – Advanced Level Protocols", Science and Technology for the Built Environment.

  The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)/Chartered Institution of Building Services Engineers (CIBSE)/U.S. Green Building Council (USGBC) performance measurement protocols provide a standardized set of protocols for measuring and comparing the operational performance of occupied commercial buildings. The ASHRAE performance measurement protocols have been developed at three levels of cost/accuracy, Basic (Indicative), Intermediate (Diagnostic), and Advanced (Investigative), for the following six performance categories: energy use, water use, thermal comfort, indoor air quality, lighting, and acoustics. This article presents the results of an effort to develop and apply a field test to evaluate the Advanced level of the performance measurement energy protocols in a case-study office building in Central Texas. The data collected include multi-year sub-hourly whole-building electricity data for the total and major end uses, thermal data for chillers and condensers, and coincident on-site weather data, as well as monthly utility bills of the case-study building. The data collected were then analyzed to calculate the corresponding performance metrics based on the Advanced level of the performance measurement protocols energy protocols and compared with the appropriate benchmarks. The problems and issues with implementing the performance measurement protocols Advanced level energy protocols in a case-study building were noted throughout the entire research process. The evaluation revealed four issues, for each of which recommendations were developed to improve the current version of the performance measurement protocols. The results for the performance measurement protocols Basic level applications, including all six areas, were reported in Kim and Haberl (2012a Kim, H., and J. Haberl. 2012 a. Field-test of the new ASHRAE/CIBSE/USGBC performance measurement protocols for commercial buildings: Basic level.

  Link: https://www.tandfonline.com/doi/abs/10.1080/23744731.2017.1368837?needAccess=true

- Shin, M.; Baltazar, J.C.; Haberl, J.; Frazier, E.; Lynn, B. 2017. "Side-by-side Tests of a Net-zero Energy Building", Building Simulation 2017 Conference.

  This paper presents the results of side-by-side tests of a net-zero energy building using various analysis approaches. The analysis includes an unadjusted measured energy use data of the both portions of the

building, a weather-normalized change-point linear regression model to estimate annual energy savings, and calibrated simulation models. The results show savings of 37% to 50% for the renovated portion of the building (i.e., net-zero energy building) compared to the un-renovated portion.

Link: http://www.ibpsa.org/proceedings/BS2017/BS2017_346.pdf

- Song, S.; Haberl, J. 2017. "Simplified Field Measurement and Verification of Global Solar Transmittance for Glazing Samples Under Natural Clear-Sky Conditions", Solar Energy.

  This paper presents the results of an experimental study to measure and verify on-site global solar transmittance as a function of varying angles of incidence for glazing samples under natural clear-sky conditions, including: single-pane clear, double-pane clear, and double-pane low-e glazing. Field measurements were implemented using a silicon photodiode sensor and two thermopile-type pyranometers based on an easily-assembled test box with sample glazing. Measurement results were then compared to the published data (i.e., Tsol values in the WINDOW libraries). The results indicate that silicon photodiode sensors can be used to measure and verify direct solar transmittance within an acceptable range of accuracy. However, the global (i.e., direct and diffuse) solar transmittance measured by the thermopile-type sensors was significantly higher than the Tsol values from the WINDOW program. As a result, it is recommended that such field measurements could be used to verify the on-site direct and global solar transmittance of as-built glazing since the WINDOW program currently only accounts for direct (i.e., beam) solar radiation in the reference solar spectrum (i.e., ASTM E891).

  Link: https://www.sciencedirect.com/science/article/pii/S0038092X17305893

6.5 Solar Test Bench (STB)

This section introduces the activities that were carried out using the Solar Test Bench (STB) during the calendar year of 2017, and the activities summary is listed as follow:

- Regular maintenance
- Weekly report.

6.5.1 Solar Test Bench Setup

Figure 44 shows the exterior view of the STB. In addition, the whole STB setup comprises the sensors indicated in Table 34, which includes the sensor name, make, model and serial number along with the multiplier, offset and unit.

Figure 44. Exterior View of the Solar Test Bench

Table 34. List of the sensors updated to the end of 2017

Index Number	Sensor Name	Make	Model	Serial Number	Multiplier	Offset	Unit
					0.18	-40	° F
1	TOA/RH[1]	Vaisala	HMP45A	D2430006	0.10	NA	%
					0.18	-40	° F
2	TOA/RH[2]	Vaisala	HMP155A	G3220004	0.10	NA	%
					1.79	0.629	MPH
3	WS/WD[1]	Met One	034B	H4735	712	NA	Degree
					1.79	0.629	MPH
4	WS/WD[2]	Met One	034B	M5048	712	NA	Degree
5	LICOR[3]	Licor	Li-cor	PY15L25	75.59	NA	W/m^2
6	LICOR[4]	Licor	Li-cor	PY49745	75.03	NA	W/m^2
7	LICOR[5]	Licor	Li-cor	PY 74409	200	NA	W/m^2
8	LICOR[6]	Licor	Li-cor	PY 74438	200	NA	W/m^2
9	LICOR[7]	Licor	Li-cor	PY 74439	200	NA	W/m^2
10	LICOR[8]	Licor	Li-cor	PY 474450	200	NA	W/m^2
11	PSP[1]	Eppley	PSP	13673F3	125.63	NA	W/m^2
12	PSP[2]	Eppley	PSP	16881F3	103.09	NA	W/m^2
13	PSP[3]	Eppley	PSP	35417F3	112.74	NA	W/m^2
14	NIP[1]	Eppley	NIP	14851E6	118.06	NA	W/m^2
15	NIP[2]	Eppley	NIP	16620E6	117.79	NA	W/m^2
16	BW[1]	Eppley	8-48	20226	96.99	NA	W/m^2
17	BW[2]	Eppley	8-48	33886	98.62	NA	W/m^2

6.5.2 2017 STB Activities

6.5.2.1 Regular Maintenance

The solar test bench regular maintenance is carried out every two weeks, the desiccants for PSPs, B&Ws and the junction boxes are replaced, and the used one are recycled. The alignment for the solar tracker and the covers for the B&Ws are checked, and the occurred problems were fixed by restarting the solar tracker and manually adjusting the devices. The sensor wiring connections are checked and fixed as needed.

6.5.2.2 Weekly Report

The data logger downloaded data have been checked every week, and the STB data was compared with NOAA data in STB weekly report. Figure 45 shows the example plots comparing the STB data with the NOAA data.

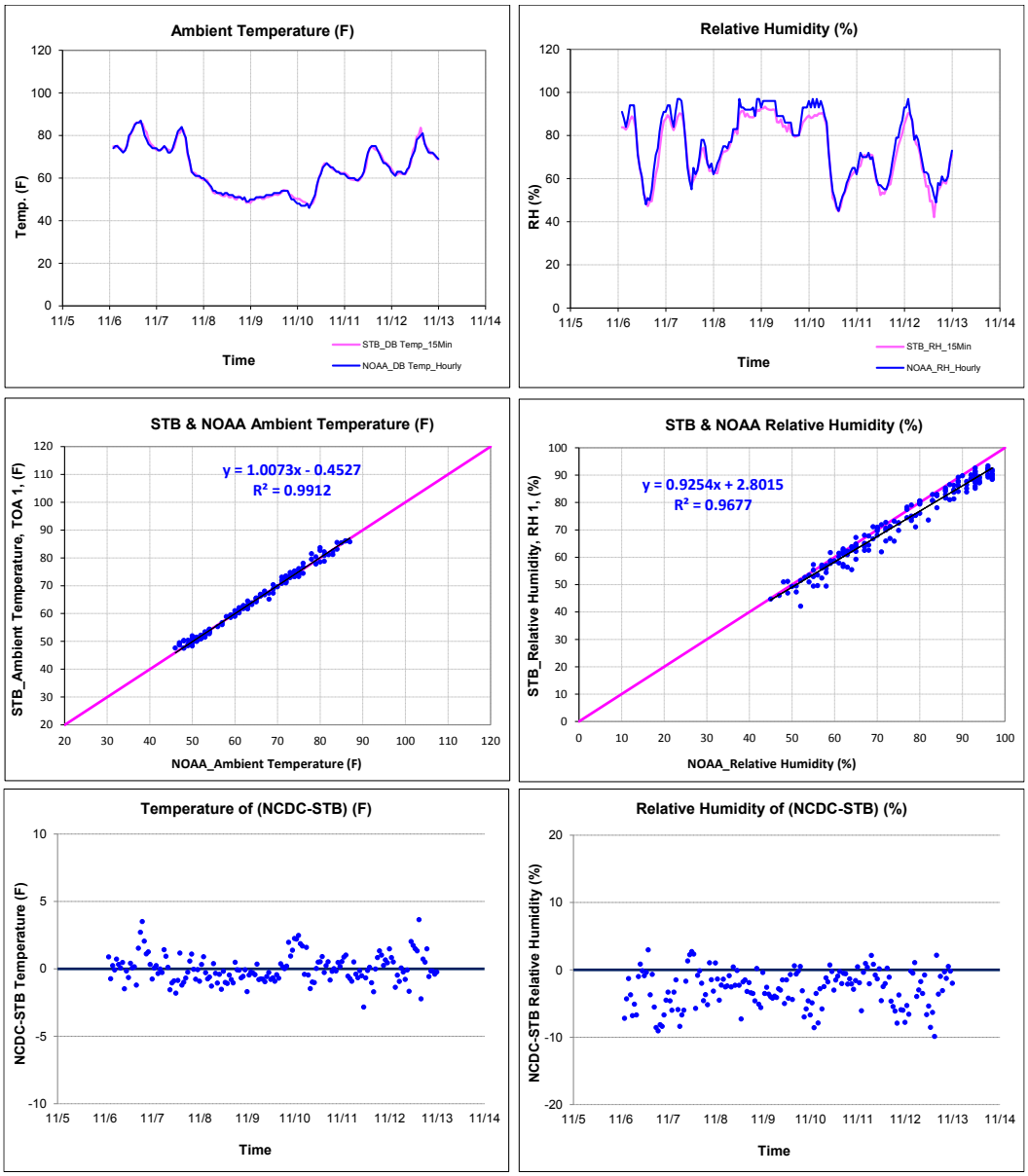

Figure 45: Comparisons of the STB Data with the NOAA Data

6.5.3 Future work Plan

6.5.3.1 Camera Installation

It is required to install a monitoring camera close enough for clear observation of the solar tracker, but avoiding any shading on the bench.

6.5.3.2 Wire Protection in Mechanical Room

In the mechanical room, some wires were outside the junction boxes. It is still necessary to install conduits for wires.

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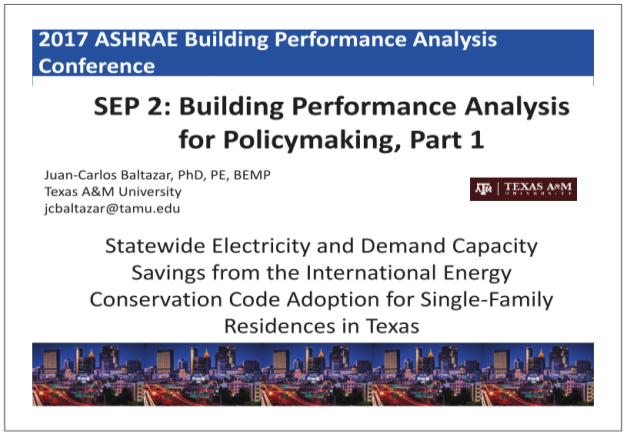
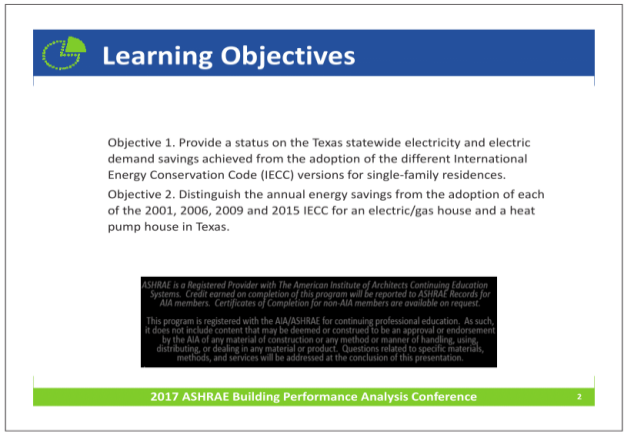
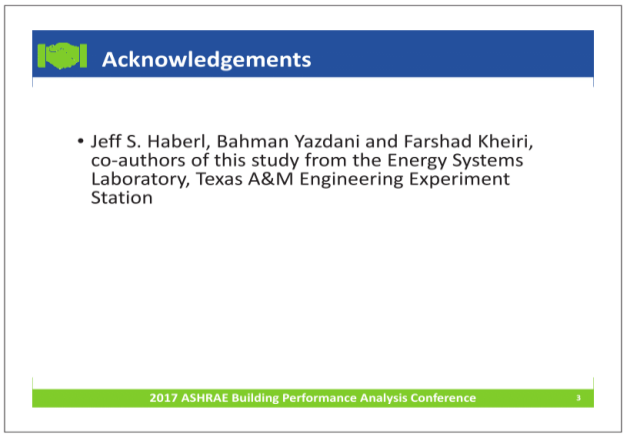
Appendix A: Presentations to Various Entities at Conferences and Workshops in 2017

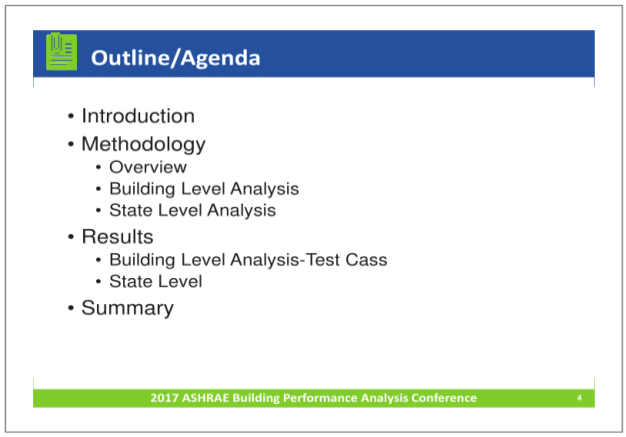
The Energy Systems Laboratory made presentations at several conferences and workshops about ways to save energy, and the appendix shows the presentation slides.

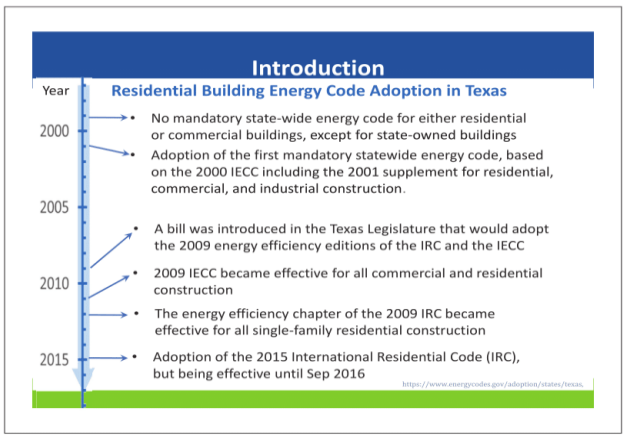
- "Statewide Electricity and Demand Capacity Savings from the International Energy Conservation Code Adoption for Single-Family Residences in Texas" ASHRAE Building Performance Analysis Conference, Atlanta, GA, Sep 2017, presented by Juan-Carlos Baltazar.

