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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 2013-December 2013

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November 2014
(Revised December 2014)

ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

TEXAS A&M ENGINEERING EXPERIMENT STATION

Energy Systems Laboratory

November 14, 2014

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

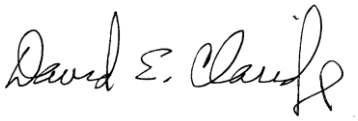
Dear Chairman Shaw:

The Energy Systems Laboratory (ESL) at the Texas Engineering Experiment Station of the Texas A&M University System is pleased to provide its annual report, "Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP)," as required under Texas Health and Safety Code Ann. § 388.003 (e) (Senate Bill 5, 77R as amended 78 R & 78S).

The Laboratory 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) 845-1280 should you or any of the TCEQ staff have any questions concerning this report or any of the work presently being done to quantify emissions reduction from energy efficiency and renewable energy measures as a result of the TERP implementation.

Sincerely,



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

Enclosure

cc: Commissioner Toby Baker
Executive Director Zak Covar
Executive Director Richard A. Hyde, P.E.

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VOLUME I – TECHNICAL REPORT

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

Executive Summary

The Energy Systems Laboratory (Laboratory), at the Texas Engineering Experiment Station of The Texas A&M University System, in fulfillment of its responsibilities under Texas Health and Safety Code Ann. § 388.003 (e), 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 congestion management zones. As the TCEQ moved the base year to more recent years, this updated version of eGRID, representing the current Texas market, has been used to estimate the emissions reduction from wind power in the next year's report.

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 2012 IECC and the ASHRAE Standards 90.1-2010. 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 2020 for the electricity and natural gas savings from the various EE/RE programs.

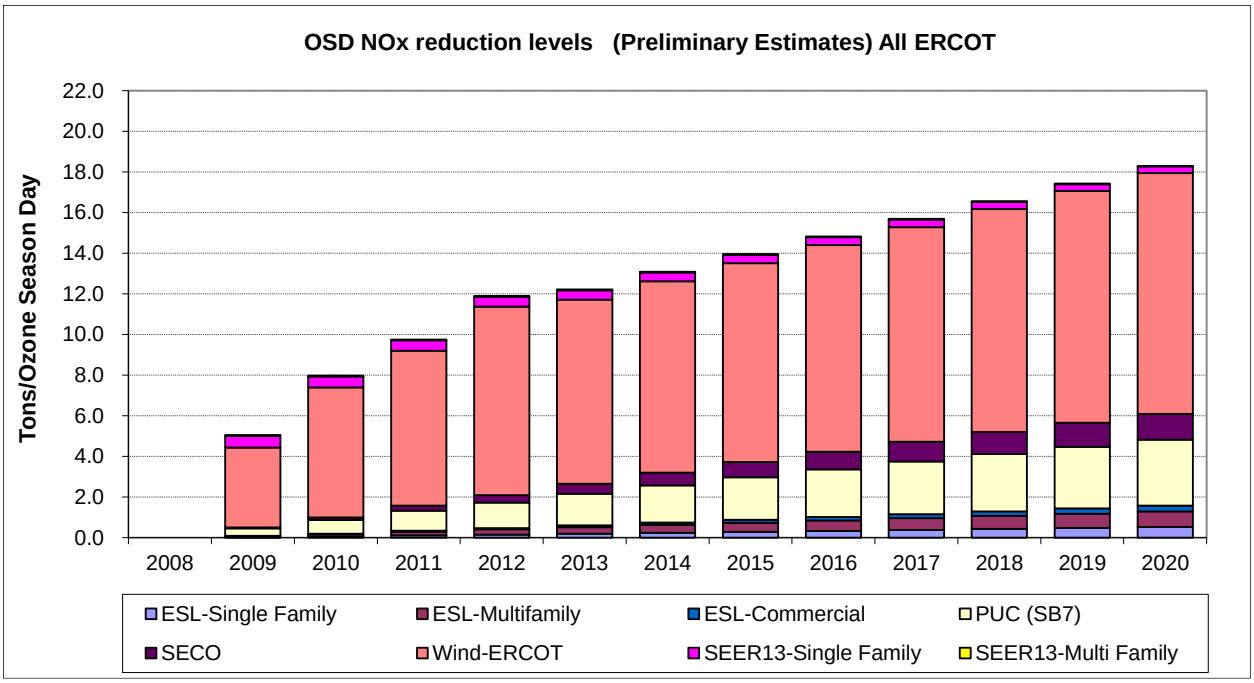

Figure 1: OSD NOx Emissions Reduction Projections through 2020 (Base Year 2008)

In 2013 (Table 1), the total integrated annual savings from all programs are 19,704,209 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction are 704,919 MWh/year (3.6% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program are 2,267,414 MWh/year (11.5%),
- Savings from SECO's Senate Bill 5 program are 705,060 MWh/year (3.6%),
- Electricity savings from green power purchases (wind) are 15,723,534 MWh/year (79.8%), and
- Savings from residential air conditioner retrofits[1] are 303,282 MWh/year (1.5%).

By 2015, the total integrated annual savings from all programs will be 22,508,426 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction will be 1,111,655 MWh/year (4.9% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program will be 3,075,280 MWh/year (13.7%),
- Savings from SECO's Senate Bill 5 program will be 1,069,420 MWh/year (4.8%),
- Electricity savings from green power purchases (wind) will be 16,978,360 MWh/year (75.4%), and
- Savings from residential air conditioner retrofits will be 273,712 MWh/year (1.2%).

In 2013 (Table 2), the total integrated annual NOx emissions reductions from all programs are 5,397 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 177 tons-NOx/year (3.3% of the total NOx savings),
- NOx emissions reductions from the PUC's Senate Bill 7 programs are 567 tons-NOx/year (10.5%),
- NOx emissions reductions from SECO's Senate Bill 5 program are 183 tons-NOx/year (3.4%),
- NOx emissions reductions from green power purchases (wind) are 4,399 tons-NOx/year (81.5%), and
- NOx emissions reductions from residential air conditioner retrofits are 71 tons-NOx/year (1.3%).

[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.

By 2015, the total integrated annual NOx emissions reductions from all programs will be 6,133 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 279 tons-NOx/year (4.6% of the total NOx savings),
- NOx emissions reductions from the PUC's Senate Bill 7 programs will be 766 tons-NOx/year (12.5%),
- NOx emissions reductions from SECO's Senate Bill 5 program will be 274 tons-NOx/year (4.5%),
- NOx emissions reductions from green power purchases (wind) will be 4,750 tons-NOx/year (77.4%), and
- NOx emissions reductions from residential air conditioner retrofits will be 64 tons-NOx/year (1.0%).

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

PROGRAM	ANNUAL												
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family (MWh)	0	21,748	55,268	93,760	153,171	220,975	289,761	359,587	430,512	502,596	575,901	650,492	726,432
ESL-Multifamily (MWh)	0	50,218	94,867	167,566	262,939	357,717	452,100	546,119	639,803	733,182	826,287	919,146	1,011,789
ESL-Commercial (MWh)	0	0	25,750	54,550	87,230	126,228	165,790	205,950	246,741	288,199	330,358	373,255	416,928
PUC (SB7) (MWh)	0	538,841	976,984	1,437,883	1,831,318	2,267,414	2,681,704	3,075,280	3,449,177	3,804,380	4,141,822	4,462,392	4,766,933
SECO (MWh)	0	71,910	154,786	347,175	508,375	705,060	891,911	1,069,420	1,238,053	1,398,254	1,550,445	1,695,027	1,832,380
Wind-ERCOT (MWh)	0	3,273,150	8,135,429	10,995,427	13,049,580	15,723,534	16,338,905	16,978,360	17,642,840	18,333,327	19,050,837	19,796,428	20,571,199
SEER13-Single Family (MWh)	0	343,330	326,163	309,855	294,362	279,644	265,662	252,379	239,760	227,772	216,383	205,564	195,286
SEER13-Multifamily (MWh)	0	29,021	27,569	26,191	24,881	23,637	22,456	21,333	20,266	19,253	18,290	17,376	16,507
Total Annual (MWh)	0	4,328,218	9,796,817	13,432,406	16,211,857	19,704,209	21,108,289	22,508,426	23,907,152	25,306,962	26,710,324	28,119,680	29,537,454

PROGRAM	OZONE SEASON DAY - OSD												
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family (MWh)	0	124	283	468	626	808	992	1,180	1,370	1,564	1,761	1,962	2,166
ESL-Multifamily (MWh)	0	233	460	744	999	1,253	1,507	1,759	2,010	2,261	2,511	2,760	3,009
ESL-Commercial (MWh)	0	0	71	149	239	346	454	564	676	790	905	1,023	1,142
PUC (SB7) (MWh)	0	1,476	2,677	3,939	5,017	6,212	7,347	8,425	9,450	10,423	11,347	12,226	13,060
SECO (MWh)	0	197	424	951	1,393	1,932	2,444	2,930	3,392	3,831	4,248	4,644	5,020
Wind-ERCOT (MWh)	0	14,246	23,054	27,654	33,273	32,560	33,834	35,158	36,534	37,964	39,450	40,994	42,598
SEER13-Single Family (MWh)	0	2,445	2,323	2,207	2,097	1,992	1,892	1,798	1,708	1,622	1,541	1,464	1,391
SEER13-Multifamily (MWh)	0	195	186	176	167	159	151	144	136	130	123	117	111
Total OSD (MWh)	0	18,918	29,477	36,289	43,812	45,262	48,621	51,958	55,277	58,584	61,887	65,189	68,498

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

PROGRAM	ANNUAL (in tons NOx)												
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family	0	5	14	23	38	54	71	89	106	124	142	160	179
ESL-Multifamily	0	13	24	43	67	91	115	139	163	187	210	234	257
ESL-Commercial	0	0	6	14	22	32	41	52	62	72	83	94	105
PUC (SB7)	0	135	246	362	460	567	669	766	858	945	1,028	1,107	1,182
SECO	0	19	43	92	133	183	230	274	317	357	395	432	466
Wind-ERCOT	0	895	2,262	3,053	3,648	4,399	4,571	4,750	4,936	5,129	5,330	5,538	5,755
SEER13-Single Family	0	81	77	73	69	66	62	59	56	53	51	48	46
SEER13-Multifamily	0	7	6	6	6	6	5	5	5	5	4	4	4
Total Annual (Tons NOx)	0	1,154	2,677	3,664	4,443	5,397	5,765	6,133	6,502	6,872	7,243	7,617	7,993

PROGRAM	OZONE SEASON DAY - OSD (in tons NOx/day)												
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family	0	0.03	0.07	0.11	0.15	0.20	0.24	0.29	0.34	0.39	0.43	0.48	0.53
ESL-Multifamily	0	0.06	0.12	0.19	0.26	0.32	0.38	0.45	0.51	0.57	0.64	0.70	0.76
ESL-Commercial	0	0.00	0.02	0.04	0.06	0.09	0.11	0.14	0.17	0.20	0.23	0.26	0.29
PUC (SB7)	0	0.37	0.67	0.99	1.26	1.55	1.83	2.10	2.35	2.59	2.82	3.03	3.24
SECO	0	0.05	0.12	0.25	0.37	0.50	0.63	0.75	0.87	0.98	1.08	1.18	1.28
Wind-ERCOT	0	3.93	6.40	7.62	9.28	9.06	9.41	9.78	10.16	10.56	10.98	11.40	11.85
SEER13-Single Family	0	0.57	0.54	0.51	0.49	0.46	0.44	0.42	0.40	0.38	0.36	0.34	0.32
SEER13-Multifamily	0	0.05	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03
Total OSD (Tons NOx)	0	5.05	7.97	9.76	11.90	12.22	13.09	13.96	14.83	15.69	16.56	17.43	18.30

d. Technology Transfer

The Laboratory, along with the TCEQ, hosts the annual Clean Air Through Energy Efficiency (CATEE) conference, which is attended by top experts and policy makers in Texas and from around the country. At the conference, the latest educational programs and technology is 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 will continue to provide 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 Texas Health and Safety Code Ann. § 388.003 (e). If any questions arise, please contact us by phone at 979-862-2804, or by email at terpinfo@tees.tamus.edu.

Acknowledgements

This work has been completed as a fulfillment of the requirements in Texas Health Code, Senate Bill 5, Section 388.003, and through Senate Bill 20, House Bill 2481 and House Bill 2129, which requires the Laboratory 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). Similarly, selected Code training workshops were funded by the US DOE through the Texas State Energy Conservation Office (SECO). Partial funding on the Texas Climate Vision project, a joint project with the City of Austin was also provided by the US DOE through SECO.

The authors are also grateful for the timely input provided by the following individuals, and agencies: Mr. 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, Sukjoon Oh and Yifu Sun.

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1 Overview

The Energy Systems Laboratory (Laboratory), at the Texas Engineering Experiment Station 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 Texas Health and Safety Code Ann. § 388.003 (e). This annual report:

- Provides an estimate of the energy savings and NOx reductions from energy code compliance in new residential construction in all ERCOT counties;
- Provides an estimate of the standardized, cumulative, integrated energy savings and NOx reductions from the TERP programs implemented by the Laboratory, SECO, the 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) the Laboratory's responsibilities under TERP increased as new legislatively allocated energy efficiency initiatives were introduced:

- 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 annually shall report 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 each year 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) the Laboratory's responsibilities under TERP kept the same as previous years.

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; and $434,481.91 in FY 2012 (with the 50% Legislature cut in ESL funding). In FY 2013 the Laboratory expended $447,907.94. 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 was 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, with the laboratory's recommendations and additional input from stakeholder meetings and public comment

periods, 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 July 2011, the Laboratory began the stringency review of the newly published 2012 IRC and IECC. In December 2011, the Laboratory provided the findings of the technical analysis of stringency to SECO, indicating that both the residential and the commercial provisions of the 2012 code are more stringent than the TBEPS, which are based on the 2009 code. In 2012, in accordance with the Health and Safety Code Section 388.003, as amended, the Laboratory reviewed and considered all 1,526 comments collected by SECO from both the individuals and the large constituencies during the public comment period. In July, 2012, the Laboratory held a stakeholders meeting in which the Laboratory presented the stringency analysis and findings and reviewed the public comments consideration and analysis. In August 2012 the Laboratory provided SECO with a final recommendation and analysis regarding the stringency and environmental impact of Chapter 11, 2012 IRC and the 2012 IECC versus the current TBEPS, based on Chapter 11 of the 2009 IRC and the 2009 IECC. The Laboratory recommended SECO to adopt Chapter 11 of the 2012 IRC, as published, as the state-mandated energy code for all residential construction, one- and two-family residences of three stories or less above grade, and to adopt the 2012 IECC, as published, for commercial, industrial and residential buildings over three stories.

As of the time of this report, SECO has not adopted the 2012.

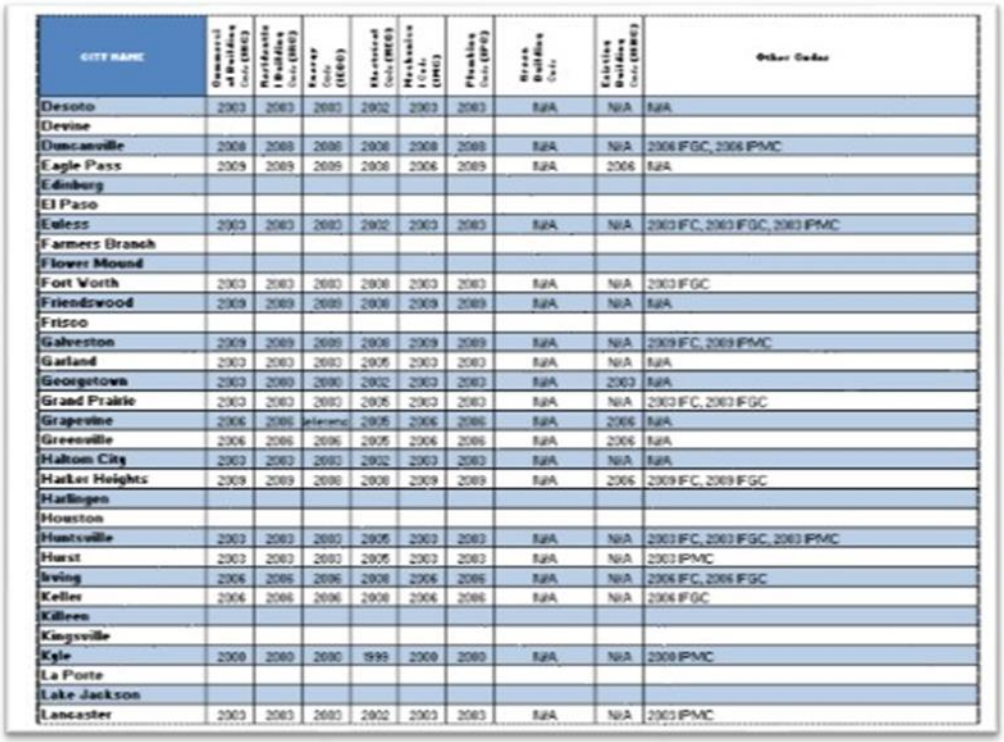
Table 3: Code adoptions

CITY NAME	Commercial Building Code (IBC)	Residential Building Code (IRC)	Energy Code (IECC)	Electrical Code (NEC)	Mechanical Code (IMC)	Plumbing Code (IPC)	Green Building Code	Existing Building Code (IEBC)	Other Codes
Abilene	2003	2003	2000	2008	2003	2003	N/A	2003	2003 IFGC
Addison									
Allen									
Amarillo	2006	2006	2006	2008	2006	2006	N/A	2006	2006 IFC, 2006 IFGC
Angleton									
Arlington	2003	2003	2003	2002	2003	2003	N/A	N/A	2003 IFC, 2003 IFGC
Austin									
Bagtown	2006	2006	2006	2008	2006	2006	N/A	2006	N/A
Beaumont									
Bedford									
Big Spring	2006	2006	2006	2005	2006	2006	N/A	2006	N/A
Borger									
Brownsville	2006	2006	2006	2008	2006	2006	N/A	N/A	2006 IFGC
Bryan	2003	2003	2003	2002	2003	2003	N/A	2003	2003 IFGC
Burleson	2006	2006	2006	2005	2006	2006	N/A	N/A	North Central Texas Council of Government Amendment
Carrollton *	2006	2006	2006	2008	2006	2006	N/A	N/A	NCTCOG Recommended Regional Amendments
Cedar Hill	2006	2006	2006	2008	2006	2006	N/A	N/A	2006 IFGC
Cedar Park	2009	2009	2009	2008	2009	2009	N/A	2009	2006 IFC with Ammendments; 2009 IPMC
Cleburne	2003	2003	2003	2002	2003	2003	N/A	N/A	N/A
College Station	2009	2009	2009	2008	2009	2009	N/A	N/A	N/A
Conroe	2003	N/A	N/A	2008	2006	2006	N/A	N/A	2003 IFC
Coppell	N/A	2006	2006	2005	2006	2006	N/A	2006	2006 IFC, 2006 IFGC, 2006 IPMC
Copperas Cove									
Corpus Christi	2003	2003	2003	2002	2003	2003	N/A	N/A	N/A
Corsicana	2009	2009	N/A	2008	2009	2009	N/A	N/A	N/A
Dallas	2006	2006	2006	2008	2006	2006	City of Dallas Ordinance #003070	2003	2006 IFC, 2006 IFGC
Deer Park									
Del Rio									
Denton									

Table 3: Code adoptions (Continued)

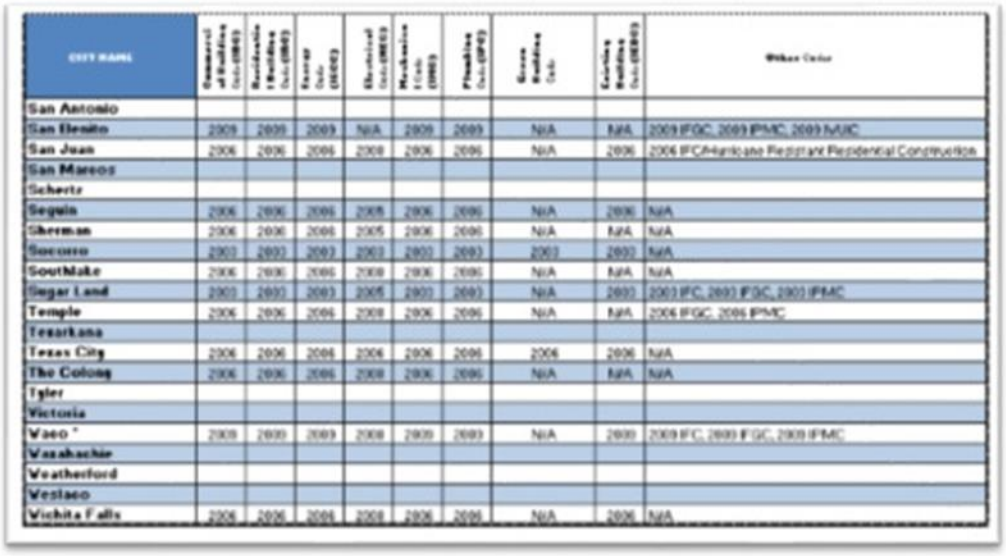
CITY NAME	Commercial Building Code (IBC)	Residential Building Code (IRC)	Energy Code (IECC)	Electrical Code (NEC)	Mechanical Code (IMC)	Plumbing Code (IPC)	Green Building Code	Existing Building Code (IEBC)	Other Codes
Desoto	2003	2003	2000	2002	2003	2003	N/A	N/A	N/A
Devine									
Duncanville	2006	2006	2006	2008	2006	2006	N/A	N/A	2006 IFGC, 2006 IPMC
Eagle Pass	2009	2009	2009	2008	2006	2009	N/A	2006	N/A
Edinburg									
El Paso									
Euless	2003	2003	2000	2002	2003	2003	N/A	N/A	2003 IFC, 2003 IFGC, 2003 IPMC
Farmers Branch									
Flower Mound									
Fort Worth	2003	2003	2000	2008	2003	2003	N/A	N/A	2003 IFGC
Friendswood	2009	2009	2000	2008	2009	2009	N/A	N/A	N/A
Frisco									
Galveston	2009	2009	2000	2008	2009	2009	N/A	N/A	2009 IFC, 2009 IPMC
Garland	2003	2003	2000	2005	2003	2003	N/A	N/A	N/A
Georgetown	2003	2003	2000	2002	2003	2003	N/A	2003	N/A
Grand Prairie	2003	2003	2000	2005	2003	2003	N/A	N/A	2003 IFC, 2003 IFGC
Grapevine	2006	2006	[illegible]	2005	2006	2006	N/A	2006	N/A
Greenville	2006	2006	2006	2005	2006	2006	N/A	2006	N/A
Haltom City	2003	2003	2000	2002	2003	2003	N/A	N/A	N/A
Harker Heights	2009	2009	2000	2008	2009	2009	N/A	2006	2009 IFC, 2009 IFGC
Harlingen									
Houston									
Huntsville	2003	2003	2000	2005	2003	2003	N/A	N/A	2003 IFC, 2003 IFGC, 2003 IPMC
Hurst	2003	2003	2000	2005	2003	2003	N/A	N/A	2003 IPMC
Irving	2006	2006	2006	2008	2006	2006	N/A	N/A	2006 IFC, 2006 IFGC
Keller	2006	2006	2006	2008	2006	2006	N/A	N/A	2006 IFGC
Killeen									
Kingsville									
Kyle	2009	2009	2000	1999	2009	2009	N/A	N/A	2009 IPMC
La Porte									
Lake Jackson									
Lancaster	2003	2003	2000	2002	2003	2003	N/A	N/A	2003 IPMC

Table 3: Code adoptions (Continued)



CITY NAME	Commercial Building Code (IECC)	Residential Building Code (IECC)	Energy Code (IECC)	Electrical Code (NEC)	Mechanical Code (IMC)	Plumbing Code (IPC)	Green Building Code	Existing Building Code (IEBC)	Other Codes
Desoto	2003	2003	2003	2002	2003	2003	N/A	N/A	N/A
Devine									
Duncanville	2008	2008	2008	2008	2008	2008	N/A	N/A	2006 IFGC, 2006 IPMC
Eagle Pass	2009	2009	2009	2008	2006	2009	N/A	2006	N/A
Edinburg									
El Paso									
Euless	2003	2003	2003	2002	2003	2003	N/A	N/A	2003 IFC, 2003 IFGC, 2003 IPMC
Farmers Branch									
Flower Mound									
Fort Worth	2003	2003	2003	2008	2003	2003	N/A	N/A	2003 IFGC
Friendswood	2009	2009	2009	2008	2009	2009	N/A	N/A	N/A
Frisco									
Galveston	2009	2009	2009	2008	2009	2009	N/A	N/A	2009 IFC, 2009 IPMC
Garland	2003	2003	2003	2005	2003	2003	N/A	N/A	N/A
Georgetown	2003	2003	2003	2002	2003	2003	N/A	2003	N/A
Grand Prairie	2003	2003	2003	2005	2003	2003	N/A	N/A	2003 IFC, 2003 IFGC
Grapevine	2006	2006	[illegible]	2005	2006	2006	N/A	2006	N/A
Greenville	2006	2006	2006	2005	2006	2006	N/A	2006	N/A
Haltom City	2003	2003	2003	2002	2003	2003	N/A	N/A	N/A
Harker Heights	2009	2009	2009	2008	2009	2009	N/A	2006	2009 IFC, 2009 IFGC
Harlingen									
Houston									
Huntsville	2003	2003	2003	2005	2003	2003	N/A	N/A	2003 IFC, 2003 IFGC, 2003 IPMC
Hurst	2003	2003	2003	2005	2003	2003	N/A	N/A	2003 IPMC
Irving	2006	2006	2006	2008	2006	2006	N/A	N/A	2006 IFC, 2006 IFGC
Keller	2006	2006	2006	2008	2006	2006	N/A	N/A	2006 IFGC
Killeen									
Kingsville									
Kyle	2009	2009	2009	1999	2009	2009	N/A	N/A	2009 IPMC
La Porte									
Lake Jackson									
Lancaster	2003	2003	2003	2002	2003	2003	N/A	N/A	2003 IPMC

Table 3: Code adoptions (continued)



CITY NAME	Commercial Building Code (IECC)	Residential Building Code (IECC)	Energy Code (IECC)	Electrical Code (NEC)	Mechanical Code (IMC)	Plumbing Code (IPC)	Green Building Code	Existing Building Code (IEBC)	Other Codes
San Antonio									
San Benito	2009	2009	2009	N/A	2009	2009	N/A	N/A	2009 IFGC, 2009 IPMC, 2009 MJC
San Juan	2006	2006	2006	2009	2006	2006	N/A	2006	2006 IFC/Hurricane Region/ Residential Construction
San Marcos									
Schertz									
Seguin	2006	2006	2006	2005	2006	2006	N/A	2006	N/A
Sherman	2006	2006	2006	2005	2006	2006	N/A	N/A	N/A
Socorro	2003	2003	2003	2003	2003	2003	2003	2003	N/A
Southlake	2006	2006	2006	2008	2006	2006	N/A	N/A	N/A
Sugar Land	2003	2003	2003	2005	2003	2003	N/A	2003	2003 IFC, 2003 IFGC, 2003 IPMC
Temple	2006	2006	2006	2008	2006	2006	N/A	N/A	2006 IFGC, 2006 IPMC
Texarkana									
Texas City	2006	2006	2006	2006	2006	2006	2006	2006	N/A
The Colony	2006	2006	2006	2008	2006	2006	N/A	N/A	N/A
Tyler									
Victoria									
Waco *	2009	2009	2009	2008	2009	2009	N/A	2009	2009 IFC, 2009 IFGC, 2009 IPMC
Waxahachie									
Weatherford									
Westlaco									
Wichita Falls	2006	2006	2006	2008	2006	2006	N/A	2006	N/A

1.4 Accomplishments since January 2013

Since January 2013, 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 energy code compliance software based on the Texas Building Energy Performance Standards by resolving minor defects found in the model, updating manual and illustrations, adding support for Manual J, and supporting amendments to the 2012 code for NCTCOG;
- 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 21st Building Professional Institute (BPI), UT Arlington;
- 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;
- Reviewed several local code proposed amendments and analyzed their stringency. For: the City of Houston. and the North Central Texas Council of Governments (NCTCOG);
- Hosted the Clean Air Through Energy Efficiency (CATEE) Conference in December 2013, 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: Residential Energy Performance; Commercial & Institutional Green Building Performance; Utility Efficiency Resources, Achievements, Challenges; Learning from Green Schools; Modeling and Data-Driven Design Tools; Energy Efficiency & Demand Response: The Future; Implementing PACE in Texas: PACE in a Box; Advancing Energy Codes; Innovative Technologies and Techniques; Collaboration is the Key; Alternative Financing for Energy Efficiency; Energy/Water Nexus; Commissioning for High Performance; A Conversation with Leading Legislators, the Hon. Rafael Anchia, and the Hon. John Raney;
- 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.
- Enhanced the web-based emissions reduction calculator, including:
  - Added in Manual J calculations to make the result more accurate,
  - Added the 2012 NCTCOG IECC versions, and
  - Improved the help text and images to make it clearer.
- 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 a project with 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). From January to April 2013, the project focused on reviewing the current practice of local jurisdictions to meet compliance with the Texas Building Energy Performance Standards -- the energy efficiency chapter of the 2009 International Residential Code (IRC) for single-family residential construction, and the 2009 International Energy Conservation Code (IECC) for commercial and residential construction, excluding single-family.

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:

- Delivered "Statewide Air Emissions Calculations from Wind and Other Renewables," to the Texas Commission on Environmental Quality in July 2013;

- Updated previously developed degradation analysis to determine if degradation could be observed in the measured power from Texas wind farms;
- 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.

Presentations of three papers at the 13th International Conference for Enhanced Building Operations, held in Montréal, Québec, Canada, October 2013

- Haberl, J.; Yazdani, B.; Baltazar, J.C.; Kim, H.; Mukhopadhyay, J.; Zilbershtein,G.; Ellis, S.; Parker, P., 2013 "Calculation of Integrated NOx Emissions Reductions from Energy Efficiency and Renewable Energy (EE/RE) Programs across State Agencies in Texas" *Proceedings of the 13th International Conference for Enhanced Building Operations,* Montréal, Québec, Canada, October 2013
- Mukhopadhyay, J.; Baltazar, J.C.; Haberl, J.; Loyd, CT., 2013 "Comparing the Performance of a 2009 IECC Code-Compliant House Using Code-Compliant Residential Simulation Programs" *Proceedings of the 13th International Conference for Enhanced Building Operations,* Montréal, Québec, Canada, October 2013
- Kim, H.; Mukhopadhyay, J.; Baltazar, J.C.; Haberl,J.; Yazdani, B., 2013 "Analysis of Code-Compliant Construction in Texas Based on Texas Building Energy Performance Standards (TBEPS)" *Proceedings of the 13th International Conference for Enhanced Building Operations,* Montréal, Québec, Canada, October 2013

Two presentations to the Clean Air Through Energy Efficiency Conference held in San Antonio, Texas, December 2013.

- Ellis, S., 2013 "2015 IECC: What's new in next edition" *Clean Air Through Energy Efficiency Conference,* San Antonio, Texas, December 2013
- Haberl, J.; Yazdani, B.; Culp, 2013 "EE/RE Impacts on Emission Reductions" *Clean Air Through Energy Efficiency Conference,* San Antonio, Texas, December 2013

Presentations of two papers at the ISES Solar World Congress, held in Cancun, Mexico, November 2013

- Kim, K.; Baltazar, J.C.; Haberl, J., 2013 "Evaluation of Meteorological Base Models for Estimating Hourly Global Solar Radiation in Texas" *Proceedings of the ISES Solar World Congress,* Cancun, Mexico, November 2013
- Baltazar, J.C.; Sun, Y.; Haberl, J., 2013 "Improved Methodology to Measure Normal Incident Solar Radiation with a Multi-Pyranometer Array" *Proceedings of the ISES Solar World Congress,* Cancun, Mexico, November 2013

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 Constructions, 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 2013, the following savings were calculated:

- In 2013, the annual electricity savings from code-compliant residential and commercial constructions are 704,919 MWh/year (3.6% of the total electricity savings),
- Savings from residential air conditioner retrofits[2] are 303,282 MWh/year (1.5%).

- In 2013, the OSD electricity savings from code-compliant residential and commercial constructions are 2,407 MWh/day (5.3%),
- Savings from residential air conditioner retrofits are 2,151 MWh/day (4.8%).

- By 2015, the annual electricity savings from code-compliant residential and commercial constructions will be 1,111,655 MWh/year (4.9% of the total electricity savings),
- Savings from residential air conditioner retrofits will be 273,712 MWh/year (1.2%).

- By 2015, the OSD electricity savings from code-compliant residential and commercial constructions will be 3,503 MWh/day (6.7%),
- Savings from residential air conditioner retrofits will be 1,941 MWh/day (3.7%).

- In 2013, the annual NOx emissions reduction from code-compliant residential and commercial constructions are 177 tons-NOx/year (3.3% of the total NOx savings),
- NOx emissions reductions from residential air conditioner retrofits are 71 tons-NOx/year (1.3%).

- In 2013, the OSD NOx emissions reduction from code-compliant residential and commercial constructions are 0.60 tons-NOx/day (4.9%),
- NOx emissions reductions from residential air conditioner retrofits are 0.50 tons-NOx/day (4.1%).

- By 2015, the NOx emissions reduction from code-compliant residential and commercial constructions will be 279 tons-NOx/year (4.6% of the total NOx savings),
- NOx emissions reductions from residential air conditioner retrofits will be 64 tons-NOx/year (1.0%).

- By 2015, the OSD NOx emissions reduction from code-compliant residential and commercial constructions will be 0.88 tons-NOx/day (6.3%),

[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.

- NOx emissions reductions from residential air conditioner retrofits will be 0.45 tons-NOx/day (3.2%).

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 2013, the total integrated annual savings from all programs are 19,704,380 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction are 705,090 MWh/year (3.6% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program are 2,267,414 MWh/year (11.5%),
- Savings from SECO's Senate Bill 5 program are 705,060 MWh/year (3.6%),
- Electricity savings from green power purchases (wind) are 15,723,534 MWh/year (79.8%), and
- Savings from residential air conditioner retrofits[3] are 303,282 MWh/year (1.5%).

In 2013, the total integrated OSD savings from all programs are 45,262 MWh/day, which would be a 1,886 MW average hourly load reduction during the OSD period. The integrated OSD electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction are 2,407 MWh/day (5.3%),
- Savings from the PUC's Senate Bill 7 programs are 6,212 MWh/day (13.7%),
- Savings from SECO's Senate Bill 5 program are 1,932 MWh/day (4.3%),
- Electricity savings from green power purchases (wind) are 32,560 MWh/day (71.9%), and
- Savings from residential air conditioner retrofits are 2,151 MWh/day (4.8%)

By 2015, the total integrated annual savings from all programs will be 22,508,426 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction will be 1,111,655 MWh/year (4.9% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program will be 3,075,280 MWh/year (13.7%),
- Savings from SECO's Senate Bill 5 program will be 1,069,420 MWh/year (4.8%),
- Electricity savings from green power purchases (wind) will be 16,978,360 MWh/year (75.4%), and
- Savings from residential air conditioner retrofits will be 273,712 MWh/year (1.2%).

By 2015, the total integrated OSD savings from all programs will be 51,958 MWh/day, which would be a 2,165 MW average hourly load reduction during the OSD period. The integrated OSD electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction will be 3,503 MWh/day (6.7%),
- Savings from the PUC's Senate Bill 7 programs will be 8,425 MWh/day (16.2%),
- Savings from SECO's Senate Bill 5 program will be 2,930 MWh/day (5.6%),
- Electricity savings from green power purchases (wind) will be 35,158 MWh/day (67.7%), and

[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.

- Savings from residential air conditioner retrofits will be 1,941 MWh/day (3.7%).

In 2013, the total integrated annual NOx emissions reductions from all programs are 5,397 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 177 tons-NOx/year (3.3% of the total NOx savings),
- NOx emissions reductions from the PUC's Senate Bill 7 programs are 567 tons-NOx/year (10.5%),
- NOx emissions reductions from SECO's Senate Bill 5 program are 183 tons-NOx/year (3.4%),
- NOx emissions reductions from green power purchases (wind) are 4,399 tons-NOx/year (81.5%), and
- NOx emissions reductions from residential air conditioner retrofits are 71 tons-NOx/year (1.3%).

In 2013, the total integrated OSD NOx emissions reductions from all programs are 12.22 tons-NOx/day. The integrated OSD NOx emissions reductions from all the different programs are:

- NOx emissions reductions from code-compliant residential and commercial construction are 0.60 tons-NOx/day (4.9%),
- NOx emissions reductions from the PUC's Senate Bill 7 programs are 1.55 tons-NOx/day (12.7%),
- NOx emissions reductions from SECO's Senate Bill 5 program are 0.50 tons-NOx/day (4.1%),
- NOx emissions reductions from green power purchases (wind) are 9.06 tons-NOx/day (74.1%), and
- NOx emissions reductions from residential air conditioner retrofits are 0.50 tons-NOx/day (4.1%).

By 2015, the total integrated annual NOx emissions reductions from all programs will be 6,133 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 279 tons-NOx/year (4.6% of the total NOx savings),
- NOx emissions reductions from the PUC's Senate Bill 7 programs will be 766 tons-NOx/year (12.5%),
- NOx emissions reductions from SECO's Senate Bill 5 program will be 274 tons-NOx/year (4.5%),
- NOx emissions reductions from green power purchases (wind) will be 4,750 tons-NOx/year (77.4%), and
- NOx emissions reductions from residential air conditioner retrofits will be 64 tons-NOx/year (1.0%).

By 2015, the total integrated OSD NOx emissions reductions from all programs will be 13.96 tons-NOx/day. The integrated OSD NOx emissions reductions from all the different programs are:

- NOx emissions reductions from code-compliant residential and commercial construction will be 0.88 tons-NOx/day (6.3%),
- NOx emissions reductions from the PUC's Senate Bill 7 programs will be 2.10 tons-NOx/day (15.0%),
- NOx emissions reductions from SECO's Senate Bill 5 program will be 0.75 tons-NOx/day (5.4%),
- NOx emissions reductions from green power purchases (wind) will be 9.78 tons-NOx/day (70.1%), and
- NOx emissions reductions from residential air conditioner retrofits will be 0.45 tons-NOx/day (3.2%).