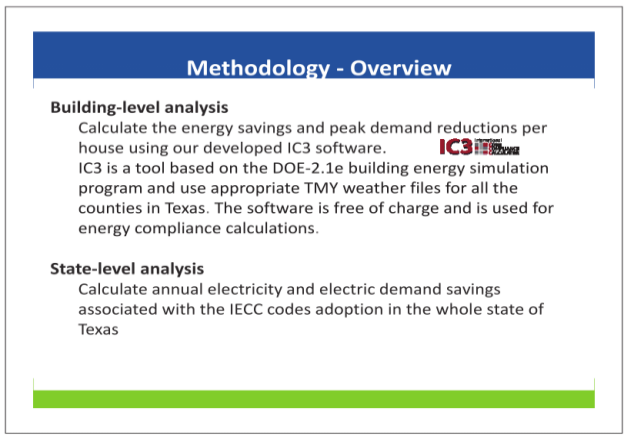






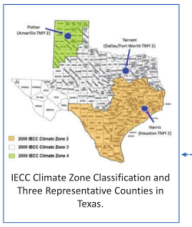






Methodology
Building Level Analysis-Test Cases

Energy savings and peak demand reductions per house compared to the pre-code building for each climate zone



IECC Climate Zone Classification and Three Representative Counties in Texas.

Code

Pre-code 1999	2001 IECC	2006 IECC	2009 IECC	2015 IECC

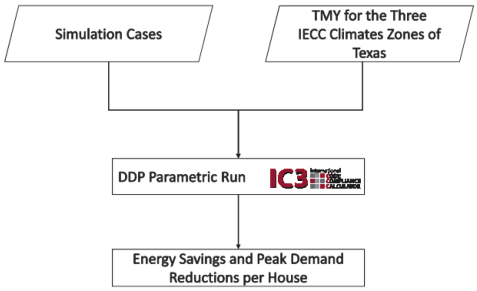
Building Type

Electric/Gas House	All Electric House

County

Harris	Tarrant	Potter

Methodology
Building Level Analysis-Process



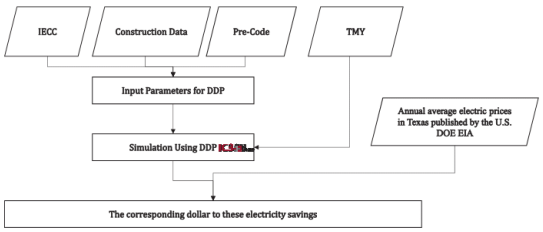
Methodology
Building Level Analysis-Building Description

Building Description	
Building type	Residential
Gross area	2,325 sq-ft
Building dimension	48.2ft x 48.2ft x 8ft (WxLxH)
Number of floors	1
Floor-to-floor height	8ft
Window-to-floor ratio	15% for 2009 and 2015 IECC compliance houses and 18% for pre-code, 2001 and 2006 IECC houses

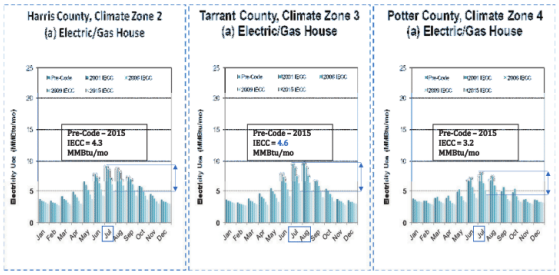
Note: Modifications to the pre-code and the 2001 and 2006 IECC codes for a fair comparison with the 2009 and 2015 IECC code.

- *Thermostat set points: 72°F for heating and 75°F for cooling with no set-back/set-up schedule*
- *Internal heat gains: 0.547 kW for lighting and 0.547 kW for equipment*
- *Interior shading fraction for winter: 0.85*

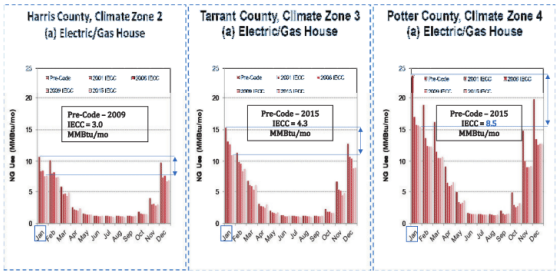
Methodology
State Level Annual Electricity Savings-Process



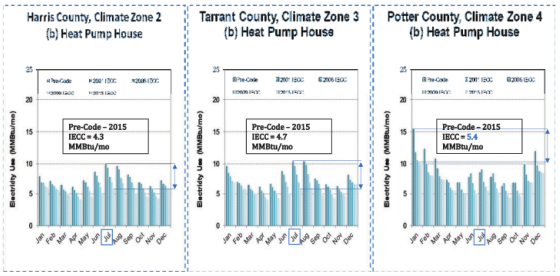
Results
Monthly Electricity Consumption-Summer



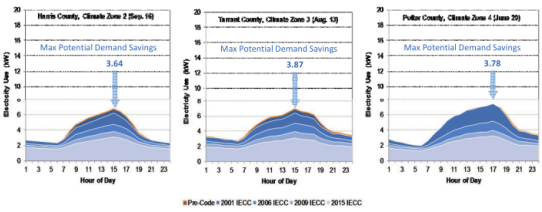
Results
Monthly Electricity Consumption-Winter



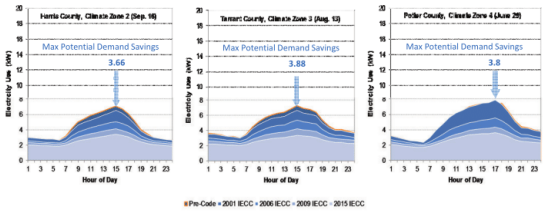
Results
Monthly Electricity Consumption-Summer & Winter



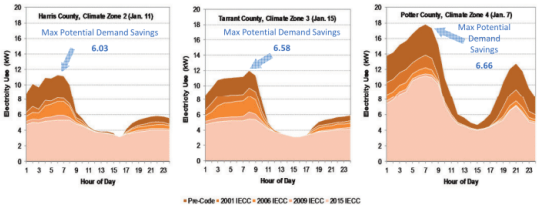
Results
Electric/Gas House Demand-Summer



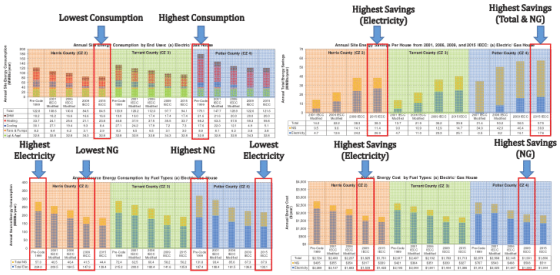
Results
All Electric House Demand-Summer



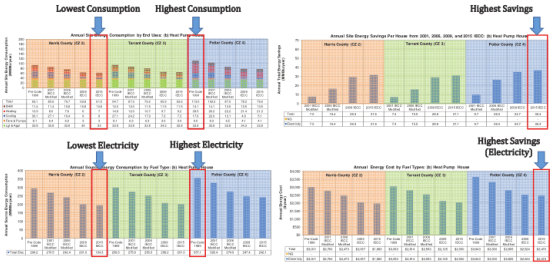
Results
All Electric House Demand-Winter



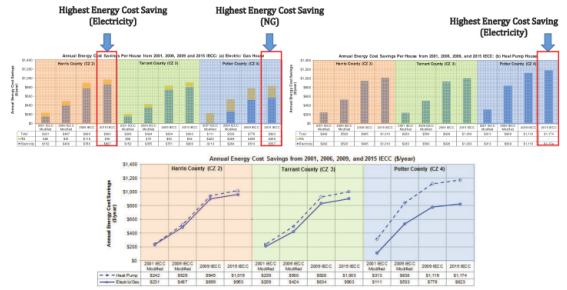
RESULTS
Building Level Analysis-Electric/Gas House



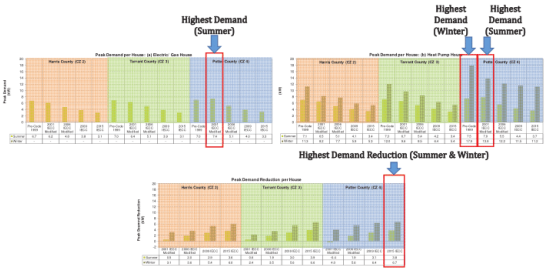
RESULTS
Building Level Analysis-All Electric House



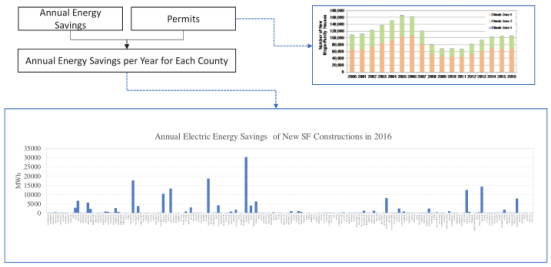
RESULTS
Building Level Analysis-Annual Energy Cost Savings



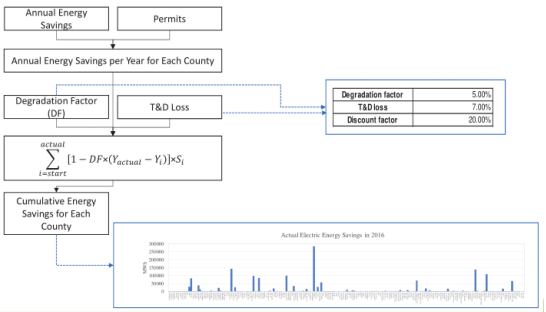
RESULTS
Building Level Analysis-Peak Demand



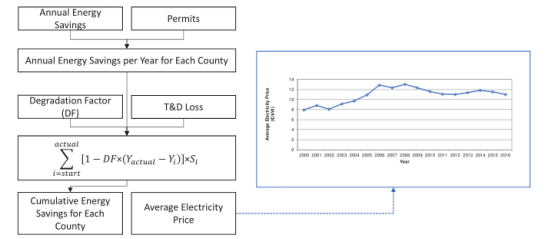
Results
Annual Electricity Savings



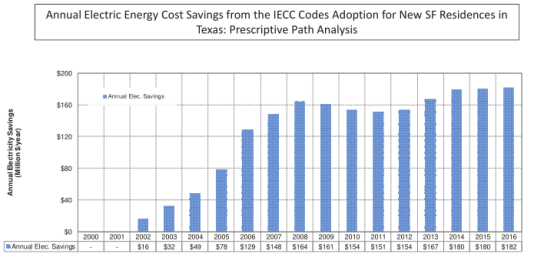
Results
Annual Electricity Savings



Results
Annual Electricity Savings



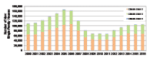
Results
Annual Electricity Savings

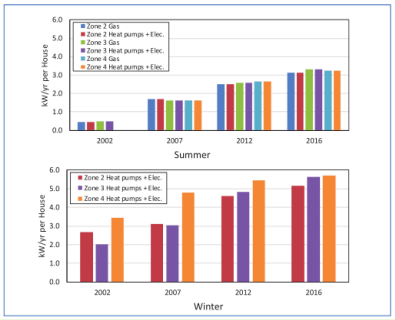


Results
Demand Savings

Per-House Demand Reduction from New Construction of the Year (MW/year)

Permits



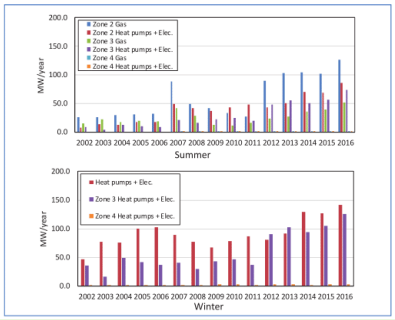


Results
Demand Savings

Per-House Demand Reduction from New Construction of the Year (MW/year)

Permits

Demand Reduction from New Construction of the Analysis Year (MW/year)



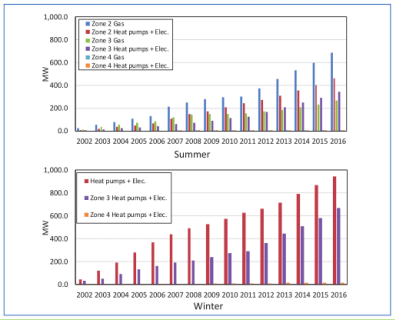
Results
Demand Savings

Per-House Demand Reduction from New Construction of the Year (MW/year)

Permits

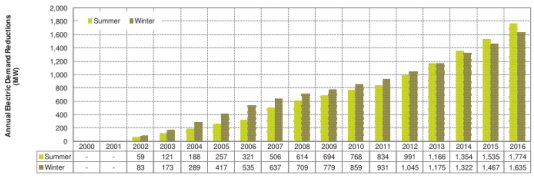
Demand Reduction from New Construction of the Analysis Year (MW/year)

Integration of Total Residences up to the Analysis Year (MW) per Climate Zone



Results
Demand Savings

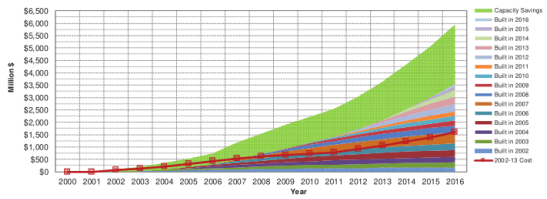
Total Demand Reduction for all the residences on the Analysis Period (MW)



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Summer	-	-	59	121	188	257	321	506	614	694	768	834	991	1,166	1,354	1,535	1,774
Winter	-	-	83	173	289	417	535	637	709	779	859	931	1,045	1,175	1,322	1,467	1,635

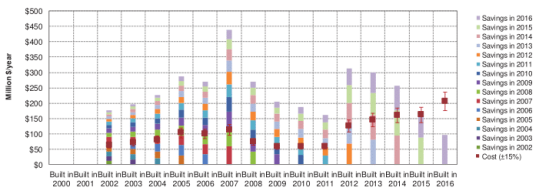
Results
Electricity Cost Savings

Cumulative Electricity Cost Savings and Increased Cost from the IECC Code Adoption for New SF Residences in Texas Built between 2002-2016



Results
Electricity Cost Savings and Increased Cost

Cumulative Electricity Cost Savings and Increased Cost from the IECC Code Adoption for New SF Residences in Texas: by Construction Year



Summary / Conclusions

- The impact of the International Energy Conservation Code (IECC) adoption in Texas has been a great economical and environmental success
- Statewide electricity savings and peak electric demand reductions achieved on residential houses with the IECC in a per house basis are:
- For an electric/gas house:
  - 14.2-38.3 MMBtu/year ($231-$963/year) for Harris County
  - 13.7-39.8 MMBtu/year ($209-$903/year) for Tarrant County
  - 31.4-57.5 MMBtu/year ($223-$823/year) for Potter County
- For a heat pump house:
  - 7.5-31.6 MMBtu/year ($242-$1,019/year) for Harris County
  - 7.4-31.1 MMBtu/year ($239-$1,003/year) for Tarrant County
  - 9.7-36.4 MMBtu/year ($313-$1,174/year) for Potter County

Summary / Conclusions

- Potential Demand Reductions on the Peak Seasons are as Follows:
- The peak summertime demand reductions per house for both electric/gas and heat pump houses are:
  - 0.5-3.6 kW for Harris County
  - 0.6-3.9 kW for Tarrant County
  - 1.9-3.8 kW for Potter County
- For winter, the demand reductions of an all electric (heat pump) house are:
  - 3.1-6.0 kW for Harris County
  - 2.4-6.6 kW for Tarrant County
  - 4.0-6.7 kW for Potter County

Summary / Conclusions

- Annual statewide electricity savings in 2016 are estimated to be $546 million, and the statewide potential electric demand reductions to be 1,774 MW for the summer and 1,635 MW for the winter periods.
- The potential cumulative statewide electricity and electric capacity savings over the fifteen year period from 2002 to 2016 are estimated to be $5,956 million for the summer ($3,580 million from electricity savings and $2,377 million from demand savings) and $5,771 million for the winter periods ($3,580 million from electricity savings and $2,191 million from demand savings), which exceeds suthe increased construction costs estimated to be $1,588 million.

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- Kim, H., Baltazar, J.C, Haberl, J. and 2013, Statewide Electricity and Demand Capacity Savings from the International Energy Conservation Code (IECC) Adoption for Single-Family Residences in Texas (2002-2011), Technical Report ESL-TR-13-07-02, Energy Systems Laboratory, Texas A&M Engineering Experiment Station.
- Oh, S., Baltazar, J.C, Haberl, J. and Yazdani, B., 2015, Statewide Electricity and Demand Capacity Savings from the International Energy Conservation Code (IECC) Adoption for Single-Family Residences in Texas (2002-2013), Technical Report ESL-TR-14-10-01, Energy Systems Laboratory, Texas A&M Engineering Experiment Station.
- Kheiri, F., Baltazar, J.C, Haberl, J. and Yazdani, B., 2017, Statewide Electricity and Demand Capacity Savings from the International Energy Conservation Code (IECC) Adoption for Single-Family Residences in Texas (2002-2016), Technical Report ESL-TR-17-10-01, Energy Systems Laboratory, Texas A&M Engineering Experiment Station.

QUESTIONS?

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- "Energy Code Software - Details that Matter" CATEE conference Dallas/Plano, TX Nov 2017, presented by Shirley Ellis.

ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

Energy Codes Software

Details that Matter

ENERGY SYSTEMS LABORATORY
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Agenda

- Compliance Tools – what are they
- Residential Software
- Commercial Software

ENERGY SYSTEMS LABORATORY
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Compliance Tool

- An approved software program or calculation-based methodology that projects the annual energy use of a building or calculation-based methodology which verifies the minimum prescriptive requirements and/or other procedures referred to in the code.

ENERGY SYSTEMS LABORATORY
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ASHRAE 140

- Framework for energy modeling engines
- Standardized and citable test procedures
  - Validation
  - Diagnosis
  - Improvement in the current generation

RESIDENTIAL Software

ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

IC3 – Energy Systems Laboratory (ESL)

- Free
- Version 4.3.2
- Pros/Cons
  - Calculates emissions reduction
  - Tablet friendly
  - ERI is included
  - Compatible with Mac/Apple
  - Not available for 2009 and 2012 IECC
  - Only in Texas

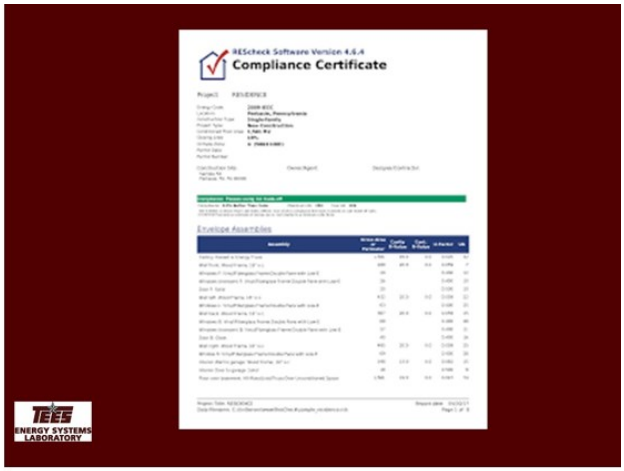
IC3 INTERNATIONAL CODE COMPLIANCE CALCULATOR

ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

RES*check*™ - Pacific Northwest National Laboratory (PNNL)

- Free
- Version 4.6.4
- Pros/Cons
  - Not a true Simulated Performance
  - Desktop version not compatible with Mac/Apple

REScheck™

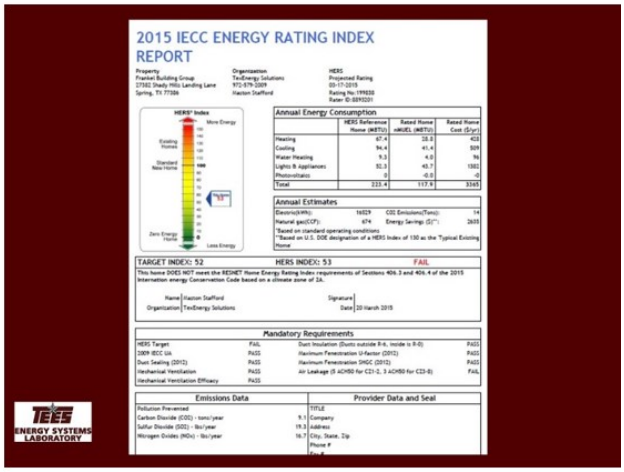


ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

REM/*Rate*™ - NORESCO

- $500 - $1,500 annual plus a per unit user fee
- Version 15.4.2
- Pros/Cons
  - DOE Zero Energy Ready Home certification
  - National Green Building Standard™ (NGBS) Compliance
  - LEED® for Homes compliance
  - Energy appraisal addendum
  - Not compatible with Mac/Apple

REM/*Rate*™

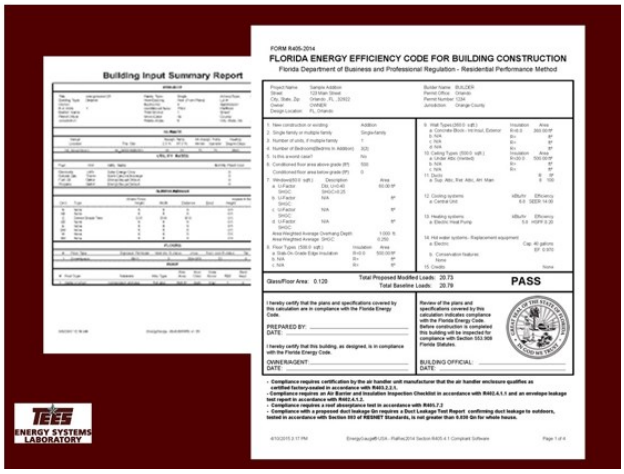


ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

EnergyGauge USA – Florida Solar Energy Center

- $199 - $349 – 1-year license
- $537 - $942 – 3 year license
- Version 5.1.04 - 5 versions
  - ResSimCode, ResSize Pro, ResRatePro, ResRateSizePro, and HERS Provider
- Pros/Cons
  - Model photovoltaic system performance
  - Generate hourly reports for utilities
  - Energy Efficient Tax Credit
  - Not Mac/Apple compatible

EnergyGauge® USA
Energy Analysis & Rating Software

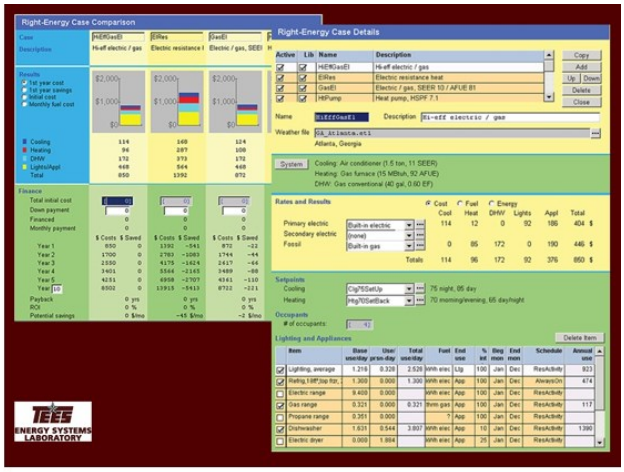


ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

Right-Energy HERS – Wrightsoft Corporation

- $209 purchase price plus an annual renewal
- Ease of use
- Updates
- Pros/Cons
  - Compare energy use of up to 4 cases at once
- Other

Right-Energy®

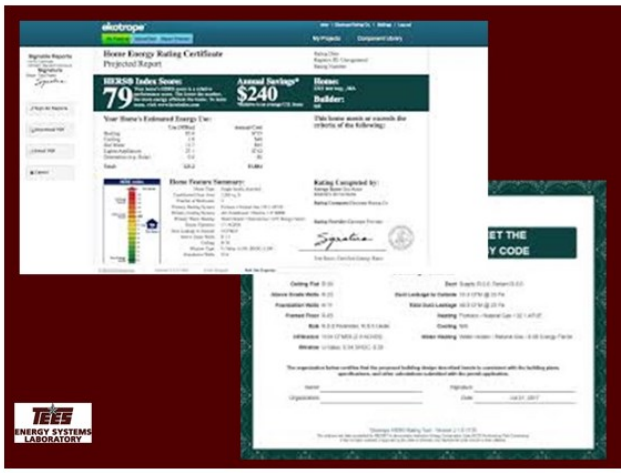


ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

Ekotrope - Ekeotrope

- $6.50 - $9.50 per rating depending on volume
- Version 2.2 – instantly updated and live
- Pros/Cons
  - Import files from *REM/Rate* ™
  - No data files
  - Cloud based
- Other

ekotrope



COMMERCIAL Software

2015 IECC C407 – Total Building Performance
ASHRAE Standard 90.1-2013
ASHRAE Standard 140

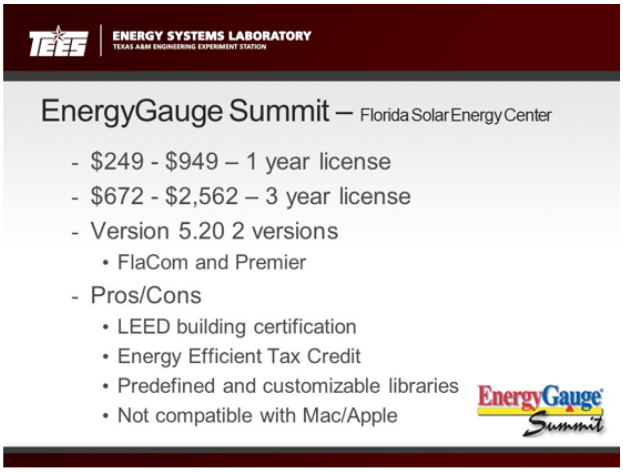
ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

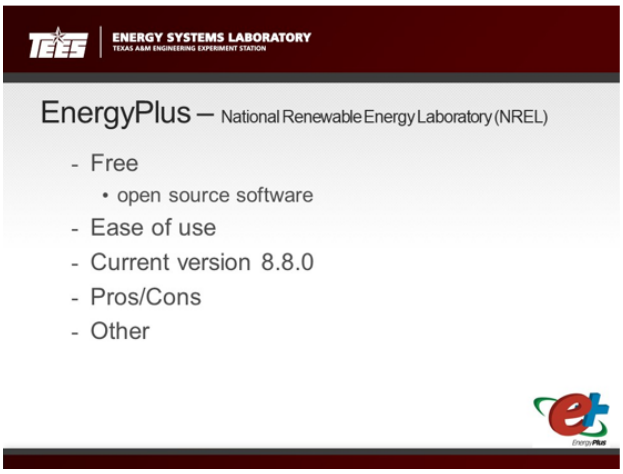
COMcheck™ - Pacific Northwest National Laboratory (PNNL)

- Free
- Ease of use
- Current version 4.0.7
- Pros/Cons
  - Desktop version not compatible with Mac/Apple
- Other

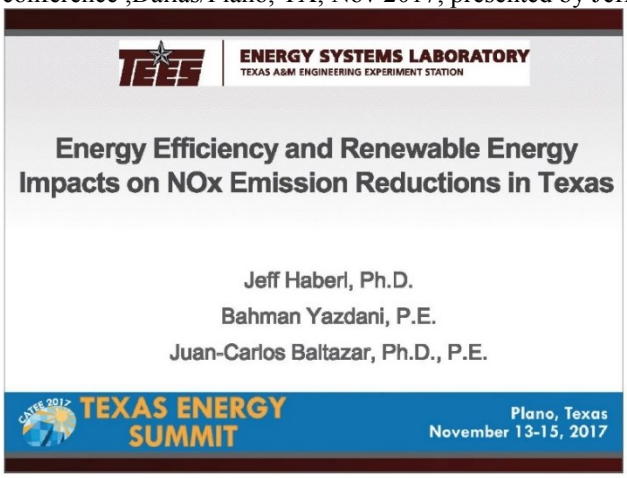
COMcheck

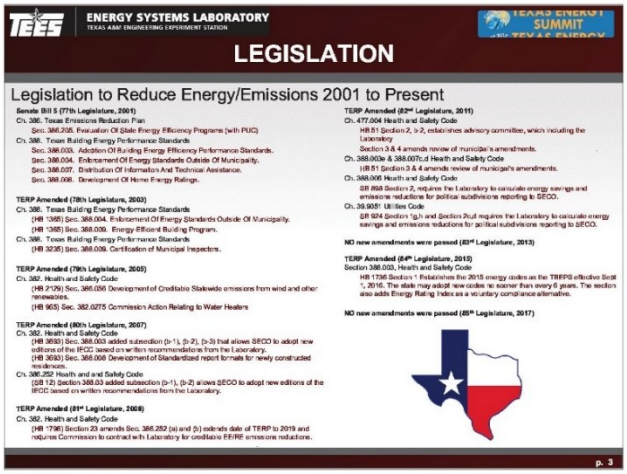

COMcheck Software Version 3.9.4
Envelope Compliance Certificate
COMcheck Software Version 4.0.2.3
Inspection Checklist
COMcheck Software Version 3.9.4
Mechanical Compliance Certificate
TEES
ENERGY SYSTEMS LABORATORY

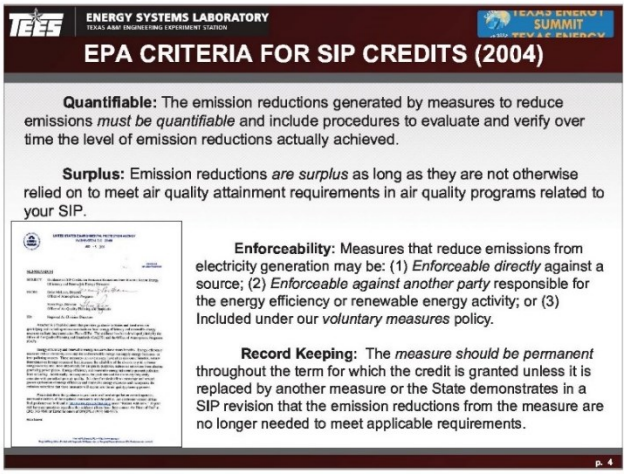

TEES
ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION
EnergyGauge Summit – Florida Solar Energy Center
- $249 - $949 – 1 year license
- $672 - $2,562 – 3 year license
- Version 5.20 2 versions
• FlaCom and Premier
- Pros/Cons
• LEED building certification
• Energy Efficient Tax Credit
• Predefined and customizable libraries
• Not compatible with Mac/Apple
EnergyGauge Summit

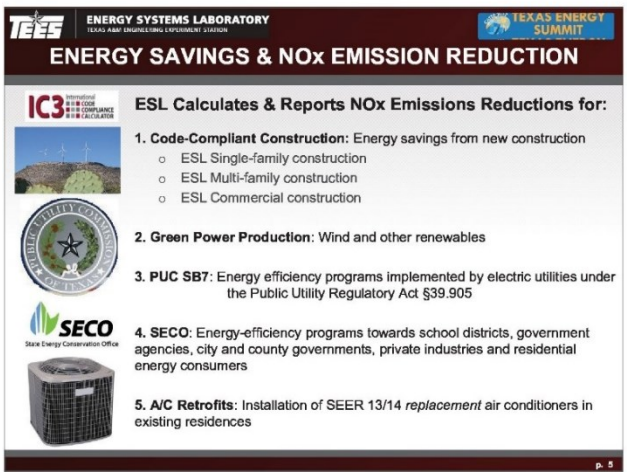

TEES
ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION
EnergyPlus – National Renewable Energy Laboratory (NREL)
- Free
• open source software
- Ease of use
- Current version 8.8.0
- Pros/Cons
- Other

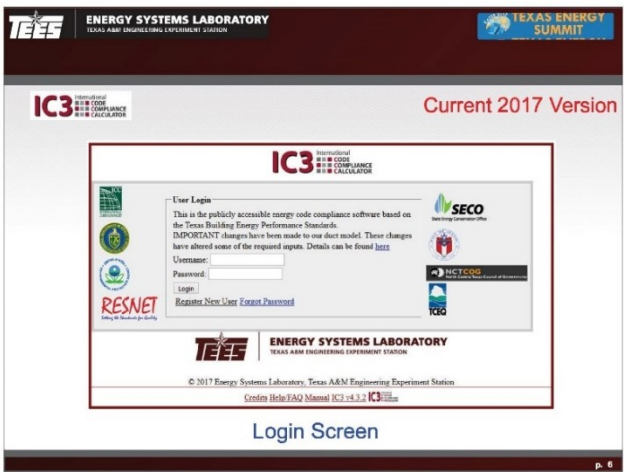
"Energy Efficiency and Renewable Energy Impacts on NOx Emission Reductions" CATEE conference ,Dallas/Plano, TX, Nov 2017, presented by Jeff Haberl.