Table 4: Adjustment Factors used for the Calculation of the Annual and OSD NOx Savings for the Different Programs

	ESL-Single Family	ESL-Multi Family	ESL-Commercial	PUC (SB7)	SECO	Wind-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%	10.0%	20.0%	20.0%
Growth Factor	3.3%	1.5%	3.3%	0.0%	0.0%	3.9%	N.A.	N.A.
Weather Normalized	Yes	Yes	Yes	No	No	No[1]	Yes	Yes

Note 1. For Wind-ERCOT, the OSD energy consumption is the average daily consumption of the measured data in the months of July, August and September.

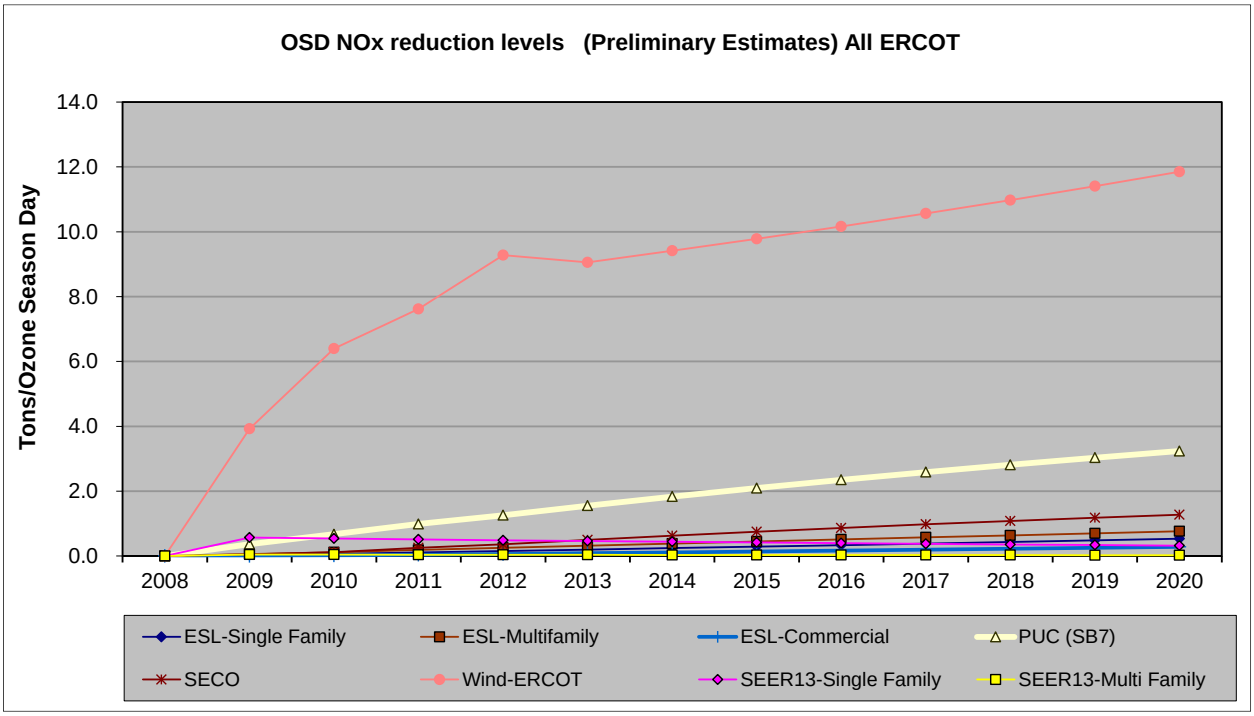


Figure 2: Integrated OSD Individual Programs NOx Emissions Reduction Projections through 2020 (Base Year 2008)

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 is 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;

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

- Deployed IC3 v3.2 to handle a wider selection of single family building 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.

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 ammendments

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 2008, 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 2008 by the Laboratory, PUCT, SECO, and ERCOT (i.e., wind).
- At the request of the TCEQ, the Laboratory has continued the development of procedures for quantifying NOx emissions reductions from wind turbines that includes weather normalization and the quantification of NOx emissions reductions from the new Federal regulations for SEER 13 air conditioners.

1.10 Planned Focus for 2014

In FY 2014, 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.
- Enhance Single-Famimily and Multifamily IC3 software to support and add other features to enhance adoption.
- Engage production builders and municipalities in overcoming obstacles to use IC3 for their new home construction.

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 979-845-1280, or by email at terpinfo@tees.tamus.edu.

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. These areas are shown on the map in Figure 3 as non-attainment and near nonattainment. In 2008, the twenty counties designated as nonattainment counties include: Brazoria, Chambers, Collin, Dallas, Denton, Ellis, Fort Bend, Hardin, Harris, Jefferson, Galveston, Johnson, Kaufman, Liberty, Montgomery, Orange, Parker, Rockwall, Tarrant, and Waller Counties. The 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 County.

These counties represent several geographic areas of the state, which have been assigned to different climate zones by the 2001 IECC[5] as shown in Figure 4, based primarily on Heating Degree Days (HDD). These include climate zone 5 or 6 (i.e., 2,000 to 2,999 HDD_{65}) for the Dallas-Ft. Worth and El Paso areas, and climate zones 3 and 4 (i.e., 1,000 to 1,999 HDD_{65}) 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 National Weather Service weather stations, (NWS) (NOAA 1993) weather stations, the ASHRAE 90.1 1989 weather locations[6], the ASHRAE 90.1 1999 weather locations, the solar stations measured by the National Renewable Energy Laboratory (NREL)[7], the solar stations measured by the TCEQ[8], and F-CHART and PV F-CHART weather locations[9].

[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.

[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 NREL stations were the primary source of the 1999 global horizontal, direct normal and diffuse solar radiation used to determine the 1999 peak-day and annual emissions for the DOE-2 simulations for code-compliant housing and commercial buildings.

[8] 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.

[9] 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.

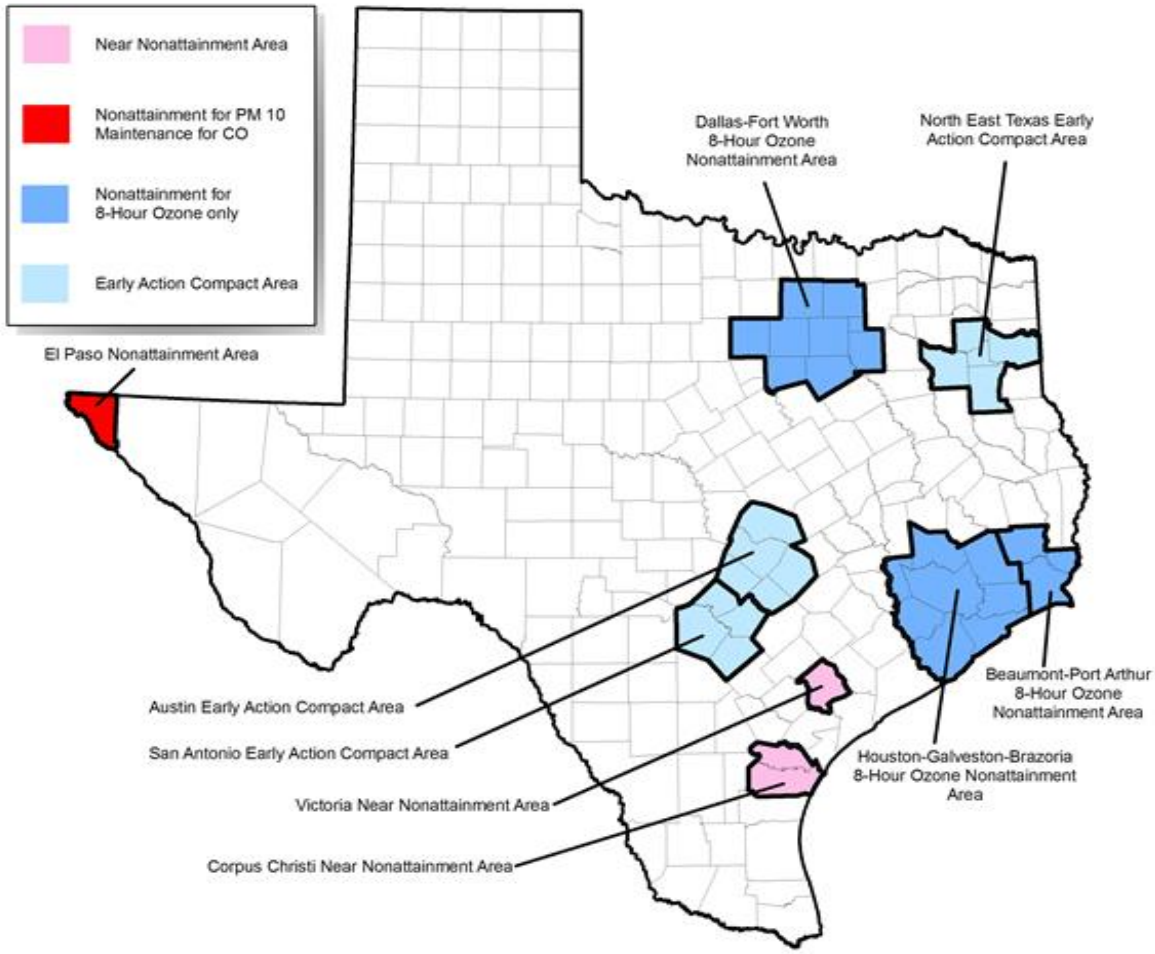


Figure 3: US EPA Nonattainment and Near Nonattainment

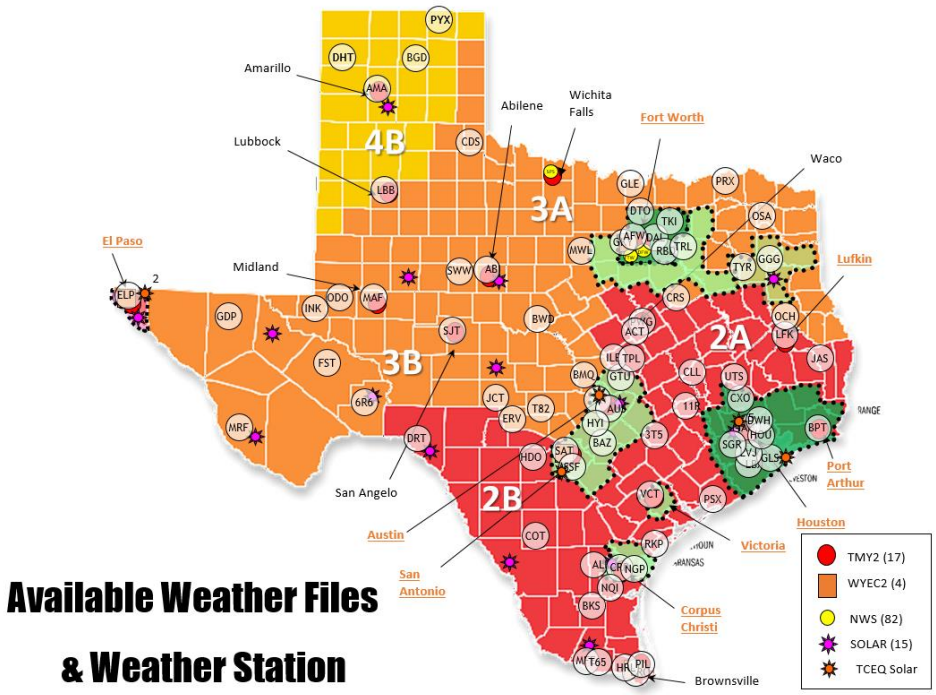
2.2 Energy Systems Laboratory's Responsibilities in the TERP

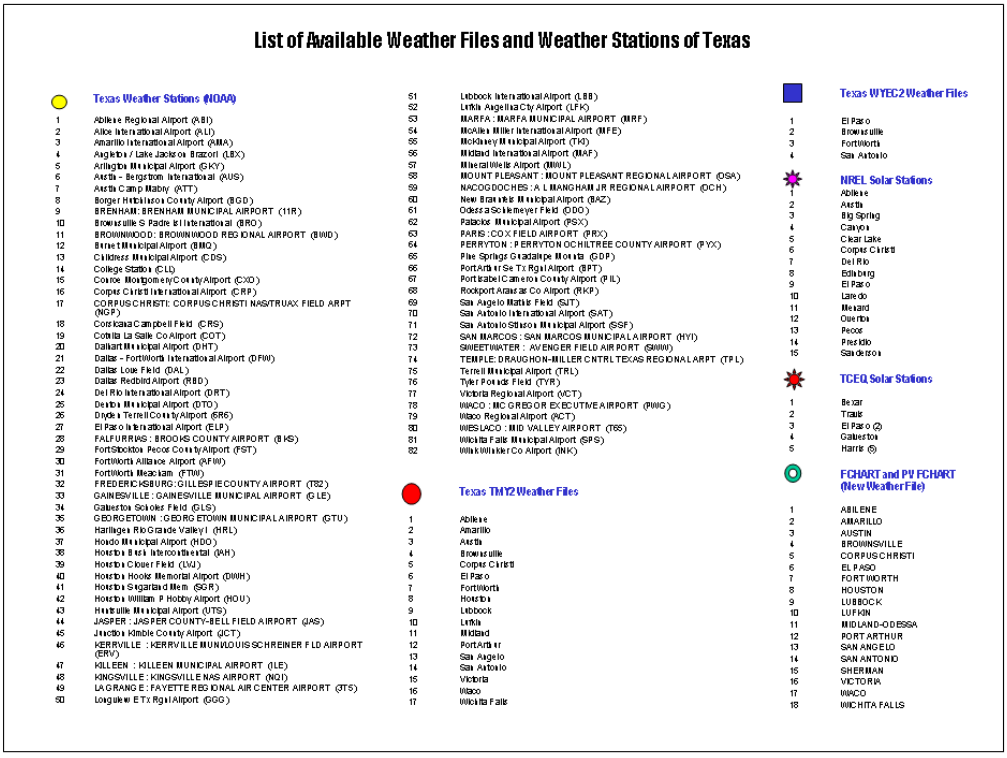
In 2001, Texas Senate Bill 5 outlined the following responsibilities for the Energy Systems Laboratory (ESL) within the TERP:

- 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.





List of Available Weather Files and Weather Stations of Texas

Texas Weather Stations (NOAA)

1 Abilene Regional Airport (ABI)
2 Alice International Airport (ALI)
3 Amarillo International Airport (AMA)
4 Angleton / Lake Jackson Brazoria (LBX)
5 Arlington Municipal Airport (GKY)
6 Austin - Bergstrom International (AUS)
7 Austin Camp Mabry (ATT)
8 Borger Hutchinson County Airport (BGD)
9 BRENHAM: BRENHAM MUNICIPAL AIRPORT (11R)
10 Brownsville S Padre Isl International (BRO)
11 BROWNWOOD: BROWNWOOD REGIONAL AIRPORT (BWD)
12 Burnet Municipal Airport (BMQ)
13 Childress Municipal Airport (CDS)
14 College Station (CLL)
15 Conroe Montgomery County Airport (CXO)
16 Corpus Christi International Airport (CRP)
17 CORPUS CHRISTI: CORPUS CHRISTI NAS/TRUAX FIELD ARPT (NGP)
18 Corsicana Campbell Field (CRS)
19 Cotulla La Salle Co Airport (COT)
20 Dalhart Municipal Airport (DHT)
21 Dallas - Fort Worth International Airport (DFW)
22 Dallas Love Field (DAL)
23 Dallas Redbird Airport (RBD)
24 Del Rio International Airport (DRT)
25 Denton Municipal Airport (DTO)
26 Dyde a Terrell County Airport (6R5)
27 El Paso International Airport (ELP)
28 FALFURRIAS : BROOKS COUNTY AIRPORT (BKS)
29 Fort Stockton Pecos County Airport (FST)
30 Fort Worth Alliance Airport (AFW)
31 Fort Worth Meacham (FTW)
32 FREDERICKSBURG: GILLESPIE COUNTY AIRPORT (T82)
33 GAINESVILLE : GAINESVILLE MUNICIPAL AIRPORT (GLE)
34 Galveston Scholes Field (GLS)
35 GEORGETOWN : GEORGETOWN MUNICIPAL AIRPORT (GTU)
36 Harlingen Rio Grande Valley I (HRL)
37 Hondo Municipal Airport (HDO)
38 Houston Bush Intercontinental (IAH)
39 Houston Clover Field (LVJ)
40 Houston Hooks Memorial Airport (DWH)
41 Houston Sugarland Mem (SGR)
42 Houston William P Hobby Airport (HOU)
43 Huntsville Municipal Airport (UTS)
44 JASPER : JASPER COUNTY-BELL FIELD AIRPORT (JAS)
45 Junction Kimble County Airport (JCT)
46 KERRVILLE : KERRVILLE MUNI/LOUIS SCHREINER F LD AIRPORT (ERV)
47 KILLEEN : KILLEEN MUNICIPAL AIRPORT (ILE)
48 KINGSVILLE : KINGSVILLE NAS AIRPORT (NQI)
49 LA GRANGE : FAYETTE REGIONAL AIR CENTER AIRPORT (7TS)
50 Longview ETX Rgnl Airport (GGG)
51 Lubbock International Airport (LBB)
52 Lufkin Angelina Cty Airport (LFK)
53 MARFA : MARFA MUNICIPAL AIRPORT (MRF)
54 McAllen Miller International Airport (MFE)
55 Mckinney Municipal Airport (TKI)
56 Midland International Airport (MAF)
57 Mineral Wells Airport (MWL)
58 MOUNT PLEASANT : MOUNT PLEASANT REGIONAL AIRPORT (OSA)
59 NACOGDOCHES : A L MANGHAM JR REGIONAL AIRPORT (OCH)
60 New Braunfels Municipal Airport (BAZ)
61 Odessa Schlemeyer Field (ODO)
62 Palacios Municipal Airport (PSX)
63 PARIS : COX FIELD AIRPORT (PRX)
64 PERRYTON : PERRYTON OCHILTREE COUNTY AIRPORT (PYX)
65 Pine Springs Guadalupe Mountains (GDP)
66 Portland Sea Tx Rgnl Airport (PPT)
67 Port Isabel Cameron County Airport (PIL)
68 Rockport Aransas Co Airport (RKP)
69 San Angelo Mathis Field (SJT)
70 San Antonio International Airport (SAT)
71 San Antonio Stinson Municipal Airport (SSF)
72 SAN MARCOS : SAN MARCOS MUNICIPAL AIRPORT (HYI)
73 SWEETWATER : AVENGER FIELD AIRPORT (SWW)
74 TEMPLE: DRAUGHON-MILLER CNTRL TEXAS REGIONAL ARPT (TPL)
75 Terrell Municipal Airport (TRL)
76 Tyler Pounds Field (TYR)
77 Victoria Regional Airport (VCT)
78 WACO : MC GREGOR EXECUTIVE AIRPORT (PWG)
79 Waco Regional Airport (ACT)
80 WESLACO : MID VALLEY AIRPORT (T65)
81 Wichita Falls Municipal Airport (SPS)
82 Wink Winkler Co Airport (INK)

Texas TMY2 Weather Files

1 Abilene
2 Amarillo
3 Austin
4 Brownsville
5 Corpus Christi
6 El Paso
7 Fort Worth
8 Houston
9 Lubbock
10 Lufkin
11 Midland
12 Port Arthur
13 San Angelo
14 San Antonio
15 Victoria
16 Waco
17 Wichita Falls

Texas WYEC2 Weather Files

1 El Paso
2 Brownsville
3 Fort Worth
4 San Antonio

NREL Solar Stations

1 Abilene
2 Austin
3 Big Spring
4 Canyon
5 Clear Lake
6 Corpus Christi
7 Del Rio
8 Edinburg
9 El Paso
10 Laredo
11 Midland
12 Odessa
13 Pecos
14 Presidio
15 Sanderson

TCEQ Solar Stations

1 Bexar
2 Travis
3 El Paso (2)
4 Galveston
5 Harris (5)

FCHART and PV FCHART (New Weather File)

1 ABILENE
2 AMARILLO
3 AUSTIN
4 BROWNSVILLE
5 CORPUS CHRISTI
6 EL PASO
7 FORT WORTH
8 HOUSTON
9 LUBBOCK
10 LUFKIN
11 MIDLAND-ODESSA
12 PORT ARTHUR
13 SAN ANGELO
14 SAN ANTONIO
15 SHERMAN
16 VICTORIA
17 WACO
18 WICHITA FALLS

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

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.

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 implemente 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 the 2005, 2006, 2007, 2008, 2009, 2010, 2011, and 2012 annual report.

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

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:

- a building certified by a national, state, or local accredited energy efficiency program shall be considered in compliance;
- a building with inspections from private code-certified inspectors using the energy efficiency chapter of the International Residential Code or International Energy Conservation Code shall be considered in compliance; and

- a builder who does not have access to either of the above methods for a building shall certify 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 will 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

In 2003, House Bill 1365 modified the TERP, adding a new Section 388.009. In this section the General Land Office, the TCEQ and the Laboratory, working with an advisory committee, may develop an energy-efficient building accreditation program for buildings that exceed the building energy performance standards under Section 388.003 by 15% or more. This program shall be updated annually to include best available energy-efficient building practices. This program shall use a checklist system to produce an energy-efficient building scorecard to help: (1) home buyers compare potential homes and, by providing a copy of the completed scorecard to a mortgage lender, qualify for energy-efficient mortgages under the National Housing Act; and (2) communities qualify for emissions reduction credits by adopting codes that meet or exceed the energy-efficient building or energy performance standards established under this chapter. This effort may include a public information program to inform homeowners, sellers, buyers, and others regarding energy-efficient building ratings. The Laboratory shall establish a system to measure the reduction in energy and emissions produced under the energy-efficient building program and report those savings to the commission.

2.2.8 (HB 3235) Sec. 388.009. Certification of Municipal 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 is 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) the Laboratory's responsibilities under TERP kept the same as previous years.

3 Statewide Air Emissions Calculations from Wind and Other Renewables

The Energy Systems Laboratory, in fulfillment of its responsibilities under this Legislation, submits its fifth 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, which have been assembled as part of the seventh year's effort

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 2013 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 2013 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 2013 measurement period, together with wind data from the nearby NOAA weather stations or the zone average wind speed provided from ERCOT.

In the 2010 Wind and Renewables report to the TCEQ (Haberl et al. 2010), weather normalization analysis methods were reviewed. This report used the same analysis method as the previous 2010 report 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 2013 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 nine new wind farms which started operation in 2013 were added, including Anacacho, Bobcat Bluff, Blue Summit, Whitetail Wind, Los Vientos 1, Los Vientos 2, Mozart, Magic Valley, and Senate. Figure 5 shows the measured annual wind power generation in 2013 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 2013 is 32,638,270 MWh/yr., which is 14.12% higher than what the same wind farms would have produced in 2008. Figure 6 shows the same comparison but for the Ozone Season Period. The measured wind power generation in the OSP of 2013 is 57,622 MWh/day, which is 3.41% higher than the 2008 OSP baseline wind production. For the analysis of this year, the measured 2013 wind power generation is fairly higher 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.

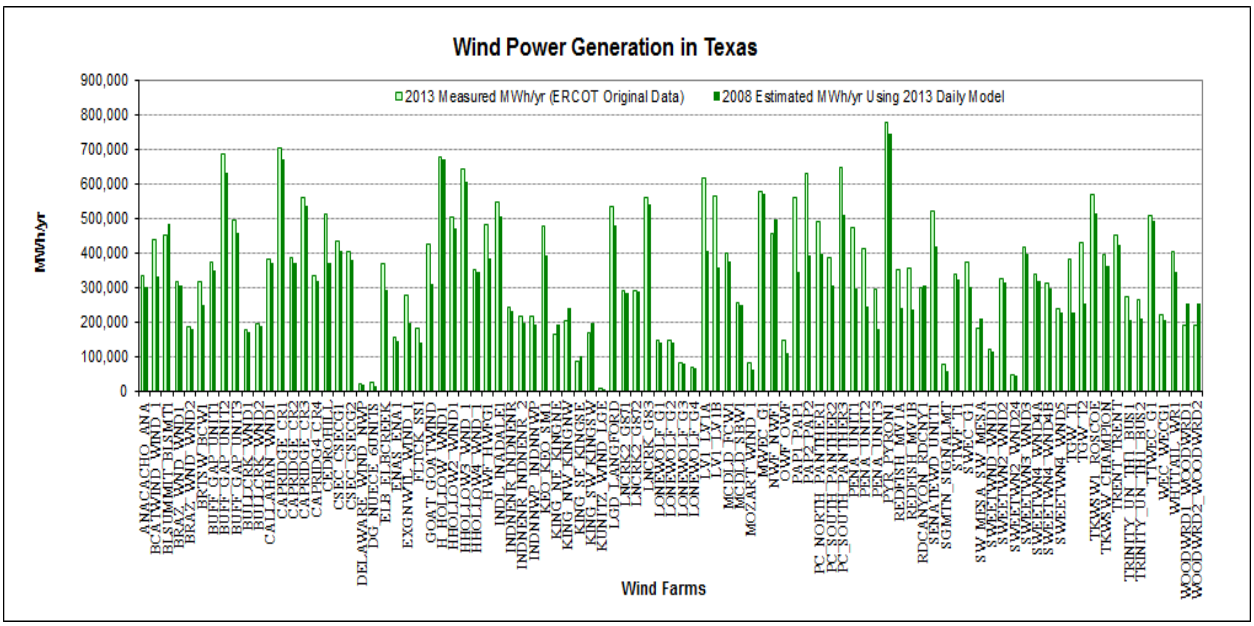


Figure 5: Comparison of 2013 Measured and 2008 Estimated Wind Power Production for Each Wind Farm

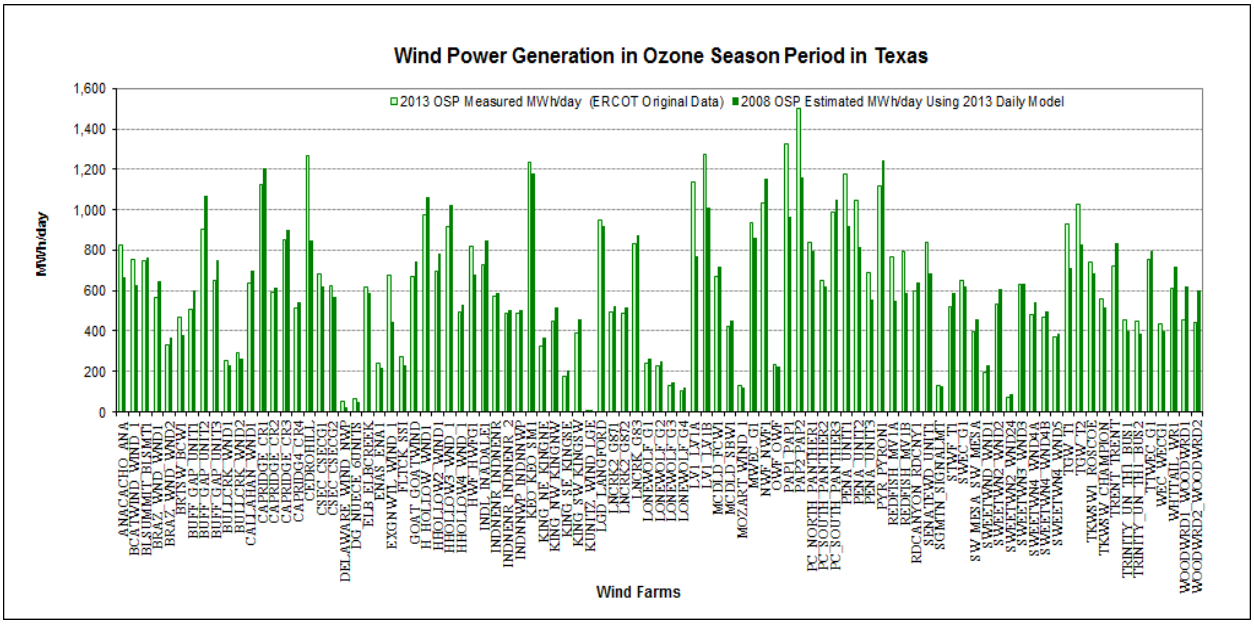


Figure 6: Comparison of 2013 OSP Measured and 2008 OSP Estimated Wind Power Production for Each Wind Farm

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 congestion management (CM) zones in ERCOT was presented and, calculating the NOx emission reductions based on the special version of 2010 eGRID, developed by the ESL and EPA for the TCEQ. According to the developed models, the total MWh savings for all the wind farms in the base year 2008 within the ERCOT region are 28,599,922 MWh/yr and 55,724 MWh/day in the Ozone Season Period.

The total NOx emissions reductions across all the counties amount are 7,856.60 tons/yr and 15.54 tons/day for the Ozone Season Period. Based on the 2013 measured ERCOT data, the total MWh savings for all the wind farms within the ERCOT region are 32,638,270 MWh/yr and 57,622 MWh/day in the Ozone Season Period. The total NOx emissions reductions in 2013 across all the counties amount are 9,078.54 tons/yr and 16.31 tons/day for the Ozone Season Period. Compared to the base year 2008, the total annual NOx emissions reductions increased by 15.55%, and the total NOx emissions reductions increase 4.95% for the Ozone Season Period.

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 request of the TCEQ associated with degradation of the wind farm power output, the ESL has been evaluating any observed degradation from the measured data for Texas wind farms.

For the analysis, a statistical index was established for each site that used the 10^{th}, 25^{th}, 50^{th}, 75^{th}, 90^{th}, and 99^{th} 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 thirty eight sites analyzed, twenty two sites showed an increase when one compares the 90^{th} percentile of the whole period to the 90^{th} percentile of the first 12-month period, ranging from 0.9% to 72.4%. The remaining sixteen sites showed a decrease from -0.5% to -41.1%. The weighted average of this increase across all wind farms studied is 6.9% (positive), which indicates that no degradation was observed from the aggregate energy production from these wind farms over the studied operation period. Similarly, the wind farms of Big Spring Wind Power (-14.6%), Delaware Mountain Wind (-16.7%), Snyder Wind Project (-15.4%), Texas Wind Power Project (-41.1%), and Whirlwind (-12.1%) have a decrease on production with a percentage larger than 10%, which may be caused by wind farm operations issues, the meter problems or other related issues.

Table 5: Summary of 90th Percentile Hourly Wind Power Analysis for Forty Five Wind Farms (38 Sites) in Texas

Wind Farm	First 12-mo 90th Percentile Hourly Wind Power		Average of the Sliding 12-mo 90th Precentile Hourly Wind Power		Minimum of the Sliding 12-mo 90th Precentile Hourly Wind Power		Maximum of the Sliding 12-mo 90th Precentile Hourly Wind Power		No. of Months of Data	Capacity (MW)
	First 12-mo Ending Mo.	MW	MW	% Diff. vs. First 12-mo	MW	% Diff. vs. First 12-mo	MW	% Diff. vs. First 12-mo		
Brazos Wind Ranch	Dec-04	127.5	126.9	-0.5%	93.5	-26.7%	139.4	9.3%	109	160
Barton Chapel Wind 1	Apr-09	60.0	79.8	33.0%	60.0	0.0%	89.1	48.5%	57	120
Buffalo Gap 1	Nov-06	100.9	97.8	-3.1%	75.4	-25.2%	105.5	4.6%	86	120
Buffalo Gap 2	Apr-08	183.4	167.4	-8.7%	104.9	-42.8%	207.6	13.2%	69	233
Big Spring Wind Power	Dec-02	27.2	23.3	-14.6%	16.3	-40.1%	27.2	0.0%	133	41
Callahan Divide Wind	Feb-06	93.3	95.3	2.1%	86.7	-7.1%	101.5	8.8%	95	114
Capricorn Ridge Wind	Aug-08	258.0	239.2	-7.3%	174.5	-32.4%	289.6	12.2%	65	364
Camp Springs Wind Energy Center	Apr-08	111.3	103.7	-6.9%	95.0	-14.6%	116.8	4.9%	69	130
Camp Springs Energy Expension	Jan-09	94.0	94.8	0.9%	88.9	-5.4%	104.7	11.5%	60	120
Champion Wind Farm	Jan-09	89.4	101.9	13.9%	87.7	-1.9%	113.2	26.6%	60	126.5
Delaware Mountain Wind	Dec-02	18.6	15.5	-16.7%	6.2	-66.6%	21.5	15.7%	133	28.5
Desert Sky	Dec-02	89.0	117.2	31.7%	83.1	-6.7%	134.4	50.9%	133	160.5
Forest Creek Wind Farm	Dec-07	105.2	106.1	0.8%	97.3	-7.5%	110.6	5.2%	73	124.2
Horse Hollow Phase 1	Jun-06	157.0	163.7	4.3%	141.3	-10.0%	177.3	12.9%	91	213
Horse Hollow Phase 2	Aug-07	145.7	136.8	-6.1%	99.0	-32.1%	151.5	4.0%	77	184
Horse Hollow Phase 3	May-07	169.2	163.1	-3.6%	123.9	-26.8%	187.4	10.8%	80	223.5
Horse Hollow Phase 4	Jun-07	88.6	88.2	-0.5%	80.9	-8.7%	93.5	5.5%	79	115
Indian Mesa	Dec-02	48.0	60.6	26.2%	42.1	-12.2%	72.2	50.5%	133	82.5
King Mountain Wind Ranch-NE	Dec-02	41.8	47.3	13.1%	36.3	-13.2%	56.4	34.8%	133	79.3
King Mountain Wind Ranch-NW	Dec-02	44.7	55.7	24.6%	40.2	-10.1%	65.3	46.1%	133	79.3
King Mountain Wind Ranch-SE	Dec-02	21.6	23.9	10.5%	18.4	-15.0%	28.1	29.8%	133	40.3
King Mountain Wind Ranch-SW	Dec-02	41.6	47.3	13.7%	38.4	-7.6%	53.7	29.1%	133	79.3
Lone Star - Post Oak Wind	Dec-08	126.5	156.5	23.7%	126.5	0.0%	170.5	34.8%	61	200
Lone-Star Mesquite Wind	Feb-08	106.1	150.6	41.9%	106.1	0.0%	168.1	58.5%	71	200
Red Canyon 1	Aug-07	75.8	76.6	1.0%	72.7	-4.1%	79.1	4.4%	77	84
Sand Bluff Wind Farm	Dec-07	39.5	68.2	72.4%	39.5	0.0%	75.4	90.6%	73	90
Southwest Mesa Wind	Dec-02	51.1	47.7	-6.5%	37.2	-27.1%	56.5	10.6%	133	74.6
Sweetwater Wind 1	Dec-04	34.1	32.9	-3.4%	29.9	-12.2%	34.9	2.4%	109	37.5
Sweetwater Wind 2 (unit 1)	Jan-06	71.4	81.0	13.5%	71.4	0.0%	85.8	20.2%	96	97.5
Sweetwater Wind 2 (unit 2)	May-08	13.8	13.8	0.5%	12.0	-13.1%	14.8	7.8%	68	16
Sweetwater Wind 3	Dec-06	99.6	99.8	0.2%	67.1	-32.7%	109.0	9.4%	85	135
Sweetwater Wind 4	Mar-08	161.0	171.2	6.3%	156.5	-2.8%	179.3	11.3%	70	240.8
Sweetwater Wind 5	Dec-08	66.5	63.5	-4.6%	56.3	-15.3%	69.3	4.3%	61	80.5
Snyder Wind Project	Dec-08	52.9	44.8	-15.4%	36.1	-31.8%	52.9	0.0%	61	63
Texas Wind Power Project	Dec-02	25.2	14.8	-41.1%	3.1	-87.7%	25.2	0.0%	133	35
Trent Mesa	Dec-02	108.8	120.0	10.3%	90.7	-16.7%	132.8	22.0%	133	150
Whirlwind	Dec-08	54.0	47.5	-12.1%	39.8	-26.3%	56.1	3.9%	61	60
Woodward Mountain Ranch	Dec-02	85.3	97.2	14.0%	80.4	-5.7%	112.4	31.8%	133	159.7
Weighted Average:				**6.9%**		**-16.5%**		**20.3%**	**Total:**	**4661.5**

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 all PV installations in Texas whereas the solar power project accounts for only solar power plant constructions. Table 6 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/Ozone Season Day (OSD) energy savings and annual NOx emission reductions for solar photovoltaic including solar power, solar thermal, biomass, and hydroelectric projects. The annual/OSD 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/OSD energy generation. Then, the annual NOx emission reductions calculation was conducted with the special version of Texas 2010 eGrid, based on their energy savings/generation.

In 2013, the total annual/OSD energy savings from each renewable projects across all the counties were:

- solar photovoltaic projects with 7% T&D loss: 253,344 MWh/yr and 759.3 MWh/day;
  in addition, solar power projects only with 7% T&D loss: 174,153 MWh/yr and 477.1 MWh/day,
- solar thermal projects with 7% T&D loss: 248 MWh/yr, and 0.7 MWh/day,
- biomass projects with 7% T&D loss: 463,933 MWh/yr and 1,271.2 MWh/day, and
- hydroelectric projects with 7% T&D loss: 62,370 MWh/yr and 170.9 MWh/day.

In 2013, the annual NOx emission reductions from renewable projects across all the counties were:

- solar photovoltaic projects: 81.3 tons/yr;
  in addition, solar power projects only: 58.3 tons/yr,
- solar thermal projects: 0.1 tons/yr,
- biomass projects: 128.3 tons/yr, and
- hydroelectric projects: 20.9 tons/yr.

Table 6: Number of Identified Projects for Other Renewable Sources

Renewable Energy Projects	Number of New Projects	Total Number of Projects
Solar Photovoltaic (Solar Power)	37 (2)	3,223 (9)
Solar Thermal	0	38
Biomass	6	19
Hydro-Electric[1]	1	26
Geothermal	7	286
Landfill Gas	0	32

Note:

[1] This report includes one more hydroelectric project information which was not identified in the previous year report; however, it does not mean that the State of Texas has a new hydroelectric power plant constructed.

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 Program site www.texasrenewables.com is 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 2013 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 7 contains the data reported by ERCOT from 2001 to 2013. Table 7 is included to better illustrate the annual data collected by ERCOT.