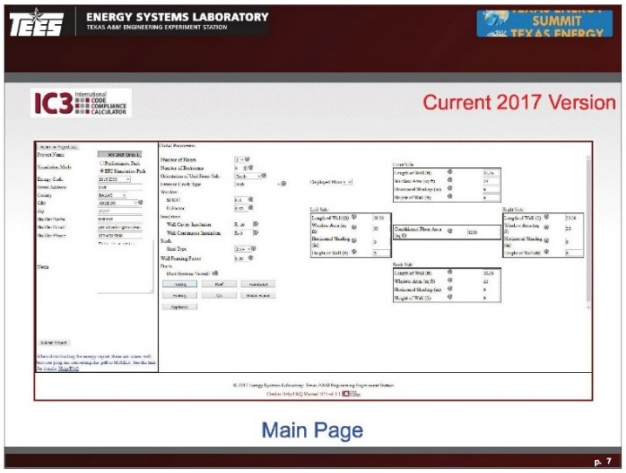


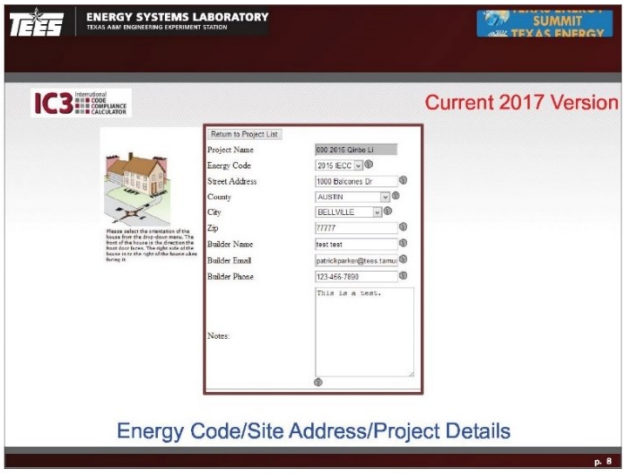


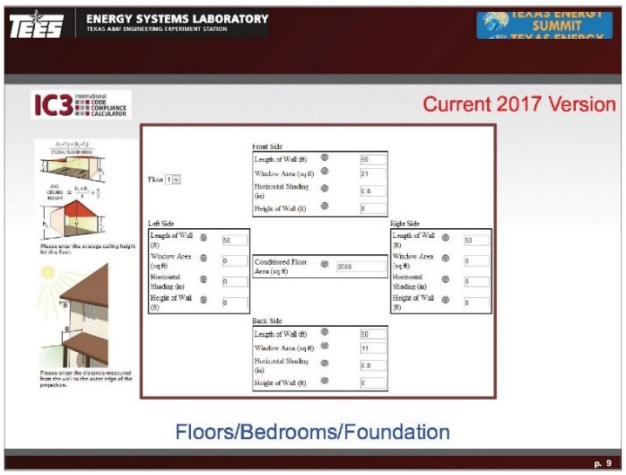


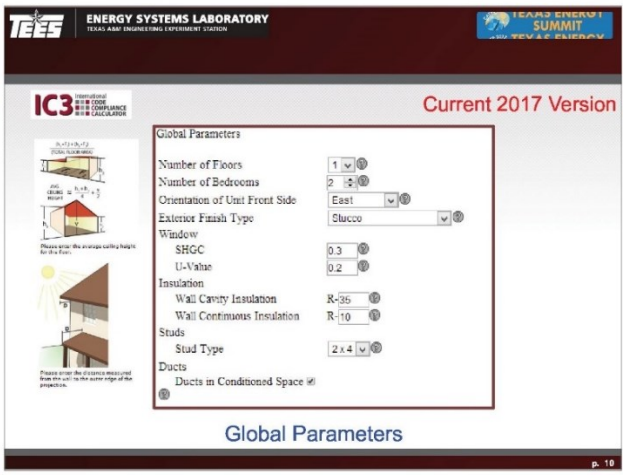


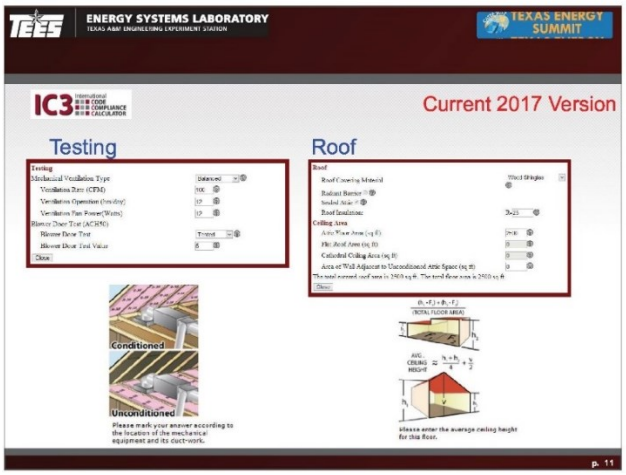


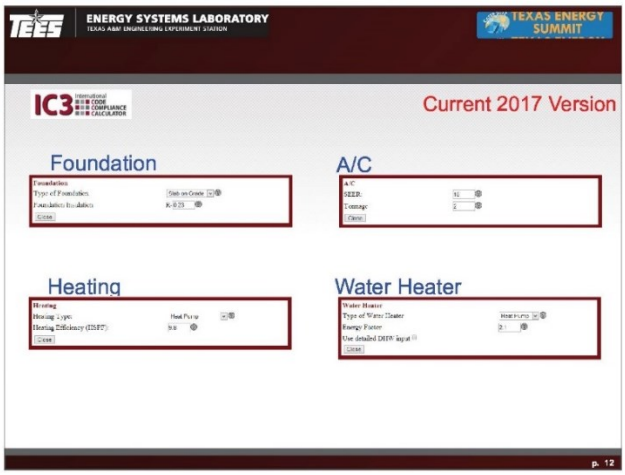

ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION
SUMMIT
IC3
Current 2017 Version
Main Page
p. 7


ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION
SUMMIT
IC3
Current 2017 Version
Return to Project List
Project Name
Energy Code
Street Address
County
City
Zip
Builder Name
Builder Email
Builder Phone
Notes:
Energy Code/Site Address/Project Details
p. 8


ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION
SUMMIT
IC3
Current 2017 Version
Front Side
Left Side
Right Side
Back Side
Conditioned Floor Area (sq ft)
Floors/Bedrooms/Foundation
p. 9

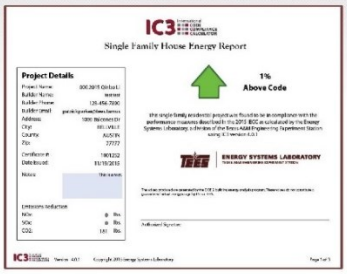

ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION
SUMMIT
IC3
Current 2017 Version
Global Parameters
Number of Floors
Number of Bedrooms
Orientation of Unit Front Side
Exterior Finish Type
Window
SHGC
U-Value
Insulation
Wall Cavity Insulation
Wall Continuous Insulation
Studs
Stud Type
Ducts
Ducts in Conditioned Space
Global Parameters
p. 10


ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION
TEXAS ENERGY SUMMIT
IC3
Current 2017 Version
Testing
Roof
Conditioned
Unconditioned
p. 11


ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION
TEXAS ENERGY SUMMIT
IC3
Current 2017 Version
Foundation
A/C
Heating
Water Heater
p. 12

ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

Current 2017 Version



Certificate

p. 13

ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

Current 2017 Version

- IC3 Prints Certificate for Posting on Electrical Panel
- Records Certificate in IC3 Registry

Certificate for Electrical Panel

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ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

2017 IC3 Includes New Energy Rating Index (ERI)

RESNET
Setting the Standards for Quality

- Texas one of only 15 states to Adopt ERI Rating for 2015 IECC
- Recognized by RESNET

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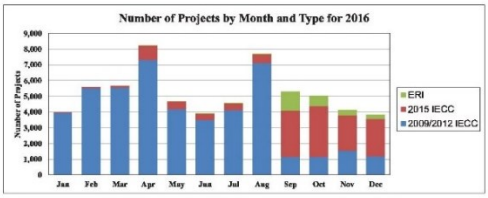
ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

STATEWIDE SAVINGS FROM CODE COMPLIANCE (2000 – 2016)

How much electricity has been saved from residential code compliance for all single-family housing 2000-2016?

IC3 Projects/Certificates



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ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

STATEWIDE SAVINGS FROM CODE COMPLIANCE 2000 – 2016 (ESTIMATED)

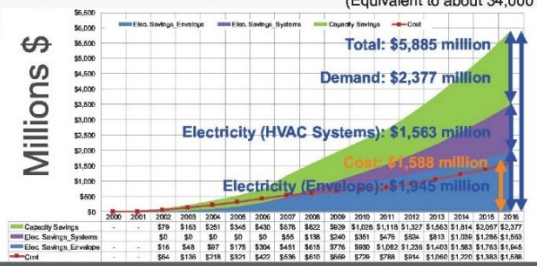
Savings (2002 to 2016)

Electricity (Envelope):	$1,945 million
Electricity (HVAC Systems):	$1,563 million
Demand:	$2,377 million
Total:	$5,885 million

Increased Costs (2002 to 2016)
Costs: $ 1,588 million

NOx Emissions Reduction
44.71 tons NOx / year

Emissions Reduction in 2016
(Equivalent to about 34,000 cars)



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Capacity Savings	-	-	$79	$163	$261	$348	$430	$678	$822	$839	$1,028	$1,118	$1,327	$1,563	$1,814	$2,057	$2,377
Elec. Savings, Systems	-	-	$0	$0	$0	$0	$0	$55	$138	$240	$361	$479	$604	$813	$1,036	$1,286	$1,563
Elec. Savings, Envelope	-	-	$16	$48	$97	$175	$304	$451	$615	$776	$930	$1,082	$1,236	$1,403	$1,583	$1,763	$1,945
Cost	-	-	$64	$136	$218	$321	$422	$536	$610	$669	$729	$788	$854	$1,060	$1,220	$1,383	$1,588

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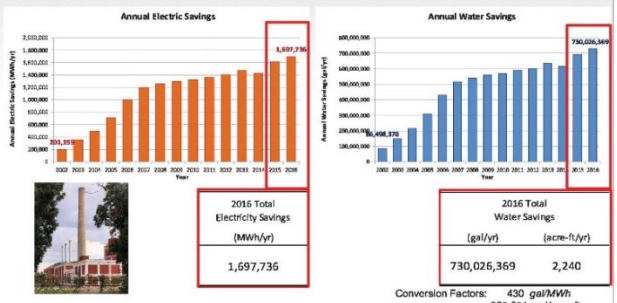
ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

STATEWIDE WATER SAVINGS AT POWER PLANTS 2002~2016

Electricity/Water Savings from SF (Code Compliance)

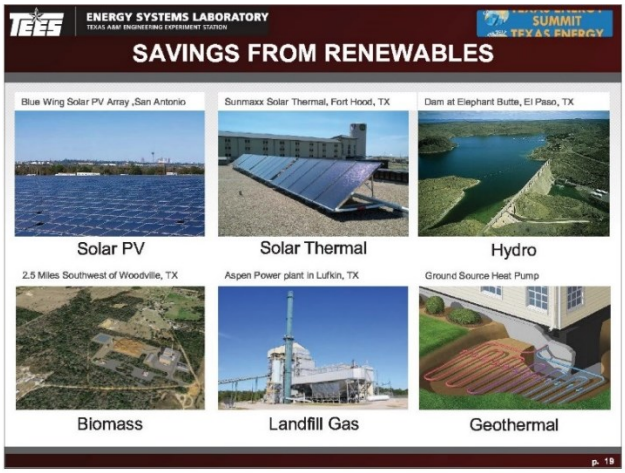


2015 Total Electricity Savings (MWh/yr)
1,697,736

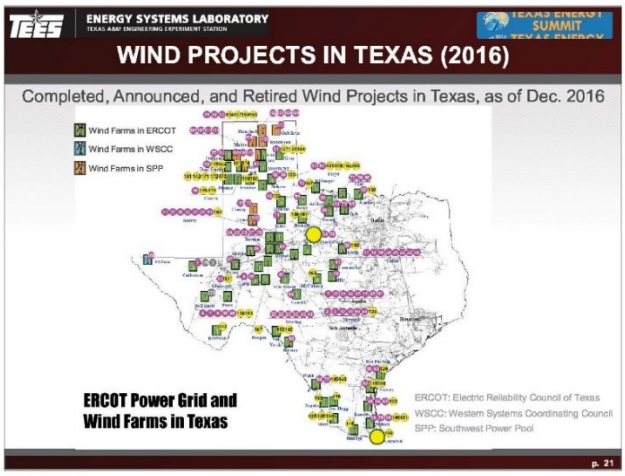
2016 Total Water Savings (gal/yr)	(acre-ft/yr)
730,026,369	2,240

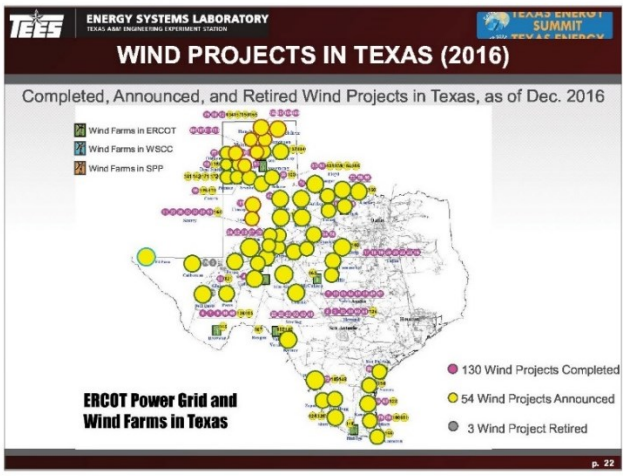
Conversion Factors: 430 *gal/MWh*
325,851 *gal/acre-ft*