Table 7: Annual Electricity Generation by Renewable Resources (MWh, ERCOT: 2001 - 2013)

Year	Biomass (MWh)	Hydro (MWh)	Landfill gas (MWh)	Solar (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	537,966	133,642	32,746,534	34,096,328
2013	200,564	294,238	550,845	178,326	36,909,385	38,133,358

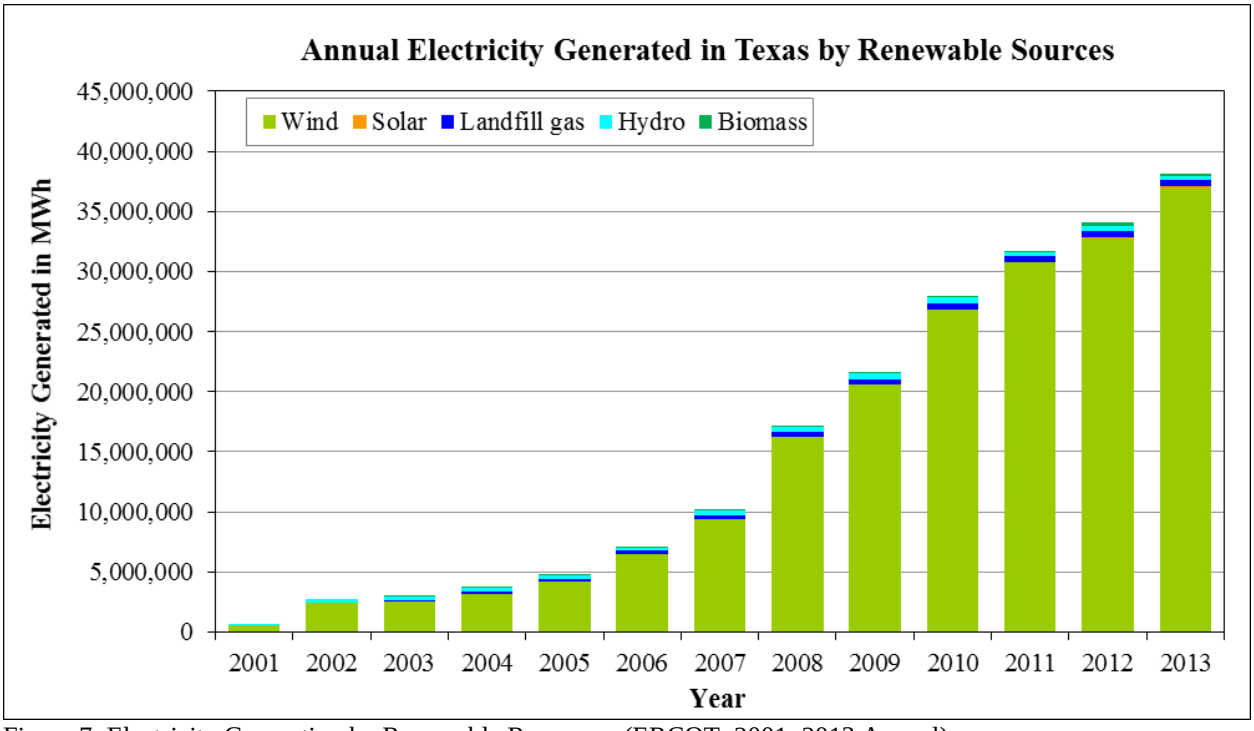


Figure 7: Electricity Generation by Renewable Resources (ERCOT: 2001–2013 Annual)

4 Calculated NOx Reductions Potential from Energy Savings of New Constructions in 2013

A complete reporting of the savings, using 2008 base year (the implementation of the 2006 IECC and the ASHRAE Standard 90.1-2004), 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) and commercial buildings. The calculation of energy savings from the adoption of the ASHRAE Standard 90.1-2007 in industrial buildings is currently under development at the Laboratory, and will be reported in future reports.

4.1 2013 Results for New Single-family Residential Constructions

This section provides the potential electricity and natural gas savings and the associated NOx emissions reductions in 2013 using the 2008 base year which implemented the 2006 IECC for new single-family residences in the 41 non-attainment and affected counties as well as other counties in the ERCOT region[10]. 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 2013 building permits per county was obtained from the real estate center at Texas A&M University (REC 2014). Next, energy savings attributable to the 2006 IECC were calculated using the Laboratory's code-traceable, DOE-2.1e simulation, which was developed for the TERP. For the savings calculation, the 2013 NAHB Builder's survey data[11] 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 2010 eGRID database[12].

In Table 8, the 2013 new single-family and 2006 IECC code-compliant building characteristics are shown for each county. The building characteristics reflect those published by the NAHB, ARI, and GAMA for Texas. The 2006 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 8, 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 NAHB Builder's survey classification is listed. The fifth through eighth columns show the NAHB Builder'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 2006 IECC minimum requirements for glazing U-value, SHGC, roof insulation, and wall insulation.

All the houses were assumed to have air-conditioner efficiency equal to a SEER of 13[13], furnace efficiency (AFUE) of 0.80, and domestic water heater efficiency of 0.78 for a natural gas type and 1 for an electric type. The values shown in Table 8 represent the only changes that were made to the simulation to obtain the savings calculations. All other variables in the simulation remained the same for the 2013 new single-family and the 2006 IECC code-compliant simulations. In cases where the 2013 values were more efficient than the 2006 IECC requirements, the 2013 values were used in the 2013 new single-family simulations. Otherwise, the 2006 IECC values were used in both simulations. For example, in the Collin County, according to the NAHB Builder's survey data, the roof insulation is R-24.95, which is less than the code-required insulation of R-30. Therefore, R-30 was used in the 2013 simulation.

[10]The three new counties added in the 2003 Legislative session (i.e., Henderson, Hood, and Hunt) were included in the ERCOT region.
[11] For the 2013 report, the 2012 NAHB data were used.
[12] 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.
[13] Based on the regulation effective.

In Table 9, the code-traceable simulation results for single-family residences are shown for each county. In a similar fashion to Table 8, Table 9 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 2006 IECC climate zone is listed followed by the number of new projected housing units[14] in the fourth column. In the fifth column, the total simulated energy use is listed if all new constructions had been built to pre-code specifications. In the sixth column, the total county-wide energy use for code-compliant constructions 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 NAHB Builder'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 2013 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 10, the Congestion Management (CM) Zones[15] assignments for each county are shown. In Table 11, the annual electricity savings are assigned to CM Zones provider(s) according to Table 10. The total electricity savings for each CM Zone, as shown in Table 11, then entered into the bottom row of Table 12, which is the 2010 US EPA's eGRID database[16] for Texas. Next, the county's NOx reductions (lbs) are calculated using the assigned 2010 eGrid proportions (lbs-NOx/MWh) to each CM zone in the county. The calculated NOx reductions are presented in the columns adjacent to the corresponding CM 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.

[14] The number of the new housing units in 2013 were obtained from the Real Estate Center at Texas A&M University.
[15] ERCOT region has employed the Congestion Management (CM) since 2010, and it is currently divided into four zones: Houston (H), North (N), South (S), and West (W).
[16] This preliminary analysis does not include actual power transfers on the grid, and assumes transmission and distribution losses of 7%. Counties were assigned to CM Zones as indicated.

Table 8: 2013 and 2006 IECC Code-compliant Building Characteristics Used in the DOE-2 Simulations for New Single-family Residences

	County	Climate Zone	Division	2013 Average				2006 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	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	Chambers	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	Collin	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	Dallas	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	Denton	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	El Paso	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	Fort Bend	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	Galveston	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	Hardin	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	Harris	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	Jefferson	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	Liberty	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	Montgomery	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	Orange	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	Tarrant	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	Waller	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
Affected	Bastrop	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	Bexar	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	Caldwell	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	Comal	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	Ellis	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	Gregg	3	East Texas	0.44	0.53	31.18	13.74	0.65	0.4	30	13
	Guadalupe	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	Harrison	3	East Texas	0.44	0.53	31.18	13.74	0.65	0.4	30	13
	Hays	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	Henderson	3	East Texas	0.44	0.53	31.18	13.74	0.65	0.4	30	13
	Hood	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	Hunt	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	Johnson	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	Kaufman	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	Nueces	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	Parker	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	Rockwall	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	Rusk	3	East Texas	0.44	0.53	31.18	13.74	0.65	0.4	30	13
	San Patricio	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	Smith	3	East Texas	0.44	0.53	31.18	13.74	0.65	0.4	30	13
	Travis	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	Upshur	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	Victoria	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	Williamson	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	Wilson	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
ERCOT	ANDERSON	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	ANDREWS	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	ANGELINA	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	ARANSAS	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	ARCHER	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	ATASCOSA	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	AUSTIN	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	BANDERA	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	BASTROP	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	BAYLOR	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	BEE	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	BELL	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	BEXAR	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	BLANCO	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	BORDEN	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	BOSQUE	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	BRAZORIA	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	BRAZOS	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	BREWSTER	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	BRISCOE	4	West Texas	0.44	0.53	24.95	15.84	0.4	NR	38	13
	BROOKS	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	BROWN	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	BURLESON	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	BURNET	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	CALDWELL	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	CALHOUN	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	CALLAHAN	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	CAMERON	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	CHAMBERS	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	CHEROKEE	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	CHILDRESS	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	CLAY	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	COKE	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	COLEMAN	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	COLLIN	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	COLORADO	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	COMAL	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	COMANCHE	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	CONCHO	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	COOKE	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	CORYELL	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	COTTLE	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	CRANE	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	CROCKETT	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	CROSBY	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	CULBERSON	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	DALLAS	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	DAWSON	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	DE WITT	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	DELTA	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	DENTON	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	DICKENS	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	DIMMIT	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	DUVAL	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	EASTLAND	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	ECTOR	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	EDWARDS	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	ELLIS	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	ERATH	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	FALLS	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	FANNIN	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	FAYETTE	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	FISHER	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	FOARD	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	FORT BEND	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	FRANKLIN	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	FREESTONE	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13

Table 8: 2013 and 2006 IECC Code-compliant Building Characteristics Used in the DOE-2 Simulations for New Single-family Residences (Continued)

	County	Climate Zone	Division	2013 Average				2006 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)
ERCOT	FRIO	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	GALVESTON	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	GILLESPIE	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	GLASSCOCK	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	GOLIAD	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	GONZALES	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	GRAYSON	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	GRIMES	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	GUADALUPE	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	HALL	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	HAMILTON	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	HARDEMAN	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	HARRIS	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	HASKELL	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	HAYS	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	HENDERSON	3	East Texas	0.44	0.53	31.18	13.74	0.65	0.4	30	13
	HIDALGO	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	HILL	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	HOOD	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	HOPKINS	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	HOUSTON	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	HOWARD	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	HUDSPETH	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	HUNT	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	IRION	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	JACK	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	JACKSON	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	JEFF DAVIS	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	JIM HOGG	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	JIM WELLS	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	JOHNSON	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	JONES	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	KARNES	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	KAUFMAN	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	KENDALL	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	KENEDY	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	KENT	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	KERR	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	KIMBLE	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	KING	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	KINNEY	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	KLEBERG	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	KNOX	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	LA SALLE	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	LAMAR	3	East Texas	0.44	0.53	31.18	13.74	0.65	0.4	30	13
	LAMPASAS	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	LAVACA	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	LEE	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	LEON	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	LIMESTONE	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	LIVE OAK	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	LLANO	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	LOVING	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	MADISON	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	MARTIN	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	MASON	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	MATAGORDA	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	MAVERICK	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	MCCULLOCH	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	MCLENNAN	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	MCMULLEN	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	MEDINA	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	MENARD	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	MIDLAND	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	MILAM	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	MILLS	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	MITCHELL	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	MONTAGUE	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	MONTGOMERY	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	MOTLEY	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	NACOGDOCHES	3	East Texas	0.44	0.53	31.18	13.74	0.65	0.4	30	13
	NAVARRO	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	NOLAN	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	NUECES	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	PALO PINTO	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	PARKER	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	PECOS	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	PRESIDIO	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	RAINS	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	REAGAN	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	REAL	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	RED RIVER	3	East Texas	0.44	0.53	31.18	13.74	0.65	0.4	30	13
	REEVES	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	REFUGIO	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	ROBERTSON	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	ROCKWALL	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	RUNNELS	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	RUSK	3	East Texas	0.44	0.53	31.18	13.74	0.65	0.4	30	13
	SAN PATRICIO	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	SAN SABA	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	SCHLEICHER	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	SCURRY	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	SHACKELFORD	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	SMITH	3	East Texas	0.44	0.53	31.18	13.74	0.65	0.4	30	13
	SOMERVELL	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	STARR	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	STEPHENS	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	STERLING	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	STONEWALL	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	SUTTON	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	TARRANT	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	TAYLOR	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	TERRELL	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	THROCKMORTON	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	TITUS	3	East Texas	0.44	0.53	31.18	13.74	0.65	0.4	30	13
	TOM GREEN	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	TRAVIS	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	UPTON	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	UVALDE	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	VAL VERDE	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	VAN ZANDT	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	VICTORIA	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	WALLER	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	WARD	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	WASHINGTON	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	WEBB	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	WHARTON	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	WICHITA	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	WILBARGER	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	WILLACY	2	East Texas	0.44	0.53	31.18	13.74	0.75	0.4	30	13
	WILLIAMSON	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	WILSON	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	WINKLER	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	WISE	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	YOUNG	3	West Texas	0.44	0.53	24.95	15.84	0.65	0.4	30	13
	ZAPATA	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13
	ZAVALA	2	West Texas	0.44	0.53	24.95	15.84	0.75	0.4	30	13

Table 9: 2013 Annual Electricity Savings from New Single-family Residences

2013 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)
Nonattain-ment County	BRAZORIA	3	1,965	26,902	25,434	1,570	390,284	368,286	21,998
	CHAMBERS	3	318	4,255	4,029	242	65,137	61,780	3,357
	COLLIN	3	6,804	117,179	109,881	7,810	1,007,367	892,513	114,854
	DALLAS	3	3,608	62,078	58,214	4,134	536,562	475,234	61,328
	DENTON	3	4,601	79,239	74,303	5,281	681,201	603,535	77,666
	EL PASO	2	2,613	39,940	37,647	2,453	439,927	384,375	55,552
	FORT BEND	3	7,913	108,356	102,436	6,334	1,569,817	1,483,079	86,739
	GALVESTON	3	2,176	29,790	28,165	1,739	432,193	407,833	24,360
	HARDIN	3	225	3,012	2,852	171	46,080	43,621	2,458
	HARRIS	2	16,986	232,596	219,889	13,596	3,369,761	3,183,568	186,193
	JEFFERSON	3	360	4,821	4,564	275	73,727	69,794	3,933
	LIBERTY	2	175	2,398	2,267	140	34,717	32,758	1,959
	MONTGOMERY	3	4,976	68,138	64,416	3,983	987,162	932,617	54,545
	ORANGE	2	144	1,929	1,826	110	29,457	27,918	1,540
	TARRANT	2	5,478	94,252	88,386	6,276	814,658	721,544	93,114
	WALLER	2	4	55	52	3	794	750	44
Affected County	BASTROP	2	77	1,136	1,069	71	20,215	17,906	2,310
	BEXAR	2	3,066	48,305	45,814	2,666	319,028	285,776	33,252
	CALDWELL	3	17	282	265	18	2,187	1,939	248
	COMAL	3	1,630	25,681	24,356	1,417	169,607	151,929	17,678
	ELLIS	3	868	14,934	14,005	994	129,084	114,330	14,754
	GREGG	3	243	3,638	3,429	223	64,685	61,150	3,535
	GUADALUPE	2	738	11,627	11,028	642	76,791	68,788	8,004
	HARRISON	2	43	641	605	39	11,561	10,908	653
	HAYS	2	1,517	25,197	23,676	1,628	194,665	172,675	21,989
	HENDERSON	2	73	1,088	1,026	66	19,676	18,567	1,109
	HOOD	2	134	2,306	2,162	154	19,928	17,650	2,278
	HUNT	2	69	1,188	1,114	79	10,240	9,074	1,166
	JOHNSON	2	691	11,889	11,149	792	102,762	91,016	11,745
	KAUFMAN	2	308	5,304	4,974	354	45,601	40,402	5,199
	NUECES	3	1,262	18,251	17,176	1,150	221,824	210,207	11,617
	PARKER	2	274	4,719	4,425	314	40,567	35,942	4,625
	ROCKWALL	2	741	12,762	11,967	851	109,709	97,200	12,508
	RUSK	2	0	0	0	0	0	0	0
	SAN PATRICIO	2	215	3,109	2,926	196	37,791	35,812	1,979
	SMITH	2	379	5,649	5,329	342	102,154	96,395	5,760
	TRAVIS	3	4,495	74,661	70,153	4,823	576,808	511,651	65,157
	UPSHUR	3	15	229	215	15	4,553	4,029	524
	VICTORIA	2	122	1,708	1,611	103	24,158	22,791	1,367
	WILLIAMSON	3	2,848	47,305	44,449	3,056	365,462	324,179	41,283
	WILSON	2	34	536	508	30	3,538	3,169	369
ERCOT	ANDERSON	2	4	54	51	3	961	903	58
	ANDREWS	3	58	962	907	59	9,608	8,461	1,147
	ANGELINA	2	63	844	797	51	15,133	14,218	915
	ARANSAS	2	115	1,663	1,565	105	20,214	19,155	1,059
	ARCHER	3	6	105	99	6	1,171	1,027	144
	ATASCOSA	2	60	934	890	48	5,901	5,256	645
	AUSTIN	2	30	411	388	24	5,952	5,623	329
	BANDERA	2	0	0	0	0	0	0	0
	BAYLOR	3	0	0	0	0	0	0	0
	BEE	2	2	28	26	2	396	374	22
	BELL	2	1,861	30,060	28,510	1,658	271,941	239,050	32,891
	BLANCO	3	3	50	47	3	385	341	43
	BORDEN	3	19	271	256	16	9,220	8,090	1,130
	BOSQUE	2	3	48	46	3	438	385	53
	BRAZOS	2	755	10,338	9,774	604	149,780	141,504	8,276
	BREWSTER	3	4	66	62	4	579	509	70
	BRISCOE	4	7	130	122	9	2,256	1,985	271
	BROOKS	2	0	0	0	0	0	0	0
	BROWN	3	58	937	889	52	8,475	7,450	1,025
	BURLESON	2	9	123	117	7	1,785	1,687	99
	BURNET	3	186	3,089	2,903	200	23,868	21,172	2,696
	CALHOUN	2	100	1,400	1,321	85	19,802	18,681	1,121
	CALLAHAN	3	8	133	126	8	1,335	1,179	156
	CAMERON	2	1,090	16,267	15,282	1,054	154,096	145,737	8,359
	CHEROKEE	2	13	174	164	10	3,123	2,934	189
	CHILDRESS	3	0	0	0	0	0	0	0
	CLAY	3	1	18	17	1	195	171	24
	COKE	3	0	0	0	0	0	0	0
	COLEMAN	3	2	33	31	2	335	296	39
	COLORADO	2	9	123	117	7	1,785	1,687	99
	COMANCHE	3	0	0	0	0	0	0	0
	CONCHO	3	1	17	16	1	145	127	17
	COOKE	3	38	654	613	44	5,639	4,997	642
	CORYELL	2	83	1,341	1,272	74	12,128	10,662	1,467
	COTTLE	3	0	0	0	0	0	0	0
	CRANE	3	9	149	141	9	1,494	1,313	181
	CROCKETT	3	19	315	297	19	2,750	2,419	332
	CROSBY	3	7	100	94	6	3,397	2,980	416
	CULBERSON	3	15	225	214	11	2,438	2,121	317
	DAWSON	3	5	139	131	8	4,608	4,024	584
	DE WITT	2	5	70	66	4	990	934	56
	DELTA	3	2	34	32	2	296	262	34
	DICKENS	3	0	0	0	0	0	0	0
	DIMMIT	2	6	94	90	5	513	465	48
	DUVAL	2	0	0	0	0	0	0	0
	EASTLAND	3	0	0	0	0	0	0	0
	ECTOR	3	718	11,905	11,227	725	118,945	104,741	14,205
	EDWARDS	2	0	0	0	0	0	0	0
	ERATH	3	26	433	409	26	4,338	3,832	506
	FALLS	2	11	178	169	10	1,607	1,413	194
	FANNIN	3	15	258	242	17	2,226	1,973	253
	FAYETTE	2	6	82	78	5	1,190	1,125	66
	FISHER	3	0	0	0	0	0	0	0
	FOARD	3	0	0	0	0	0	0	0
	FRANKLIN	3	0	0	0	0	0	0	0
	FREESTONE	2	2	32	31	2	292	257	35
	FRIO	2	13	202	193	10	1,279	1,139	140

Table 9: 2013 Annual Electricity Savings from New Single-family Residences (Continued)

2013 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)
	GILLESPIE	3	41	681	640	44	5,261	4,667	594
	GLASSCOCK	3	0	0	0	0	0	0	0
	GOLIAD	2	2	28	26	2	396	374	22
	GONZALES	2	15	236	224	13	1,561	1,398	163
	GRAYSON	3	172	2,961	2,776	197	25,525	22,619	2,906
	GRIMES	2	19	260	246	15	3,769	3,561	208
	HALL	3	5	93	87	6	1,611	1,418	193
	HAMILTON	3	1	16	15	1	146	128	18
	HARDEMAN	3	0	0	0	0	0	0	0
	HASKELL	3	2	33	31	2	334	295	39
	HIDALGO	2	2,572	38,384	36,060	2,486	363,610	343,886	19,725
	HILL	2	10	162	153	9	1,461	1,285	177
	HOPKINS	3	12	207	194	14	1,777	1,574	203
	HOUSTON	2	6	80	76	5	1,441	1,354	87
	HOWARD	3	43	713	672	43	7,123	6,273	851
	HUDSPETH	3	0	0	0	0	0	0	0
	IRION	3	0	0	0	0	0	0	0
	JACK	3	3	50	47	3	500	442	58
	JACKSON	2	15	210	198	13	2,970	2,802	168
	JEFF DAVIS	3	0	0	0	0	0	0	0
	JIM HOGG	2	0	0	0	0	0	0	0
	JIM WELLS	2	29	419	395	26	5,097	4,830	267
	JONES	3	2	33	31	2	334	295	39
	KARNES	2	71	1,099	1,047	56	7,053	6,297	756
	KENDALL	3	284	4,427	4,215	227	27,871	24,812	3,058
	KENEDY	2	0	0	0	0	0	0	0
	KENT	3	0	0	0	0	0	0	0
	KERR	3	51	847	796	55	6,544	5,805	739
	KIMBLE	3	2	33	31	2	290	255	35
	KING	3	0	0	0	0	0	0	0
	KINNEY	2	1	16	15	1	104	93	11
	KLEBERG	2	37	532	501	33	6,047	5,705	341
	KNOX	3	0	0	0	0	0	0	0
	LA SALLE	2	10	157	150	8	855	776	80
	LAMAR	3	35	518	490	30	8,992	8,460	532
	LAMPASAS	3	170	2,746	2,604	151	24,841	21,837	3,005
	LAVACA	2	4	56	53	3	742	697	45
	LEE	2	12	199	187	13	1,544	1,368	175
	LEON	2	0	0	0	0	0	0	0
	LIMESTONE	2	2	32	31	2	292	257	35
	LIVE OAK	2	15	217	204	14	2,637	2,499	138
	LLANO	3	121	2,010	1,888	130	15,527	13,773	1,754
	LOVING	3	0	0	0	0	0	0	0
	MADISON	2	10	137	129	8	1,984	1,874	110
	MARTIN	3	1	17	16	1	166	146	20
	MASON	3	7	116	109	8	898	797	101
	MATAGORDA	2	110	1,540	1,453	93	21,782	20,549	1,233
	MAVERICK	2	68	1,070	1,020	54	5,816	5,275	542
	MCCULLOCH	3	1	17	16	1	145	127	17
	MCLENNAN	2	611	9,869	9,360	544	89,283	78,485	10,799
	MCMULLEN	2	0	0	0	0	0	0	0
ERCOT	MEDINA	2	16	252	239	14	1,665	1,491	174
	MENARD	3	0	0	0	0	0	0	0
	MIDLAND	3	732	12,137	11,446	739	121,264	106,783	14,482
	MILAM	2	5	76	72	4	498	446	52
	MILLS	3	0	0	0	0	0	0	0
	MITCHELL	3	0	0	0	0	0	0	0
	MONTAGUE	3	5	86	81	6	742	658	84
	MOTLEY	3	0	0	0	0	0	0	0
	NACOGDOCHES	3	35	469	443	28	8,407	7,899	508
	NAVARRO	3	22	355	337	20	3,215	2,826	389
	NOLAN	3	1	17	16	1	167	147	19
	PALO PINTO	3	11	183	173	11	1,835	1,621	214
	PECOS	3	7	116	109	7	1,013	891	122
	PRESIDIO	3	9	149	140	9	1,303	1,146	157
	RAINS	3	2	34	32	2	296	262	34
	REAGAN	3	5	83	78	5	830	729	101
	REAL	2	0	0	0	0	0	0	0
	RED RIVER	3	8	118	112	7	2,055	1,934	122
	REEVES	3	3	50	47	3	497	438	59
	REFUGIO	2	3	42	40	3	594	560	34
	ROBERTSON	2	60	822	777	48	11,903	11,245	658
	RUNNELS	3	1	17	16	1	145	127	17
	SAN SABA	3	0	0	0	0	0	0	0
	SCHLEICHER	3	1	17	16	1	145	127	17
	SCURRY	3	4	57	54	3	1,941	1,703	238
	SHACKELFORD	3	0	0	0	0	0	0	0
	SOMERVELL	3	6	103	97	7	892	790	102
	STARR	2	1	15	14	1	141	134	8
	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	282	4,698	4,436	280	47,046	41,562	5,484
	TERRELL	3	0	0	0	0	0	0	0
	THROCKMORTO	3	0	0	0	0	0	0	0
	TITUS	3	0	0	0	0	0	0	0
	TOM GREEN	3	326	5,399	5,088	332	47,190	41,498	5,692
	UPTON	3	1	17	16	1	166	146	20
	UVALDE	2	24	378	359	21	2,497	2,237	260
	VAL VERDE	2	44	693	657	38	4,578	4,101	477
	VAN ZANDT	3	3	52	48	3	444	394	51
	WARD	3	7	116	109	7	1,160	1,021	138
	WASHINGTON	2	46	630	595	37	9,126	8,621	504
	WEBB	2	915	14,392	13,719	720	78,263	70,974	7,289
	WHARTON	2	145	2,030	1,915	123	28,713	27,087	1,625
	WICHITA	3	108	1,897	1,789	116	21,079	18,480	2,599
	WILBARGER	3	1	18	17	1	195	171	24
	WILLACY	2	46	686	645	44	6,503	6,150	353
	WINKLER	3	0	0	0	0	0	0	0
	WISE	3	64	1,102	1,034	73	9,476	8,395	1,080
	YOUNG	3	36	600	566	36	6,006	5,306	700
	ZAPATA	2	0	0	0	0	0	0	0
	ZAVALA	2	14	220	210	11	1,197	1,086	112
	TOTAL		91,223			86,216			1,232,344

Table 10: Allocation of CM Zones for Each of Applicable ERCOT Counties[17]

County	Plant	CM Zones Percentage			
		H	N	W	S
Andrews	Fullerton	0.10	0.58	99.31	0.01
Atascosa	San Miguel	11.04	0.74	0.04	88.18
Bastrop	Bastrop Energy Center	11.04	0.74	0.04	88.18
	Lost Pines 1 Power Project				
	Sim Gideon 1				
	Sim Gideon 2				
	Sim Gideon 3				
Bexar	Arthur Von Rosenberg	11.04	0.74	0.04	88.18
	Covel Gardens				
	J K Spruce				
	J K Spruce 2				
	J T Deely 1				
	J T Deely 2				
	Leon Creek				
	O W Sommers 1				
	O W Sommers 2				
	University of Texas at San Antonio				
	V H Braunig 1				
	V H Braunig 2				
	V H Braunig 3				
	V H Braunig 6				
	W B Tuttle				
Bosque	Bosque County Peaking	13.35	81.87	3.95	0.84
Brazoria	BASF Freeport Works	99.06	0.01	0.00	0.93
	Chocolate Bayou Plant				
	Chocolate Bayou Works				
	Dow Chemical Texas Operation				
	Freeport Energy Center (expansion)				
	Oyster Creek Unit VIII				
	Sweeny Cogen Facility				
Brazos	Bryan 3	13.09	72.93	3.52	10.45
	Bryan 4				
	Bryan 5				
	Bryan 6				
	Bryan 7				
	Dansby 1				
	Dansby 2				
	Dansby 3				
Calhoun	Point Comfort Operations	11.04	0.74	0.04	88.18
	Seadrift Coke LP				
	Union Carbide Seadrift Cogen				
Cameron	La Palma 4	11.04	0.74	0.04	88.18
	La Palma 5				
	La Palma 6				
	La Palma 7				
	Silas Ray				
Chambers	Baytown Energy Center	99.06	0.01	0.00	0.93
	Cedar Bayou 1				
	Cedar Bayou 2				
	Enterprise Products Operating				
Cherokee	Stryker Creek 1	13.35	81.87	3.95	0.84
	Stryker Creek 2				
	Stryker Creek 3				
Coke	Jameson Gas Processing Plant	0.00	0.00	0.00	0.00
Collin	Ray Olinger 2	13.35	81.87	3.95	0.84
	Ray Olinger 3				
	Ray Olinger 4				
	Ray Olinger 5				
	University of Texas at Dallas				
Dallas	C E Newman	13.35	81.87	3.95	0.84
	Lake Hubbard 1				
	Lake Hubbard 2				
	Mountain Creek				
	State Farm Insur Support Center Central				
Denton	Spencer 4	13.35	81.87	3.95	0.84
	Spencer 5				
Ector	Odessa Ector Generating Station	0.97	0.60	91.36	7.07
	Quail Run Energy Center				
	Quail Run Energy Center				
	Quail Run Energy Center				
Ellis	Ennis Tractebel Power LP	13.35	81.87	3.95	0.84
	Midlothian Energy Facility				
Fannin	Valley	13.35	81.87	3.95	0.84
Fayette	Fayette Power Project	11.89	30.55	1.48	56.09
	Winchester Power Park				
Fort Bend	Brazos Valley Generating Facility	99.06	0.01	0.00	0.93
	W A Parish 1				
	W A Parish 2				
	W A Parish 3				
	W A Parish 4				
	W A Parish 5				
	W A Parish 7 (Uprated)				
	W A Parish 8				
	W A Parish GT1				
Freestone	Big Brown 1 (Upgrade)	13.35	81.87	3.95	0.84
	Big Brown 2				
	Freestone Power Generation LP				
Frio	Pearsall 1	0.10	0.58	99.31	0.01
	Pearsall 2				
	Pearsall 3				
Galveston	Green Power 2	99.06	0.01	0.00	0.93
	P H Robinson				
	Power Station 4				
	S&L Cogeneration				
	Texas City Plant Union Carbide				
	Texas City Power Plant				
	Valero Refining Texas City				
Goliad	Coleto Creek	0.00	0.00	0.00	0.00
Grimes	Gibbons Creek	0.00	0.00	0.00	0.00
Guadalupe	Guadalupe Generating Station	11.04	0.74	0.04	88.18
	Rio Nogales Power Project				

[17] 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.

Table 10: Allocation of CM Zones for Each of Applicable ERCOT Counties (Continued)

County	Plant	CM Zones Percentage			
		H	N	W	S
Harris	AES Deepwater	99.06	0.01	0.00	0.93
	Altura Cogen				
	Bayou Cogen Plant				
	Cedar Bayou 4				
	Channel Energy Center				
	Channelview Cogeneration Plant				
	Clear Lake Cogeneration Ltd				
	Deepwater				
	Deer Creek Energy Center				
	Deer Park Energy Center				
	Exelon LaPorte Generating Station				
	ExxonMobil Baytown Refinery				
	ExxonMobil Baytown Turbine				
	Greens Bayou 5				
	Greens Bayou Others				
	Hiram Clarke				
	Houston Chemical Complex Battleground				
	Pasadena				
	Pasadena Cogeneration				
	Rice University				
	Sam Bertron 1				
	Sam Bertron 2				
	Sam Bertron 3				
	Sam Bertron 4				
	Sam Bertron Others				
	San Jacinto Steam Electric Station				
	Shell Deer Park				
	T H Wharton				
	Texas Medical Center				
	Texas Petrochemicals				
	Valero Refining Texas Houston				
	Webster				
	Westhollow Technology Center				
Hays	Hays Energy Project	11.04	0.74	0.04	88.18
	Southwest Texas State University				
Henderson	Trinidad	13.35	81.87	3.95	0.84
Hidalgo	Frontera Energy Center	11.04	0.74	0.04	88.18
	Hidalgo Energy Center				
	J L Bates 1				
	J L Bates 2				
	Magic Valley Generating Station				
Hood	DeCordova Steam Electric Station 1	13.35	81.87	3.95	0.84
	DeCordova Steam Electric Station CTs				
	Wolf Hollow I, L.P.				
Howard	Big Spring Carbon Plant	0.20	0.59	98.34	0.87
	C R Wing Cogen Plant				
Hunt	Engine Plant	11.08	2.24	0.11	86.57
	Greenville				
	Powerlane Plant				
Jack	Jack County Project	13.35	81.87	3.95	0.84
	Jack Energy Facility				
Johnson	Johnson County	13.35	81.87	3.95	0.84
Kaufman	Forney Energy Center	13.35	81.87	3.95	0.84
Lamar	Lamar Power Project	13.35	81.87	3.95	0.84
	Paris Generating Station				
Limestone	Limestone 1	0.00	0.00	0.00	0.00
	Limestone 2 (Uprated)				
Llano	Thomas C Ferguson	11.04	0.74	0.04	88.18
McLennan	Baylor University Cogen	13.35	81.87	3.95	0.84
	Lake Creek				
	Tradinghouse 1				
	Tradinghouse 2				
Milam	Sandow 5	11.04	0.74	0.04	88.18
	Sandow No 4				
	Sandow Station				
Mitchell	Morgan Creek	0.10	0.58	99.31	0.01
Nolan	TXU Sweetwater Generating Plant	0.10	0.58	99.31	0.01
Nueces	Barney M. Davis 1	11.04	0.74	0.04	88.18
	Barney M. Davis 2				
	Barney M. Davis Power Plant (repowering)				
	Celanese Engineering Resin				
	Corpus Christi				
	Corpus Christi Energy Center				
	Corpus Refinery				
	Nueces Bay Power Plant (repowering)				
	Valero Refinery Corpus Christi East				
	Valero Refinery Corpus Christi West				
Palo Pinto	R W Miller 1	13.35	81.87	3.95	0.84
	R W Miller 2				
	R W Miller 3				
	R W Miller Others				
Parker	North Texas	13.35	81.87	3.95	0.84
	Weatherford				
Pecos	Yates Gas Plant	0.10	0.58	99.31	0.01
Reagan	Midkiff Plant	0.10	0.58	99.31	0.01
Robertson	Oak Grove 1	11.34	11.28	0.55	76.83
	Oak Grove 2				
	Twin Oaks Power One 1				
	Twin Oaks Power One 2				
Rusk	Martin Lake	0.00	0.00	0.00	0.00
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	Eagle Mountain	13.35	81.87	3.95	0.84
	Handley				
Titus	Monticello	0.00	0.00	0.00	0.00

Table 10: Allocation of CM Zones for Each of Applicable ERCOT Counties (Continued)

County	Plant	CM Zones Percentage			
		H	N	W	S
Travis	Central Utility Plant	11.04	0.74	0.04	88.18
	Decker Creek 1				
	Decker Creek 2				
	Decker Creek GT (1-4)				
	Hal C Weaver Power Plant				
	Holly Street 3				
	Holly Street 4				
	Mueller Energy Center				
	Sand Hill				
Upton	Benedum Plant	0.10	0.58	99.31	0.01
Victoria	Sam Rayburn	11.04	0.74	0.04	88.18
	Victoria (refurbish)				
	Victoria Texas Plant				
Ward	Permian Basin 5	0.10	0.58	99.31	0.01
	Permian Basin 6				
	Permian Basin Others				
Webb	Laredo 1	11.04	0.74	0.04	88.18
	Laredo 2				
	Laredo 3				
	Laredo Energy Center (refurbish)				
Wharton	Colorado Bend Energy Center	11.04	0.74	0.04	88.18
	Colorado Bend Energy Center				
	Colorado Bend Energy Center				
	New gulf Cogen				
Wichita	PPG Industries Works 4	0.10	0.58	99.31	0.01
	Signal Hill Wichita Falls Power LP				
Wilbarger	Oklaunion	13.35	81.87	3.95	0.84
Wise	Bridgeport Gas Processing Plant	13.35	81.87	3.95	0.84
	Wise County Power LP				
Young	Graham 1	13.35	81.87	3.95	0.84
	Graham 2				

Table 11: 2013 Totalized Annual Electricity Savings by CM Zone from New Single-family Residences

CM Zone	Total Electricity Savings by CM Zone (MWh) 2013-TRY 2008
Houston (H)	28,709
North (N)	22,602
West (W)	2,005
South (S)	14,711
Total	68,027