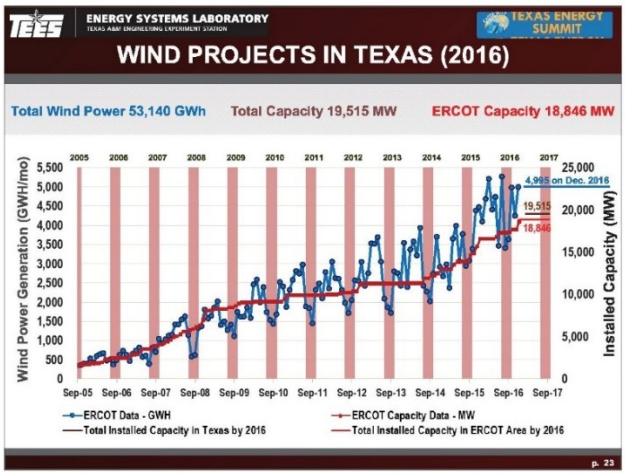
p. 18

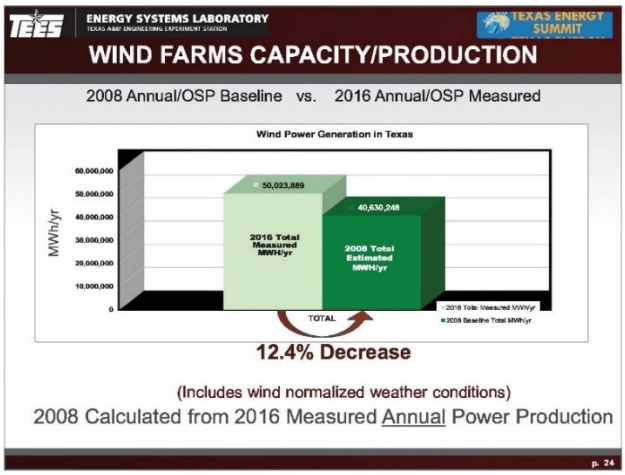

ENERGY SYSTEMS LABORATORY
SAVINGS FROM RENEWABLES
Blue Wing Solar PV Array ,San Antonio
Sunmaxx Solar Thermal, Fort Hood, TX
Dam at Elephant Butte, El Paso, TX
Solar PV
Solar Thermal
Hydro
2.5 Miles Southwest of Woodville, TX
Aspen Power plant in Lufkin, TX
Ground Source Heat Pump
Biomass
Landfill Gas
Geothermal
p. 19

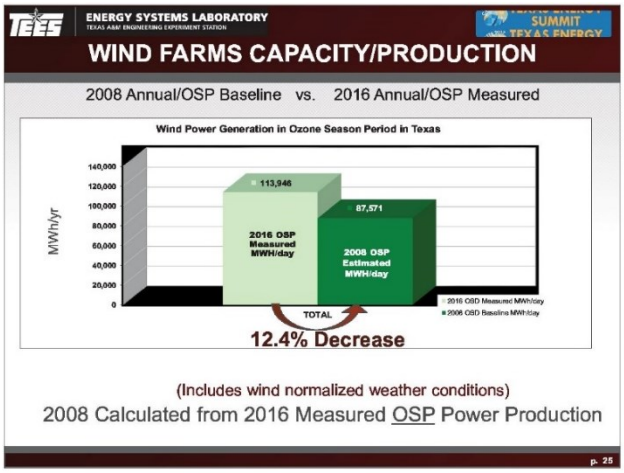

ENERGY SYSTEMS LABORATORY
SAVINGS FROM RENEWABLES
Wind
Brazos Wind Ranch, TX.
Biomass
Landfill Gas
Geothermal
p. 20

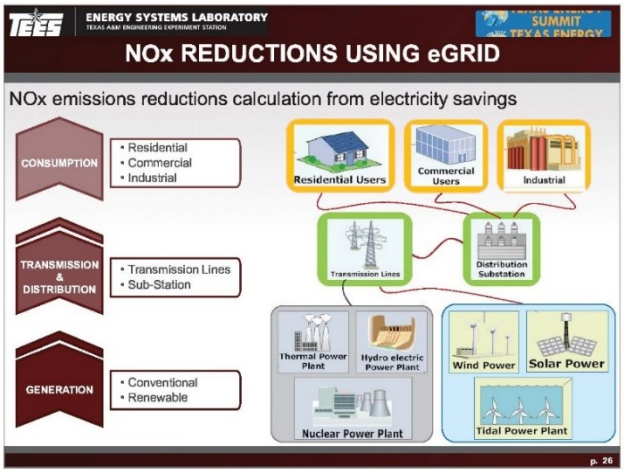

ENERGY SYSTEMS LABORATORY
WIND PROJECTS IN TEXAS (2016)
Completed, Announced, and Retired Wind Projects in Texas, as of Dec. 2016
Wind Farms in ERCOT
Wind Farms in WSCC
Wind Farms in SPP
ERCOT Power Grid and Wind Farms in Texas
ERCOT: Electric Reliability Council of Texas
WSCC: Western Systems Coordinating Council
SPP: Southwest Power Pool
p. 21

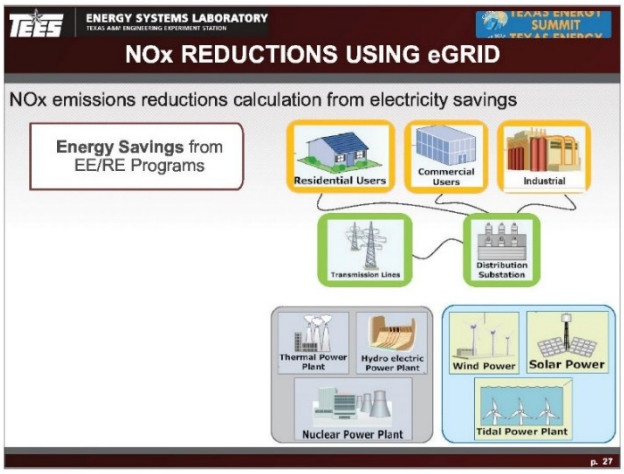

ENERGY SYSTEMS LABORATORY
WIND PROJECTS IN TEXAS (2016)
Completed, Announced, and Retired Wind Projects in Texas, as of Dec. 2016
Wind Farms in ERCOT
Wind Farms in WSCC
Wind Farms in SPP
ERCOT Power Grid and Wind Farms in Texas
130 Wind Projects Completed
54 Wind Projects Announced
3 Wind Project Retired
p. 22

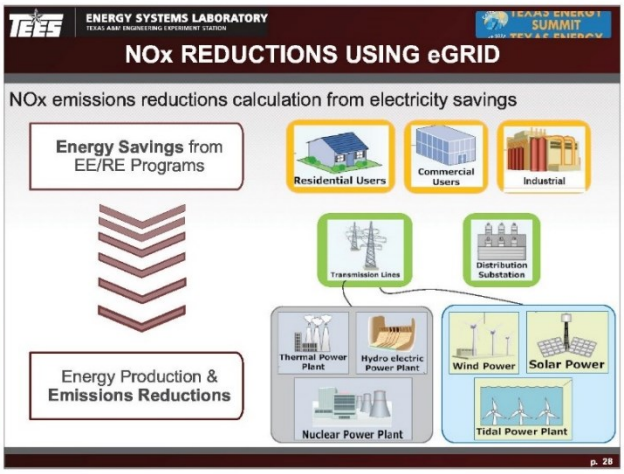

ENERGY SYSTEMS LABORATORY
WIND PROJECTS IN TEXAS (2016)
Total Wind Power 53,140 GWh
Total Capacity 19,515 MW
ERCOT Capacity 18,846 MW
Wind Power Generation (GWH/mo)
Installed Capacity (MW)
4,995 on Dec. 2016
19,515
18,846
ERCOT Data - GWH
Total Installed Capacity in Texas by 2016
ERCOT Capacity Data - MW
Total Installed Capacity in ERCOT Area by 2016
p. 23

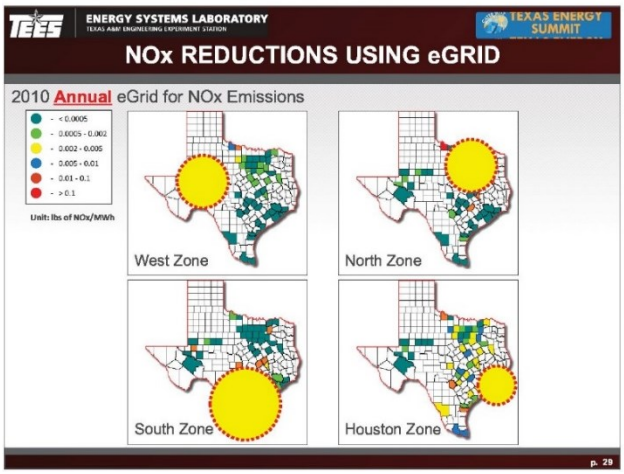

ENERGY SYSTEMS LABORATORY
WIND FARMS CAPACITY/PRODUCTION
2008 Annual/OSP Baseline vs. 2016 Annual/OSP Measured
Wind Power Generation in Texas
MWh/yr
50,023,889
40,630,248
2016 Total Measured MWH/yr
2008 Total Estimated MWH/yr
TOTAL
12.4% Decrease
(Includes wind normalized weather conditions)
2008 Calculated from 2016 Measured Annual Power Production
p. 24

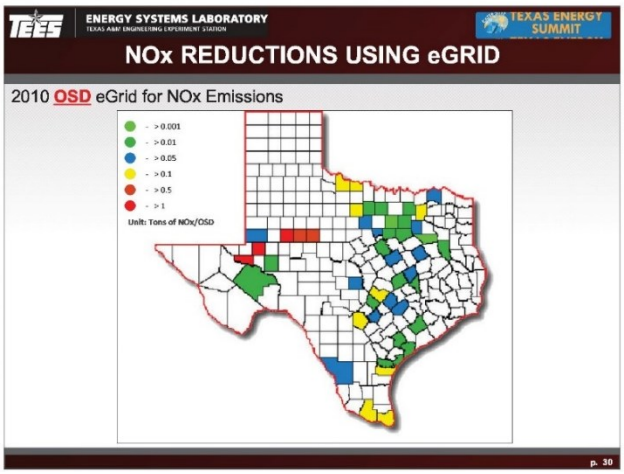

ENERGY SYSTEMS LABORATORY
WIND FARMS CAPACITY/PRODUCTION
2008 Annual/OSP Baseline vs. 2016 Annual/OSP Measured
Wind Power Generation in Ozone Season Period in Texas
MWh/yr
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
113,946
87,571
2016 OSP Measured MWH/day
2008 OSP Estimated MWH/day
TOTAL
12.4% Decrease
(Includes wind normalized weather conditions)
2008 Calculated from 2016 Measured OSP Power Production
p. 25


ENERGY SYSTEMS LABORATORY
NOx REDUCTIONS USING eGRID
NOx emissions reductions calculation from electricity savings
CONSUMPTION
• Residential
• Commercial
• Industrial
TRANSMISSION & DISTRIBUTION
• Transmission Lines
• Sub-Station
GENERATION
• Conventional
• Renewable
Residential Users
Commercial Users
Industrial
Transmission Lines
Distribution Substation
Thermal Power Plant
Hydro electric Power Plant
Wind Power
Solar Power
Nuclear Power Plant
Tidal Power Plant
p. 26


ENERGY SYSTEMS LABORATORY
NOx REDUCTIONS USING eGRID
NOx emissions reductions calculation from electricity savings
Energy Savings from EE/RE Programs
Residential Users
Commercial Users
Industrial
Transmission Lines
Distribution Substation
Thermal Power Plant
Hydro electric Power Plant
Wind Power
Solar Power
Nuclear Power Plant
Tidal Power Plant
p. 27


ENERGY SYSTEMS LABORATORY
NOx REDUCTIONS USING eGRID
NOx emissions reductions calculation from electricity savings
Energy Savings from EE/RE Programs
Energy Production & Emissions Reductions
Residential Users
Commercial Users
Industrial
Transmission Lines
Distribution Substation
Thermal Power Plant
Hydro electric Power Plant
Wind Power
Solar Power
Nuclear Power Plant
Tidal Power Plant
p. 28

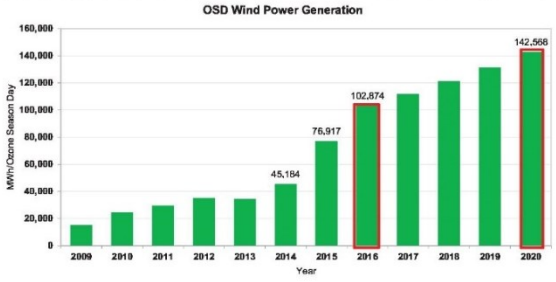

ENERGY SYSTEMS LABORATORY
NOx REDUCTIONS USING eGRID
2010 Annual eGrid for NOx Emissions
Unit: lbs of NOx/MWh
West Zone
North Zone
South Zone
Houston Zone
p. 29


ENERGY SYSTEMS LABORATORY
NOx REDUCTIONS USING eGRID
2010 OSD eGrid for NOx Emissions
Unit: Tons of NOx/OSD
p. 30

ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

NOx REDUCTIONS FROM WIND POWER

OSD Power Generation and NOx Emissions Reductions (2008 base year)



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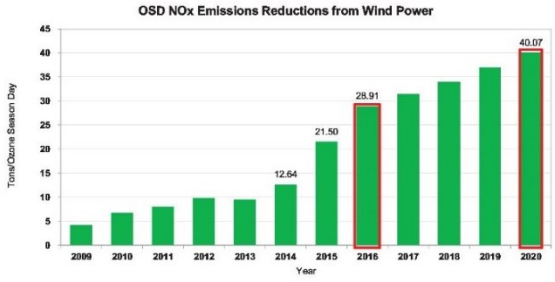
ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

NOx REDUCTIONS FROM WIND POWER

OSD Power Generation and NOx Emissions Reductions (2008 base year)



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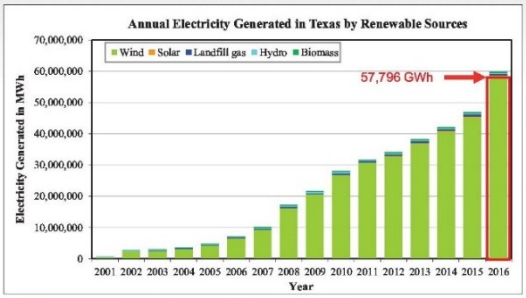
ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

SAVINGS FROM OTHER RENEWABLES (2001-2016)

Renewables: Biomass, Hydro, Landfill Gas, Solar, Wind

✓ Wind energy is the largest portion



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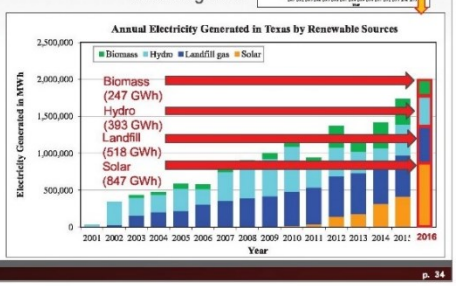
ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

SAVINGS FROM OTHER RENEWABLES (2001-2016)

Renewables: Biomass, Hydro, Landfill Gas, Solar, Wind

✓ Wind energy is the largest portion

Excluding Wind



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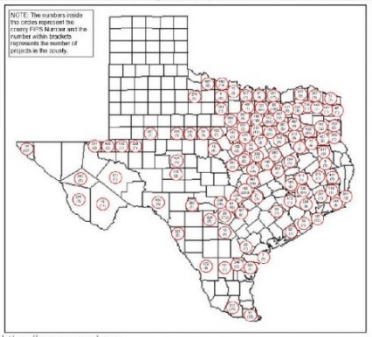
ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

RENEWABLE PROJECTS IN TEXAS (2016)

Solar PV



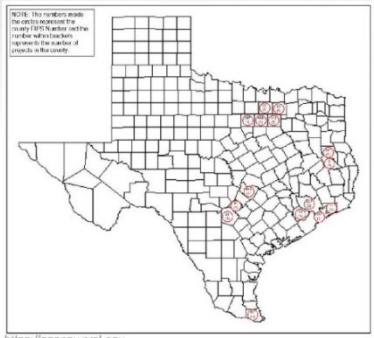
Renewables*:
Solar PV (4,750 projects)

p. 35

ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

RENEWABLE PROJECTS IN TEXAS (2016)

Biomass



Renewables*:
Solar PV (4,750 projects)
Biomass (18 projects)

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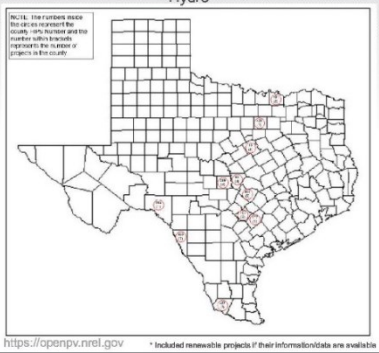
ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

RENEWABLE PROJECTS IN TEXAS (2016)

Hydro



Renewables*:
- Solar PV (4,750 projects)
- Biomass (18 projects)
- Hydro (29 projects)

https://openpv.nrel.gov * Included renewable projects if their information/data are available

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ENERGY SYSTEMS LABORATORY
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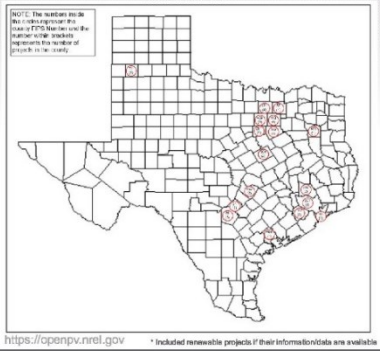
RENEWABLE PROJECTS IN TEXAS (2016)

Landfill Gas



Renewables*:
- Solar PV (4,750 projects)
- Biomass (18 projects)
- Hydro (29 projects)
- Landfill Gas (35 projects)

https://openpv.nrel.gov * Included renewable projects if their information/data are available

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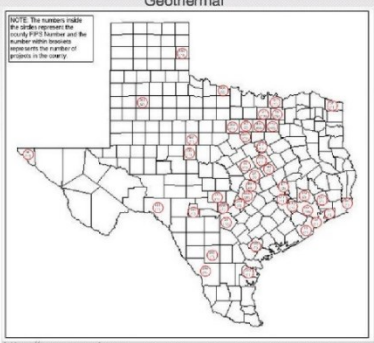
RENEWABLE PROJECTS IN TEXAS (2016)

Geothermal



Renewables*:
- Solar PV (4,750 projects)
- Biomass (18 projects)
- Hydro (29 projects)
- Landfill Gas (35 projects)
- Geothermal (286 projects)

https://openpv.nrel.gov * Included renewable projects if their information/data are available

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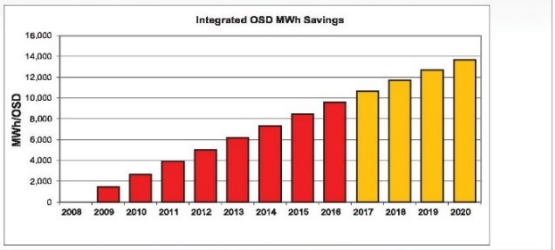
ENERGY SAVINGS FROM PUC SB7

PUC SB7 Savings and Projections

- The Public Utility Commission of Texas (PUC) Senate Bill 7 program includes their incentive and rebates programs managed by the different Utilities for Texas.
- These include the Residential Energy Efficiency Programs (REEP) as well as the Commercial & Industrial Standard Offer Programs.



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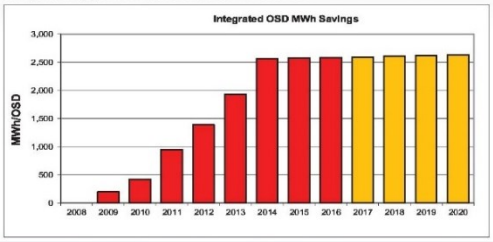
ENERGY SAVINGS FROM SECO

SECO Savings and Projections

- The Texas State Energy Conservation Office (SECO) funds energy-efficiency programs directed towards school districts, government agencies, city and county governments, private industries and residential energy consumers.
- The annual electricity savings are obtained from SECO's energy conservation projects reported by political subdivisions for 47 counties.

SECO
State Energy Conservation Office



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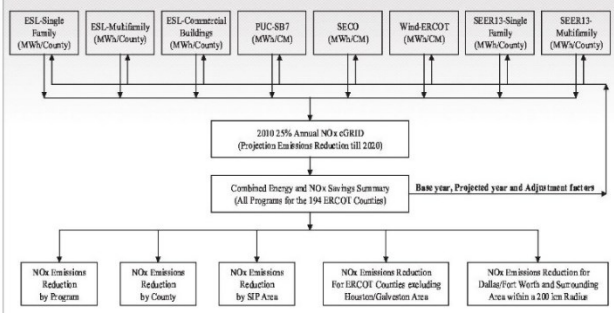
INTEGRATED NOx EMISSIONS REDUCTION

Integrated Emissions Savings Across Agencies To Report Savings To TCEQ and EPA



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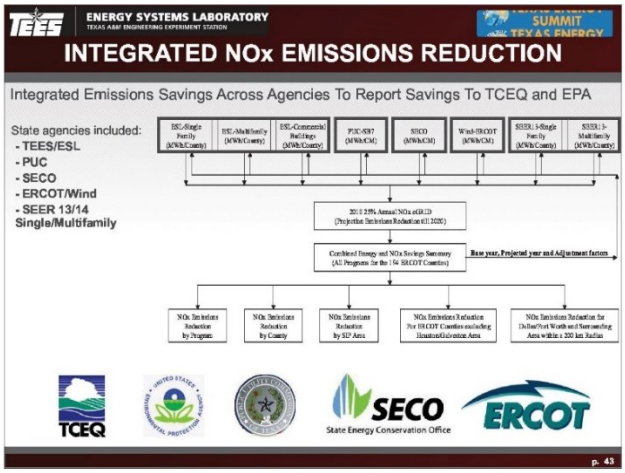
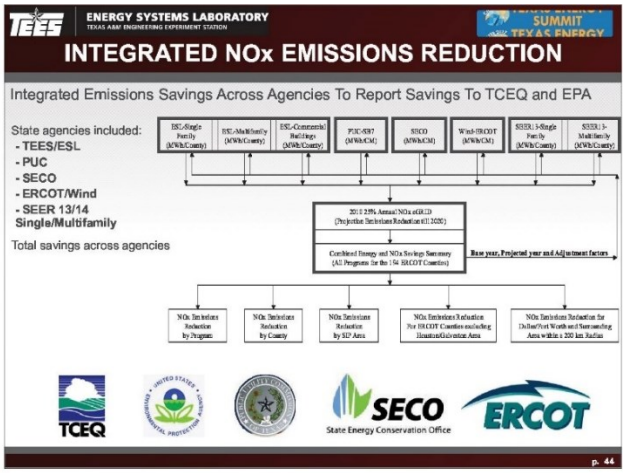

ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION
TEXAS ENERGY SUMMIT
INTEGRATED NOx EMISSIONS REDUCTION
Integrated Emissions Savings Across Agencies To Report Savings To TCEQ and EPA
State agencies included:
- TEES/ESL
- PUC
- SECO
- ERCOT/Wind
- SEER 13/14
Single/Multifamily
ESL-Single Family (MWh/County)
ESL-Multifamily (MWh/County)
ESL-Commercial Buildings (MWh/County)
PUC-SB7 (MWh/CM)
SECO (MWh/CM)
Wind-ERCOT (MWh/CM)
SEER13-Single Family (MWh/County)
SEER13-Multifamily (MWh/County)
2012 25% Annual NOx eGRID (Projection Emissions Reduction 03/2020)
Combined Energy and NOx Savings Summary (All Programs for the 154 ERCOT Counties)
Base year, Projected year and Adjustment factors
NOx Emissions Reduction by Program
NOx Emissions Reduction by County
NOx Emissions Reduction by SIP Area
NOx Emissions Reduction For ERCOT Counties excluding Houston/Galveston Area
NOx Emissions Reduction for Dallas/Fort Worth and Surrounding Area within a 200 km Radius
TCEQ
SECO
State Energy Conservation Office
ERCOT
p. 43


ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION
TEXAS ENERGY SUMMIT
INTEGRATED NOx EMISSIONS REDUCTION
Integrated Emissions Savings Across Agencies To Report Savings To TCEQ and EPA
State agencies included:
- TEES/ESL
- PUC
- SECO
- ERCOT/Wind
- SEER 13/14
Single/Multifamily
Total savings across agencies
ESL-Single Family (MWh/County)
ESL-Multifamily (MWh/County)
ESL-Commercial Buildings (MWh/County)
PUC-SB7 (MWh/CM)
SECO (MWh/CM)
Wind-ERCOT (MWh/CM)
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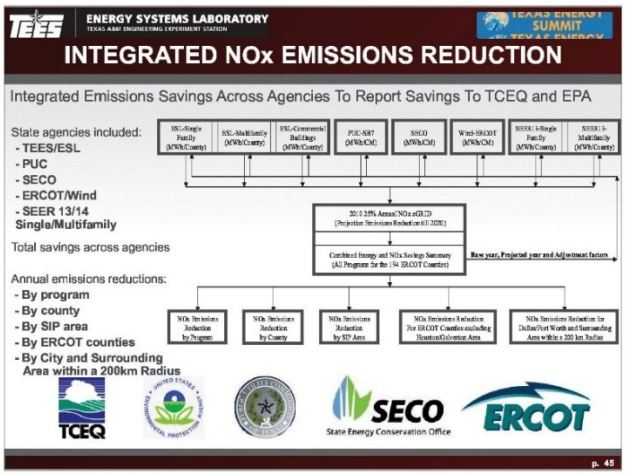
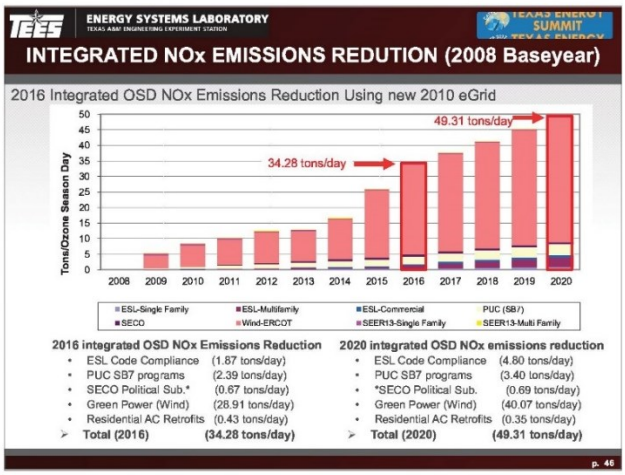
NOx Emissions Reduction For ERCOT Counties excluding Houston/Galveston Area
NOx Emissions Reduction for Dallas/Fort Worth and Surrounding Area within a 200 km Radius
TCEQ
SECO
State Energy Conservation Office
ERCOT
p. 44


ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION
TEXAS ENERGY SUMMIT
INTEGRATED NOx EMISSIONS REDUCTION
Integrated Emissions Savings Across Agencies To Report Savings To TCEQ and EPA
State agencies included:
- TEES/ESL
- PUC
- SECO
- ERCOT/Wind
- SEER 13/14
Single/Multifamily
Total savings across agencies
Annual emissions reductions:
- By program
- By county
- By SIP area
- By ERCOT counties
- By City and Surrounding Area within a 200km Radius
ESL-Single Family (MWh/County)
ESL-Multifamily (MWh/County)
ESL-Commercial Buildings (MWh/County)
PUC-SB7 (MWh/CM)
SECO (MWh/CM)
Wind-ERCOT (MWh/CM)
SEER13-Single Family (MWh/County)
SEER13-Multifamily (MWh/County)
2012 25% Annual NOx eGRID (Projection Emissions Reduction 03/2020)
Combined Energy and NOx Savings Summary (All Programs for the 154 ERCOT Counties)
Base year, Projected year and Adjustment factors
NOx Emissions Reduction by Program
NOx Emissions Reduction by County
NOx Emissions Reduction by SIP Area
NOx Emissions Reduction For ERCOT Counties excluding Houston/Galveston Area
NOx Emissions Reduction for Dallas/Fort Worth and Surrounding Area within a 200 km Radius
TCEQ
SECO
State Energy Conservation Office
ERCOT
p. 45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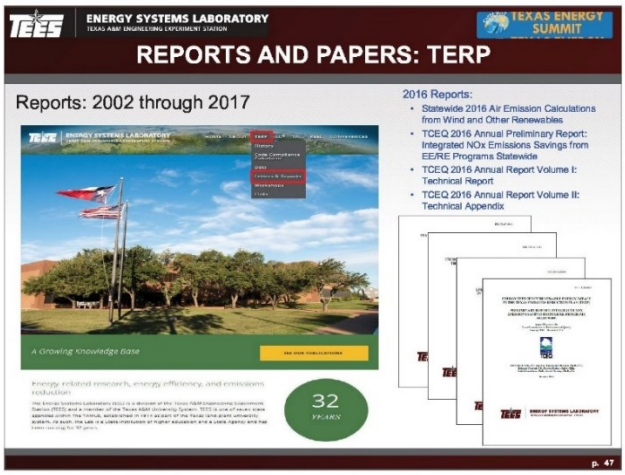
TEXAS ENERGY SUMMIT
INTEGRATED NOx EMISSIONS REDUTION (2008 Baseyear)
2016 Integrated OSD NOx Emissions Reduction Using new 2010 eGrid
Tons/Ozone Season Day
49.31 tons/day
34.28 tons/day
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020
ESL-Single Family
ESL-Multifamily
ESL-Commercial
PUC (SB7)
SECO
Wind-ERCOT
SEER13-Single Family
SEER13-Multi Family
2016 integrated OSD NOx Emissions Reduction
ESL Code Compliance (1.87 tons/day)
PUC SB7 programs (2.39 tons/day)
SECO Political Sub.* (0.67 tons/day)
Green Power (Wind) (28.91 tons/day)
Residential AC Retrofits (0.43 tons/day)
Total (2016) (34.28 tons/day)
2020 integrated OSD NOx emissions reduction
ESL Code Compliance (4.80 tons/day)
PUC SB7 programs (3.40 tons/day)
*SECO Political Sub. (0.69 tons/day)
Green Power (Wind) (40.07 tons/day)
Residential AC Retrofits (0.35 tons/day)
Total (2020) (49.31 tons/day)
p. 46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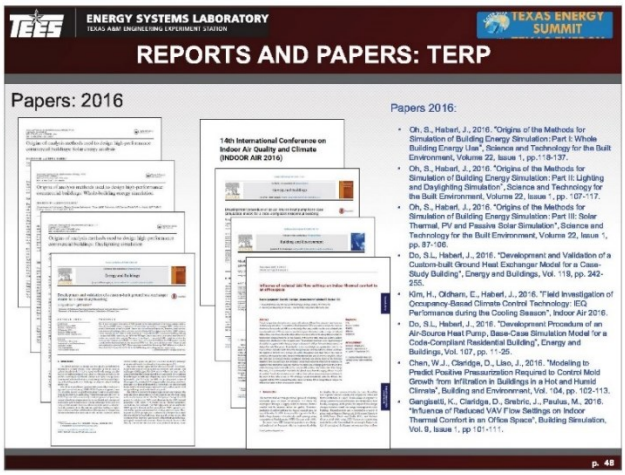
TEXAS ENERGY SUMMIT
REPORTS AND PAPERS: TERP
Reports: 2002 through 2017
A Growing Knowledge Base
32 YEARS
2016 Reports:
Statewide 2016 Air Emission Calculations from Wind and Other Renewables
TCEQ 2016 Annual Preliminary Report: Integrated NOx Emissions Savings from EE/RE Programs Statewide
TCEQ 2016 Annual Report Volume I: Technical Report
TCEQ 2016 Annual Report Volume II: Technical Appendix
p. 47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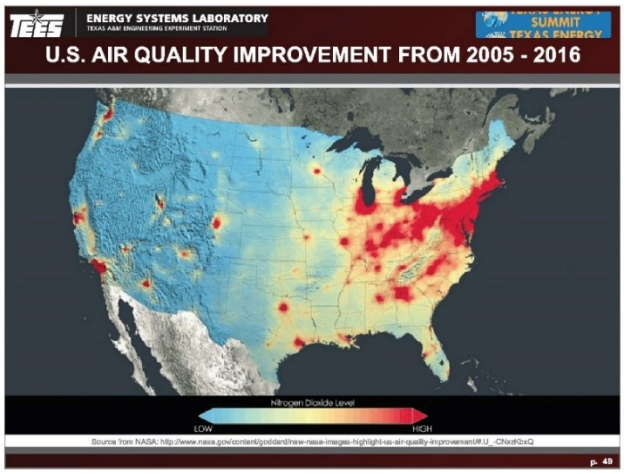
TEXAS A&M ENGINEERING EXPERIMENT STATION
TEXAS ENERGY SUMMIT
REPORTS AND PAPERS: TERP
Papers: 2016
14th International Conference on Indoor Air Quality and Climate (INDOOR AIR 2016)
Papers 2016:
Oh, S., Haberl, J., 2016. "Origins of the Methods for Simulation of Building Energy Simulation: Part I: Whole Building Energy Use", Science and Technology for the Built Environment, Volume 22, Issue 1, pp. 118-137.
Oh, S., Haberl, J., 2016. "Origins of the Methods for Simulation of Building Energy Simulation: Part II: Lighting and Daylighting Simulation", Science and Technology for the Built Environment, Volume 22, Issue 1, pp. 107-117.
Oh, S., Haberl, J., 2016. "Origins of the Methods for Simulation of Building Energy Simulation: Part III: Solar Thermal, PV and Passive Solar Simulation", Science and Technology for the Built Environment, Volume 22, Issue 1, pp. 87-106.
Do, S.L., Haberl, J., 2016. "Development and Validation of a Custom-built Ground Heat Exchanger Model for a Case-Study Building", Energy and Buildings, Vol. 119, pp. 342-255.
Kim, H., Oldham, E., Haberl, J., 2016. "Field Investigation of Occupancy-Based Climate Control Technology: IEQ Performance during the Cooling Season", Indoor Air 2016.
Do, S.L., Haberl, J., 2016. "Development Procedure of an Air-Source Heat Pump, Base-Case Simulation Model for a Code-Compliant Residential Building", Energy and Buildings, Vol. 107, pp. 11-25.
Chen, W.J., Claridge, D., Liao, J., 2016. "Modeling to Predict Positive Pressurization Required to Control Mold Growth from Infiltration in Buildings in a Hot and Humid Climate", Building and Environment, Vol. 104, pp. 102-113.
Gangisetti, K., Claridge, D., Srebric, J., Peshlai, M., 2016. "Influence of Reduced VAV Flow Settings on Indoor Thermal Comfort in an Office Space", Building Simulation, Vol. 9, Issue 1, pp 101-111.
p. 48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SUMMIT
U.S. AIR QUALITY IMPROVEMENT FROM 2005 - 2016
Nitrogen Dioxide Level
LOW
HIGH
p. 49