Table 12: 2013 Annual NOx Reductions from New Single-family Residences Using 2010 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	0.0562032	1613.5635175	0.0000071	0.1611668	0.0000003	0.0006905	0.0005265	7.7458269	1621.4712017	0.8107356
	Chambers	0.0204500	587.1086381	0.0000026	0.0586419	0.0000001	0.0002512	0.0001916	2.8183842	589.9859154	0.2949930
	Fort Bend	0.0313463	899.9360330	0.0000040	0.0898879	0.0000002	0.0003851	0.0002937	4.3200957	904.3464017	0.4521732
	Galveston	0.0226620	650.6128294	0.0000029	0.0649848	0.0000001	0.0002784	0.0002123	3.1232327	653.8013254	0.3269007
	Harris	0.1486911	4268.8420102	0.0000189	0.4263826	0.0000009	0.0018268	0.0013930	20.4923519	4289.7625714	2.1448813
Dallas/ Fort Worth Area	Collin	0.0012932	37.1261578	0.0079329	179.3023103	0.0003832	0.7681887	0.0000809	1.1906096	218.3872664	0.1091936
	Dallas	0.0024826	71.2743495	0.0152295	344.2224105	0.0007356	1.4747593	0.0001554	2.2857178	419.2572372	0.2096286
	Denton	0.0001267	3.6364420	0.0007770	17.5623467	0.0000375	0.0752427	0.0000079	0.1166181	21.3906496	0.0106953
	Tarrant	0.0004742	13.6135291	0.0029089	65.7471000	0.0001405	0.2816817	0.0000297	0.4365762	80.0788870	0.0400394
	Ellis	0.0029920	85.8984839	0.0183544	414.8502705	0.0008865	1.7773518	0.0001873	2.7547035	505.2808097	0.2526404
	Johnson	0.0007256	20.8315546	0.0044512	100.6068522	0.0002150	0.4310321	0.0000454	0.6680532	122.5374921	0.0612687
	Kaufman	0.0059718	171.4485491	0.0366343	828.0178389	0.0017695	3.5474943	0.0003738	5.4982334	1008.5121157	0.5042561
	Parker	0.0000012	0.0352989	0.0000075	0.1704774	0.0000004	0.0007304	0.0000001	0.0011320	0.2076386	0.0001038
	Henderson	0.0006908	19.8318133	0.0042376	95.7785600	0.0002047	0.4103461	0.0000432	0.6359922	116.6567116	0.0583284
	Hood	0.0050771	145.7606776	0.0311454	703.9572039	0.0015044	3.0159787	0.0003178	4.6744416	857.4083018	0.4287042
	Hunt	0.0088463	253.9735332	0.0047066	106.3807487	0.0002273	0.4557693	0.0652823	960.3512805	1321.1613317	0.6605807
San Antonio Area	Bexar	0.0138906	398.7917838	0.0009368	21.1741336	0.0000452	0.0907168	0.1109355	1631.9445988	2052.0012329	1.0260006
	Guadalupe	0.0032029	91.9532220	0.0002160	4.8823218	0.0000104	0.0209174	0.0255795	376.2930182	473.1494794	0.2365747
Austin Area	Bastrop	0.0033782	96.9869895	0.0002278	5.1495932	0.0000110	0.0220625	0.0269798	396.8923134	499.0509586	0.2495255
	Hays	0.0008331	23.9186804	0.0000562	1.2699794	0.0000027	0.0054410	0.0066537	97.8805555	123.0746563	0.0615373
	Travis	0.0051785	148.6729547	0.0003493	7.8938963	0.0000169	0.0338200	0.0413577	608.4027688	765.0034398	0.3825017
	Rusk	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Corpus Christi Area	Nueces	0.0128578	369.1398929	0.0008672	19.5997453	0.0000419	0.0839716	0.1026870	1510.6024717	1899.4260814	0.9497130
	San Patricio	0.0015100	43.3499547	0.0001018	2.3016967	0.0000049	0.0098612	0.0120591	177.3976479	223.0591605	0.1115296
Victoria Area	Victoria	0.0021192	60.8398203	0.0001429	3.2303336	0.0000069	0.0138398	0.0169244	248.9700645	313.0540581	0.1565270
Other ERCOT counties	Andrews	0.0000037	0.1074953	0.0000230	0.5191528	0.0039003	7.8192910	0.0000002	0.0034473	8.4493864	0.0042247
	Bosque	0.0022204	63.7471790	0.0136212	307.8696301	0.0006579	1.3190124	0.0001390	2.0443268	374.9801483	0.1874901
	Brazos	0.0024089	69.1575705	0.0112305	253.8353405	0.0005425	1.0875121	0.0047829	70.3601569	394.4405800	0.1972203
	Calhoun	0.0009466	27.1758825	0.0000638	1.4429228	0.0000031	0.0061819	0.0075598	111.2097502	139.8347374	0.0699174
	Cameron	0.0063536	182.4093092	0.0004285	9.6851521	0.0000207	0.0414943	0.0507425	746.4594281	938.5953836	0.4692977
	Cherokee	0.0027392	78.6396712	0.0168033	379.7935355	0.0008116	1.6271575	0.0001714	2.5219185	462.5822827	0.2312911
	Coke	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Ector	0.0019215	55.1654704	0.0006604	14.9255318	0.0911346	182.7071860	0.0146527	215.5519166	468.3501048	0.2341751
	Fannin	0.0000041	0.1164145	0.0000249	0.5622284	0.0000012	0.0024088	0.0000003	0.0037333	0.6847850	0.0003424
	Fayette	0.0051867	148.9074253	0.0103217	233.2934838	0.0004986	0.9995042	0.0283993	417.7749856	800.9753989	0.4004877
	Freestone	0.0047643	136.7815990	0.0292268	660.5923737	0.0014117	2.8301899	0.0002982	4.3864889	804.5906515	0.4022953
	Frio	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Grimes	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Hidalgo	0.0053716	154.2150378	0.0003623	8.1881572	0.0000175	0.0350807	0.0428994	631.0822041	793.5204798	0.3967602
	Howard	0.0002411	6.9223615	0.0007641	17.2697337	0.1283942	257.4052684	0.0009490	13.9603667	295.5577304	0.1477789
	Jack	0.0030783	88.3767174	0.0188839	426.8190015	0.0009121	1.8286297	0.0001927	2.8341787	519.8585272	0.2599293
	Lamar	0.0040001	114.8419146	0.0245388	554.6337628	0.0011853	2.3762292	0.0002504	3.6828988	675.5348053	0.3377674
	Limestone	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Llano	0.0040314	115.7406829	0.0002719	6.1453339	0.0000131	0.0263286	0.0321966	473.6365942	595.5489395	0.2977745
	McLennan	0.0056576	162.4272864	0.0347066	784.4492788	0.0016764	3.3608326	0.0003541	5.2089279	955.4463258	0.4777232
	Milam	0.0012686	36.4210013	0.0000856	1.9337990	0.0000041	0.0082850	0.0101316	149.0428308	187.4059162	0.0937030
	Mitchell	0.0000311	0.8936902	0.0001910	4.3161138	0.0324260	65.0077440	0.0000019	0.0286600	70.2462080	0.0351231
	Nolan	0.0000293	0.8399053	0.0001795	4.0563575	0.0304745	61.0953881	0.0000018	0.0269352	66.0185861	0.0330093
	Palo Pinto	0.0036129	103.7255177	0.0221635	500.9466655	0.0010705	2.1462164	0.0002261	3.3264038	610.1448034	0.3050724
	Pecos	0.0000020	0.0565559	0.0000121	0.2731390	0.0020520	4.1139205	0.0000001	0.0018137	4.4454291	0.0022227
	Robertson	0.0039506	113.4188493	0.0055755	126.0184501	0.0002693	0.5399035	0.0246170	362.1338219	602.1110248	0.3010555
	Titus	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Upton	0.0000025	0.0730208	0.0000156	0.3526569	0.0026494	5.3115902	0.0000002	0.0023417	5.7396096	0.0028698
	Ward	0.0001995	5.7280879	0.0012239	27.6640368	0.2078335	416.6657091	0.0000125	0.1836957	450.2415296	0.2251208
	Webb	0.0042017	120.6292903	0.0002834	6.4048980	0.0000137	0.0274406	0.0335565	493.6418622	620.7034911	0.3103517
	Wharton	0.0021095	60.5629847	0.0001423	3.2156348	0.0000069	0.0137768	0.0168474	247.8371915	311.6295878	0.1558148
	Wichita	0.0000121	0.3477912	0.0000743	1.6796718	0.0126190	25.2986090	0.0000008	0.0111534	27.3372254	0.0136686
	Wilbarger	0.0179710	515.9379658	0.1102430	2491.7436844	0.0053249	10.6754301	0.0011247	16.5457647	3034.9028451	1.5174514
	Wise	0.0010202	29.2888340	0.0062583	141.4516316	0.0003023	0.6060242	0.0000638	0.9392721	172.2857619	0.0861429
	Young	0.0071054	203.9922381	0.0435880	985.1889272	0.0021054	4.2208657	0.0004447	6.5418864	1199.9439175	0.5999720
	Total	**0.4414501**	**12673.79447**	**0.4812863**	**10878.16917**	**0.5345786**	**1071.725848**	**0.6829349**	**10046.48164**	**34670.1711264**	**17.3350856**

Energy Savings by PCA (MWh)		28,709		22,602		2,005		14,711			

4.2 2013 Results for New Multi-family Residential Constructions

This section provides the potential electricity and natural gas savings and the associated NOx emissions reductions in 2013 using the 2008 base year which implemented the 2006 IECC for new multi-family residences in the 41 non-attainment and affected counties as well as other counties in the ERCOT region[18]. 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 2013 building permits per county was obtained from the real estate center at Texas A&M University (REC 2014). Next, energy savings attributable to the 2006 IECC were calculated using the Laboratory's code-traceable, DOE-2.1e simulation, which was developed for the TERP. For the savings calculatioin, the 2013 NAHB Builder's survey data[19] 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 2010 eGRID database[20].

In Table 13, the 2013 new multi-family and 2006 IECC code-compliant building characteristics are shown for each county. The 2006 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 13, 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 NAHB Builder's survey classification is listed. The fifth through eighth columns show the NAHB Builder'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 2006 IECC minimum requirements for glazing U-value, SHGC, roof insulation, and wall insulation.

All the houses were assumed to have air conditioner efficiency equal to a SEER of 13 and furnace efficiency (AFUE) of 0.80, and domestic water heater efficiency of 0.78 for a natural gas type and 1 for an electric type. The values shown in Table 13 represent the only changes that were made to the simulations to obtain the savings calculations. All other variables in the simulations remained the same for the 2013 new multi-family and the 2006 IECC code-compliant simulations. In cases where the 2013 new multi-family values were more efficient than the 2006 IECC requirements, the 2013 new multi-family values were used in 2013 new multi-family simulations. Otherwise, the 2006 IECC values were used in both simulations.

In Table 14, the code-traceable simulation results for multi-family residences are shown for each county. In a similar fashion to Table 13, Table 14 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 2006 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 constructions had been built to pre-code specifications. In the sixth column, the total county-wide energy use for code-compliant constructions 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 NAHB Builder'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 14 are assigned to CM Zones[22] provider(s) in a similar fashion to the single-family residential assignments. The total electricity savings for each CM Zone, as shown in Table 15, are then entered into the bottom row of Table 16, the 2010 US EPA's eGRID database for Texas. Next, the county's NOx reductions (lbs) are calculated using the assigned 2010 eGrid proportions (lbs-NOx/MWh) to each CM zone in the

[18]The three new counties added in the 2003 Legislative session (i.e., Henderson, Hood, and Hunt) were included in the ERCOT region.
[19] For the 2013 report, the 2012 NAHB data were used.
[20] This analysis assumes transmission and distribution losses of 7%. Counties were assigned to utility service districts as indicated.
[21] The number of the new housing units in 2013 were obtained from the Real Estate Center at Texas A&M University.
[22] ERCOT region has employed the Congestion Management (CM) since 2010, and it is currently divided into four zones: Houston (H), North (N), South (S), and West (W).

county. The calculated NOx reductions are presented in the columns adjacent to the corresponding CM 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 13: 2013 and 2006 IECC Code-compliant Building Characteristics Used in the DOE-2 Simulations for New Multi-family Residences

	County	Climate Zone	Division	2013 Average				2006 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	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Chambers	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Collin	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	Dallas	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	Denton	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	El Paso	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	Fort Bend	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Galveston	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Hardin	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Harris	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Jefferson	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Liberty	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Montgomery	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Orange	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Tarrant	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	Waller	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
Affected	Bastrop	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Bexar	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Caldwell	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Comal	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Ellis	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	Gregg	3	East Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	Guadalupe	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Harrison	3	East Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	Hays	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Henderson	3	East Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	Hood	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	Hunt	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	Johnson	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	Kaufman	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	Nueces	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Parker	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	Rockwall	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	Rusk	3	East Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	San Patricio	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Smith	3	East Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	Travis	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Upshur	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	Victoria	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Williamson	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	Wilson	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
ERCOT	ANDERSON	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	ANDREWS	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	ANGELINA	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	ARANSAS	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	ARCHER	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	ATASCOSA	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	AUSTIN	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	BANDERA	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	BASTROP	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	BAYLOR	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	BEE	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	BELL	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	BEXAR	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	BLANCO	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	BORDEN	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	BOSQUE	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	BRAZORIA	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	BRAZOS	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	BREWSTER	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	BRISCOE	4	West Texas	0.44	0.53	33.68	17.52	0.4	NR	38	13
	BROOKS	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	BROWN	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	BURLESON	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	BURNET	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	CALDWELL	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	CALHOUN	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	CALLAHAN	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	CAMERON	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	CHAMBERS	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	CHEROKEE	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	CHILDRESS	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	CLAY	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	COKE	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	COLEMAN	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	COLLIN	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	COLORADO	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	COMAL	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	COMANCHE	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	CONCHO	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	COOKE	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	CORYELL	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	COTTLE	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	CRANE	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	CROCKETT	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	CROSBY	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	CULBERSON	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	DALLAS	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	DAWSON	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	DE WITT	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	DELTA	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	DENTON	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	DICKENS	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	DIMMIT	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	DUVAL	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	EASTLAND	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	ECTOR	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	EDWARDS	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	ELLIS	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	ERATH	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	FALLS	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	FANNIN	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	FAYETTE	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	FISHER	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	FOARD	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	FORT BEND	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	FRANKLIN	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	FREESTONE	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13

Table 13: 2013 and 2006 IECC Code-compliant Building Characteristics Used in the DOE-2 Simulations for New Multi-family Residences (Continued)

	County	Climate Zone	Division	2013 Average				2006 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)
ERCOT	FRIO	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	GALVESTON	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	GILLESPIE	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	GLASSCOCK	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	GOLIAD	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	GONZALES	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	GRAYSON	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	GRIMES	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	GUADALUPE	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	HALL	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	HAMILTON	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	HARDEMAN	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	HARRIS	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	HASKELL	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	HAYS	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	HENDERSON	3	East Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	HIDALGO	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	HILL	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	HOOD	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	HOPKINS	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	HOUSTON	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	HOWARD	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	HUDSPETH	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	HUNT	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	IRION	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	JACK	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	JACKSON	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	JEFF DAVIS	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	JIM HOGG	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	JIM WELLS	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	JOHNSON	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	JONES	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	KARNES	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	KAUFMAN	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	KENDALL	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	KENEDY	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	KENT	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	KERR	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	KIMBLE	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	KING	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	KINNEY	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	KLEBERG	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	KNOX	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	LA SALLE	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	LAMAR	3	East Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	LAMPASAS	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	LAVACA	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	LEE	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	LEON	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	LIMESTONE	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	LIVE OAK	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	LLANO	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	LOVING	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	MADISON	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	MARTIN	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	MASON	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	MATAGORDA	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	MAVERICK	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	MCCULLOCH	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	MCLENNAN	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	MCMULLEN	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	MEDINA	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	MENARD	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	MIDLAND	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	MILAM	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	MILLS	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	MITCHELL	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	MONTAGUE	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	MONTGOMERY	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	MOTLEY	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	NACOGDOCHES	3	East Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	NAVARRO	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	NOLAN	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	NUECES	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	PALO PINTO	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	PARKER	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	PECOS	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	PRESIDIO	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	RAINS	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	REAGAN	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	REAL	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	RED RIVER	3	East Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	REEVES	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	REFUGIO	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	ROBERTSON	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	ROCKWALL	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	RUNNELS	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	RUSK	3	East Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	SAN PATRICIO	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	SAN SABA	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	SCHLEICHER	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	SCURRY	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	SHACKELFORD	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	SMITH	3	East Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	SOMERVELL	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	STARR	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	STEPHENS	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	STERLING	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	STONEWALL	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	SUTTON	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	TARRANT	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	TAYLOR	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	TERRELL	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	THROCKMORTON	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	TITUS	3	East Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	TOM GREEN	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	TRAVIS	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	UPTON	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	UVALDE	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	VAL VERDE	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	VAN ZANDT	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	VICTORIA	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	WALLER	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	WARD	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	WASHINGTON	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	WEBB	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	WHARTON	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	WICHITA	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	WILBARGER	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	WILLACY	2	East Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	WILLIAMSON	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	WILSON	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	WINKLER	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	WISE	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	YOUNG	3	West Texas	0.44	0.53	33.68	17.52	0.65	0.4	30	13
	ZAPATA	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13
	ZAVALA	2	West Texas	0.44	0.53	33.68	17.52	0.75	0.4	30	13

Table 14: 2013 Annual Electricity Savings from New Multi-family Residences

2013 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)
Nonattain-ment County	BRAZORIA	2	124	5,584	5,391	206.89	26,902	26,865	36.98
	CHAMBERS	2	0	0	0	0.00	0	0	0.00
	COLLIN	2	1,282	63,911	60,804	3,324.13	375,512	348,603	26,909.44
	DALLAS	2	11,171	556,308	529,322	28,875.11	3,279,657	3,042,784	236,873.07
	DENTON	2	1,453	72,436	68,915	3,767.52	425,600	395,101	30,498.76
	EL PASO	3	1,484	66,764	63,806	3,165.18	455,888	416,253	39,635.00
	FORT BEND	2	1,222	55,042	53,133	2,042.85	265,117	264,686	431.04
	GALVESTON	2	0	0	0	0.00	0	0	0.00
	HARDIN	2	2	89	86	3.21	441	442	-0.39
	HARRIS	2	14,012	631,133	609,241	23,424.25	3,039,948	3,035,005	4,942.52
	JEFFERSON	2	4	177	171	6.43	883	882	0.81
	LIBERTY	3	0	0	0	0.00	0	0	0.00
	MONTGOMERY	3	1,364	61,438	59,307	2,280.24	295,924	295,443	481.13
	ORANGE	2	0	0	0	0.00	0	0	0.00
	TARRANT	3	2,703	134,608	128,078	6,986.79	793,565	736,250	57,315.18
	WALLER	2	69	3,108	3,000	115.35	14,970	14,945	24.34
Affected County	BASTROP	3	4	192	183	9.62	1,021	950	71.28
	BEXAR	3	195	9,009	8,652	382.53	44,353	42,073	2,280.44
	CALDWELL	3	4	192	183	9.62	0	0	0.00
	COMAL	3	100	4,620	4,437	196.17	22,745	21,576	1,169.45
	ELLIS	3	14	697	663	36.19	4,110	3,813	296.86
	GREGG	2	531	26,161	25,224	1,002.54	144,038	144,045	-6.24
	GUADALUPE	3	0	0	0	0.00	0	0	0.00
	HARRISON	3	0	0	0	0.00	0	0	0.00
	HAYS	3	1,726	82,840	78,959	4,152.56	440,644	409,983	30,661.28
	HENDERSON	2	0	0	0	0.00	0	0	0.00
	HOOD	3	18	896	853	46.53	5,285	4,903	381.68
	HUNT	2	7	349	332	18.12	2,053	1,904	148.52
	JOHNSON	3	0	0	0	0.00	0	0	0.00
	KAUFMAN	2	0	0	0	0.00	0	0	0.00
	NUECES	2	904	41,844	40,216	1,741.60	179,542	179,367	174.63
	PARKER	2	70	3,490	3,320	181.50	20,504	19,034	1,469.31
	ROCKWALL	2	0	0	0	0.00	0	0	0.00
	RUSK	2	0	0	0	0.00	0	0	0.00
	SAN PATRICIO	3	0	0	0	0.00	0	0	0.00
	SMITH	3	0	0	0	0.00	0	0	0.00
	TRAVIS	3	9,421	452,166	430,983	22,665.85	2,405,161	2,237,803	167,357.99
	UPSHUR	3	0	0	0	0.00	0	0	0.00
	VICTORIA	2	342	15,588	15,029	598.86	72,715	72,623	91.86
	WILLIAMSON	2	756	36,285	34,585	1,818.85	193,005	179,575	13,429.85
	WILSON	2	0	0	0	0.00	0	0	0.00
ERCOT	ANDERSON	2	2	90	87	3.28	480	479	1
	ANDREWS	3	0	0	0	0.00	0	0	0
	ANGELINA	2	7	315	304	11.47	1,681	1,678	3
	ARANSAS	2	0	0	0	0.00	0	0	0
	ARCHER	3	0	0	0	0.00	0	0	0
	ATASCOSA	2	4	185	178	7.81	923	872	51
	AUSTIN	2	0	0	0	0.00	0	0	0
	BANDERA	2	0	0	0	0.00	0	0	0
	BAYLOR	3	0	0	0	0.00	0	0	0
	BEE	2	0	0	0	0.00	0	0	0
	BELL	2	246	11,725	11,171	592.81	72,981	67,254	5,726
	BLANCO	3	88	4,224	4,026	211.72	22,466	20,903	1,563
	BORDEN	3	0	0	0	0.00	0	0	0
	BOSQUE	2	0	0	0	0.00	0	0	0
	BRAZOS	2	850	38,286	36,958	1,420.97	184,410	184,110	300
	BREWSTER	3	8	385	366	20.90	2,379	2,191	189
	BRISCOE	4	0	0	0	0.00	0	0	0
	BROOKS	2	0	0	0	0.00	0	0	0
	BROWN	3	38	1,811	1,726	91.57	11,273	10,389	885
	BURLESON	2	2	90	87	3.34	434	433	1
	BURNET	3	4	192	183	9.62	1,021	950	71
	CALHOUN	2	94	4,285	4,131	164.60	19,986	19,961	25
	CALLAHAN	3	12	581	551	32.21	3,907	3,588	319
	CAMERON	2	173	8,162	7,835	349.81	31,806	31,702	104
	CHEROKEE	2	2	90	87	3.28	480	479	1
	CHILDRESS	3	0	0	0	0.00	0	0	0
	CLAY	3	0	0	0	0.00	0	0	0
	COKE	3	0	0	0	0.00	0	0	0
	COLEMAN	3	0	0	0	0.00	0	0	0
	COLORADO	2	0	0	0	0.00	0	0	0
	COMANCHE	3	48	2,288	2,180	115.67	14,240	13,123	1,117
	CONCHO	3	0	0	0	0.00	0	0	0
	COOKE	3	0	0	0	0.00	0	0	0
	CORYELL	2	10	477	454	24.10	2,967	2,734	233
	COTTLE	3	0	0	0	0.00	0	0	0
	CRANE	3	0	0	0	0.00	0	0	0
	CROCKETT	3	0	0	0	0.00	0	0	0
	CROSBY	3	0	0	0	0.00	0	0	0
	CULBERSON	3	0	0	0	0.00	0	0	0
	DAWSON	3	0	0	0	0.00	0	0	0
	DE WITT	2	0	0	0	0.00	0	0	0
	DELTA	3	0	0	0	0.00	0	0	0
	DICKENS	3	0	0	0	0.00	0	0	0
	DIMMIT	2	0	0	0	0.00	0	0	0
	DUVAL	2	0	0	0	0.00	0	0	0
	EASTLAND	3	0	0	0	0.00	0	0	0
	ECTOR	3	572	27,692	26,252	1,540.90	183,660	168,218	15,442
	EDWARDS	2	0	0	0	0.00	0	0	0
	ERATH	3	333	16,115	15,279	893.76	108,416	99,576	8,841
	FALLS	2	0	0	0	0.00	0	0	0
	FANNIN	3	18	897	853	46.59	5,279	4,897	382
	FAYETTE	2	0	0	0	0.00	0	0	0
	FISHER	3	0	0	0	0.00	0	0	0
	FOARD	3	0	0	0	0.00	0	0	0
	FRANKLIN	3	0	0	0	0.00	0	0	0
	FREESTONE	2	0	0	0	0.00	0	0	0
	FRIO	2	0	0	0	0.00	0	0	0

Table 14: 2013 Annual Electricity Savings from New Multi-family Residences (Continued)

2013 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
	GLASSCOCK	3	0	0	0	0.00	0	0	0
	GOLIAD	2	0	0	0	0.00	0	0	0
	GONZALES	2	0	0	0	0.00	0	0	0
	GRAYSON	3	191	9,517	9,055	494.36	56,016	51,963	4,052
	GRIMES	2	0	0	0	0.00	0	0	0
	HALL	3	0	0	0	0.00	0	0	0
	HAMILTON	3	0	0	0	0.00	0	0	0
	HARDEMAN	3	0	0	0	0.00	0	0	0
	HASKELL	3	0	0	0	0.00	0	0	0
	HIDALGO	2	749	35,337	33,921	1,514.49	137,702	137,253	449
	HILL	2	0	0	0	0.00	0	0	0
	HOPKINS	3	0	0	0	0.00	0	0	0
	HOUSTON	2	0	0	0	0.00	0	0	0
	HOWARD	3	0	0	0	0.00	0	0	0
	HUDSPETH	3	0	0	0	0.00	0	0	0
	IRION	3	0	0	0	0.00	0	0	0
	JACK	3	0	0	0	0.00	0	0	0
	JACKSON	2	0	0	0	0.00	0	0	0
	JEFF DAVIS	3	0	0	0	0.00	0	0	0
	JIM HOGG	2	0	0	0	0.00	0	0	0
	JIM WELLS	2	0	0	0	0.00	0	0	0
	JONES	3	0	0	0	0.00	0	0	0
	KARNES	2	12	547	527	21.01	2,551	2,548	3
	KENDALL	3	0	0	0	0.00	0	0	0
	KENEDY	2	0	0	0	0.00	0	0	0
	KENT	3	0	0	0	0.00	0	0	0
	KERR	3	0	0	0	0.00	0	0	0
	KIMBLE	3	0	0	0	0.00	0	0	0
	KING	3	0	0	0	0.00	0	0	0
	KINNEY	2	0	0	0	0.00	0	0	0
	KLEBERG	2	386	17,854	17,160	743.49	77,513	77,401	112
	KNOX	3	0	0	0	0.00	0	0	0
	LA SALLE	2	16	741	712	30.82	3,178	3,175	3
	LAMAR	3	0	0	0	0.00	0	0	0
	LAMPASAS	3	84	4,004	3,814	202.42	24,920	22,965	1,955
	LAVACA	2	0	0	0	0.00	0	0	0
	LEE	2	0	0	0	0.00	0	0	0
	LEON	2	0	0	0	0.00	0	0	0
	LIMESTONE	2	0	0	0	0.00	0	0	0
	LIVE OAK	2	0	0	0	0.00	0	0	0
	LLANO	3	0	0	0	0.00	0	0	0
	LOVING	3	0	0	0	0.00	0	0	0
	MADISON	2	4	180	174	6.69	868	866	1
	MARTIN	3	0	0	0	0.00	0	0	0
	MASON	3	0	0	0	0.00	0	0	0
	MATAGORDA	2	0	0	0	0.00	0	0	0
	MAVERICK	2	45	2,083	2,002	86.69	8,937	8,929	9
	MCCULLOCH	3	0	0	0	0.00	0	0	0
	MCLENNAN	2	65	3,098	2,952	156.64	19,283	17,770	1,513
	MCMULLEN	2	0	0	0	0.00	0	0	0
	MEDINA	2	2	92	89	3.92	455	432	23
	MENARD	3	0	0	0	0.00	0	0	0
	MIDLAND	3	1,092	52,867	50,118	2,941.72	350,623	321,143	29,481
	MILAM	2	82	3,693	3,565	137.08	17,790	17,761	29
	MILLS	3	0	0	0	0.00	0	0	0
	MITCHELL	3	0	0	0	0.00	0	0	0
	MONTAGUE	3	0	0	0	0.00	0	0	0
	MOTLEY	3	0	0	0	0.00	0	0	0
	NACOGDOCHES	3	2	90	87	3.28	480	479	1
	NAVARRO	3	0	0	0	0.00	0	0	0
	NOLAN	3	0	0	0	0.00	0	0	0
	PALO PINTO	3	0	0	0	0.00	0	0	0
	PECOS	3	0	0	0	0.00	0	0	0
	PRESIDIO	3	0	0	0	0.00	0	0	0
	RAINS	3	0	0	0	0.00	0	0	0
	REAGAN	3	4	194	184	10.78	1,285	1,176	109
	REAL	2	0	0	0	0.00	0	0	0
	RED RIVER	3	0	0	0	0.00	0	0	0
	REEVES	3	0	0	0	0.00	0	0	0
	REFUGIO	2	0	0	0	0.00	0	0	0
	ROBERTSON	2	0	0	0	0.00	0	0	0
	RUNNELS	3	0	0	0	0.00	0	0	0
	SAN SABA	3	0	0	0	0.00	0	0	0
	SCHLEICHER	3	0	0	0	0.00	0	0	0
	SCURRY	3	2	100	94	5.91	838	759	79
	SHACKELFORD	3	0	0	0	0.00	0	0	0
	SOMERVELL	3	0	0	0	0.00	0	0	0
	STARR	2	0	0	0	0.00	0	0	0
	STEPHENS	3	0	0	0	0.00	0	0	0
	STERLING	3	0	0	0	0.00	0	0	0
	STONEWALL	3	0	0	0	0.00	0	0	0
	SUTTON	3	0	0	0	0.00	0	0	0
	TAYLOR	3	2	97	92	5.37	651	598	53
	TERRELL	3	0	0	0	0.00	0	0	0
	THROCKMORTON	3	0	0	0	0.00	0	0	0
	TITUS	3	0	0	0	0.00	0	0	0
	TOM GREEN	3	200	9,627	9,138	522.51	59,482	54,764	4,718
	UPTON	3	0	0	0	0.00	0	0	0
	UVALDE	2	4	185	177	7.85	910	863	47
	VAL VERDE	2	2	92	89	3.92	455	432	23
	VAN ZANDT	3	0	0	0	0.00	0	0	0
	WARD	3	24	1,162	1,101	64.65	7,706	7,058	648
	WASHINGTON	2	0	0	0	0.00	0	0	0
	WEBB	2	708	32,772	31,497	1,364.00	140,615	140,478	137
	WHARTON	2	0	0	0	0.00	0	0	0
	WICHITA	3	102	5,269	4,975	314.98	38,033	34,678	3,355
	WILBARGER	3	0	0	0	0.00	0	0	0
	WILLACY	2	0	0	0	0.00	0	0	0
	WINKLER	3	0	0	0	0.00	0	0	0
	WISE	3	0	0	0	0.00	0	0	0
	YOUNG	3	0	0	0	0.00	0	0	0
	ZAPATA	2	0	0	0	0.00	0	0	0
	ZAVALA	2	0	0	0	0.00	0	0	0
	TOTAL		55,271			121,245			696,729

Table 15: 2013 Totalized Annual Electricity Savings by CM Zone from New Multi-family Residences

CM Zone	Total Electricity Savings by CM Zone (MWh) 2013-TRY 2008
Houston (H)	35,084
North (N)	36,847
West (W)	3,581
South (S)	30,051
Total	105,563

Table 16: 2013 Annual NOx Reductions from New Multi-family Residences Using 2010 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	0.0562032	1971.8390540	0.0000071	0.2627420	0.0000003	0.0012332	0.0005265	15.8232375	1987.9262667	0.9939631
	Chambers	0.0204500	717.4702012	0.0000026	0.0956009	0.0000001	0.0004487	0.0001916	5.7574179	723.3236686	0.3616618
	Fort Bend	0.0313463	1099.7577702	0.0000040	0.1465396	0.0000002	0.0006878	0.0002937	8.8251262	1108.7301238	0.5543651
	Galveston	0.0226620	795.0748590	0.0000029	0.1059415	0.0000001	0.0004973	0.0002123	6.3801649	801.5614626	0.4007807
	Harris	0.1486911	5216.6954071	0.0000189	0.6951100	0.0000009	0.0032627	0.0013930	41.8619412	5259.2557209	2.6296279
Dallas/ Fort Worth Area	Collin	0.0012932	45.3696474	0.0079329	292.3074779	0.0003832	1.3720124	0.0000809	2.4321868	341.4813245	0.1707407
	Dallas	0.0024826	87.1001014	0.0152295	561.1683669	0.0007356	2.6339728	0.0001554	4.6692828	655.5717238	0.3277859
	Denton	0.0001267	4.4438774	0.0007770	28.6310046	0.0000375	0.1343862	0.0000079	0.2382284	33.4474966	0.0167237
	Tarrant	0.0004742	16.6362761	0.0029089	107.1841682	0.0001405	0.5030935	0.0000297	0.8918414	125.2153793	0.0626077
	Ellis	0.0029920	104.9713775	0.0183544	676.3093910	0.0008865	3.1744137	0.0001873	5.6273304	790.0825126	0.3950413
	Johnson	0.0007256	25.4569916	0.0044512	164.0142572	0.0002150	0.7698386	0.0000454	1.3647044	191.6057919	0.0958029
	Kaufman	0.0059718	209.5169736	0.0366343	1349.8755578	0.0017695	6.3359514	0.0003738	11.2318354	1576.9603182	0.7884802
	Parker	0.0000012	0.0431366	0.0000075	0.2779206	0.0000004	0.0013045	0.0000001	0.0023125	0.3246742	0.0001623
	Henderson	0.0006908	24.2352678	0.0042376	156.1429369	0.0002047	0.7328928	0.0000432	1.2992100	182.4103074	0.0912052
	Hood	0.0050771	178.1253688	0.0311454	1147.6257862	0.0015044	5.3866456	0.0003178	9.5489868	1340.6867874	0.6703434
	Hunt	0.0088463	310.3657997	0.0047066	173.4271483	0.0002273	0.8140202	0.0652823	1961.8133187	2446.4202869	1.2232101
San Antonio Area	Bexar	0.0138906	487.3394851	0.0009368	34.5191178	0.0000452	0.1620234	0.1109355	3333.7495500	3855.7701764	1.9278851
	Guadalupe	0.0032029	112.3705093	0.0002160	7.9594020	0.0000104	0.0373593	0.0255795	768.6944037	889.0616742	0.4445308
Austin Area	Bastrop	0.0033782	118.5219742	0.0002278	8.3951211	0.0000110	0.0394044	0.0269798	810.7748095	937.7313092	0.4688657
	Hays	0.0008331	29.2295827	0.0000562	2.0703830	0.0000027	0.0097178	0.0066537	199.9511860	231.2608695	0.1156304
	Travis	0.0051785	181.6842877	0.0003493	12.8690195	0.0000169	0.0604037	0.0413577	1242.8500687	1437.4637796	0.7187319
	Rusk	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Corpus Christi Area	Nueces	0.0128578	451.1036902	0.0008672	31.9524724	0.0000419	0.1499763	0.1026870	3085.8708770	3569.0770159	1.7845385
	San Patricio	0.0015100	52.9753758	0.0001018	3.7523396	0.0000049	0.0176125	0.0120591	362.3893417	419.1346695	0.2095673
Victoria Area	Victoria	0.0021192	74.3486900	0.0001429	5.2662492	0.0000069	0.0247184	0.0169244	508.5980499	588.2377074	0.2941189
Other ERCOT counties	Andrews	0.0000037	0.1313635	0.0000230	0.8463485	0.0039003	13.9655327	0.0000002	0.0070422	14.9502868	0.0074751
	Bosque	0.0022204	77.9015984	0.0136212	501.9042696	0.0006579	2.3558031	0.0001390	4.1761673	586.3378384	0.2931689
	Brazos	0.0024089	84.5133128	0.0112305	413.8149031	0.0005425	1.9423354	0.0047829	143.7322944	644.0028458	0.3220014
	Calhoun	0.0009466	33.2100136	0.0000638	2.3523240	0.0000031	0.0110412	0.0075598	227.1801720	262.7535508	0.1313768
	Cameron	0.0063536	222.9114601	0.0004285	15.7892130	0.0000207	0.0741103	0.0507425	1524.8733225	1763.6481060	0.8818241
	Cherokee	0.0027392	96.1008186	0.0168033	619.1581709	0.0008116	2.9061613	0.0001714	5.1517954	723.3169462	0.3616585
	Coke	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Ector	0.0019215	67.4144078	0.0006604	24.3323387	0.0911346	326.3215513	0.0146527	440.3311886	858.3994865	0.4291997
	Fannin	0.0000041	0.1422631	0.0000249	0.9165725	0.0000012	0.0043021	0.0000003	0.0076265	1.0707642	0.0005354
	Fayette	0.0051867	181.9708201	0.0103217	380.3265543	0.0004986	1.7851502	0.0283993	853.4341003	1417.5166249	0.7087583
	Freestone	0.0047643	167.1525762	0.0292268	1076.9302992	0.0014117	5.0548201	0.0002982	8.9607548	1258.0984502	0.6290492
	Frio	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Grimes	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Hidalgo	0.0053716	188.4569345	0.0003623	13.3487380	0.0000175	0.0626554	0.0428994	1289.1798016	1491.0481295	0.7455241
	Howard	0.0002411	8.4594021	0.0007641	28.1539725	0.1283942	459.7349909	0.0009490	28.5183494	524.8667150	0.2624334
	Jack	0.0030783	107.9998778	0.0188839	695.8214070	0.0009121	3.2659978	0.0001927	5.7896830	812.8769656	0.4064385
	Lamar	0.0040001	140.3414057	0.0245388	904.1913409	0.0011853	4.2440300	0.0002504	7.5234552	1056.3002318	0.5281501
	Limestone	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Llano	0.0040314	141.4397364	0.0002719	10.0184267	0.0000131	0.0470238	0.0321966	967.5486434	1119.0538304	0.5595269
	McLennan	0.0056576	198.4926304	0.0347066	1278.8479403	0.0016764	6.0025670	0.0003541	10.6408398	1493.9839774	0.7469920
	Milam	0.0012686	44.5079180	0.0000856	3.1525746	0.0000041	0.0147973	0.0101316	304.4658934	352.1411834	0.1760706
	Mitchell	0.0000311	1.0921251	0.0001910	7.0363418	0.0324260	116.1061495	0.0000019	0.0585469	124.2931634	0.0621466
	Nolan	0.0000293	1.0263979	0.0001795	6.6128742	0.0304745	109.1185424	0.0000018	0.0550234	116.8128379	0.0584064
	Palo Pinto	0.0036129	126.7567247	0.0221635	816.6679845	0.0010705	3.8332190	0.0002261	6.7952044	954.0531327	0.4770266
	Pecos	0.0000020	0.0691136	0.0000121	0.4452847	0.0020520	7.3476088	0.0000001	0.0037051	7.8657121	0.0039329
	Robertson	0.0039506	138.6023631	0.0055755	205.4414985	0.0002693	0.9642869	0.0246170	739.7698836	1084.7780321	0.5423890
	Titus	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Upton	0.0000025	0.0892343	0.0000156	0.5749187	0.0026494	9.4866896	0.0000002	0.0047837	10.1556263	0.0050778
	Ward	0.0001995	6.9999522	0.0012239	45.0992786	0.2078335	744.1798186	0.0000125	0.3752551	796.6543045	0.3983272
	Webb	0.0042017	147.4138099	0.0002834	10.4415809	0.0000137	0.0490100	0.0335565	1008.4155657	1166.3199666	0.5831600
	Wharton	0.0021095	74.0103858	0.0001423	5.2422865	0.0000069	0.0246059	0.0168474	506.2838079	585.5610861	0.2927805
	Wichita	0.0000121	0.4250147	0.0000743	2.7382839	0.0126190	45.1842180	0.0000008	0.0227843	48.3703009	0.0241852
	Wilbarger	0.0179710	630.4967975	0.1102430	4062.1635645	0.0053249	19.0666990	0.0011247	33.7998212	4745.5268823	2.3727634
	Wise	0.0010202	35.7921247	0.0062583	230.6014329	0.0003023	1.0823809	0.0000638	1.9187527	269.3946912	0.1346973
	Young	0.0071054	249.2866612	0.0435880	1606.1036251	0.0021054	7.5386168	0.0004447	13.3638182	1876.2927213	0.9381464
	Total	**0.4414501**	**15487.88295**	**0.4812863**	**17734.1284**	**0.5345786**	**1914.140593**	**0.6829349**	**20523.03349**	**55659.1854373**	**27.8295927**

Energy Savings by PCA (MWh)		35,084		36,847		3,581		30,051	

4.3 2013 Results for New Residential Constructions (Single-family and Multi-family)

Table 17 presents the individual and combined annual electricity savings and NOx emissions reductions resulted from the new single-family and multi-family constructions in 2013. In addition, Table 17 includes the combined natural gas savings from the new constructions for both single-family and multi-family and the corresponding NOx emissions reductions[23].