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SUMMIT
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Juan-Carlos Baltazar: jbaltazar@tamu.edu
http://esl.tamu.edu/terp
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Appendix B: Comparative Analysis of Integrated NOx Reduction Levels Using 2010, 2016 and Mixed eGRIDs

The Emissions and Generation Resource Integrated Database (eGRID) is a comprehensive database developed by the EPA that represents the environmental characteristics of most electric power generations in the United States. These environmental characteristics contain (USEPA 2018):

- Several air emissions from nitrogen oxides, sulfur dioxide, carbon dioxide, methane, and nitrous oxide;
- Gas emissions rates;
- Net generation from the power plants;
- Energy resource mix; and
- Many other characteristics.

The Energy Systems Laboratory (ESL) has worked with the EPA and the TCEQ to estimate the NOx reductions potential from the electricity and natural gas savings in each county. For this year, the ESL adopted 2016 eGRID as the new version of eGRID to more accurately predict the NOx reductions potential in Texas based on the ERCOT Competitive Load (CL) zones. To apply this in the report, 2016 eGRID was modified according to ESL-TR-08-12-04 report (US EPA and ESL 2008).

The two different eGRIDs were used together for the calculations in this report: 2016 eGRID and 2010 eGRID. The new version of 2016 eGRID was applied to the projection from 2017 to 2022 and 2010 eGRID was used for the previous period before 2017 to show the consistent results with the previous annual reports. However, in this mixed eGRIDs[48] analysis, a sharp increase can be seen between 2016 and 2017 NOx reduction levels.Therefore, this appendix provides a comparative analysis of integrated NOx reduction levels using 2010, 2016 and mixed eGRIDs, which allows readers to have a comprehensive perspective about the prediction results of integrated NOx reduction levels based on the different eGRID versions in this report.

Figure *48* to Figure *51*Figure *48*Figure *51* and Table **36** and Table **37** show the differences in the NOx reductions calculations with 2010 and 2016 eGRIDs. The NOx reductions calculated with 2010 eGRID differ from the mixed eGRIDs for the period of 2017 to 2022 and the NOx reductions calculated with 2016 eGRID differ from the mixed eGRIDs for the period of 2008 to 2016.

a. Mixed eGRID Calculations for NOx Emissions Reduction

First of all, Figure 46 shows the results of the integrated NOx emissions reduction and Figure 47 shows the same results except renewables using mixed eGRIDs through 2022 for the electricity and natural gas savings from the various EE/RE programs. Table 35 shows the annual and OSP NOx emissions reductions values using mixed eGRIDs.

Table 35: Annual and OSP NOx Emissions Reductions Values using Mixed eGRID (Base Year 2008)

PROGRAM	ANNUAL (in tons NOx)														
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ESL-Single Family	0	3	8	15	34	50	65	86	129	206	263	320	379	440	502
ESL-Multifamily	0	4	19	43	77	127	190	305	468	810	1,028	1,256	1,494	1,744	2,006
ESL-Commercial	0	0	5	16	22	47	79	114	141	197	232	267	304	343	383
PUC (SB7)	0	135	246	362	460	567	669	770	874	1,326	1,438	1,545	1,646	1,742	1,833
SECO	0	19	43	92	133	183	264	265	294	400	458	514	567	617	665
Renewables-ERCOT	0	951	2,645	3,258	3,561	4,693	5,116	5,683	9,360	24,054	26,098	28,317	30,724	33,335	36,169
SEER13-Single Family	0	81	77	73	69	66	62	59	56	66	63	60	57	54	51
SEER13-Multi Family	0	7	6	6	6	6	5	5	5	6	5	5	5	5	4
Total Annual (Tons NOx)	**0**	**1,199**	**3,048**	**3,864**	**4,363**	**5,738**	**6,451**	**7,287**	**11,328**	**27,065**	**29,585**	**32,283**	**35,175**	**38,279**	**41,612**

PROGRAM	OZONE SEASON PERIOD - OSP (in tons NOx/day)														
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ESL-Single Family	0.00	0.01	0.02	0.04	0.09	0.14	0.18	0.24	0.35	0.57	0.73	0.89	1.05	1.22	1.39
ESL-Multifamily	0.00	0.01	0.05	0.12	0.21	0.35	0.52	0.83	1.28	2.24	2.84	3.47	4.13	4.82	5.54
ESL-Commercial	0.00	0.00	0.01	0.04	0.06	0.13	0.22	0.31	0.39	0.54	0.64	0.74	0.84	0.94	1.05
PUC (SB7)	0.00	0.37	0.67	0.99	1.26	1.55	1.83	2.11	2.39	3.75	4.07	4.37	4.65	4.93	5.19
SECO	0.00	0.05	0.12	0.25	0.37	0.50	0.72	0.73	0.81	1.12	1.28	1.44	1.58	1.72	1.85
Renewables-ERCOT	0.00	4.15	7.53	8.42	8.91	9.03	12.87	17.55	24.11	50.25	54.53	59.16	64.19	69.65	75.57
SEER13-Single Family	0.00	0.57	0.54	0.51	0.49	0.46	0.44	0.42	0.40	0.48	0.46	0.44	0.41	0.39	0.37
SEER13-Multi Family	0.00	0.05	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.04	0.04	0.03	0.03	0.03	0.03
Total OSP (Tons NOx)	**0.00**	**5.20**	**8.99**	**10.41**	**11.42**	**12.20**	**16.82**	**22.22**	**29.76**	**59.00**	**64.58**	**70.53**	**76.90**	**83.71**	**91.00**

[48] The *Mixed eGrid* indicates using 2010 eGrid for the period of 2008 through 2016 and 2016 eGrid for the period of 2017 through 2022 for the NOx reductions calculations.

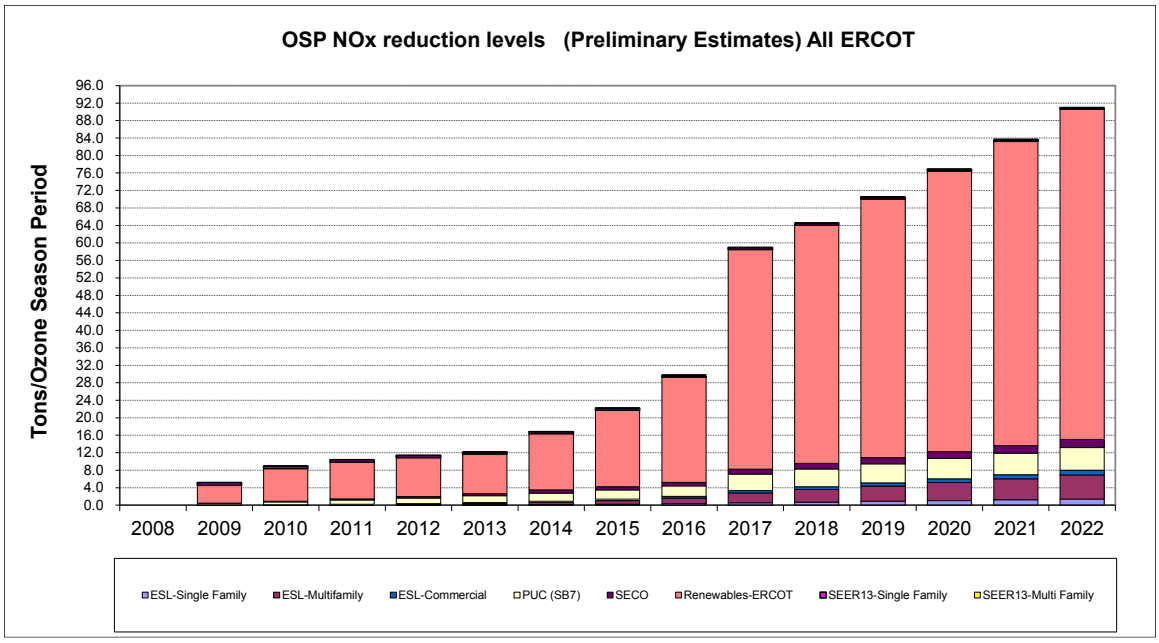

Figure 46: Integrated OSP NOx Emissions Reductions for All Programs Using Mixed eGRID (Base Year 2008)

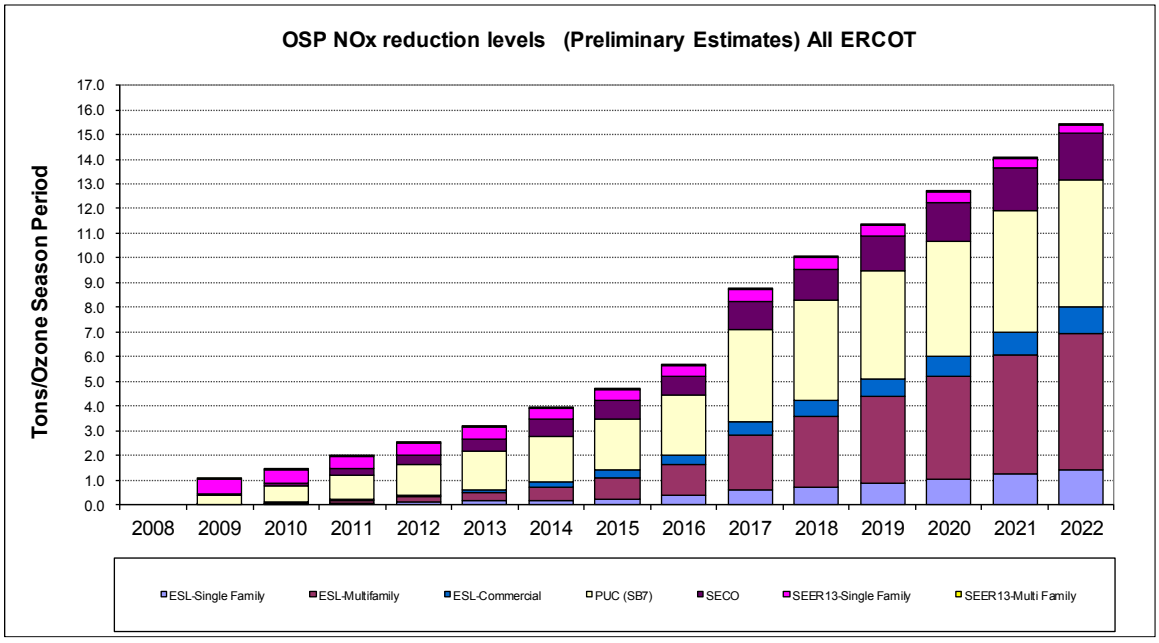

Figure 47: Integrated OSP NOx Emissions Reduction for All Programs Except Renewables Using Mixed eGRID (Base Year 2008)

b. 2010 eGRID Calculations for NOx Emissions Reduction

Figure 48 shows the results of the integrated NOx emissions reduction and Figure 49 shows the same results except renewables using 2010 eGRID through 2022 for the electricity and natural gas savings from the various EE/RE programs. Table 36 shows the annual and OSP NOx emissions reductions values using 2010 eGRID.

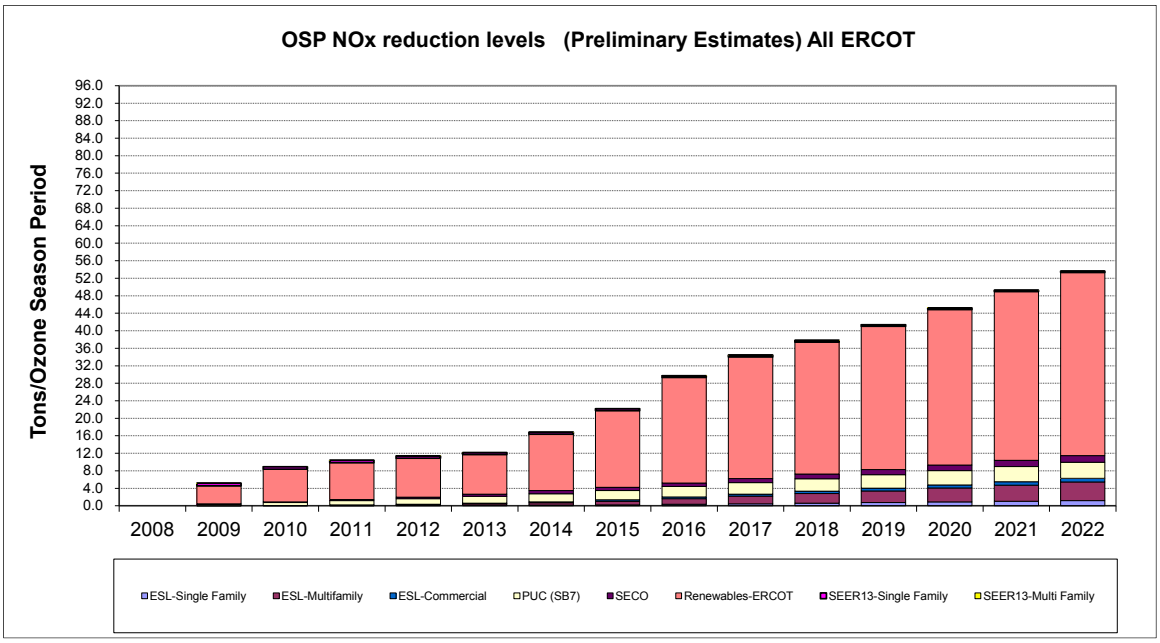

Figure 48: Integrated OSP NOx Emissions Reductions for All Programs Using 2010 eGRID (Base Year 2008)

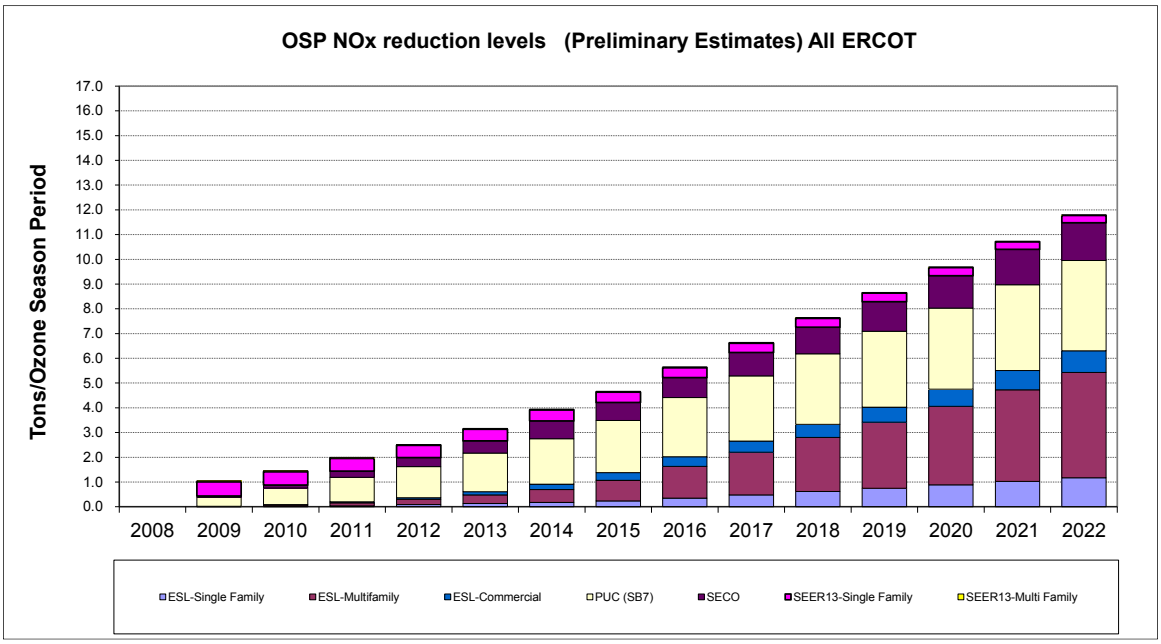

Figure 49: Integrated OSP NOx Emissions Reduction for All Programs Except Renewables Using 2010 eGRID (Base Year 2008)

Table 36: Annual and OSP NOx Emissions Reductions Values using 2010 eGRID (Base Year 2008)

PROGRAM	ANNUAL (in tons NOx)														
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ESL-Single Family	0	3	8	15	34	50	65	86	129	176	225	274	324	376	429
ESL-Multifamily	0	4	19	43	77	127	190	305	468	629	798	974	1,158	1,351	1,553
ESL-Commercial	0	0	5	16	22	47	79	114	141	164	192	222	253	285	318
PUC (SB7)	0	135	246	362	460	567	669	770	874	960	1,042	1,120	1,194	1,265	1,331
SECO	0	19	43	92	133	183	264	265	294	344	392	437	480	521	560
Renewables-ERCOT	0	951	2,645	3,258	3,561	4,693	5,116	5,683	9,359	13,218	14,341	15,560	16,883	18,318	19,875
SEER13-Single Family	0	81	77	73	69	66	62	59	56	53	51	48	46	44	41
SEER13-Multi Family	0	7	6	6	6	6	5	5	5	5	4	4	4	4	3
Total Annual (Tons NOx)	**0**	**1,199**	**3,048**	**3,864**	**4,363**	**5,738**	**6,451**	**7,287**	**11,327**	**15,550**	**17,045**	**18,639**	**20,341**	**22,162**	**24,110**

PROGRAM	OZONE SEASON PERIOD - OSP (in tons NOx/day)														
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ESL-Single Family	0.00	0.01	0.02	0.04	0.09	0.14	0.18	0.24	0.35	0.48	0.62	0.75	0.89	1.03	1.18
ESL-Multifamily	0.00	0.01	0.05	0.12	0.21	0.35	0.52	0.83	1.28	1.72	2.19	2.67	3.17	3.70	4.25
ESL-Commercial	0.00	0.00	0.01	0.04	0.06	0.13	0.22	0.31	0.39	0.45	0.53	0.61	0.69	0.78	0.87
PUC (SB7)	0.00	0.37	0.67	0.99	1.26	1.55	1.83	2.11	2.39	2.63	2.86	3.07	3.27	3.46	3.65
SECO	0.00	0.05	0.12	0.25	0.37	0.50	0.72	0.73	0.81	0.94	1.07	1.20	1.32	1.43	1.53
Renewables-ERCOT	0.00	4.15	7.53	8.42	8.91	9.03	12.87	17.55	24.11	27.81	30.17	32.74	35.52	38.54	41.81
SEER13-Single Family	0.00	0.57	0.54	0.51	0.49	0.46	0.44	0.42	0.40	0.38	0.36	0.34	0.32	0.31	0.29
SEER13-Multi Family	0.00	0.05	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02
Total OSP (Tons NOx)	**0.00**	**5.20**	**8.99**	**10.41**	**11.42**	**12.20**	**16.82**	**22.22**	**29.76**	**34.45**	**37.81**	**41.40**	**45.21**	**49.27**	**53.61**

c. 2016 eGRID Calculations for NOx Emissions Reduction

Figure 50 shows the results of the integrated NOx emissions reduction for all programs and Figure 51 shows the same results except wind using 2016 eGRID through 2022 for the electricity and natural gas savings from the various EE/RE programs. shows the annual and OSP NOx emissions reductions values using 2016 eGRID. Table **37** shows the annual and OSP NOx emissions reductions values using 2016 eGRID.

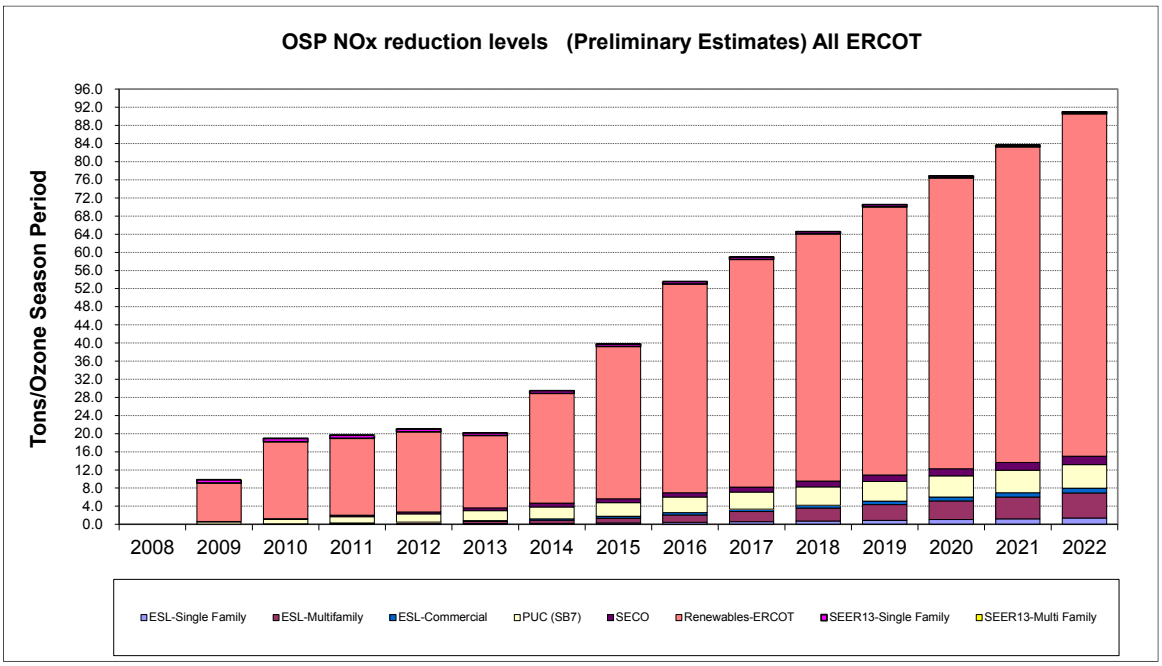

Figure 50: Integrated OSP NOx Emissions Reduction for All Programs Using 2016 eGRID (Base Year 2008)

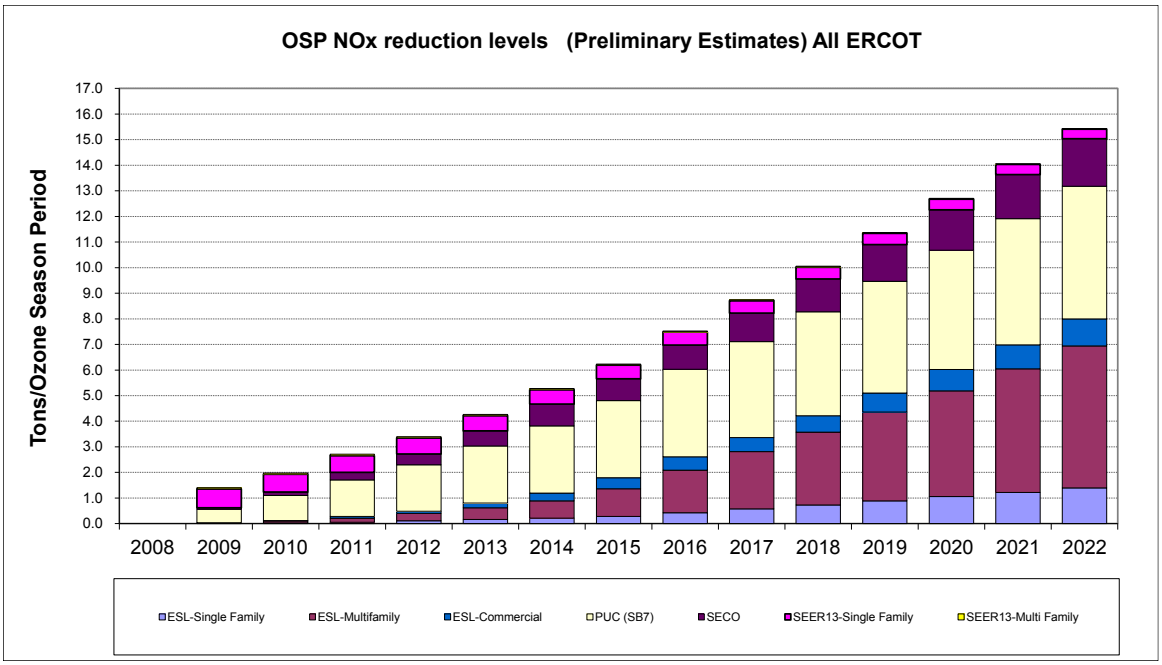

Figure 51: Integrated OSP NOx Emissions Reduction for All Programs Except Renewables Using 2016 eGRID (Base Year 2008)

Table 37: Annual and OSP NOx Emissions Reductions Values using 2016 eGRID (Base Year 2008)

PROGRAM	ANNUAL (in tons NOx)														
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ESL-Single Family	0	4	10	18	41	59	77	102	151	206	263	320	379	440	502
ESL-Multifamily	0	8	27	58	102	163	242	390	601	810	1,028	1,256	1,494	1,744	2,006
ESL-Commercial	0	0	7	24	31	67	109	153	188	197	232	267	304	343	383
PUC (SB7)	0	187	345	505	641	789	930	1,066	1,208	1,326	1,438	1,545	1,646	1,742	1,833
SECO	0	23	49	105	153	210	304	304	338	400	458	514	567	617	665
Renewables-ERCOT	0	1,901	5,553	6,450	7,074	8,456	9,320	10,487	17,151	24,054	26,098	28,316	30,723	33,335	36,168
SEER13-Single Family	0	100	95	90	85	81	77	73	70	66	63	60	57	54	51
SEER13-Multi Family	0	8	8	8	7	7	6	6	6	6	5	5	5	5	4
Total Annual (Tons NOx)	**0**	**2,230**	**6,095**	**7,258**	**8,135**	**9,832**	**11,065**	**12,581**	**19,713**	**27,065**	**29,585**	**32,283**	**35,175**	**38,278**	**41,612**

PROGRAM	OZONE SEASON PERIOD - OSP (in tons NOx/day)														
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ESL-Single Family	0.00	0.01	0.03	0.05	0.12	0.17	0.21	0.28	0.42	0.57	0.73	0.89	1.05	1.22	1.39
ESL-Multifamily	0.00	0.02	0.08	0.16	0.28	0.45	0.67	1.08	1.66	2.24	2.84	3.47	4.13	4.82	5.54
ESL-Commercial	0.00	0.00	0.02	0.07	0.09	0.19	0.31	0.43	0.53	0.54	0.64	0.74	0.84	0.94	1.05
PUC (SB7)	0.00	0.53	0.97	1.43	1.81	2.23	2.63	3.01	3.41	3.75	4.07	4.37	4.65	4.93	5.19
SECO	0.00	0.06	0.14	0.29	0.43	0.59	0.85	0.85	0.95	1.12	1.28	1.44	1.58	1.72	1.85
Renewables-ERCOT	0.00	8.49	17.01	17.00	17.67	15.98	24.23	33.58	46.06	50.25	54.53	59.16	64.19	69.64	75.56
SEER13-Single Family	0.00	0.73	0.69	0.66	0.62	0.59	0.56	0.53	0.51	0.48	0.46	0.44	0.41	0.39	0.37
SEER13-Multi Family	0.00	0.06	0.06	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03
Total OSP (Tons NOx)	**0.00**	**9.89**	**18.99**	**19.71**	**21.07**	**20.24**	**29.51**	**39.82**	**53.58**	**59.00**	**64.58**	**70.53**	**76.90**	**83.71**	**91.00**