The total NOx reductions from electricity and natural gas savings from total new single-family and multi-family constructions in 2013 are 54.02 tons NOx/year, including 17.34 tons NOx/year (32.10 %) from single-family residential electricity savings, 27.83 tons NOx/year (51.52 %) from multi-family residential electricity savings, and 8.85 tons NOx/year (16.38 %) from natural gas savings from both single-family and multi-family residences.Figure 8 through Figure 11 show the electricity savings and NOx reductions tabulated in Table 17. Figure 8 shows the annual electricity savings by county using a stacked bar chart and Figure 9 shows the spatial distribution of the electricity savings by county across the state. Figure 10 shows the annual NOx reductions by using a stacked bar chart and Figure 11 shows the spatial distribution of the NOx reductions by county across the state.

[23] 0.092 lb-NOx/MMBtu of emission rate was used for the calculation.

Table 17: 2013 Annual NOx Reductions from New Single-family and Multi-family Residences

	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
County	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)
HARRIS	13,595.59	2.14	23,424.25	2.63	37,019.84	4.77	191,135.53	0.88	5.65
TARRANT	6,276.29	0.04	6,986.79	0.06	13,263.08	0.10	150,428.92	0.69	0.79
COLLIN	7,809.51	0.11	3,324.13	0.17	11,133.64	0.28	141,763.10	0.65	0.93
DALLAS	4,133.78	0.21	28,875.11	0.33	33,008.89	0.54	298,200.99	1.37	1.91
BEXAR	2,666.05	1.03	382.53	1.93	3,048.57	2.95	35,532.05	0.16	3.12
TRAVIS	4,823.27	0.38	22,665.85	0.72	27,489.12	1.10	232,514.73	1.07	2.17
DENTON	5,280.95	0.01	3,767.52	0.02	9,048.46	0.03	108,165.09	0.50	0.52
WILLIAMSON	3,055.99		1,818.85		4,874.84	0.00	54,712.70	0.25	0.25
EL PASO	2,453.45		3,165.18		5,618.63	0.00	95,186.69	0.44	0.44
MONTGOMERY	3,982.79		2,280.24		6,263.03	0.00	55,025.84	0.25	0.25
GALVESTON	1,738.77	0.33	0.00	0.40	1,738.77	0.73	24,360.15	0.11	0.84
BRAZORIA	1,570.16	0.81	206.89	0.99	1,777.06	1.80	22,035.00	0.10	1.91
COMAL	1,417.37		196.17		1,613.54	0.00	18,847.25	0.09	0.09
ROCKWALL	850.51		0.00		850.51	0.00	12,508.31	0.06	0.06
HAYS	1,627.79	0.06	4,152.56	0.12	5,780.35	0.18	52,650.77	0.24	0.42
NUECES	1,150.32	0.95	1,741.60	1.78	2,891.92	2.73	11,791.73	0.05	2.79
FORT BEND	6,333.57	0.45	2,042.85	0.55	8,376.42	1.01	87,169.84	0.40	1.41
ELLIS	994.49	0.25	36.19	0.40	1,030.68	0.65	15,050.92	0.07	0.72
JOHNSON	791.70	0.06	0.00	0.10	791.70	0.16	11,745.45	0.05	0.21
GUADALUPE	641.73	0.24	0.00	0.44	641.73	0.68	8,003.81	0.04	0.72
KAUFMAN	353.52	0.50	0.00	0.79	353.52	1.29	5,199.14	0.02	1.32
JEFFERSON	275.05		6.43		281.48	0.00	3,933.88	0.02	0.02
PARKER	314.49	0.00	181.50	0.00	496.00	0.00	6,094.52	0.03	0.03
SMITH	342.06		0.00		342.06	0.00	5,759.73	0.03	0.03
BASTROP	71.13	0.25	9.62	0.47	80.75	0.72	2,381.07	0.01	0.73
CHAMBERS	242.04	0.29	0.00	0.36	242.04	0.66	3,357.43	0.02	0.67
GREGG	223.35		1,002.54		1,225.89	0.00	3,528.66	0.02	0.02
SAN PATRICIO	195.97	0.11	0.00	0.21	195.97	0.32	1,979.14	0.01	0.33
LIBERTY	140.46		0.00		140.46	0.00	1,959.11	0.01	0.01
VICTORIA	103.30	0.16	598.86	0.29	702.16	0.45	1,459.27	0.01	0.46
ORANGE	110.05		0.00		110.05	0.00	1,539.62	0.01	0.01
CALDWELL	18.24		9.62		27.86	0.00	248.42	0.00	0.00
WILSON	29.56		0.00		29.56	0.00	368.74	0.00	0.00
HARDIN	171.50		3.21		174.71	0.00	2,457.78	0.01	0.01
HARRISON	38.88		0.00		38.88	0.00	652.91	0.00	0.00
WALLER	3.20		115.35		118.55	0.00	68.18	0.00	0.00
UPSHUR	14.67		0.00		14.67	0.00	523.81	0.00	0.00
RUSK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HOOD	153.53	0.43	46.53	0.67	200.05	1.10	2,659.38	0.01	1.11
HUNT	79.07	0.66	18.12	1.22	97.19	1.88	1,314.40	0.01	1.89
HENDERSON	65.88	0.06	0.00	0.09	65.88	0.15	1,109.39	0.01	0.15
HIDALGO	2,486.33	0.40	1,514.49	0.75	4,000.81	1.14	20,173.99	0.09	1.24
CAMERON	1,053.69	0.47	349.81	0.88	1,403.50	1.35	8,462.98	0.04	1.39
BELL	1,657.68		592.81		2,250.50	0.00	38,616.53	0.18	0.18
WEBB	720.14	0.31	1,364.00	0.58	2,084.14	0.89	7,425.43	0.03	0.93
BRAZOS	604.30	0.20	1,420.97	0.32	2,025.27	0.52	8,575.80	0.04	0.56
KENDALL	226.89		0.00		226.89	0.00	3,058.12	0.01	0.01
BURNET	199.58		9.62		209.21	0.00	2,767.20	0.01	0.01
GRAYSON	197.11		494.36		691.47	0.00	6,958.69	0.03	0.03
CORYELL	73.93		24.10		98.03	0.00	1,699.67	0.01	0.01
MIDLAND	739.43		2,941.72		3,681.15	0.00	43,962.08	0.20	0.20
LLANO	129.84	0.30	0.00	0.56	129.84	0.86	1,753.94	0.01	0.87
MAVERICK	53.52		86.69		140.21	0.00	550.36	0.00	0.00
MCMULLEN	0.00		0.00		0.00	0.00	0.00	0.00	0.00
ARANSAS	104.82		0.00		104.82	0.00	1,058.61	0.00	0.00
WICHITA	116.02	0.01	314.98	0.02	431.00	0.04	5,954.02	0.03	0.07
TAYLOR	280.37		5.37		285.74	0.00	5,537.05	0.03	0.03
TOM GREEN	332.31		522.51		854.82	0.00	10,410.49	0.05	0.05
MCLENNAN	544.25	0.48	156.64	0.75	700.88	1.22	12,311.52	0.06	1.28
MCCULLOCH	1.02		0.00		1.02	0.00	17.46	0.00	0.00
WISE	73.46	0.09	0.00	0.13	73.46	0.22	1,080.34	0.00	0.23
JIM HOGG	0.00		0.00		0.00	0.00	0.00	0.00	0.00
VAL VERDE	38.26		3.92		42.18	0.00	500.58	0.00	0.00
ECTOR	725.29	0.23	1,540.90	0.43	2,266.19	0.66	29,646.78	0.14	0.80
WHARTON	122.78	0.16	0.00	0.29	122.78	0.45	1,625.19	0.01	0.46
KERR	54.72		0.00		54.72	0.00	739.26	0.00	0.00
PRESIDIO	9.17		0.00		9.17	0.00	157.15	0.00	0.00
JIM WELLS	26.43		0.00		26.43	0.00	266.95	0.00	0.00
CALHOUN	84.68	0.07	164.60	0.13	249.27	0.20	1,146.07	0.01	0.21
GILLESPIE	43.99		0.00		43.99	0.00	594.31	0.00	0.00
MATAGORDA	93.14		0.00		93.14	0.00	1,232.91	0.01	0.01
NAVARRO	19.60		0.00		19.60	0.00	388.82	0.00	0.00
ANGELINA	50.57		11.47		62.04	0.00	918.44	0.00	0.00
NACOGDOCHES	28.10		3.28		31.37	0.00	509.32	0.00	0.00
FANNIN	17.19	0.00	46.59	0.00	63.78	0.00	635.36	0.00	0.00
ATASCOSA	47.52		7.81		55.33	0.00	695.80	0.00	0.00
WASHINGTON	36.82		0.00		36.82	0.00	504.23	0.00	0.00
LAMAR	29.83	0.34	0.00	0.53	29.83	0.87	531.90	0.00	0.87
VAN ZANDT	3.44		0.00		3.44	0.00	50.64	0.00	0.00
WILLACY	44.47		0.00		44.47	0.00	352.77	0.00	0.00
BROWN	51.66		91.57		143.24	0.00	1,909.57	0.01	0.01
ERATH	25.85		893.76		919.61	0.00	9,346.16	0.04	0.04
AUSTIN	24.01		0.00		24.01	0.00	328.85	0.00	0.00
COOKE	43.55		0.00		43.55	0.00	642.08	0.00	0.00
MEDINA	13.91		3.92		17.84	0.00	196.91	0.00	0.00
TITUS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UVALDE	20.87		7.85		28.72	0.00	307.06	0.00	0.00
FAYETTE	4.80	0.40	0.00	0.71	4.80	1.11	65.77	0.00	1.11
CALLAHAN	7.95		32.21		40.16	0.00	474.15	0.00	0.00
HOPKINS	13.77		0.00		13.77	0.00	202.56	0.00	0.00
LAMPASAS	151.43		0.00		151.43	0.00	0.00	0.00	0.00
BLANCO	3.22		211.72		214.94	0.00	1,606.75	0.01	0.01
FREESTONE	1.78	0.40	0.00	0.63	1.78	1.03	35.35	0.00	1.03
GRIMES	15.21	0.00	0.00	0.00	15.21	0.00	208.27	0.00	0.00
LEE	12.88		0.00		12.88	0.00	175.35	0.00	0.00
SOMERVELL	6.87		0.00		6.87	0.00	101.99	0.00	0.00
ANDREWS	58.59	0.00	0.00	0.01	58.59	0.01	1,147.45	0.01	0.02
BORDEN	15.71		0.00		15.71	0.00	1,130.12	0.01	0.01

Table 17: 2013 Annual NOx Reductions from New Single-family and Multi-family Residences (Continued)

	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
County	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)
CHEROKEE	10.44	0.23	3.28	0.36	13.71	0.59	189.79	0.00	0.59
DIMMIT	4.72		0.00		4.72	0.00	47.79	0.00	0.00
FALLS	9.80		0.00		9.80	0.00	194.41	0.00	0.00
COLORADO	7.20		0.00		7.20	0.00	98.65	0.00	0.00
FRIO	10.30	0.00	0.00	0.00	10.30	0.00	139.77	0.00	0.00
MILAM	3.72	0.09	137.08	0.18	140.80	0.27	81.00	0.00	0.27
JACKSON	12.70		0.00		12.70	0.00	168.12	0.00	0.00
ANDERSON	3.21		3.28		6.49	0.00	59.08	0.00	0.00
HILL	8.91		0.00		8.91	0.00	176.74	0.00	0.00
CULBERSON	11.09		0.00		11.09	0.00	317.49	0.00	0.00
MASON	7.51		0.00		7.51	0.00	101.47	0.00	0.00
PECOS	7.14	0.00	0.00	0.00	7.14	0.01	122.23	0.00	0.01
RAINS	2.30		0.00		2.30	0.00	33.76	0.00	0.00
LAVACA	3.30		0.00		3.30	0.00	44.87	0.00	0.00
PALO PINTO	10.94	0.31	0.00	0.48	10.94	0.78	213.91	0.00	0.78
KIMBLE	2.04		0.00		2.04	0.00	34.92	0.00	0.00
MADISON	8.00		6.69		14.69	0.00	111.03	0.00	0.00
ARCHER	6.45		0.00		6.45	0.00	144.37	0.00	0.00
REFUGIO	2.54		0.00		2.54	0.00	33.62	0.00	0.00
LIMESTONE	1.78	0.00	0.00	0.00	1.78	0.00	35.35	0.00	0.00
CLAY	1.07		0.00		1.07	0.00	24.06	0.00	0.00
BEE	1.69		0.00		1.69	0.00	22.42	0.00	0.00
MARTIN	1.01		0.00		1.01	0.00	19.78	0.00	0.00
GONZALES	13.04		0.00		13.04	0.00	162.68	0.00	0.00
BURLESON	7.20		3.34		10.55	0.00	99.36	0.00	0.00
KARNES	55.72		21.01		76.74	0.00	759.41	0.00	0.00
KLEBERG	33.07		743.49		776.56	0.00	452.84	0.00	0.00
BREWSTER	4.08		20.90		24.98	0.00	258.57	0.00	0.00
WINKLER	0.00		0.00		0.00	0.00	0.00	0.00	0.00
FRANKLIN	0.00		0.00		0.00	0.00	0.00	0.00	0.00
YOUNG	35.79	0.60	0.00	0.94	35.79	1.54	700.08	0.00	1.54
HOUSTON	4.82		0.00		4.82	0.00	87.14	0.00	0.00
SCURRY	3.31		5.91		9.22	0.00	317.26	0.00	0.00
BOSQUE	2.67	0.19	0.00	0.29	2.67	0.48	53.02	0.00	0.48
COMANCHE	0.00		115.67		115.67	0.00	1,117.27	0.01	0.01
BRISCOE	8.83		0.00		8.83	0.00	270.66	0.00	0.00
CONCHO	1.02		0.00		1.02	0.00	17.46	0.00	0.00
ZAVALA	11.02		0.00		11.02	0.00	111.52	0.00	0.00
NOLAN	0.99	0.03	0.00	0.06	0.99	0.09	19.45	0.00	0.09
BROOKS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
ROBERTSON	48.02	0.30	0.00	0.54	48.02	0.84	657.69	0.00	0.85
LIVE OAK	13.67		0.00		13.67	0.00	138.08	0.00	0.00
HAMILTON	0.89		0.00		0.89	0.00	17.67	0.00	0.00
JONES	1.99		0.00		1.99	0.00	38.89	0.00	0.00
REAGAN	5.02		10.78		15.79	0.00	209.46	0.00	0.00
WARD	7.07	0.23	64.65	0.40	71.72	0.62	786.41	0.00	0.63
RED RIVER	6.82		0.00		6.82	0.00	121.58	0.00	0.00
HASKELL	1.99		0.00		1.99	0.00	38.89	0.00	0.00
HOWARD	43.44	0.15	0.00	0.26	43.44	0.41	850.69	0.00	0.41
SAN SABA	0.00		0.00		0.00	0.00	0.00	0.00	0.00
JACK	2.98	0.26	0.00	0.41	2.98	0.67	58.34	0.00	0.67
STEPHENS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
RUNNELS	1.02		0.00		1.02	0.00	17.46	0.00	0.00
REEVES	3.03		0.00		3.03	0.00	59.35	0.00	0.00
DE WITT	4.23		0.00		4.23	0.00	56.04	0.00	0.00
CHILDRESS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
CROSBY	5.79		0.00		5.79	0.00	416.36	0.00	0.00
DAWSON	8.32		0.00		8.32	0.00	584.09	0.00	0.00
MITCHELL	0.00	0.04	0.00	0.06	0.00	0.10	0.00	0.00	0.10
WILBARGER	1.07	1.52	0.00	2.37	1.07	3.89	24.06	0.00	3.89
COLEMAN	1.98		0.00		1.98	0.00	38.89	0.00	0.00
UPTON	1.00	0.00	0.00	0.01	1.00	0.01	20.11	0.00	0.01
COKE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CROCKETT	19.37		0.00		19.37	0.00	331.77	0.00	0.00
HARDEMAN	0.00		0.00		0.00	0.00	0.00	0.00	0.00
BANDERA	0.00		0.00		0.00	0.00	0.00	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	9.03		0.00		9.03	0.00	180.95	0.00	0.00
DELTA	2.30		0.00		2.30	0.00	33.76	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	1.69		0.00		1.69	0.00	22.42	0.00	0.00
HALL	6.31		0.00		6.31	0.00	193.33	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	0.87		0.00		0.87	0.00	10.85	0.00	0.00
KNOX	0.00		0.00		0.00	0.00	0.00	0.00	0.00
LA SALLE	7.87		30.82		38.70	0.00	82.75	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	5.73		0.00		5.73	0.00	84.48	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	1.02		0.00		1.02	0.00	17.46	0.00	0.00
SHACKELFORD	0.00		0.00		0.00	0.00	0.00	0.00	0.00
STARR	0.97		0.00		0.97	0.00	7.67	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	**532.91**	**3.94**	**1,166.91**	**6.36**	**1,699.82**	**10.30**	**11,940.88**	**0.05**	**10.36**

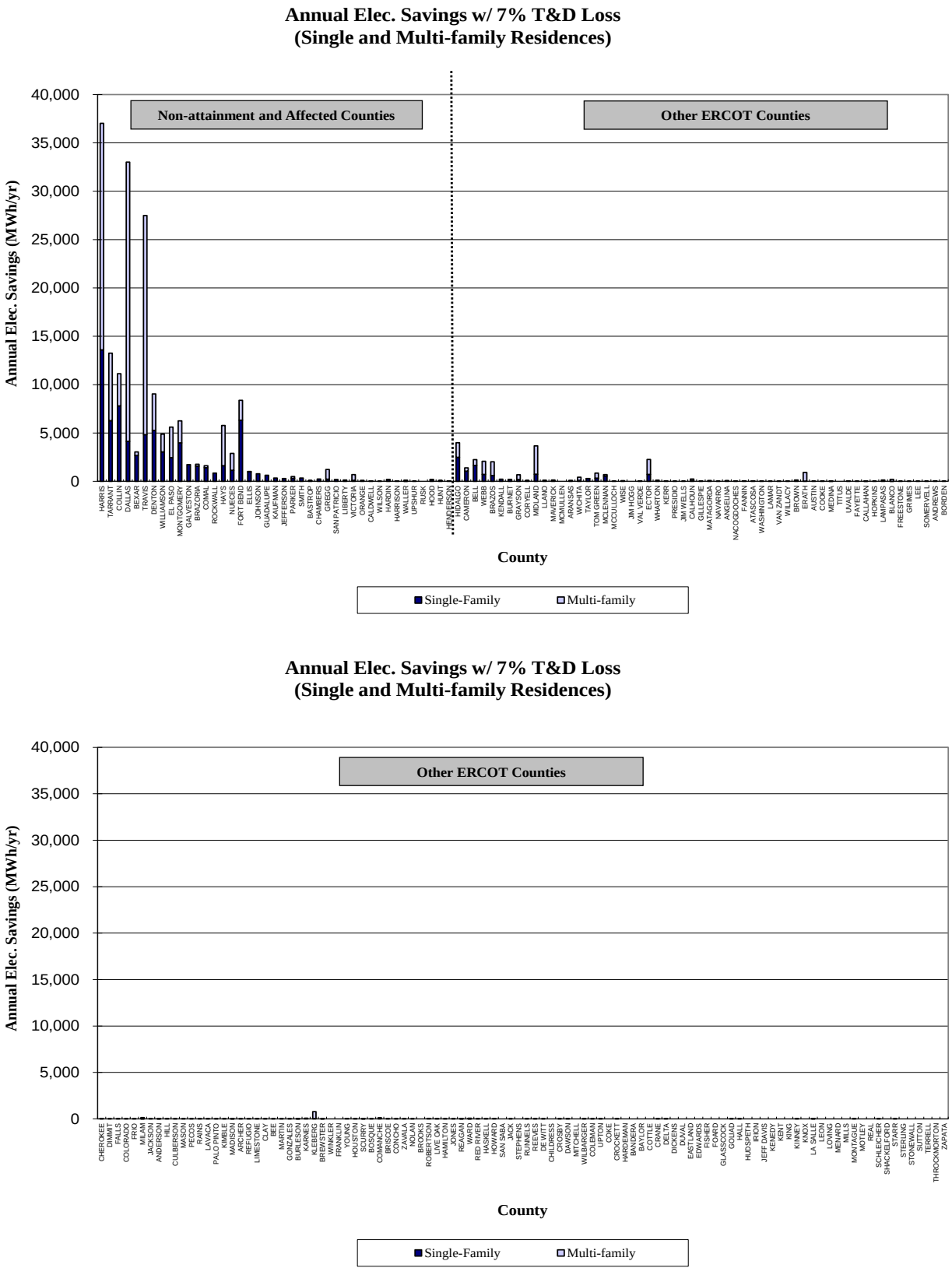


Figure 8: 2013 Annual Electricity Savings by County from New Single-family and Multi-family Residences

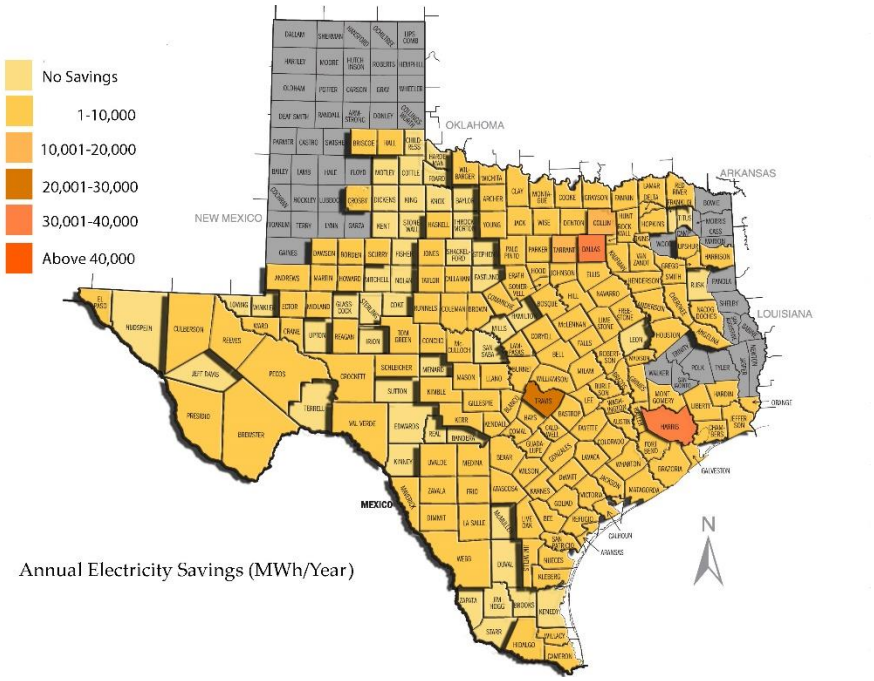


Figure 9: Map of 2013 Annual Electricity Savings by County from New Single-family and Multi-family Residences

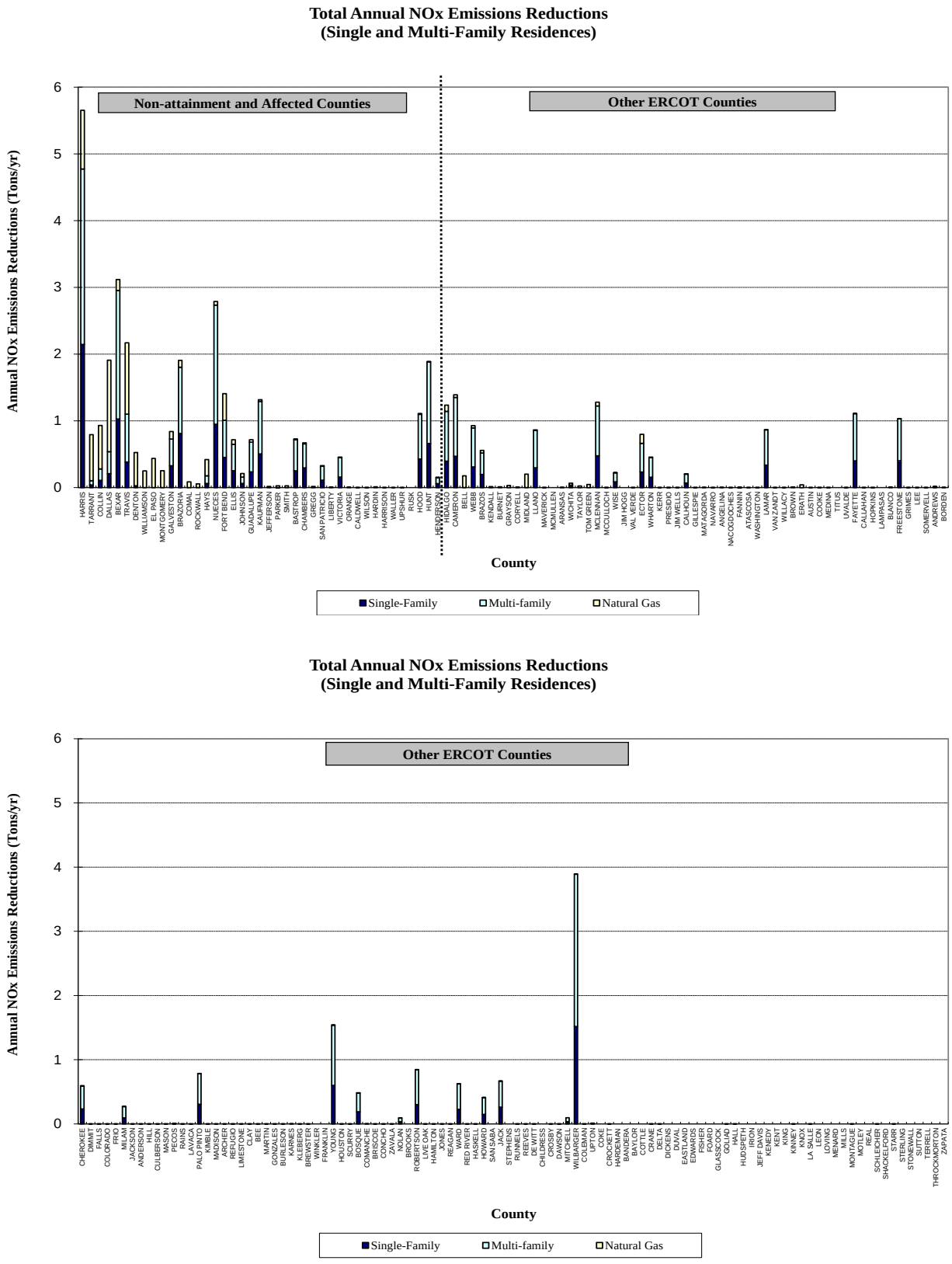


Figure 10: 2013 Annual NOx Reductions by County from New Single-family and Multi-family Residences

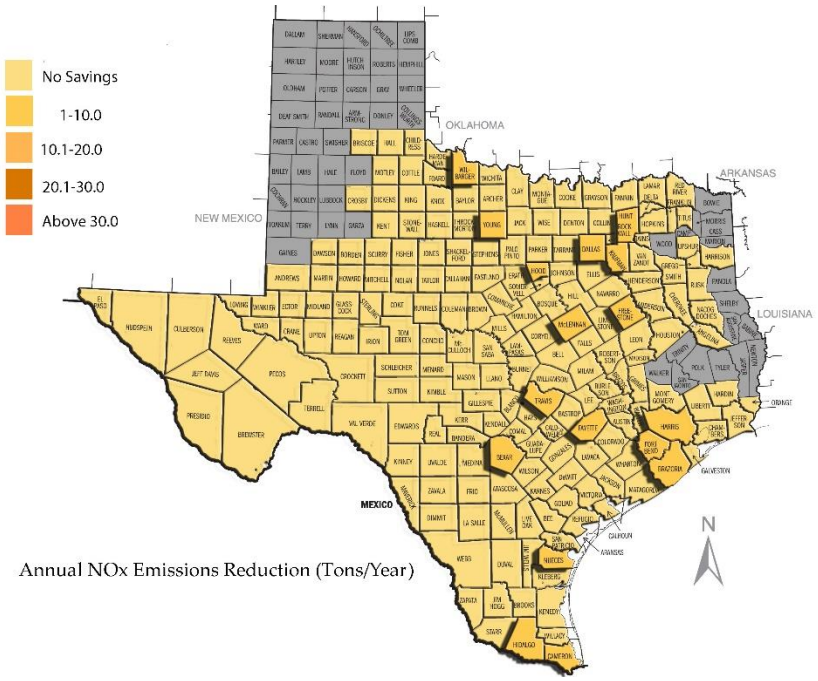


Figure 11: Map of 2013 Annual NOx Reductions by County from New Single-family and Multi-family Residences

4.4 2013 Results for Commercial Constructions

This section reports the calculated energy savings and emissions reductions from new commercial constructions in 2013 that were built to meet ASHRAE Standard 90.1-2007.

To determine the energy savings and emissions reductions from new commercial constructions in all counties in the ERCOT region as well as the 41 non-attainment and affected counties, data from two sources (i.e., Dodge and DOE) were merged into one analysis as shown in Figure 12. Beginning in the upper left of Figure 12, the Dodge database of the square footage of new commercial constructions per county in Texas (MHC 2014) was categorized by the building types in the report published by the US Department of Energy (DOE) (USDOE 2011). This allowed for the new constructions to be tracked by county and building type. The next block in Figure 12 and Table 18 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 1999 and 2003 CBECS database (Table 19) 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., 21.06% for food and 78.94% for retail). As a result, six Dodge building types were categorized into seven DOE building types and the resultant square footage of new commercial constructions by the seven DOE building types is shown in Figure 13 for all building types and in Figure 14 for each building type.

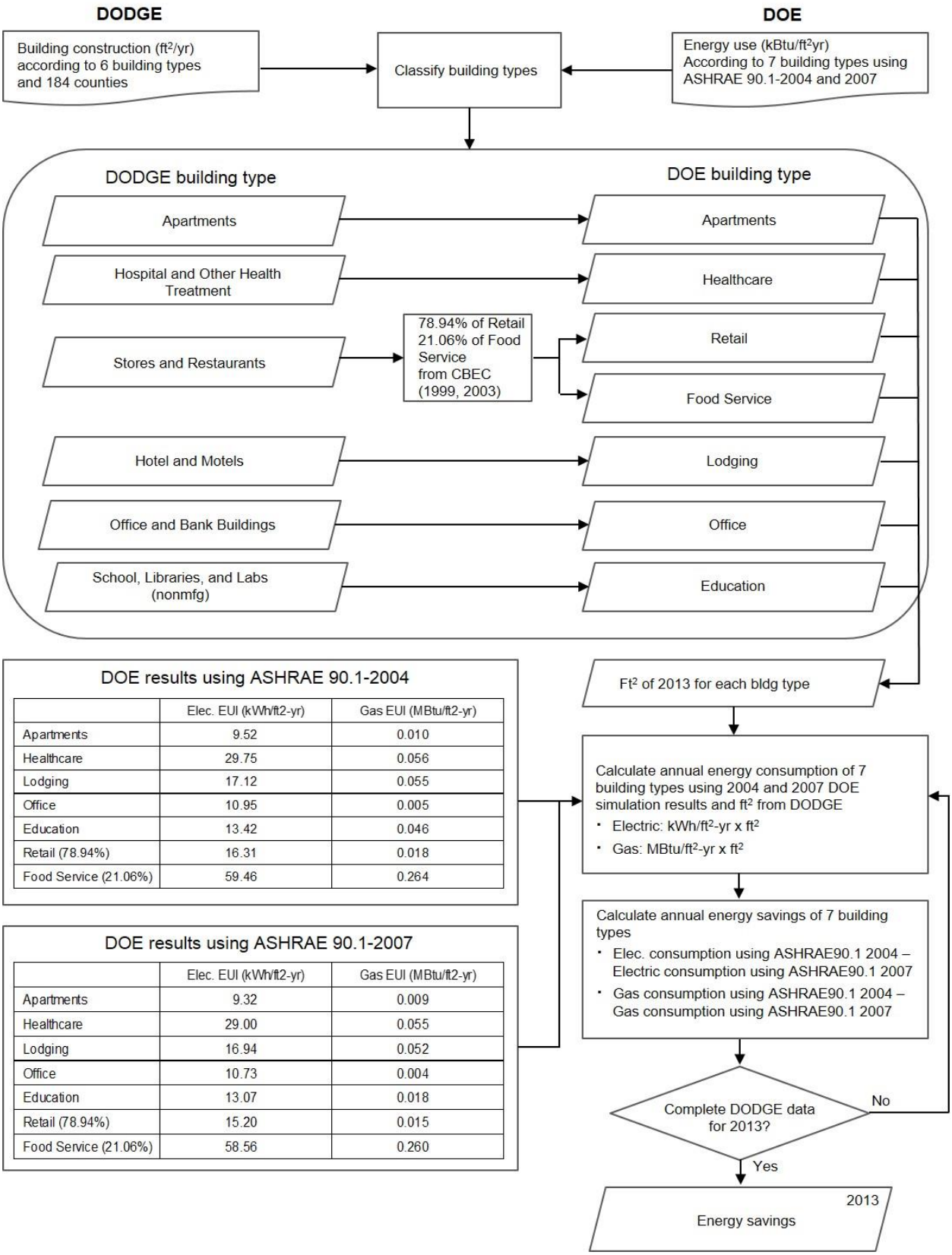
In the next step, the annual energy savings were calaulated. To accomplish this, this report used the resultant square footage and savings of the annual energy use intensity (EUI). The DOE report included the annual EUI values, which comply with the ASHRAE Standard 90.1-2004 and 2007, by seven building types (DOE 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 Standard 90.1-2004 to the annual energy use from ASHRAE Standard 90.1-2007. From Table 21 to Table 23 show the annual energy use calculated for new commercial constructions, by building type, for ASHRAE Standard 90.1-

2004 and ASHRAE Standard 90.1-2007. Table 24 shows the county-wide annual electricity and natural gas savings by building type[24].

In the next calculation step, CM 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. In Table 26, the total electricity savings by CM Zones are shown for 2013 for all estimated new commercial constructions. In addtition, Table 26 shows the calculated annual NOx emissions reductions from electricity savings, using the 2010 eGRID for Texas.

Table 27 shows the transformation of the annual county-wide electricity and natural gas savings, along with the associated 2013 NOx emissions reductions with 7% T&D losses[25]. Figure 15 shows the bar chart of the annual electricity savings for 2013. Figure 16 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 constructions in 2013 are calculated to be 39.72 tons NOx/year which represents 10.10 tons NOx/year from electricity savings and 29.62 tons NOx/year from natural gas savings.

[24] In this table (-) values are savings, (+) values are increased energy use.
[25] 0.092 lb-NOx/MMBtu of emission rate was used for the calculation.



	Elec. EUI (kWh/ft2-yr)	Gas EUI (MBtu/ft2-yr)
Apartments	9.52	0.010
Healthcare	29.75	0.056
Lodging	17.12	0.055
Office	10.95	0.005
Education	13.42	0.046
Retail (78.94%)	16.31	0.018
Food Service (21.06%)	59.46	0.264

	Elec. EUI (kWh/ft2-yr)	Gas EUI (MBtu/ft2-yr)
Apartments	9.32	0.009
Healthcare	29.00	0.055
Lodging	16.94	0.052
Office	10.73	0.004
Education	13.07	0.018
Retail (78.94%)	15.20	0.015
Food Service (21.06%)	58.56	0.260

Figure 12: Calculation Method for 2013 Energy Savings from New Commercial Buildings

Table 18: 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	Stores and Restaurants

Table 19: Commercial Building Floor Area for Retail and Food Service Types from CBECS Database

		CBECS (1999)		CBECS (2003)	
		All (million square feet)	South (million square feet)	All (million square feet)	South (million square feet)
Food	Food Sales	994	392	1,255	487
	Food Service	1,851	676	1,654	764
Retail	Retail (Other Than Mall)	4,766	1,566	4,317	1,844
	Enclosed and Strip Malls	5,631	2,513	6,875	3,251

Table 20: Resultant % Distribution of Commercial Building Floor Area for Retail and Food Service Types

	South		All	
	Food %	Retail %	Food %	Retail %
CBECS (1999)	20.75	79.25	21.48	78.52
CBECS (2003)	19.71	80.29	20.63	79.37
Average	20.23	79.77	21.06	78.94

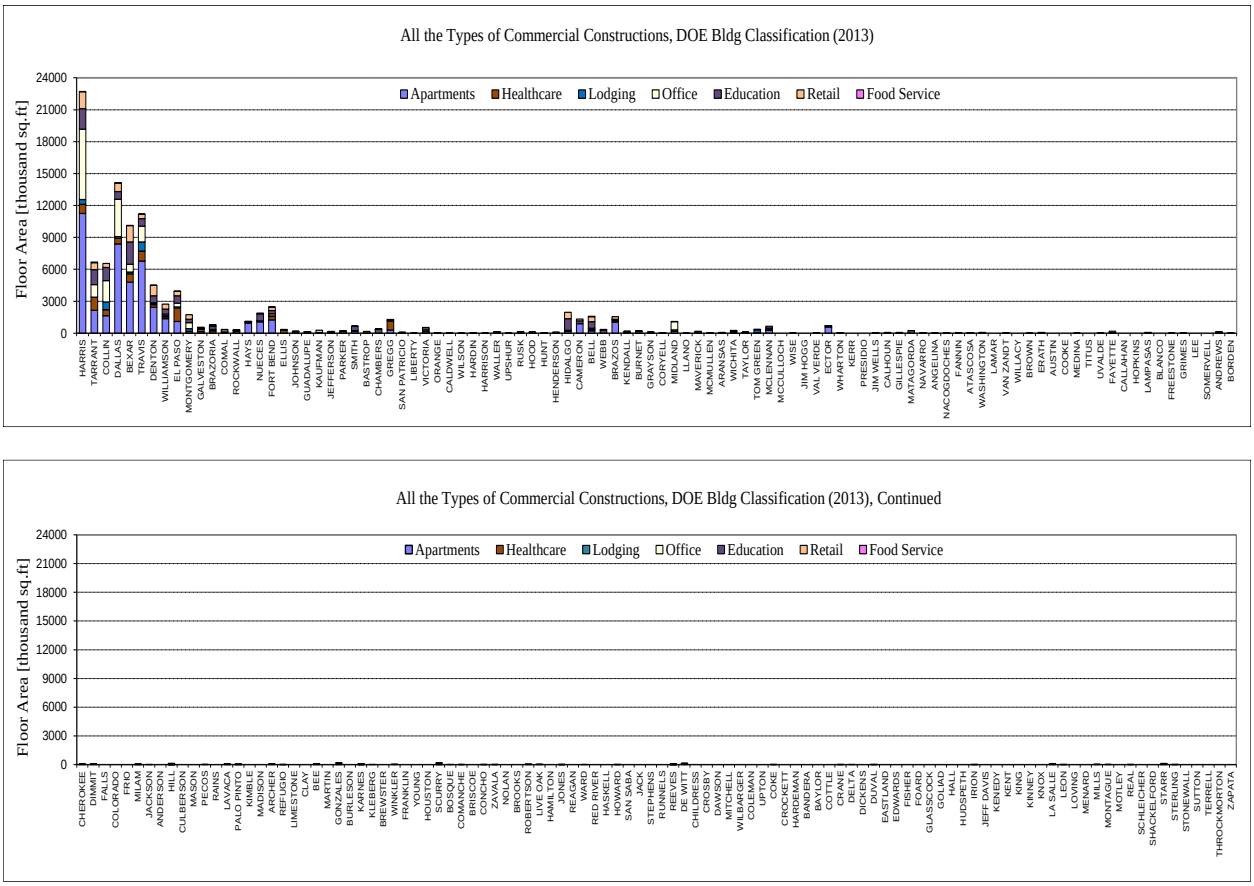


Figure 13: All the Types of 2013 New Commercial Building Constructions (Dodge 2013)

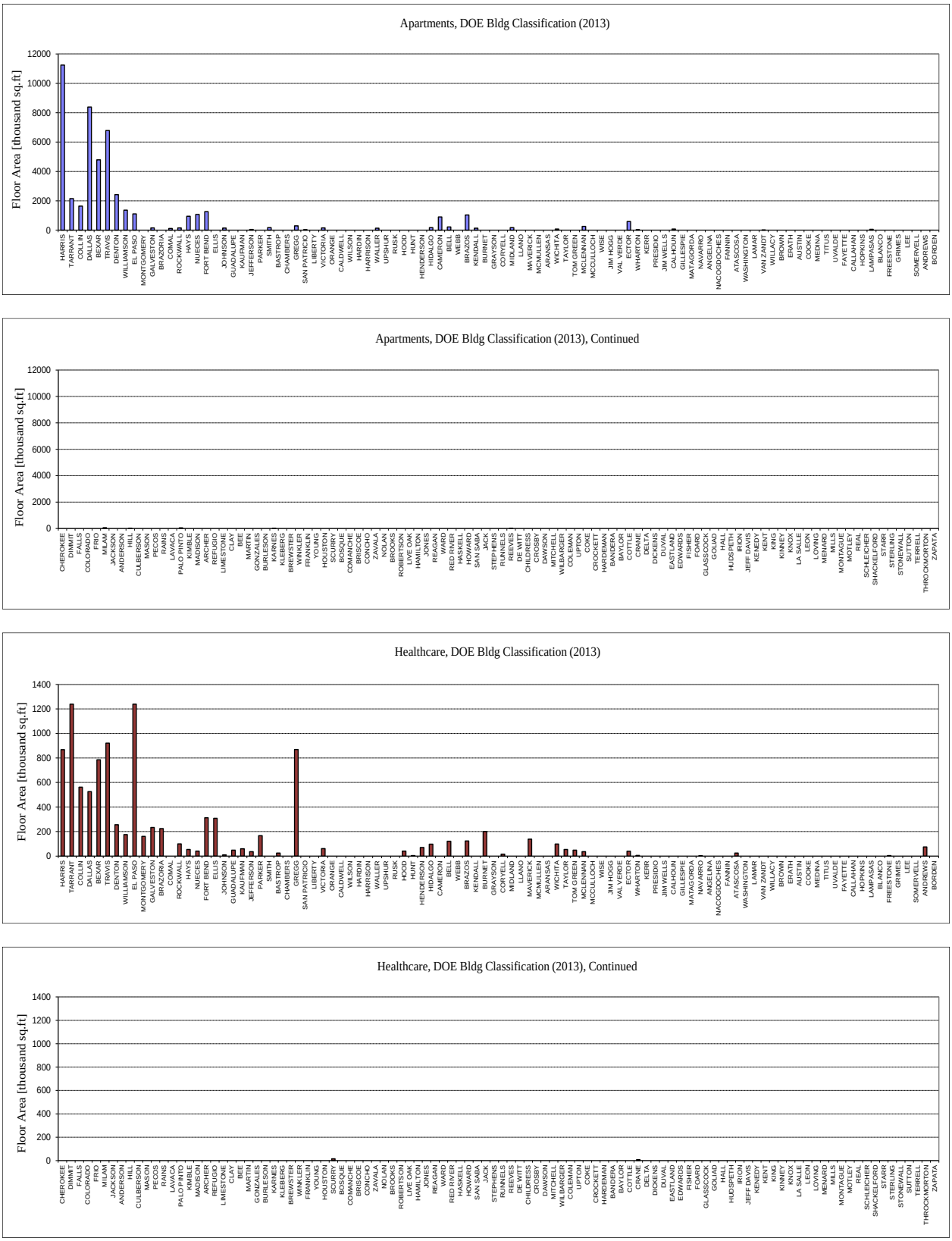
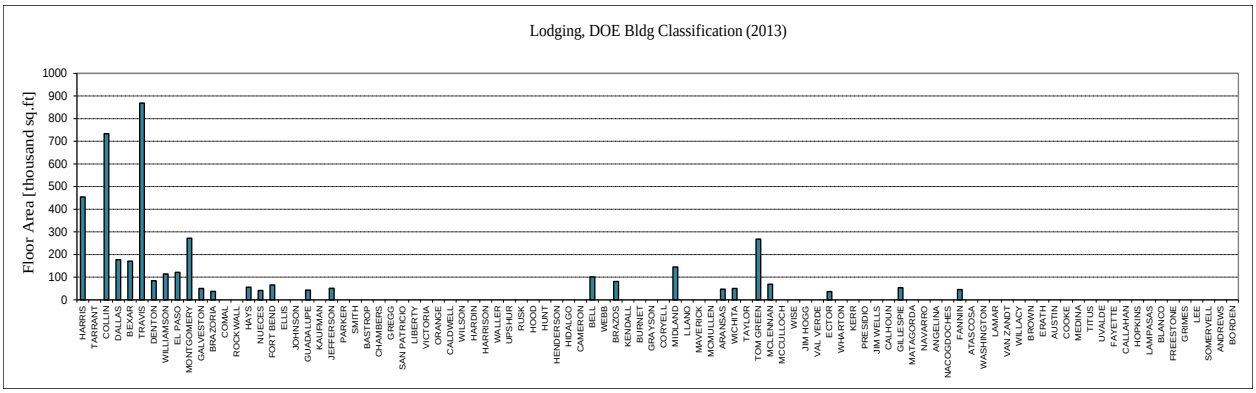
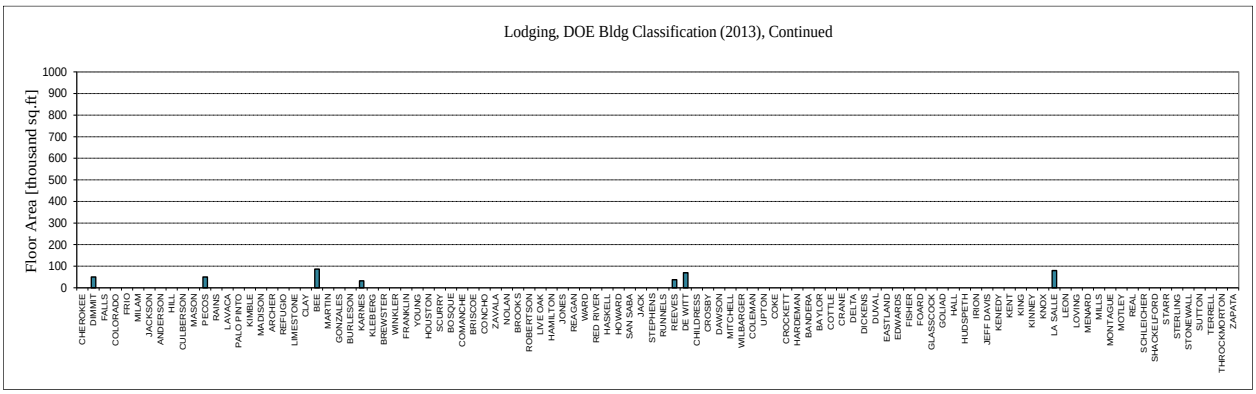
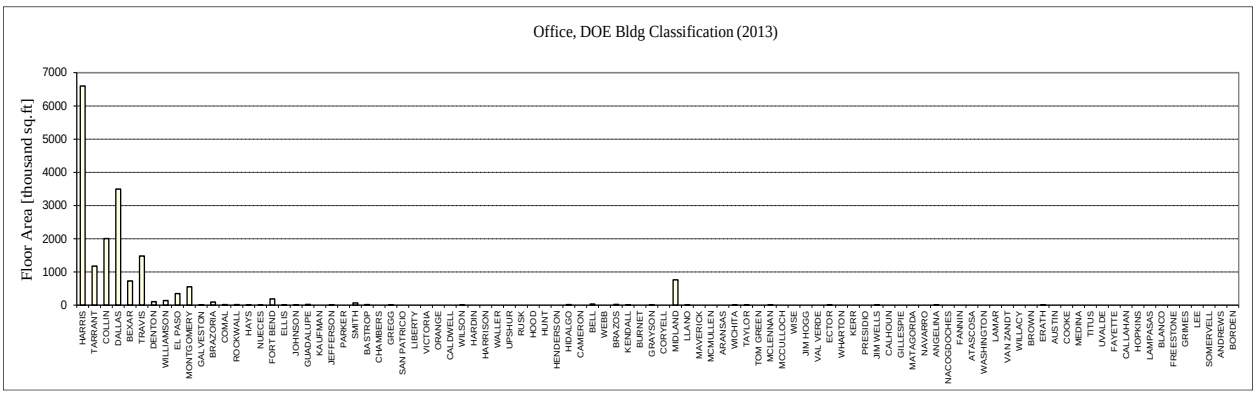


Figure 14: 2013 New Commercial Building Constructions by Type (Dodge 2013)







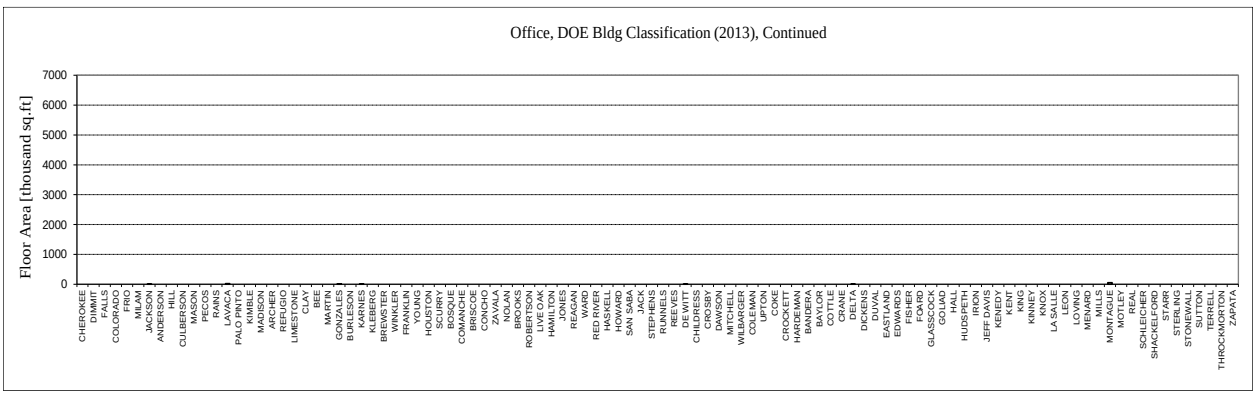
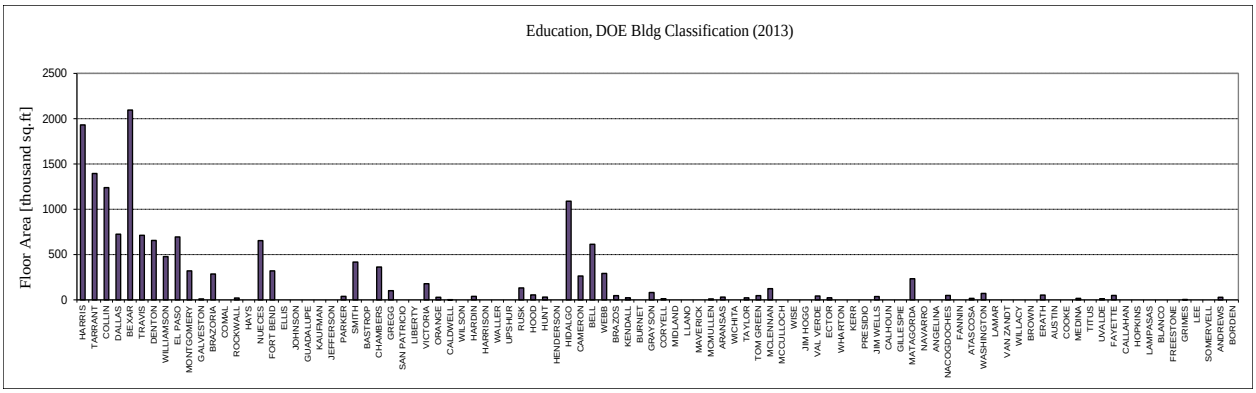
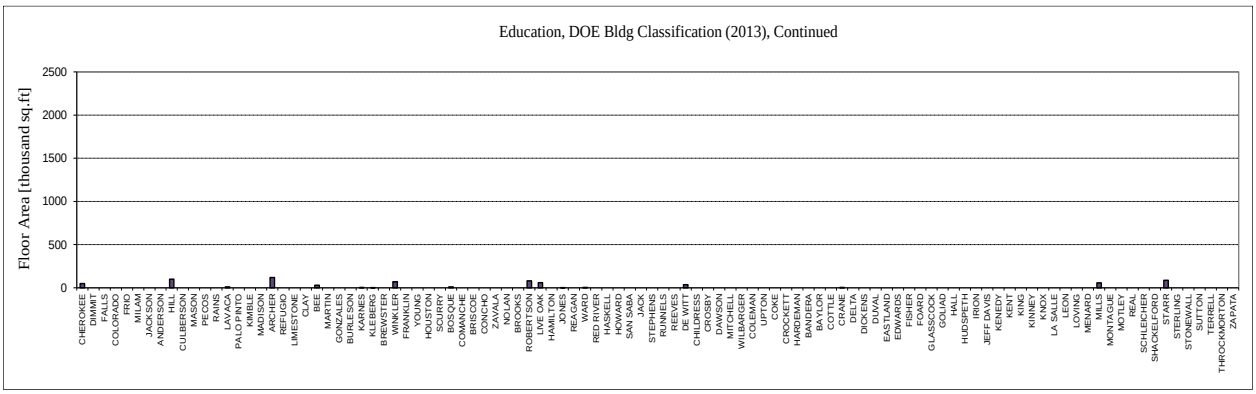
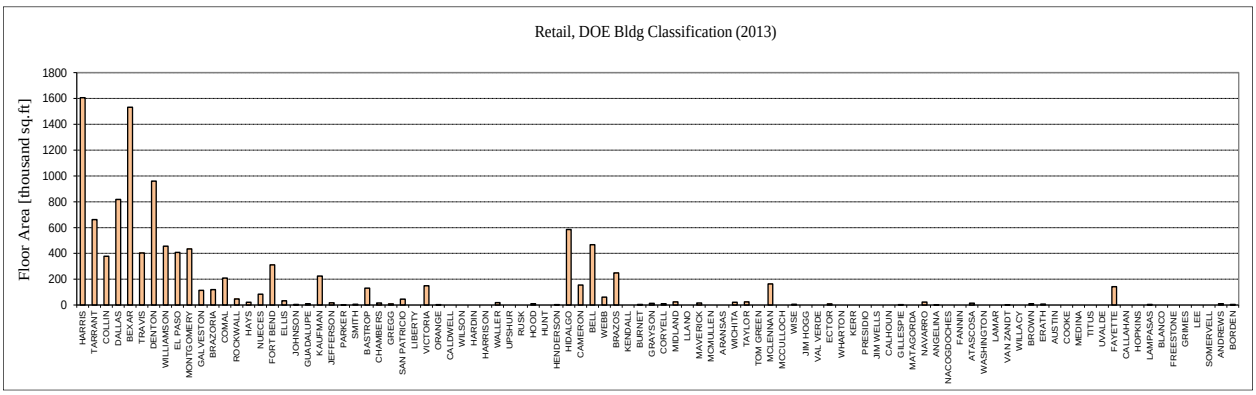


Figure 14: 2013 New Commercial Building Constructions by Type (Dodge 2013) (Continued)







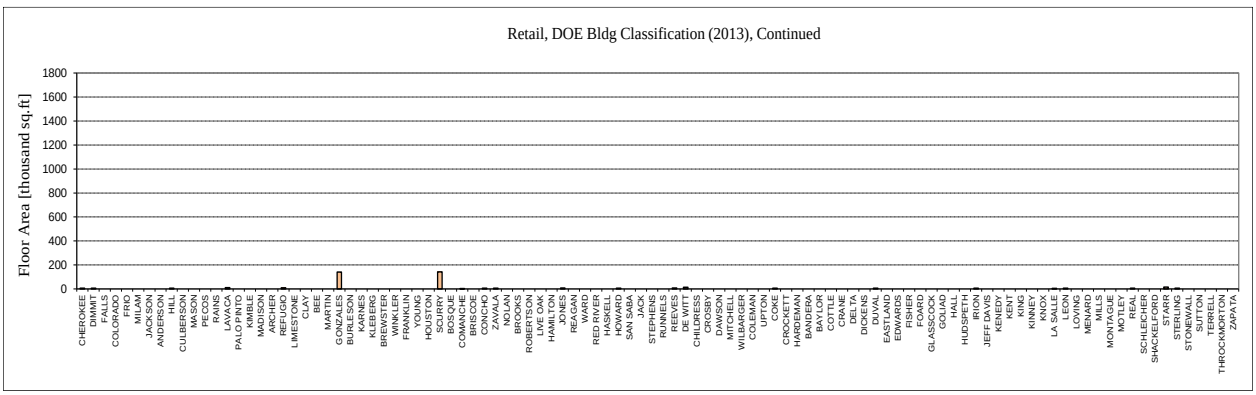


Figure 14: 2013 New Commercial Building Constructions by Type (Dodge 2013) (Continued)

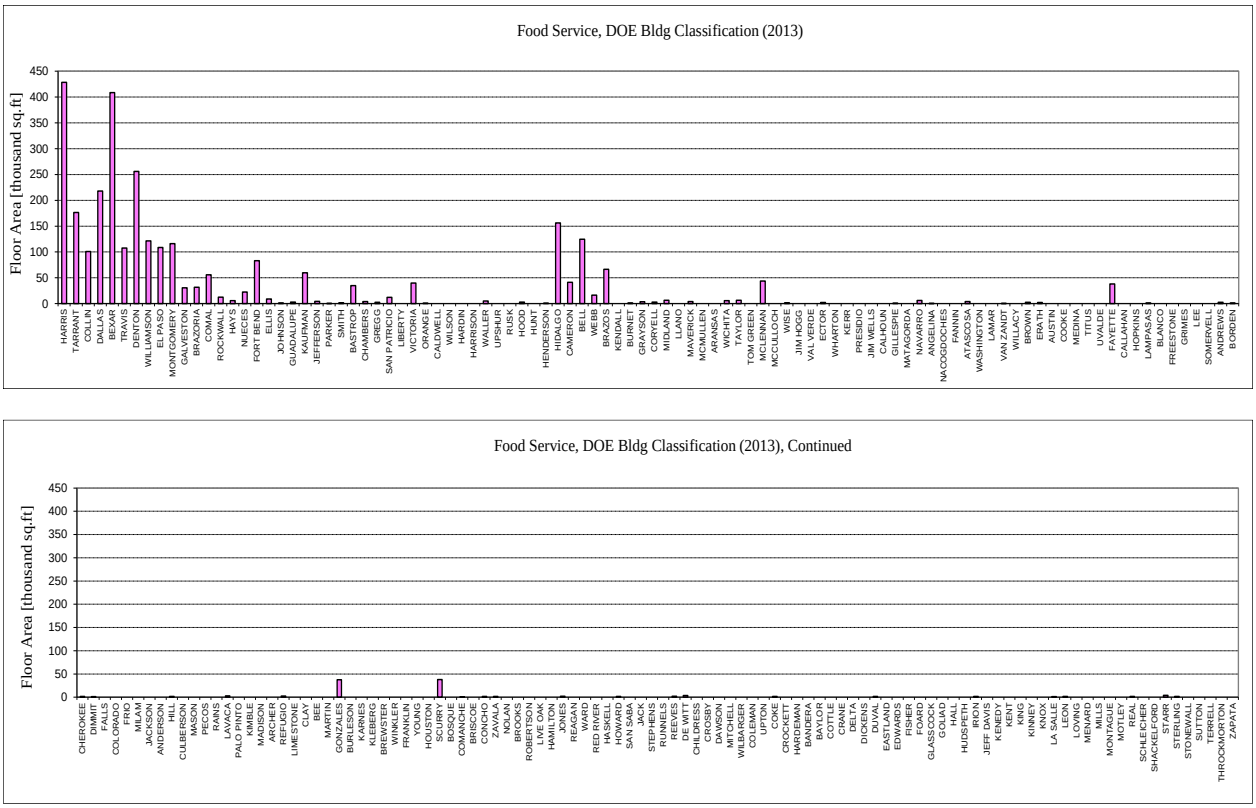


Figure 14: 2013 New Commercial Building Constructions by Type (Dodge 2013) (Continued)

Table 21: Energy Use of ASHRAE Standard 90.1-2004 and 90.1-2007 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	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)
Brazoria	0	0	0	0	6663267	6495865	12578	12208	634980	628456	2050	1925
Chambers	0	0	0	0	0	0	0	0	0	0	0	0
Collin	15591169	15255359	16533	14732	16717661	16297661	31556	30629	12559250	12430217	40542	38084
Dallas	79866521	78146319	84690	75466	15643804	15250783	29529	28662	3032842	3001682	9790	9197
Denton	23066243	22569432	24459	21795	7597314	7406446	14341	13919	1437690	1422919	4641	4360
El Paso	10564924	10337372	11203	9983	36862145	35936052	69581	67536	2074381	2053069	6696	6290
Fort Bend	11957452	11699907	12680	11299	9292878	9059411	17541	17026	1112498	1101069	3591	3374
Galveston	1425865	1395154	1512	1347	6951810	6777159	13122	12737	855768	846976	2763	2595
Hardin	0	0	0	0	0	0	0	0	0	0	0	0
Harris	107112252	104805219	113581	101210	25820160	25171476	48738	47306	7773796	7693928	25095	23573
Jefferson	476241	465983	505	450	1058984	1032379	1999	1940	872883	863915	2818	2647
Liberty	0	0	0	0	0	0	0	0	0	0	0	0
Montgomery	0	0	0	0	4765426	4645703	8995	8731	4653666	4605854	15022	14112
Orange	0	0	0	0	0	0	0	0	0	0	0	0
Tarrant	20504068	20062442	21742	19374	36847272	35921552	69553	67509	0	0	0	0
Waller	1298232	1270270	1377	1227	0	0	0	0	0	0	0	0
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	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)
Bastrop	0	0	0	0	743668	724985	1404	1363	0	0	0	0
Bexar	45663865	44680336	48421	43148	23357131	22770326	44089	42793	2925015	2894963	9442	8870
Caldwell	0	0	0	0	0	0	0	0	0	0	0	0
Comal	1063922	1041007	1128	1005	0	0	0	0	0	0	0	0
Ellis	0	0	0	0	9179840	8949214	17328	16819	0	0	0	0
Gregg	2775531	2715750	2943	2623	25846932	25197575	48789	47355	0	0	0	0
Guadalupe	0	0	0	0	1439742	1403571	2718	2638	732537	725011	2365	2221
Harrison	0	0	0	0	0	0	0	0	0	0	0	0
Hays	8993330	8799627	9536	8498	1618222	1577567	3055	2965	958460	948613	3094	2906
Henderson	0	0	0	0	2082271	2029958	3931	3815	0	0	0	0
Hood	0	0	0	0	1219616	1188975	2302	2235	0	0	0	0
Hunt	0	0	0	0	130886	127597	247	240	0	0	0	0
Johnson	1333474	1304753	1414	1260	297467	289994	562	545	0	0	0	0
Kaufman	0	0	0	0	1784804	1739964	3369	3270	0	0	0	0
Nueces	10202981	9983225	10819	9641	1189869	1159976	2246	2180	701730	694520	2265	2128
Parker	0	0	0	0	4937957	4813900	9321	9047	0	0	0	0
Rockwall	1419197	1388630	1505	1341	2944926	2870940	5559	5396	0	0	0	0
Rusk	0	0	0	0	0	0	0	0	0	0	0	0
San Patricio	266695	260951	283	252	0	0	0	0	0	0	0	0
Smith	1607789	1573159	1705	1519	0	0	0	0	0	0	0	0
Travis	64630628	63238583	68534	61070	27420534	26731643	51759	50238	14868112	14715358	47996	45086
Upshur	0	0	0	0	0	0	0	0	0	0	0	0
Victoria	1422055	1391426	1508	1344	1799677	1754463	3397	3297	0	0	0	0
Williamson	12980417	12700839	13764	12265	5223525	5092294	9860	9570	1949439	1929411	6293	5911
Wilson	0	0	0	0	0	0	0	0	0	0	0	0

Table 21: Energy Use of ASHRAE Standard 90.1-2004 and 90.1-2007 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	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)
ANDERSON	0	0	0	0	0	0	0	0	0	0	0	0
ANDREWS	0	0	0	0	2231005	2174955	4211	4088	0	0	0	0
ANGELINA	0	0	0	0	0	0	0	0	0	0	0	0
ARANSAS	0	0	0	0	0	0	0	0	804422	796157	2597	2439
ARCHER	0	0	0	0	0	0	0	0	0	0	0	0
ATASCOSA	0	0	0	0	725820	707585	1370	1330	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	1487325	1472044	4801	4510
BELL	2095459	2050326	2222	1980	3584481	3494427	6766	6567	1733786	1715973	5597	5257
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	9813416	9602050	10406	9273	3679670	3587225	6946	6742	1386344	1372101	4475	4204
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	0	0	0	0	0	0	0	0
BURLESON	0	0	0	0	0	0	0	0	0	0	0	0
BURNET	0	0	0	0	5949346	5799879	11230	10900	0	0	0	0
CALHOUN	738173	722274	783	698	0	0	0	0	0	0	0	0
CALLAHAN	0	0	0	0	0	0	0	0	0	0	0	0
CAMERON	8601860	8416589	9121	8128	0	0	0	0	0	0	0	0
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	0	0	0	0	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	475948	463990	898	872	0	0	0	0
COTTLE	0	0	0	0	0	0	0	0	0	0	0	0
CRANE	0	0	0	0	229050	223295	432	420	0	0	0	0
CROCKETT	0	0	0	0	0	0	0	0	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
DE WITT	0	0	0	0	0	0	0	0	1198075	1185766	3868	3633
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	855768	846976	2763	2595
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	5560587	5440820	5896	5254	1186894	1157076	2240	2175	616153	609823	1989	1868
EDWARDS	0	0	0	0	0	0	0	0	0	0	0	0
ERATH	0	0	0	0	0	0	0	0	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	770191	762278	2486	2336
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	124936	121797	236	229	0	0	0	0
FRIO	0	0	0	0	0	0	0	0	0	0	0	0
GILLESPIE	0	0	0	0	0	0	0	0	915672	906264	2956	2777
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	0	0	0	0	0	0	0	0
GRAYSON	0	0	0	0	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
HIDALGO	1598264	1563840	1695	1510	2879483	2807142	5435	5276	0	0	0	0
HILL	129537	126747	137	122	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
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 21: Energy Use of ASHRAE Standard 90.1-2004 and 90.1-2007 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	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (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	230501	225536	244	218	0	0	0	0	552826	547146	1785	1676
KENDALL	1302042	1273998	1381	1230	0	0	0	0	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	1369229	1355161	4420	4152
LAMAR	0	0	0	0	0	0	0	0	0	0	0	0
LAMPASAS	571489	559180	606	540	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	0	0	0	0
MAVERICK	0	0	0	0	4116947	4013516	7771	7543	0	0	0	0
MCCULLOCH	0	0	0	0	0	0	0	0	0	0	0	0
MCLENNAN	2447877	2395154	2596	2313	1079806	1052678	2038	1978	1180960	1168827	3812	3581
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	1619218	1584343	1717	1530	0	0	0	0	2481727	2456230	8011	7526
MILAM	626733	613234	665	592	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0
NAVARRO	0	0	0	0	95190	92798	180	174	0	0	0	0
NOLAN	0	0	0	0	0	0	0	0	0	0	0	0
PALO PINTO	570536	558248	605	539	0	0	0	0	0	0	0	0
PECOS	0	0	0	0	0	0	0	0	852345	843588	2751	2585
PRESIDIO	0	0	0	0	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	30479	29823	32	29	0	0	0	0	640114	633538	2066	1941
REFUGIO	0	0	0	0	0	0	0	0	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	446201	434991	842	818	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	1606323	1565967	3032	2943	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	1448666	1412271	2735	2654	4590339	4543178	14818	13920
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	0	0	0	0	0	0	0	0
VAN ZANDT	91438	89469	97	86	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0	0
WHARTON	244788	239515	260	231	166582	162397	314	305	0	0	0	0
WICHITA	707694	692451	750	669	2915179	2841941	5503	5341	860903	852058	2779	2611
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
WISE	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	461202940	451269338	489054	435791	312379313	304531360	589648	572321	79439226	78623069	256437	240889

Table 22: Energy Use of ASHRAE Standard 90.1-2004 and 90.1-2007 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	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)
Brazoria	1011881	991120	416	376	3825459	3725228	13053	5201
Chambers	0	0	0	0	4859003	4731693	16580	6607
Collin	21959134	21508590	9023	8154	16621282	16185790	56714	22599
Dallas	38274074	37488790	15728	14213	9715322	9460772	33150	13209
Denton	1164101	1140217	478	432	8809293	8578482	30059	11977
El Paso	3829598	3751024	1574	1422	9316669	9072564	31790	12667
Fort Bend	2051140	2009056	843	762	4277802	4165720	14596	5816
Galveston	102940	100828	42	38	134227	130710	458	183
Hardin	0	0	0	0	496638	483626	1695	675
Harris	72265176	70782483	29695	26836	25916475	25237440	88431	35237
Jefferson	120462	117990	50	45	0	0	0	0
Liberty	0	0	0	0	0	0	0	0
Montgomery	6069096	5944574	2494	2254	4289883	4177484	14638	5833
Orange	0	0	0	0	362412	352916	1237	493
Tarrant	12878487	12614254	5292	4782	18715217	18224862	63859	25446
Waller	0	0	0	0	0	0	0	0
Affected Counties	Office				Education			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)
Bastrop	162076	158751	67	60	0	0	0	0
Bexar	7987728	7823841	3282	2966	28128529	27391537	95978	38245
Caldwell	0	0	0	0	20134	19606	69	27
Comal	174122	170550	72	65	0	0	0	0
Ellis	18617	18235	8	7	0	0	0	0
Gregg	78848	77230	32	29	1342266	1307098	4580	1825
Guadalupe	240924	235981	99	89	0	0	0	0
Harrison	0	0	0	0	0	0	0	0
Hays	81038	79375	33	30	0	0	0	0
Henderson	0	0	0	0	0	0	0	0
Hood	0	0	0	0	723481	704526	2469	984
Hunt	0	0	0	0	389257	379058	1328	529
Johnson	134698	131935	55	50	0	0	0	0
Kaufman	0	0	0	0	0	0	0	0
Nueces	63516	62213	26	24	8774394	8544497	29939	11930
Parker	0	0	0	0	503350	490162	1718	684
Rockwall	168647	165187	69	63	268453	261420	916	365
Rusk	0	0	0	0	1750315	1704455	5972	2380
San Patricio	0	0	0	0	0	0	0	0
Smith	733723	718669	302	272	5577116	5430991	19030	7583
Travis	16195573	15863282	6655	6014	9548881	9298692	32582	12983
Upshur	0	0	0	0	0	0	0	0
Victoria	0	0	0	0	2389234	2326634	8152	3249
Williamson	1516727	1485607	623	563	6398583	6230934	21833	8700
Wilson	43804	42906	18	16	0	0	0	0

Table 22: Energy Use of ASHRAE Standard 90.1-2004 and 90.1-2007 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	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)
ANDERSON	0	0	0	0	0	0	0	0
ANDREWS	0	0	0	0	371808	362066	1269	506
ANGELINA	13141	12872	5	5	0	0	0	0
ARANSAS	0	0	0	0	389257	379058	1328	529
ARCHER	0	0	0	0	1595954	1554139	5446	2170
ATASCOSA	0	0	0	0	201340	196065	687	274
AUSTIN	0	0	0	0	0	0	0	0
BANDERA	0	0	0	0	0	0	0	0
BAYLOR	0	0	0	0	0	0	0	0
BEE	0	0	0	0	402680	392129	1374	548
BELL	350435	343245	144	130	8236145	8020351	28103	11198
BLANCO	0	0	0	0	0	0	0	0
BORDEN	0	0	0	0	0	0	0	0
BOSQUE	0	0	0	0	154361	150316	527	210
BRAZOS	243114	238126	100	90	626838	610415	2139	852
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	0	0	0	0	0	0	0	0
CALHOUN	0	0	0	0	0	0	0	0
CALLAHAN	0	0	0	0	0	0	0	0
CAMERON	0	0	0	0	3522106	3429824	12018	4789
CHEROKEE	0	0	0	0	640261	623486	2185	871
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	0	0	0	0	161072	156852	550	219
COTTLE	0	0	0	0	0	0	0	0
CRANE	0	0	0	0	67113	65355	229	91
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
DE WITT	113891	111555	47	42	472478	460098	1612	642
DELTA	20807	20380	9	8	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	53660	52559	22	20	292614	284947	998	398
EDWARDS	0	0	0	0	0	0	0	0
ERATH	109511	107264	45	41	693952	675769	2368	944
FALLS	0	0	0	0	0	0	0	0
FANNIN	0	0	0	0	0	0	0	0
FAYETTE	0	0	0	0	638919	622178	2180	869
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	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	219022	214528	90	81	0	0	0	0
GRAYSON	6571	6436	3	2	1073813	1045678	3664	1460
GRIMES	0	0	0	0	53691	52284	183	73
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
HIDALGO	190549	186639	78	71	14609225	14226450	49849	19863
HILL	0	0	0	0	1328843	1294027	4534	1807
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
IRION	0	0	0	0	0	0	0	0
JACK	0	0	0	0	0	0	0	0
JACKSON	100750	98683	41	37	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 22: Energy Use of ASHRAE Standard 90.1-2004 and 90.1-2007 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	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)
JIM WELLS	109511	107264	45	41	469793	457484	1603	639
JONES	0	0	0	0	34899	33985	119	47
KARNES	164266	160896	68	61	67113	65355	229	91
KENDALL	76658	75085	32	28	295299	287561	1008	402
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	0	0	0	0	26845	26142	92	37
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	250780	245635	103	93	136911	133324	467	186
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	805360	784259	2748	1095
LLANO	17522	17162	7	7	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	3119427	3037695	10644	4241
MAVERICK	0	0	0	0	0	0	0	0
MCCULLOCH	0	0	0	0	0	0	0	0
MCLENNAN	108416	106191	45	40	1652330	1609037	5638	2247
MCMULLEN	0	0	0	0	135569	132017	463	184
MEDINA	0	0	0	0	201340	196065	687	274
MENARD	0	0	0	0	0	0	0	0
MIDLAND	8367731	8196047	3438	3107	0	0	0	0
MILAM	0	0	0	0	0	0	0	0
MILLS	0	0	0	0	777172	756810	2652	1057
MITCHELL	0	0	0	0	0	0	0	0
MONTAGUE	586979	574935	241	218	0	0	0	0
MOTLEY	0	0	0	0	0	0	0	0
NACOGDOCHES	0	0	0	0	648315	631328	2212	881
NAVARRO	0	0	0	0	0	0	0	0
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	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	0	0	0	0
ROBERTSON	0	0	0	0	1087236	1058749	3710	1478
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	0	0	0	0	1162402	1131947	3966	1580
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	54755	53632	23	20	292614	284947	998	398
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	0	0	0	0	625496	609107	2134	850
UPTON	0	0	0	0	0	0	0	0
UVALDE	0	0	0	0	147649	143781	504	201
VAL VERDE	0	0	0	0	562410	547674	1919	765
VAN ZANDT	0	0	0	0	0	0	0	0
WARD	0	0	0	0	67113	65355	229	91
WASHINGTON	0	0	0	0	939586	914968	3206	1278
WEBB	0	0	0	0	3901968	3799733	13314	5305
WHARTON	0	0	0	0	0	0	0	0
WICHITA	56946	55777	23	21	0	0	0	0
WILBARGER	0	0	0	0	0	0	0	0
WILLACY	0	0	0	0	0	0	0	0
WINKLER	0	0	0	0	939586	914968	3206	1278
WISE	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	198541148	194467601	81584	73728	226782576	220840675	773814	308343

Table 23: Energy Use of ASHRAE Standard 90.1-2004 and 90.1-2007 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	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)
Brazoria	1936347	1804126	2084	1793	1883482	1854705	8365	8227
Chambers	245906	229114	265	228	239192	235538	1062	1045
Collin	6168245	5747053	6637	5711	5999841	5908173	26647	26208
Dallas	13332988	12422559	14347	12344	12968974	12770828	57600	56651
Denton	15658150	14588950	16849	14497	15230655	14997954	67644	66530
El Paso	6644607	6190887	7150	6152	6463198	6364450	28705	28232
Fort Bend	5079050	4732232	5465	4702	4940383	4864901	21942	21580
Galveston	1862962	1735752	2005	1725	1812100	1784414	8048	7916
Hardin	0	0	0	0	0	0	0	0
Harris	26199914	24410881	28193	24257	25484610	25095244	113186	111321
Jefferson	271655	253105	292	252	264238	260201	1174	1154
Liberty	0	0	0	0	0	0	0	0
Montgomery	7092645	6608331	7632	6567	6899003	6793597	30641	30136
Orange	37336	34787	40	35	36317	35762	161	159
Tarrant	10786382	10049846	11607	9987	10491895	10331595	46598	45830
Waller	307704	286693	331	285	299303	294730	1329	1307
Affected Counties	Retail				Food Service			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)
Bastrop	2124317	1979261	2286	1967	2066320	2034750	9177	9026
Bexar	24987122	23280903	26888	23134	24304929	23933587	107946	106168
Caldwell	0	0	0	0	0	0	0	0
Comal	3406633	3174014	3666	3154	3313625	3262998	14717	14475
Ellis	535585	499014	576	496	520963	513004	2314	2276
Gregg	144196	134350	155	134	140259	138116	623	613
Guadalupe	169945	158341	183	157	165306	162780	734	722
Harrison	0	0	0	0	0	0	0	0
Hays	341178	317881	367	316	331863	326793	1474	1450
Henderson	41199	38386	44	38	40074	39462	178	175
Hood	166083	154742	179	154	161549	159080	717	706
Hunt	0	0	0	0	0	0	0	0
Johnson	74673	69574	80	69	72634	71525	323	317
Kaufman	3649963	3400730	3928	3379	3550313	3496070	15768	15508
Nueces	1369863	1276323	1474	1268	1332463	1312105	5918	5820
Parker	33474	31188	36	31	32560	32063	145	142
Rockwall	757029	705337	815	701	736361	725111	3270	3217
Rusk	0	0	0	0	0	0	0	0
San Patricio	733855	683745	790	679	713820	702913	3170	3118
Smith	93985	87567	101	87	91419	90022	406	399
Travis	6573797	6124912	7074	6086	6394320	6296625	28399	27932
Upshur	0	0	0	0	0	0	0	0
Victoria	2433309	2267153	2618	2253	2366875	2330713	10512	10339
Williamson	7427386	6920215	7992	6877	7224605	7114224	32087	31558
Wilson	0	0	0	0	0	0	0	0

Table 23: Energy Use of ASHRAE Standard 90.1-2004 and 90.1-2007 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	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)
ANDERSON	0	0	0	0	0	0	0	0
ANDREWS	162221	151144	175	150	157792	155381	701	689
ANGELINA	28324	26390	30	26	27551	27130	122	120
ARANSAS	0	0	0	0	0	0	0	0
ARCHER	0	0	0	0	0	0	0	0
ATASCOSA	236894	220718	255	219	230426	226905	1023	1007
AUSTIN	0	0	0	0	0	0	0	0
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	7612781	7092950	8192	7048	7404938	7291802	32888	32346
BLANCO	0	0	0	0	0	0	0	0
BORDEN	73386	68374	79	68	71382	70291	317	312
BOSQUE	0	0	0	0	0	0	0	0
BRAZOS	4065815	3788185	4375	3764	3954811	3894387	17565	17275
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	162221	151144	175	150	157792	155381	701	689
BURLESON	0	0	0	0	0	0	0	0
BURNET	60511	56379	65	56	58859	57960	261	257
CALHOUN	0	0	0	0	0	0	0	0
CALLAHAN	0	0	0	0	0	0	0	0
CAMERON	2516994	2345124	2708	2330	2448276	2410870	10874	10695
CHEROKEE	106860	99563	115	99	103942	102354	462	454
CHILDRESS	0	0	0	0	0	0	0	0
CLAY	0	0	0	0	0	0	0	0
COKE	106860	99563	115	99	103942	102354	462	454
COLEMAN	0	0	0	0	0	0	0	0
COLORADO	0	0	0	0	0	0	0	0
COMANCHE	60511	56379	65	56	58859	57960	261	257
CONCHO	106860	99563	115	99	103942	102354	462	454
COOKE	0	0	0	0	0	0	0	0
CORYELL	167370	155942	180	155	162801	160314	723	711
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
DE WITT	211144	196727	227	195	205380	202242	912	897
DELTA	0	0	0	0	0	0	0	0
DICKENS	0	0	0	0	0	0	0	0
DIMMIT	86260	80370	93	80	83905	82623	373	367
DUVAL	108147	100762	116	100	105194	103587	467	460
EASTLAND	0	0	0	0	0	0	0	0
ECTOR	140334	130751	151	130	136502	134417	606	596
EDWARDS	0	0	0	0	0	0	0	0
ERATH	128747	119955	139	119	125231	123318	556	547
FALLS	0	0	0	0	0	0	0	0
FANNIN	0	0	0	0	0	0	0	0
FAYETTE	2317437	2159193	2494	2146	2254167	2219727	10012	9847
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	0	0	0	0
GILLESPIE	46349	43184	50	43	45083	44395	200	197
GLASSCOCK	0	0	0	0	0	0	0	0
GOLIAD	0	0	0	0	0	0	0	0
GONZALES	2295550	2138801	2470	2125	2232878	2198763	9917	9754
GRAYSON	218869	203924	236	203	212894	209641	946	930
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
HIDALGO	9550416	8898276	10277	8842	9289672	9147741	41259	40579
HILL	106860	99563	115	99	103942	102354	462	454
HOPKINS	0	0	0	0	0	0	0	0
HOUSTON	0	0	0	0	0	0	0	0
HOWARD	106860	99563	115	99	103942	102354	462	454
HUDSPETH	0	0	0	0	0	0	0	0
IRION	105572	98363	114	98	102690	101121	456	449
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 23: Energy Use of ASHRAE Standard 90.1-2004 and 90.1-2007 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	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)
JIM WELLS	0	0	0	0	0	0	0	0
JONES	117159	109159	126	108	113961	112220	506	498
KARNES	0	0	0	0	0	0	0	0
KENDALL	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0
KNOX	0	0	0	0	0	0	0	0
LA SALLE	81110	75572	87	75	78896	77690	350	345
LAMAR	0	0	0	0	0	0	0	0
LAMPASAS	77248	71973	83	72	75139	73991	334	328
LAVACA	184108	171536	198	170	179081	176345	795	782
LEE	0	0	0	0	0	0	0	0
LEON	102997	95964	111	95	100185	98655	445	438
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	245906	229114	265	228	239192	235538	1062	1045
MCCULLOCH	0	0	0	0	0	0	0	0
MCLENNAN	2663765	2481873	2866	2466	2591040	2551453	11508	11318
MCMULLEN	0	0	0	0	0	0	0	0
MEDINA	0	0	0	0	0	0	0	0
MENARD	0	0	0	0	0	0	0	0
MIDLAND	384952	358666	414	356	374442	368721	1663	1636
MILAM	0	0	0	0	0	0	0	0
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	0	0	0	0
NAVARRO	370790	345471	399	343	360667	355156	1602	1575
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	0	0	0	0	0	0	0	0
REAGAN	0	0	0	0	0	0	0	0
REAL	108147	100762	116	100	105194	103587	467	460
RED RIVER	0	0	0	0	0	0	0	0
REEVES	122309	113957	132	113	118970	117152	528	520
REFUGIO	158358	147545	170	147	154035	151681	684	673
ROBERTSON	0	0	0	0	0	0	0	0
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	2317437	2159193	2494	2146	2254167	2219727	10012	9847
SHACKELFORD	0	0	0	0	0	0	0	0
SOMERVELL	0	0	0	0	0	0	0	0
STARR	236894	220718	255	219	230426	226905	1023	1007
STEPHENS	0	0	0	0	0	0	0	0
STERLING	106860	99563	115	99	103942	102354	462	454
STONEWALL	0	0	0	0	0	0	0	0
SUTTON	0	0	0	0	0	0	0	0
TAYLOR	397827	370662	428	368	386965	381053	1719	1690
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	0	0	0	0	0	0	0	0
UPTON	0	0	0	0	0	0	0	0
UVALDE	0	0	0	0	0	0	0	0
VAL VERDE	0	0	0	0	0	0	0	0
VAN ZANDT	3862	3599	4	4	3757	3700	17	16
WARD	0	0	0	0	0	0	0	0
WASHINGTON	0	0	0	0	0	0	0	0
WEBB	990061	922455	1065	917	963030	948317	4277	4207
WHARTON	0	0	0	0	0	0	0	0
WICHITA	348903	325079	375	323	339377	334192	1507	1482
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
WISE	90123	83969	97	83	87662	86323	389	383
YOUNG	0	0	0	0	0	0	0	0
ZAPATA	0	0	0	0	0	0	0	0
ZAVALA	106860	99563	115	99	103942	102354	462	454
Total	190793308	177765194	205306	176645	185584312	182748869	824241	810665

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

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	0	0	-167402	-370	-6524	-124	-20761	-40	-100230	-7852	-132221	-291	-28777	-138	-455916	-8814	488	94313
Chambers	0	0	0	0	0	0	0	0	-127310	-9973	-16791	-37	-3654	-17	-147756	-10028	158	107295
Collin	-335810	-1801	-420000	-927	-129033	-2458	-450544	-869	-435492	-34115	-421192	-927	-91668	-439	-2283740	-41536	2444	444432
Dallas	-1720202	-9224	-393022	-868	-31159	-594	-785284	-1515	-254550	-19941	-910429	-2003	-198146	-949	-4292792	-35092	4593	375482
Denton	-496811	-2664	-190868	-421	-14771	-281	-23884	-46	-230811	-18081	-1069200	-2352	-232701	-1114	-2259047	-24960	2417	267074
El Paso	-227552	-1220	-926093	-2045	-21312	-406	-78573	-152	-244105	-19122	-453720	-998	-98748	-473	-2050103	-24416	2194	261249
Fort Bend	-257545	-1381	-233466	-515	-11430	-218	-42084	-81	-112082	-8780	-346817	-763	-75481	-361	-1078906	-12100	1154	129469
Galveston	-30711	-165	-174651	-386	-8792	-168	-2112	-4	-3517	-276	-127210	-280	-27686	-133	-374680	-1410	401	15084
Hardin	0	0	0	0	0	0	0	0	-13012	-1019	0	0	0	0	-13012	-1019	14	10907
Harris	-2307033	-12370	-648684	-1432	-79868	-1522	-1482693	-2860	-679034	-53194	-1789033	-3936	-389366	-1864	-7375711	-77177	7892	825794
Jefferson	-10257	-55	-26605	-59	-8968	-171	-2472	-5	0	0	-18550	-41	-4037	-19	-70889	-349	76	3740
Liberty	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Montgomery	0	0	-119723	-264	-47812	-911	-124522	-240	-112399	-8805	-484314	-1065	-105406	-505	-994175	-11790	1064	126158
Orange	0	0	0	0	0	0	0	0	-9496	-744	-2549	-6	-555	-3	-12600	-752	13	8048
Tarrant	-441626	-2368	-925720	-2044	0	0	-264233	-510	-490355	-38413	-736536	-1620	-160300	-768	-3018770	-45722	3230	489228
Waller	-27962	-150	0	0	0	0	0	0	0	0	-21011	-46	-4573	-22	-53546	-218	57	2333
Affected Counties																		
(square feet in thousands)																		
Bastrop	0	0	-18683	-41	0	0	-3325	-6	0	0	-145057	-319	-31570	-151	-198636	-518	213	5542
Bexar	-983529	-5274	-586805	-1296	-30052	-573	-163887	-316	-736992	-57734	-1706219	-3754	-371342	-1778	-4578826	-70723	4899	756737
Caldwell	0	0	0	0	0	0	0	0	-528	-41	0	0	0	0	-528	-41	1	442
Comal	-22915	-123	0	0	0	0	-3573	-7	0	0	-232618	-512	-50627	-242	-309733	-884	331	9458
Ellis	0	0	-230627	-509	0	0	-382	-1	0	0	-36572	-80	-7960	-38	-275540	-628	295	6725
Gregg	-59781	-321	-649356	-1434	0	0	-1618	-3	-35169	-2755	-9846	-22	-2143	-10	-757913	-4544	811	48624
Guadalupe	0	0	-36171	-80	-7526	-143	-4943	-10	0	0	-11605	-26	-2526	-12	-62770	-270	67	2893
Harrison	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hays	-193702	-1039	-40655	-90	-9847	-188	-1663	-3	0	0	-23297	-51	-5070	-24	-274235	-1395	293	14923
Henderson	0	0	-52313	-116	0	0	0	0	0	0	-2813	-6	-612	-3	-55739	-125	60	1333
Hood	0	0	-30641	-68	0	0	0	0	-18956	-1485	-11341	-25	-2468	-12	-63405	-1589	68	17006
Hunt	0	0	-3288	-7	0	0	0	0	-10199	-799	0	0	0	0	-13487	-806	14	8626
Johnson	-28721	-154	-7473	-17	0	0	-2764	-5	0	0	-5099	-11	-1110	-5	-45167	-192	48	2058
Kaufman	0	0	-44840	-99	0	0	0	0	0	0	-249234	-548	-54243	-260	-348317	-907	373	9705
Nueces	-219757	-1178	-29893	-66	-7210	-137	-1303	-3	-229897	-18009	-93540	-206	-20358	-97	-601957	-19697	644	210757
Parker	0	0	-124057	-274	0	0	0	0	-13188	-1033	-2286	-5	-497	-2	-140028	-1314	150	14064
Rockwall	-30567	-164	-73986	-163	0	0	-3460	-7	-7034	-551	-51693	-114	-11250	-54	-177990	-1053	190	11262
Rusk	0	0	0	0	0	0	0	0	-45860	-3593	0	0	0	0	-45860	-3593	49	38440
San Patricio	-5744	-31	0	0	0	0	0	0	0	0	-50110	-110	-10906	-52	-66761	-193	71	2068
Smith	-34629	-186	0	0	0	0	-15054	-29	-146125	-11447	-6418	-14	-1397	-7	-203623	-11683	218	125003
Travis	-1392044	-7464	-688890	-1521	-152755	-2910	-332291	-641	-250189	-19599	-448885	-988	-97695	-468	-3362749	-33590	3598	359417
Upshur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Victoria	-30629	-164	-45214	-100	0	0	0	0	-62600	-4904	-166156	-366	-36162	-173	-340761	-5707	365	61061
Williamson	-279578	-1499	-131231	-290	-20028	-382	-31119	-60	-167648	-13133	-507171	-1116	-110381	-529	-1247158	-17008	1334	181983
Wilson	0	0	0	0	0	0	-899	-2	0	0	0	0	0	0	-899	-2	1	19

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

Table 24: Annual Electricity and Natural Gas Savings from New Commercial Constructions (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	-56050	-124	0	0	0	0	-9742	-763	-11077	-24	-2411	-12	-79279	-923	85	9874
ANGELINA	0	0	0	0	0	0	-270	-1	0	0	-1934	-4	-421	-2	-2625	-7	3	73
ARANSAS	0	0	0	0	-8265	-157	0	0	-10199	-799	0	0	0	0	-18463	-956	20	10233
ARCHER	0	0	0	0	0	0	0	0	-41815	-3276	0	0	0	0	-41815	-3276	45	35050
ATASCOSA	0	0	-18235	-40	0	0	0	0	-5275	-413	-16176	-36	-3521	-17	-43207	-506	46	5414
AUSTIN	0	0	0	0	0	0	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	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	-15281	-291	0	0	-10551	-827	0	0	0	0	-25831	-1118	28	11958
BELL	-45133	-242	-90053	-199	-17813	-339	-7190	-14	-215794	-16905	-519830	-1144	-113136	-542	-1008950	-19384	1080	207409
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	-5011	-11	-1091	-5	-6102	-16	7	174
BOSQUE	0	0	0	0	0	0	0	0	-4044	-317	0	0	0	0	-4044	-317	4	3390
BRAZOS	-211366	-1133	-92445	-204	-14243	-271	-4988	-10	-16424	-1287	-277630	-611	-60423	-289	-677519	-3805	725	40714
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	0	0	0	0	0	0	0	0
BROOKS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BROWN	0	0	0	0	0	0	0	0	0	0	-11077	-24	-2411	-12	-13488	-36	14	384
BURLESON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BURNET	0	0	-149466	-330	0	0	0	0	0	0	-4132	-9	-899	-4	-154498	-343	165	3674
CALHOUN	-15899	-85	0	0	0	0	0	0	0	0	0	0	0	0	-15899	-85	17	912
CALLAHAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMERON	-185271	-993	0	0	0	0	0	0	-92282	-7229	-171870	-378	-37406	-179	-486829	-8780	521	93943
CHEROKEE	0	0	0	0	0	0	0	0	-16775	-1314	-7297	-16	-1588	-8	-25660	-1338	27	14314
CHILDRESS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLAY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COKE	0	0	0	0	0	0	0	0	0	0	-7297	-16	-1588	-8	-8885	-24	10	253
COLEMAN	0	0	0	0	0	0	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	0	0	0	0	0	0
COMANCHE	0	0	0	0	0	0	0	0	0	0	-4132	-9	-899	-4	-5031	-13	5	143
CONCHO	0	0	0	0	0	0	0	0	0	0	-7297	-16	-1588	-8	-8885	-24	10	253
COOKE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CORYELL	0	0	-11957	-26	0	0	0	0	-4220	-331	-11429	-25	-2487	-12	-30094	-394	32	4216
COTTLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CRANE	0	0	-5754	-13	0	0	0	0	-1758	-138	0	0	0	0	-7513	-150	8	1610
CROCKETT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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
DE WITT	0	0	0	0	-12309	-235	-2337	-5	-12379	-970	-14418	-32	-3138	-15	-44581	-1256	48	13434
DELTA	0	0	0	0	0	0	-427	-1	0	0	0	0	0	0	-427	-1	0	9
DICKENS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIMMIT	0	0	0	0	-8792	-168	0	0	0	0	-5890	-13	-1282	-6	-15964	-187	17	1997
DUVAL	0	0	0	0	0	0	0	0	0	0	-7385	-16	-1607	-8	-8992	-24	10	256
EASTLAND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ECTOR	-119766	-642	-29819	-66	-6330	-121	-1101	-2	-7667	-601	-9583	-21	-2086	-10	-176351	-1462	189	15648
EDWARDS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ERATH	0	0	0	0	0	0	-2247	-4	-18182	-1424	-8791	-19	-1913	-9	-31134	-1457	33	15592
FALLS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FANNIN	0	0	0	0	-7913	-151	0	0	0	0	0	0	0	0	-7913	-151	8	1613
FAYETTE	0	0	0	0	0	0	0	0	-16740	-1311	-158244	-348	-34440	-165	-209424	-1824	224	19521
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	-3139	-7	0	0	0	0	0	0	0	0	0	0	-3139	-7	3	74
FRIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GILLESPIE	0	0	0	0	-9408	-179	0	0	0	0	-3165	-7	-689	-3	-13261	-189	14	2027
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	0	0	0	0	-4494	-9	0	0	-156749	-345	-34115	-163	-195358	-517	209	5530
GRAYSON	0	0	0	0	0	0	-135	0	-28135	-2204	-14945	-33	-3253	-16	-46468	-2253	50	24104
GRIMES	0	0	0	0	0	0	0	0	-1407	-110	0	0	0	0	-1407	-110	2	1179
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
HIDALGO	-34424	-185	-72342	-160	0	0	-3910	-8	-382774	-29985	-652140	-1435	-141932	-680	-1287522	-32451	1378	347231
HILL	-2790	-15	0	0	0	0	0	0	-34817	-2727	-7297	-16	-1588	-8	-46492	-2766	50	29597
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	-7297	-16	-1588	-8	-8885	-24	10	253
HUDSPETH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IRION	0	0	0	0	0	0	0	0	0	0	-7209	-16	-1569	-8	-8778	-23	9	250
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	-2067	-4	0	0	0	0	0	0	-2067	-4	2	43
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	-2247	-4	-12309	-964	0	0	0	0	-14556	-969	16	10364
JONES	0	0	0	0	0	0	0	0	-914	-72	-8000	-18	-1741	-8	-10656	-98	11	1044
KARNES	-4965	-27	0	0	-5680	-108	-3370	-7	-1758	-138	0	0	0	0	-15773	-279	17	2986

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

Table 24: Annual Electricity and Natural Gas Savings from New Commercial Constructions (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	-28044	-150	0	0	0	0	-1573	-3	-7737	-606	0	0	0	0	-37354	-760	40	8127
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	0	0	0	0	0	0	0	0	0	0
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	-703	-55	0	0	0	0	-703	-55	1	590
KNOX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LA SALLE	0	0	0	0	-14067	-268	0	0	0	0	-5539	-12	-1205	-6	-20811	-286	22	3060
LAMAR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAMPASAS	-12309	-66	0	0	0	0	0	0	0	0	-5275	-12	-1148	-5	-18732	-83	20	889
LAVACA	0	0	0	0	0	0	-5145	-10	-3587	-281	-12572	-28	-2736	-13	-24040	-332	26	3549
LEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LEON	0	0	0	0	0	0	0	0	0	0	-7033	-15	-1531	-7	-8564	-23	9	244
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	-21101	-1653	0	0	0	0	-21101	-1653	23	17687
LLANO	0	0	0	0	0	0	-360	-1	0	0	0	0	0	0	-360	-1	0	7
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	0	0	0	0	0	0	0	0	0	0
MARTIN	0	0	0	0	0	0	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	0	0	0	0	0	0
MATAGORDA	0	0	0	0	0	0	0	0	-81732	-6403	0	0	0	0	-81732	-6403	87	68508
MAVERICK	0	0	-103431	-228	0	0	0	0	0	0	-16791	-37	-3654	-17	-123877	-283	133	3026
MCCULLOCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MCLENNAN	-52724	-283	-27128	-60	-12133	-231	-2224	-4	-43292	-3391	-181892	-400	-39587	-190	-358981	-4559	384	48783
MCMULLEN	0	0	0	0	0	0	0	0	-3552	-278	0	0	0	0	-3552	-278	4	2977
MEDINA	0	0	0	0	0	0	0	0	-5275	-413	0	0	0	0	-5275	-413	6	4422
MENARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MIDLAND	-34875	-187	0	0	-25497	-486	-171684	-331	0	0	-26286	-58	-5721	-27	-264064	-1089	283	11653
MILAM	-13499	-72	0	0	0	0	0	0	0	0	0	0	0	0	-13499	-72	14	774
MILLS	0	0	0	0	0	0	0	0	-20363	-1595	0	0	0	0	-20363	-1595	22	17068
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	-12043	-23	0	0	0	0	0	0	-12043	-23	13	249
MOTLEY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NACOGDOCHES	0	0	0	0	0	0	0	0	-16986	-1331	0	0	0	0	-16986	-1331	18	14238
NAVARRO	0	0	-2391	-5	0	0	0	0	0	0	-25319	-56	-5510	-26	-33221	-87	36	935
NOLAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PALO PINTO	-12288	-66	0	0	0	0	0	0	0	0	0	0	0	0	-12288	-66	13	705
PECOS	0	0	0	0	-8757	-167	0	0	0	0	0	0	0	0	-8757	-167	9	1785
PRESIDIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RAINS	0	0	0	0	0	0	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	0	0	0	0	0	0
REAL	0	0	0	0	0	0	0	0	0	0	-7385	-16	-1607	-8	-8992	-24	10	256
RED RIVER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REEVES	-656	-4	0	0	-6577	-125	0	0	0	0	-8352	-18	-1818	-9	-17402	-156	19	1668
REFUGIO	0	0	0	0	0	0	0	0	0	0	-10813	-24	-2353	-11	-13167	-35	14	375
ROBERTSON	0	0	0	0	0	0	0	0	-28487	-2232	0	0	0	0	-28487	-2232	30	23878
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	-11210	-25	0	0	0	0	0	0	-158244	-348	-34440	-165	-203894	-538	218	5754
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	0	0	-30456	-2386	-16176	-36	-3521	-17	-50153	-2438	54	26090
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	0	0	-7297	-16	-1588	-8	-8885	-24	10	253
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	-40356	-89	0	0	-1123	-2	-7667	-601	-27165	-60	-5912	-28	-82223	-780	88	8345
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	-36395	-80	-47161	-898	0	0	-16389	-1284	0	0	0	0	-99945	-2263	107	24210
UPTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UVALDE	0	0	0	0	0	0	0	0	-3869	-303	0	0	0	0	-3869	-303	4	3243
VAL VERDE	0	0	0	0	0	0	0	0	-14736	-1154	0	0	0	0	-14736	-1154	16	12351
VAN ZANDT	-1969	-11	0	0	0	0	0	0	0	0	-264	-1	-57	0	-2291	-11	2	122
WARD	0	0	0	0	0	0	0	0	-1758	-138	0	0	0	0	-1758	-138	2	1474
WASHINGTON	0	0	0	0	0	0	0	0	-24618	-1929	0	0	0	0	-24618	-1929	26	20635
WEBB	0	0	0	0	0	0	0	0	-102235	-8009	-67605	-149	-14714	-70	-184554	-8228	197	88039
WHARTON	-5272	-28	-4185	-9	0	0	0	0	0	0	0	0	0	0	-9457	-38	10	401
WICHITA	-15243	-82	-73238	-162	-8845	-169	-1168	-2	0	0	-23824	-52	-5185	-25	-127504	-491	136	5258
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	0	0	0	0	0	0	0	0	0	0
WINKLER	0	0	0	0	0	0	0	0	-24618	-1929	0	0	0	0	-24618	-1929	26	20635
WISE	0	0	0	0	0	0	0	0	0	0	-6154	-14	-1339	-6	-7493	-20	8	213
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	0	0	-7297	-16	-1588	-8	-8885	-24	10	253
Total	-9933602	-53263	-7847953	-17327	-816156	-15549	-4073547	-7856	-5941902	-465471	-13028114	-28661	-2835443	-13576	-44476718	-601704	47590	6438228

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

Table 25: 2013 Totalized Annual Electricity Savings by CM Zone from New Commercial Constructions

CM Zone	Total Electricity Savings by CM Zone (MWh) 2013-TRY 2008
Houston (H)	13,374
North (N)	12,262
West (W)	1,221
South (S)	11,339
Total	38,197

Table 26: 2013 Annual NOx Reductions from New Commercial Constructions Using 2010 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	0.0562032	751.6747639	0.0000071	0.0874374	0.0000003	0.0004207	0.0005265	5.9705944	757.7332163	0.3788666
	Chambers	0.0204500	273.5031761	0.0000026	0.0318148	0.0000001	0.0001531	0.0001916	2.1724509	275.7075949	0.1378538
	Fort Bend	0.0313463	419.2330812	0.0000040	0.0487666	0.0000002	0.0002346	0.0002937	3.3299916	422.6120741	0.2113060
	Galveston	0.0226620	303.0864541	0.0000029	0.0352561	0.0000001	0.0001696	0.0002123	2.4074325	305.5293123	0.1527647
	Harris	0.1486911	1988.6299953	0.0000189	0.2313242	0.0000009	0.0011130	0.0013930	15.7957984	2004.6582309	1.0023291
Dallas/ Fort Worth Area	Collin	0.0012932	17.2951332	0.0079329	97.2764109	0.0003832	0.4680235	0.0000809	0.9177389	115.9573065	0.0579787
	Dallas	0.0024826	33.2029878	0.0152295	186.7500791	0.0007356	0.8985059	0.0001554	1.7618641	222.6134369	0.1113067
	Denton	0.0001267	1.6940279	0.0007770	9.5280538	0.0000375	0.0458421	0.0000079	0.0898909	11.3578147	0.0056789
	Tarrant	0.0004742	6.3418304	0.0029089	35.6696013	0.0001405	0.1716163	0.0000297	0.3365192	42.5195672	0.0212598
	Ellis	0.0029920	40.0156064	0.0183544	225.0676262	0.0008865	1.0828622	0.0001873	2.1233649	268.2894597	0.1341447
	Johnson	0.0007256	9.7043307	0.0044512	54.5819710	0.0002150	0.2626089	0.0000454	0.5149450	65.0638554	0.0325319
	Kaufman	0.0059718	79.8689028	0.0366343	449.2223405	0.0017695	2.1613321	0.0003738	4.2381171	535.4906925	0.2677453
	Parker	0.0000012	0.0164439	0.0000075	0.0924886	0.0000004	0.0004450	0.0000001	0.0008726	0.1102501	0.0000551
	Henderson	0.0006908	9.2386035	0.0042376	51.9624903	0.0002047	0.2500058	0.0000432	0.4902319	61.9413315	0.0309707
	Hood	0.0050771	67.9022683	0.0311454	381.9160505	0.0015044	1.8375031	0.0003178	3.6031265	455.2589484	0.2276295
	Hunt	0.0088463	118.3129722	0.0047066	57.7144678	0.0002273	0.2776802	0.0652823	740.2525260	916.5576462	0.4582788
San Antonio Area	Bexar	0.0138906	185.7762132	0.0009368	11.4875470	0.0000452	0.0552697	0.1109355	1257.9262777	1455.2453076	0.7276227
	Guadalupe	0.0032029	42.8361919	0.0002160	2.6487932	0.0000104	0.0127441	0.0255795	290.0520496	335.5497787	0.1677749
Austin Area	Bastrop	0.0033782	45.1811606	0.0002278	2.7937953	0.0000110	0.0134417	0.0269798	305.9302815	353.9186790	0.1769593
	Hays	0.0008331	11.1424609	0.0000562	0.6889986	0.0000027	0.0033150	0.0066537	75.4477345	87.2825090	0.0436413
	Travis	0.0051785	69.2589458	0.0003493	4.2826548	0.0000169	0.0206050	0.0413577	468.9655708	542.5277764	0.2712639
	Rusk	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Corpus Christi Area	Nueces	0.0128578	171.9629496	0.0008672	10.6333983	0.0000419	0.0511602	0.1026870	1164.3940277	1347.0415357	0.6735208
	San Patricio	0.0015100	20.1944743	0.0001018	1.2487335	0.0000049	0.0060080	0.0120591	136.7406486	158.1898643	0.0790949
Victoria Area	Victoria	0.0021192	28.3420870	0.0001429	1.7525444	0.0000069	0.0084320	0.0169244	191.9096927	222.0127560	0.1110064
Other ERCOT counties	Andrews	0.0000037	0.0500764	0.0000230	0.2816546	0.0039003	4.7639498	0.0000002	0.0026572	5.0983380	0.0025492
	Bosque	0.0022204	29.6964732	0.0136212	167.0277007	0.0006579	0.8036162	0.0001390	1.5757964	199.1035865	0.0995518
	Brazos	0.0024089	32.2168913	0.0112305	137.7126197	0.0005425	0.6625733	0.0047829	54.2346170	224.8267013	0.1124134
	Calhoun	0.0009466	12.6598208	0.0000638	0.7828251	0.0000031	0.0037664	0.0075598	85.7220687	99.1684811	0.0495842
	Cameron	0.0063536	84.9749470	0.0004285	5.2544601	0.0000207	0.0252807	0.0507425	575.3816217	665.6363095	0.3328182
	Cherokee	0.0027392	36.6341056	0.0168033	206.0483880	0.0008116	0.9913554	0.0001714	1.9439309	245.6177799	0.1228089
	Coke	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Ector	0.0019215	25.6987044	0.0006604	8.0975095	0.0911346	111.3154448	0.0146527	166.1505055	311.2621643	0.1556311
	Fannin	0.0000041	0.0542314	0.0000249	0.3050243	0.0000012	0.0014676	0.0000003	0.0028777	0.3636010	0.0001818
	Fayette	0.0051867	69.3681733	0.0103217	126.5681002	0.0004986	0.6089539	0.0283993	322.0269444	518.5721719	0.2592861
	Freestone	0.0047643	63.7193857	0.0292268	358.3894432	0.0014117	1.7243101	0.0002982	3.3811685	427.2143075	0.2136072
	Frio	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Grimes	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Hidalgo	0.0053716	71.8407121	0.0003623	4.4422994	0.0000175	0.0213731	0.0428994	486.4472045	562.7515891	0.2813758
	Howard	0.0002411	3.2247658	0.0007641	9.3693032	0.1283942	156.8256979	0.0009490	10.7608507	180.1806176	0.0900903
	Jack	0.0030783	41.1700856	0.0188839	231.5609904	0.0009121	1.1141036	0.0001927	2.1846255	276.0298050	0.1380149
	Lamar	0.0040001	53.4988354	0.0245388	300.9039967	0.0011853	1.4477318	0.0002504	2.8388311	358.6893951	0.1793447
	Limestone	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Llano	0.0040314	53.9175245	0.0002719	3.3340119	0.0000131	0.0160408	0.0321966	365.0858726	422.3534498	0.2111767
	McLennan	0.0056576	75.6663688	0.0347066	425.5852042	0.0016764	2.0476074	0.0003541	4.0151163	507.3142966	0.2536571
	Milam	0.0012686	16.9666377	0.0000856	1.0491389	0.0000041	0.0050477	0.0101316	114.8843494	132.9051736	0.0664526
	Mitchell	0.0000311	0.4163235	0.0001910	2.3416099	0.0324260	39.6063565	0.0000019	0.0220915	42.3863814	0.0211932
	Nolan	0.0000293	0.3912679	0.0001795	2.2006850	0.0304745	37.2227303	0.0000018	0.0207620	39.8354452	0.0199177
	Palo Pinto	0.0036129	48.3202881	0.0221635	271.7772770	0.0010705	1.3075952	0.0002261	2.5640397	323.9692000	0.1619846
	Pecos	0.0000020	0.0263464	0.0000121	0.1481854	0.0020520	2.5064307	0.0000001	0.0013980	2.6823605	0.0013412
	Robertson	0.0039506	52.8359038	0.0055755	68.3684583	0.0002693	0.3289394	0.0246170	279.1379382	400.6712398	0.2003356
	Titus	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Upton	0.0000025	0.0340166	0.0000156	0.1913260	0.0026494	3.2361181	0.0000002	0.0018050	3.4632657	0.0017316
	Ward	0.0001995	2.6684163	0.0012239	15.0084972	0.2078335	253.8560730	0.0000125	0.1415953	271.6745817	0.1358373
	Webb	0.0042017	56.1948708	0.0002834	3.4748325	0.0000137	0.0167184	0.0335565	380.5062198	440.1926414	0.2200963
	Wharton	0.0021095	28.2131238	0.0001423	1.7445699	0.0000069	0.0083936	0.0168474	191.0364580	221.0025452	0.1105013
	Wichita	0.0000121	0.1620177	0.0000743	0.9112679	0.0126190	15.4133287	0.0000008	0.0085972	16.4952115	0.0082476
	Wilbarger	0.0179710	240.3484861	0.1102430	1351.8391480	0.0053249	6.5040696	0.0011247	12.7537125	1611.4454162	0.8057227
	Wise	0.0010202	13.6441343	0.0062583	76.7413817	0.0003023	0.3692239	0.0000638	0.7240044	91.4787443	0.0457394
	Young	0.0071054	95.0293036	0.0435880	534.4919577	0.0021054	2.5715877	0.0004447	5.0425798	637.1354288	0.3185677
	Total	**0.4414501**	**5904.057299**	**0.4812863**	**5901.70451**	**0.5345786**	**652.9553768**	**0.6829349**	**7743.971988**	**20202.6891737**	**10.1013446**

Energy Savings by PCA (MWh)		13,374		12,262		1,221		11,339		

Table 27: 2013 Annual Electricity and Natural Gas Savings and NOx Reductions from New Commercial Constructions

	Electricity Savings and Resultant NOx Reductions (Commercial)		Total Natural Gas Savings and Resultant NOx Reductions (Commercial)		Total Nox Reductions
County	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)
HARRIS	7,892.01	1.00	825,794.20	3.80	4.80
TARRANT	3,230.08	0.02	489,227.94	2.25	2.27
COLLIN	2,443.60	0.06	444,432.07	2.04	2.10
DALLAS	4,593.29	0.11	375,481.83	1.73	1.84
BEXAR	4,899.34	0.73	756,737.38	3.48	4.21
TRAVIS	3,598.14	0.27	359,416.99	1.65	1.92
DENTON	2,417.18	0.01	267,073.59	1.23	1.23
WILLIAMSON	1,334.46		181,982.74	0.84	0.84
EL PASO	2,193.61		261,248.73	1.20	1.20
MONTGOMERY	1,063.77		126,158.03	0.58	0.58
GALVESTON	400.91	0.15	15,084.47	0.07	0.22
BRAZORIA	487.83	0.38	94,313.40	0.43	0.81
COMAL	331.41		9,457.81	0.04	0.04
ROCKWALL	190.45		11,261.87	0.05	0.05
HAYS	293.43	0.04	14,923.45	0.07	0.11
NUECES	644.09	0.67	210,756.54	0.97	1.64
FORT BEND	1,154.43	0.21	129,468.70	0.60	0.81
ELLIS	294.83	0.13	6,724.87	0.03	0.17
JOHNSON	48.33	0.03	2,058.26	0.01	0.04
GUADALUPE	67.16	0.17	2,893.23	0.01	0.18
KAUFMAN	372.70	0.27	9,705.06	0.04	0.31
JEFFERSON	75.85		3,739.59	0.02	0.02
PARKER	149.83	0.00	14,064.46	0.06	0.06
SMITH	217.88		125,003.22	0.58	0.58
BASTROP	212.54	0.18	5,541.92	0.03	0.20
CHAMBERS	158.10	0.14	107,294.65	0.49	0.63
GREGG	810.97		48,623.65	0.22	0.22
SAN PATRICIO	71.43	0.08	2,067.86	0.01	0.09
LIBERTY	0.00		0.00	0.00	0.00
VICTORIA	364.61	0.11	61,060.96	0.28	0.39
ORANGE	13.48		8,047.63	0.04	0.04
CALDWELL	0.56		442.18	0.00	0.00
WILSON	0.96		18.55	0.00	0.00
HARDIN	13.92		10,907.05	0.05	0.05
HARRISON	0.00		0.00	0.00	0.00
WALLER	57.29		2,333.12	0.01	0.01
UPSHUR	0.00		0.00	0.00	0.00
RUSK	49.07	0.00	38,439.96	0.18	0.18
HOOD	67.84	0.23	17,006.17	0.08	0.31
HUNT	14.43	0.46	8,626.45	0.04	0.50
HENDERSON	59.64	0.03	1,333.44	0.01	0.04
HIDALGO	1,377.65	0.28	347,230.98	1.60	1.88
CAMERON	520.91	0.33	93,943.14	0.43	0.76
BELL	1,079.58		207,408.95	0.95	0.95
WEBB	197.47	0.22	88,039.18	0.40	0.63
BRAZOS	724.95	0.11	40,714.19	0.19	0.30
KENDALL	39.97		8,126.69	0.04	0.04
BURNET	165.31		3,674.33	0.02	0.02
GRAYSON	49.72		24,104.02	0.11	0.11
CORYELL	32.20		4,216.35	0.02	0.02
MIDLAND	282.55		11,653.15	0.05	0.05
LLANO	0.38	0.21	7.42	0.00	0.21
MAVERICK	132.55		3,025.94	0.01	0.01
MCMULLEN	3.80		2,977.33	0.01	0.01
ARANSAS	19.76		10,233.48	0.05	0.05
WICHITA	136.43	0.01	5,258.27	0.02	0.03
TAYLOR	87.98		8,345.21	0.04	0.04
TOM GREEN	106.94		24,210.41	0.11	0.11
MCLENNAN	384.11	0.25	48,782.73	0.22	0.48
MCCULLOCH	0.00		0.00	0.00	0.00
WISE	8.02	0.05	213.48	0.00	0.05
JIM HOGG	0.00		0.00	0.00	0.00
VAL VERDE	15.77		12,351.49	0.06	0.06
ECTOR	188.70	0.16	15,647.62	0.07	0.23
WHARTON	10.12	0.11	401.36	0.00	0.11
KERR	0.00		0.00	0.00	0.00
PRESIDIO	0.00		0.00	0.00	0.00
JIM WELLS	15.57		10,363.84	0.05	0.05
CALHOUN	17.01	0.05	912.18	0.00	0.05
GILLESPIE	14.19		2,027.49	0.01	0.01
MATAGORDA	87.45		68,508.03	0.32	0.32
NAVARRO	35.55		934.80	0.00	0.00
ANGELINA	2.81		72.66	0.00	0.00
NACOGDOCHES	18.18		14,238.12	0.07	0.07
FANNIN	8.47	0.00	1,613.03	0.01	0.01
ATASCOSA	46.23		5,413.69	0.02	0.02
WASHINGTON	26.34		20,634.95	0.09	0.09
LAMAR	0.00	0.18	0.00	0.00	0.18
VAN ZANDT	2.45		122.14	0.00	0.00
WILLACY	0.00		0.00	0.00	0.00
BROWN	14.43		384.26	0.00	0.00
ERATH	33.31		15,591.72	0.07	0.07
AUSTIN	0.00		0.00	0.00	0.00
COOKE	0.00		0.00	0.00	0.00
MEDINA	5.64		4,421.78	0.02	0.02
TITUS	0.00	0.00	0.00	0.00	0.00
UVALDE	4.14		3,242.64	0.01	0.01
FAYETTE	224.08	0.26	19,521.14	0.09	0.35
CALLAHAN	0.00		0.00	0.00	0.00
HOPKINS	0.00		0.00	0.00	0.00
LAMPASAS	20.04		889.18	0.00	0.00
BLANCO	0.00		0.00	0.00	0.00
FREESTONE	3.36	0.21	74.15	0.00	0.21
GRIMES	1.51	0.00	1,179.14	0.01	0.01
LEE	0.00		0.00	0.00	0.00
SOMERVELL	0.00		0.00	0.00	0.00
ANDREWS	84.83	0.00	9,873.93	0.05	0.05
BORDEN	6.53		173.83	0.00	0.00

Table 27: 2013 Annual Electricity and Natural Gas Savings and NOx Reductions from New Commercial Constructions (Continued)

	Electricity Savings and Resultant NOx Reductions (Commercial)		Total Natural Gas Savings and Resultant NOx Reductions (Commercial)		Total Nox Reductions
County	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)
CHEROKEE	27.46	0.12	14,314.37	0.07	0.19
DIMMIT	17.08		1,996.58	0.01	0.01
FALLS	0.00		0.00	0.00	0.00
COLORADO	0.00		0.00	0.00	0.00
FRIO	0.00	0.00	0.00	0.00	0.00
MILAM	14.44	0.07	774.47	0.00	0.07
JACKSON	2.21		42.66	0.00	0.00
ANDERSON	0.00		0.00	0.00	0.00
HILL	49.75		29,596.91	0.14	0.14
CULBERSON	0.00		0.00	0.00	0.00
MASON	0.00		0.00	0.00	0.00
PECOS	9.37	0.00	1,785.08	0.01	0.01
RAINS	0.00		0.00	0.00	0.00
LAVACA	25.72		3,549.09	0.02	0.02
PALO PINTO	13.15	0.16	705.02	0.00	0.17
KIMBLE	0.00		0.00	0.00	0.00
MADISON	0.00		0.00	0.00	0.00
ARCHER	44.74		35,049.94	0.16	0.16
REFUGIO	14.09		375.11	0.00	0.00
LIMESTONE	0.00	0.00	0.00	0.00	0.00
CLAY	0.00		0.00	0.00	0.00
BEE	27.64		11,958.48	0.06	0.06
MARTIN	0.00		0.00	0.00	0.00
GONZALES	209.03		5,530.26	0.03	0.03
BURLESON	0.00		0.00	0.00	0.00
KARNES	16.88		2,986.10	0.01	0.01
KLEBERG	0.75		589.57	0.00	0.00
BREWSTER	0.00		0.00	0.00	0.00
WINKLER	26.34		20,634.95	0.09	0.09
FRANKLIN	0.00		0.00	0.00	0.00
YOUNG	0.00	0.32	0.00	0.00	0.32
HOUSTON	0.00		0.00	0.00	0.00
SCURRY	218.17		5,754.19	0.03	0.03
BOSQUE	4.33	0.10	3,390.03	0.02	0.12
COMANCHE	5.38		143.33	0.00	0.00
BRISCOE	0.00		0.00	0.00	0.00
CONCHO	9.51		253.12	0.00	0.00
ZAVALA	9.51		253.12	0.00	0.00
NOLAN	0.00	0.02	0.00	0.00	0.02
BROOKS	0.00		0.00	0.00	0.00
ROBERTSON	30.48	0.20	23,877.59	0.11	0.31
LIVE OAK	22.58		17,687.10	0.08	0.08
HAMILTON	0.00		0.00	0.00	0.00
JONES	11.40		1,043.96	0.00	0.00
REAGAN	0.00		0.00	0.00	0.00
WARD	1.88	0.14	1,473.93	0.01	0.14
RED RIVER	0.00		0.00	0.00	0.00
HASKELL	0.00		0.00	0.00	0.00
HOWARD	9.51	0.09	253.12	0.00	0.09
SAN SABA	0.00		0.00	0.00	0.00
JACK	0.00	0.14	0.00	0.00	0.14
STEPHENS	0.00		0.00	0.00	0.00
RUNNELS	0.00		0.00	0.00	0.00
REEVES	18.62		1,667.98	0.01	0.01
DE WITT	47.70		13,433.95	0.06	0.06
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	0.02	0.00	0.00	0.02
WILBARGER	0.00	0.81	0.00	0.00	0.81
COLEMAN	0.00		0.00	0.00	0.00
UPTON	0.00	0.00	0.00	0.00	0.00
COKE	9.51	0.00	253.12	0.00	0.00
CROCKETT	0.00		0.00	0.00	0.00
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	8.04		1,609.87	0.01	0.01
DELTA	0.46		8.81	0.00	0.00
DICKENS	0.00		0.00	0.00	0.00
DUVAL	9.62		256.17	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		0.00	0.00	0.00
HALL	0.00		0.00	0.00	0.00
HUDSPETH	0.00		0.00	0.00	0.00
IRION	9.39		250.07	0.00	0.00
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	0.00		0.00	0.00	0.00
LA SALLE	22.27		3,059.73	0.01	0.01
LEON	9.16		243.97	0.00	0.00
LOVING	0.00		0.00	0.00	0.00
MENARD	0.00		0.00	0.00	0.00
MILLS	21.79		17,068.05	0.08	0.08
MONTAGUE	12.89		248.53	0.00	0.00
MOTLEY	0.00		0.00	0.00	0.00
REAL	9.62		256.17	0.00	0.00
SCHLEICHER	0.00		0.00	0.00	0.00
SHACKELFORD	0.00		0.00	0.00	0.00
STARR	53.66		26,089.52	0.12	0.12
STERLING	9.51		253.12	0.00	0.00
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	**47,590.09**	**10.10**	**6,438,227.52**	**29.62**	**39.72**

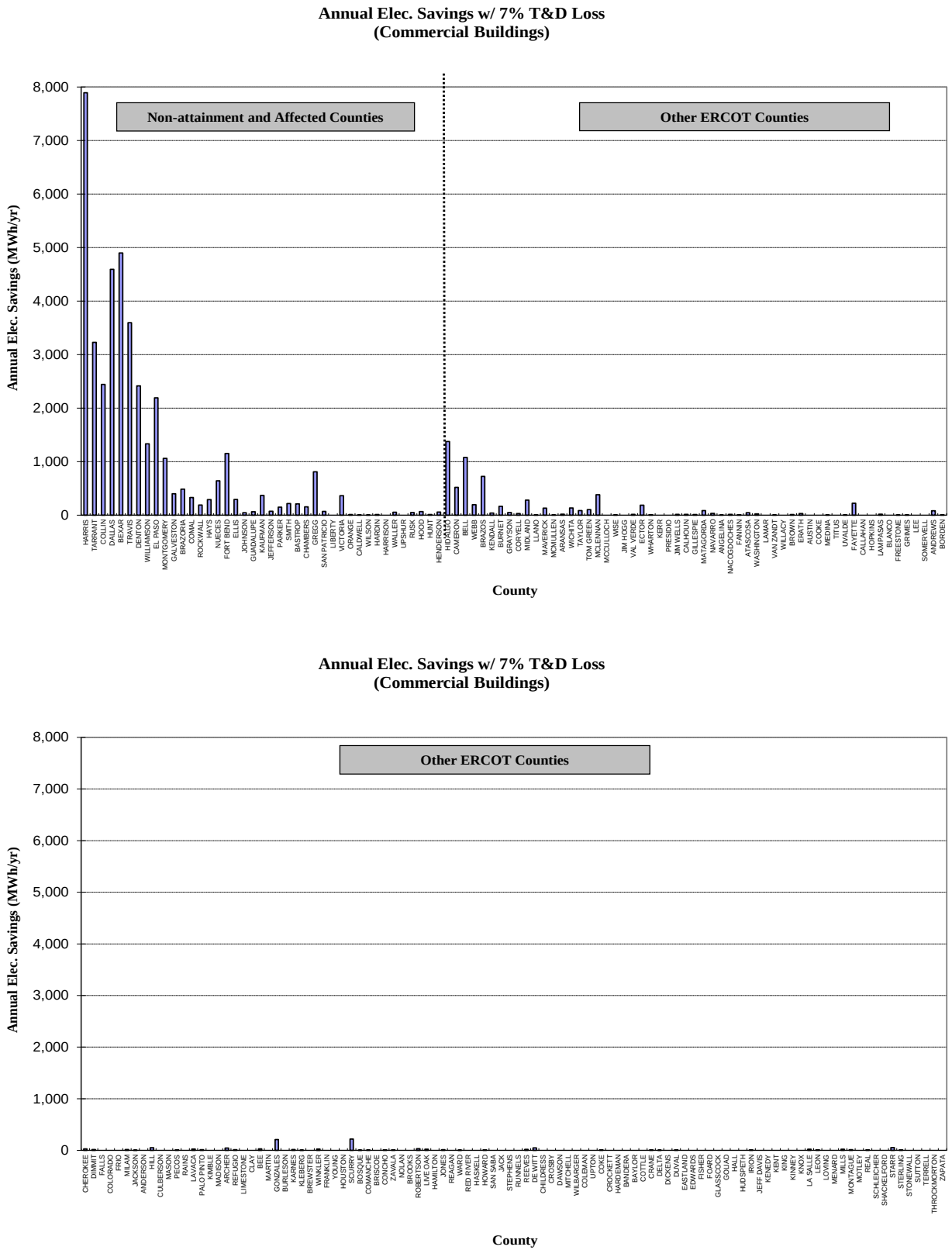
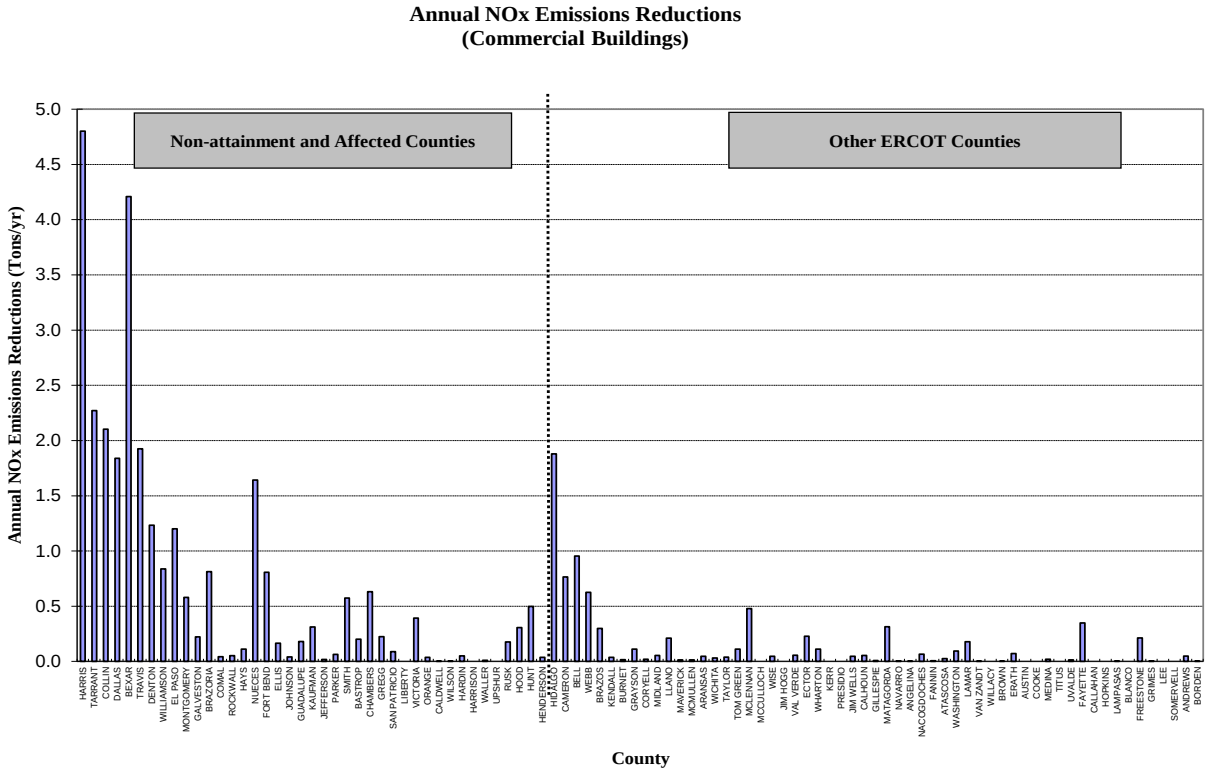


Figure 15: 2013 Annual Electricity Savings by County from New Commercial Constructions



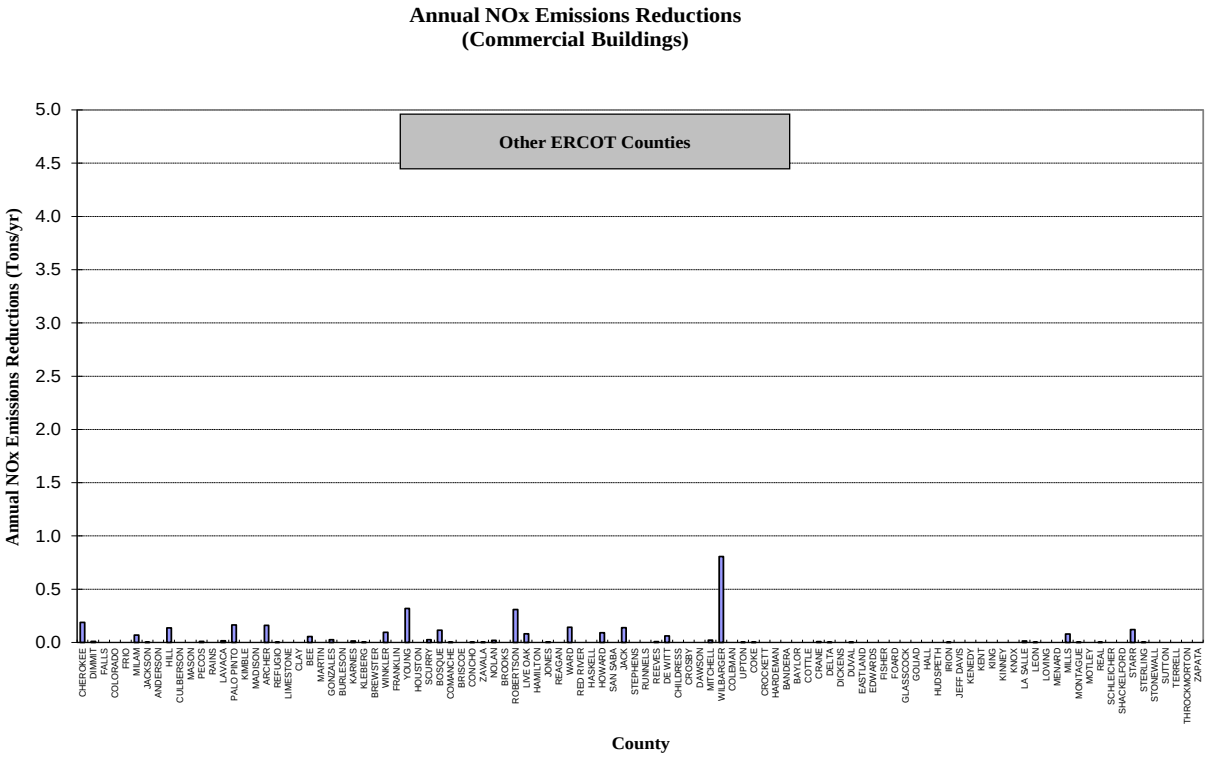


Figure 16: 2013 Annual NOx Reductions by County from New Commercial Constructions

4.5 2013 Results for New Residential (Single-family and Multi-family) and Commercial Constructions

Figure 17 shows the bar chart and Figure 18 shows the spatial distribution of the 2013 annual electricity savings, and Figure 19 shows the bar chart and Figure 20 shows the spatial distribution of the 2013 annual NOx reductions for new residential and commercial constructions, respectively. As shown in Table 28, the total annual electricity savings in 2013 resulted in 254,848.85 MWh/yr which includes 86,215.75 MWh/yr (i.e., 33.83 %) for single-family buildings, 121,043.02 MWh/yr (i.e., 47.50 %) for multi-family buildings, and 47,590.09 MWh/yr (i.e., 18.67 %) for new commercial buildings. In addition, the total annual natural gas savings from new residential and commercial constructions in 2013 resulted in 836,534.56 MMBtu (8,365,345.55 therms).

The total NOx reductions[26] from electricity and natural gas savings from new residential (single-family and multi-family) and commercial constructions in 2013 resulted in 93.75 tons NOx/year which represents 55.27 tons NOx/year from electricity savings and 38.48 tons NOx/year from natural gas savings.

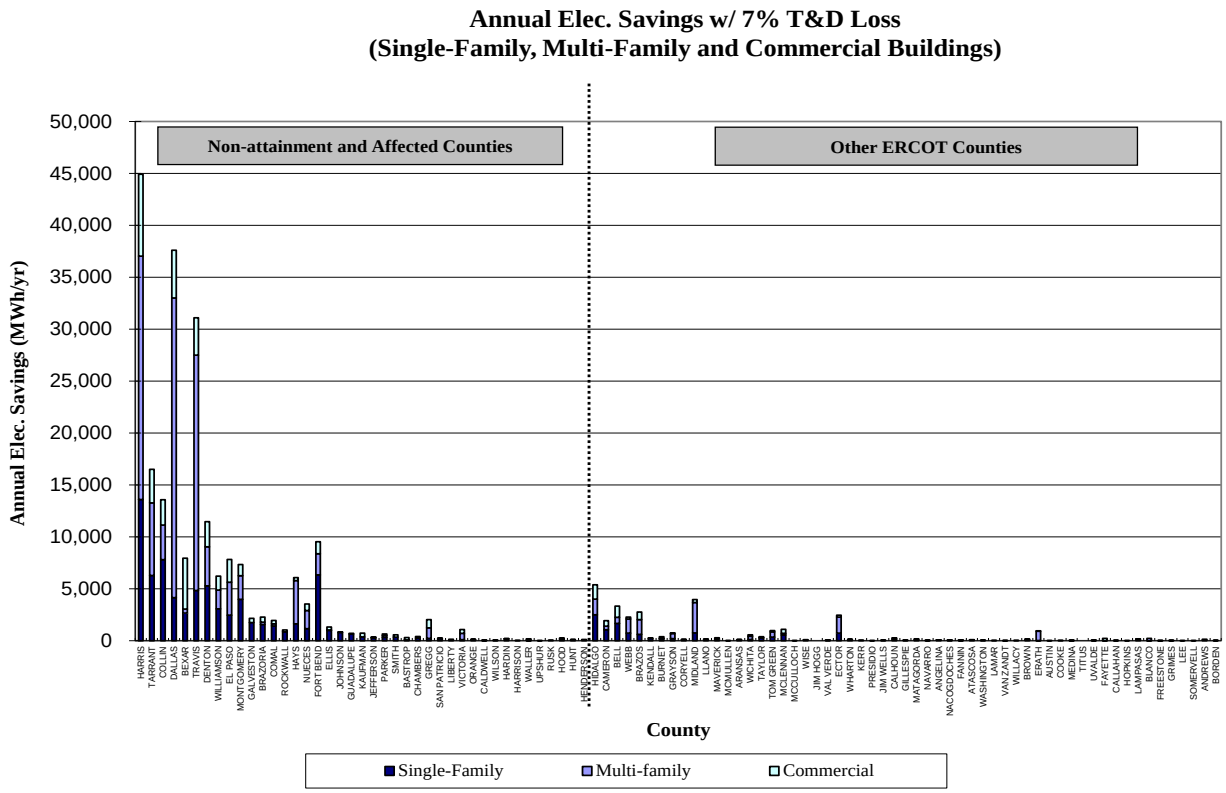
[26] 0.092 lb-NOx/MMBtu of emission rate was used for the calculation.

Table 28: 2013 Annual NOx Reductions from New Residential and Commercial Constructions

	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
County	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)
HARRIS	13,595.59	2.14	23,424.25	2.63	7,892.01	1.00	44,911.85	5.78	191,135.53	0.88	1,016,929.74	4.68	10.45
TARRANT	6,276.29	0.04	6,986.79	0.06	3,230.08	0.02	16,493.16	0.12	150,428.92	0.69	639,656.86	2.94	3.07
COLLIN	7,809.51	0.11	3,324.13	0.17	2,443.60	0.06	13,577.24	0.34	141,763.10	0.65	586,195.17	2.70	3.03
DALLAS	4,133.78	0.21	28,875.11	0.33	4,593.29	0.11	37,602.18	0.65	298,200.99	1.37	673,682.82	3.10	3.75
BEXAR	2,666.05	1.03	382.53	1.93	4,899.34	0.73	7,947.92	3.68	35,532.05	0.16	792,269.44	3.64	7.33
TRAVIS	4,823.27	0.38	22,665.85	0.72	3,598.14	0.27	31,087.26	1.37	232,514.73	1.07	591,931.72	2.72	4.10
DENTON	5,280.95	0.01	3,767.52	0.02	2,417.18	0.01	11,465.64	0.03	108,165.09	0.50	375,238.68	1.73	1.76
WILLIAMSON	3,055.99		1,818.85		1,334.46	0.00	6,209.30	0.00	54,712.70	0.25	236,695.44	1.09	1.09
EL PASO	2,453.45		3,165.18		2,193.61	0.00	7,812.24	0.00	95,186.69	0.44	356,435.41	1.64	1.64
MONTGOMERY	3,982.79		2,280.24		1,063.77	0.00	7,326.79	0.00	55,025.84	0.25	181,183.87	0.83	0.83
GALVESTON	1,738.77	0.33	0.00	0.40	400.91	0.15	2,139.67	0.88	24,360.15	0.11	39,444.62	0.18	1.06
BRAZORIA	1,570.16	0.81	206.89	0.99	487.83	0.38	2,264.88	2.18	22,035.00	0.10	116,348.39	0.54	2.72
COMAL	1,417.37		196.17		331.41	0.00	1,944.95	0.00	18,847.25	0.09	28,305.06	0.13	0.13
ROCKWALL	850.51		0.00		190.45	0.00	1,040.96	0.00	12,508.31	0.06	23,770.19	0.11	0.11
HAYS	1,627.79	0.06	4,152.56	0.12	293.43	0.04	6,073.78	0.22	52,650.77	0.24	67,574.23	0.31	0.53
NUECES	1,150.32	0.95	1,741.60	1.78	644.09	0.67	3,536.02	3.41	11,791.73	0.05	222,548.27	1.02	4.43
FORT BEND	6,333.57	0.45	2,042.85	0.55	1,154.43	0.21	9,530.85	1.22	87,169.84	0.40	216,638.55	1.00	2.21
ELLIS	994.49	0.25	36.19	0.40	294.83	0.13	1,325.51	0.78	15,050.92	0.07	21,775.79	0.10	0.88
JOHNSON	791.70	0.06	0.00	0.10	48.33	0.03	840.03	0.19	11,745.45	0.05	13,803.71	0.06	0.25
GUADALUPE	641.73	0.24	0.00	0.44	67.16	0.17	708.89	0.85	8,003.81	0.04	10,897.04	0.05	0.90
KAUFMAN	353.52	0.50	0.00	0.79	372.70	0.27	726.22	1.56	5,199.14	0.02	14,904.19	0.07	1.63
JEFFERSON	275.05		6.43		75.85	0.00	357.33	0.00	3,933.88	0.02	7,673.47	0.04	0.04
PARKER	314.49	0.00	181.50	0.00	149.83	0.00	645.83	0.00	6,094.52	0.03	20,158.98	0.09	0.09
SMITH	342.06		0.00		217.88	0.00	559.94	0.00	5,759.73	0.03	130,762.96	0.60	0.60
BASTROP	71.13	0.25	9.62	0.47	212.54	0.18	293.29	0.90	2,381.07	0.01	7,922.99	0.04	0.93
CHAMBERS	242.04	0.29	0.00	0.36	158.10	0.14	400.14	0.79	3,357.43	0.02	110,652.08	0.51	1.30
GREGG	223.35		1,002.54		810.97	0.00	2,036.86	0.00	3,528.66	0.02	52,152.31	0.24	0.24
SAN PATRICIO	195.97	0.11	0.00	0.21	71.43	0.08	267.41	0.40	1,979.14	0.01	4,047.00	0.02	0.42
LIBERTY	140.46		0.00		0.00	0.00	140.46	0.00	1,959.11	0.01	1,959.11	0.01	0.01
VICTORIA	103.30	0.16	598.86	0.29	364.61	0.11	1,066.77	0.56	1,459.27	0.01	62,520.22	0.29	0.85
ORANGE	110.05		0.00		13.48	0.00	123.54	0.00	1,539.62	0.01	9,587.26	0.04	0.04
CALDWELL	18.24		9.62		0.56	0.00	28.43	0.00	248.42	0.00	690.60	0.00	0.00
WILSON	29.56		0.00		0.96	0.00	30.53	0.00	368.74	0.00	387.29	0.00	0.00
HARDIN	171.50		3.21		13.92	0.00	188.63	0.00	2,457.78	0.01	13,364.83	0.06	0.06
HARRISON	38.88		0.00		0.00	0.00	38.88	0.00	652.91	0.00	652.91	0.00	0.00
WALLER	3.20		115.35		57.29	0.00	175.85	0.00	68.18	0.00	2,401.30	0.01	0.01
UPSHUR	14.67		0.00		0.00	0.00	14.67	0.00	523.81	0.00	523.81	0.00	0.00
RUSK	0.00	0.00	0.00	0.00	49.07	0.00	49.07	0.00	0.00	0.00	38,439.96	0.18	0.18
HOOD	153.53	0.43	46.53	0.67	67.84	0.23	267.90	1.33	2,659.38	0.01	19,665.55	0.09	1.42
HUNT	79.07	0.66	18.12	1.22	14.43	0.46	111.62	2.34	1,314.40	0.01	9,940.84	0.05	2.39
HENDERSON	65.88	0.06	0.00	0.09	59.64	0.03	125.53	0.18	1,109.39	0.01	2,442.83	0.01	0.19
HIDALGO	2,486.33	0.40	1,514.49	0.75	1,377.65	0.28	5,378.46	1.42	20,173.99	0.09	367,404.97	1.69	3.11
CAMERON	1,053.69	0.47	349.81	0.88	520.91	0.33	1,924.41	1.68	8,462.98	0.04	102,406.12	0.47	2.16
BELL	1,657.68		592.81		1,079.58	0.00	3,330.07	0.00	38,616.53	0.18	246,025.49	1.13	1.13
WEBB	720.14	0.31	1,364.00	0.58	197.47	0.22	2,281.61	1.11	7,425.43	0.03	95,464.61	0.44	1.55
BRAZOS	604.30	0.20	1,420.97	0.32	724.95	0.11	2,750.22	0.63	8,575.80	0.04	49,289.99	0.23	0.86
KENDALL	226.89		0.00		39.97	0.00	266.86	0.00	3,058.12	0.01	11,184.81	0.05	0.05
BURNET	199.58		9.62		165.31	0.00	374.52	0.00	2,767.20	0.01	6,441.53	0.03	0.03
GRAYSON	197.11		494.36		49.72	0.00	741.19	0.00	6,958.69	0.03	31,062.71	0.14	0.14
CORYELL	73.93		24.10		32.20	0.00	130.23	0.00	1,699.67	0.01	5,916.03	0.03	0.03
MIDLAND	739.43		2,941.72		282.55	0.00	3,963.69	0.00	43,962.08	0.20	55,615.23	0.26	0.26
LLANO	129.84	0.30	0.00	0.56	0.38	0.21	130.22	1.07	1,753.94	0.01	1,761.36	0.01	1.08
MAVERICK	53.52		86.69		132.55	0.00	272.76	0.00	550.36	0.00	3,576.30	0.02	0.02
MCMULLEN	0.00		0.00		3.80	0.00	3.80	0.00	0.00	0.00	2,977.33	0.01	0.01
ARANSAS	104.82		0.00		19.76	0.00	124.58	0.00	1,058.61	0.00	11,292.09	0.05	0.05
WICHITA	116.02	0.01	314.98	0.02	136.43	0.01	567.43	0.05	5,954.02	0.03	11,212.29	0.05	0.10
TAYLOR	280.37		5.37		87.98	0.00	373.72	0.00	5,537.05	0.03	13,882.26	0.06	0.06
TOM GREEN	332.31		522.51		106.94	0.00	961.76	0.00	10,410.49	0.05	34,620.90	0.16	0.16
MCLENNAN	544.25	0.48	156.64	0.75	384.11	0.25	1,084.99	1.48	12,311.52	0.06	61,094.26	0.28	1.76
MCCULLOCH	1.02		0.00		0.00	0.00	1.02	0.00	17.46	0.00	17.46	0.00	0.00
WISE	73.46	0.09	0.00	0.13	8.02	0.05	81.48	0.27	1,080.34	0.00	1,293.82	0.01	0.27
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	38.26		3.92		15.77	0.00	57.95	0.00	500.58	0.00	12,852.07	0.06	0.06
ECTOR	725.29	0.23	1,540.90	0.43	188.70	0.16	2,454.88	0.82	29,646.78	0.14	45,294.40	0.21	1.03
WHARTON	122.78	0.16	0.00	0.29	10.12	0.11	132.90	0.56	1,625.19	0.01	2,026.55	0.01	0.57
KERR	54.72		0.00		0.00	0.00	54.72	0.00	739.26	0.00	739.26	0.00	0.00
PRESIDIO	9.17		0.00		0.00	0.00	9.17	0.00	157.15	0.00	157.15	0.00	0.00
JIM WELLS	26.43		0.00		15.57	0.00	42.01	0.00	266.95	0.00	10,630.80	0.05	0.05
CALHOUN	84.68	0.07	164.60	0.13	17.01	0.05	266.29	0.25	1,146.07	0.01	2,058.25	0.01	0.26
GILLESPIE	43.99		0.00		14.19	0.00	58.18	0.00	594.31	0.00	2,621.81	0.01	0.01
MATAGORDA	93.14		0.00		87.45	0.00	180.60	0.00	1,232.91	0.01	69,740.94	0.32	0.32
NAVARRO	19.60		0.00		35.55	0.00	55.14	0.00	388.82	0.00	1,323.61	0.01	0.01
ANGELINA	50.57		11.47		2.81	0.00	64.85	0.00	918.44	0.00	991.10	0.00	0.00
NACOGDOCHES	28.10		3.28		18.18	0.00	49.55	0.00	509.32	0.00	14,747.43	0.07	0.07
FANNIN	17.19	0.00	46.59	0.00	8.47	0.00	72.25	0.00	635.36	0.00	2,248.38	0.01	0.01
ATASCOSA	47.52		7.81		46.23	0.00	101.56	0.00	695.80	0.00	6,109.49	0.03	0.03
WASHINGTON	36.82		0.00		26.34	0.00	63.16	0.00	504.23	0.00	21,139.18	0.10	0.10
LAMAR	29.83	0.34	0.00	0.53	0.00	0.18	29.83	1.05	531.90	0.00	531.90	0.00	1.05
VAN ZANDT	3.44		0.00		2.45	0.00	5.89	0.00	50.64	0.00	172.78	0.00	0.00
WILLACY	44.47		0.00		0.00	0.00	44.47	0.00	352.77	0.00	352.77	0.00	0.00
BROWN	51.66		91.57		14.43	0.00	157.67	0.00	1,909.57	0.01	2,293.83	0.01	0.01
ERATH	25.85		893.76		33.31	0.00	952.92	0.00	9,346.16	0.04	24,937.87	0.11	0.11
AUSTIN	24.01		0.00		0.00	0.00	24.01	0.00	328.85	0.00	328.85	0.00	0.00
COOKE	43.55		0.00		0.00	0.00	43.55	0.00	642.08	0.00	642.08	0.00	0.00
MEDINA	13.91		3.92		5.64	0.00	23.48	0.00	196.91	0.00	4,618.69	0.02	0.02
TITUS	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
UVALDE	20.87		7.85		4.14	0.00	32.86	0.00	307.06	0.00	3,549.70	0.02	0.02
FAYETTE	4.80	0.40	0.00	0.71	224.08	0.26	228.89	1.37	65.77	0.00	19,586.90	0.09	1.46
CALLAHAN	7.95		32.21		0.00	0.00	40.16	0.00	474.15	0.00	474.15	0.00	0.00
HOPKINS	13.77		0.00		0.00	0.00	13.77	0.00	202.56	0.00	202.56	0.00	0.00
LAMPASAS	151.43		0.00		20.04	0.00	171.47	0.00	0.00	0.00	3,893.69	0.02	0.02
BLANCO	3.22		211.72		0.00	0.00	214.94	0.00	1,606.75	0.01	1,606.75	0.01	0.01
FREESTONE	1.78	0.40	0.00	0.63	3.36	0.21	5.14	1.24	35.35	0.00	109.50	0.00	1.25
GRIMES	15.21	0.00	0.00	0.00	1.51	0.00	16.71	0.00	208.27	0.00	1,387.41	0.01	0.01
LEE	12.88		0.00		0.00	0.00	12.88	0.00	175.35	0.00	175.35	0.00	0.00
SOMERVELL	6.87		0.00		0.00	0.00	6.87	0.00	101.99	0.00	101.99	0.00	0.00
ANDREWS	58.59	0.00	0.00	0.01	84.83	0.00	143.42	0.01	1,147.45	0.01	11,021.37	0.05	0.06
BORDEN	15.71		0.00		6.53	0.00	22.24	0.00	1,130.12	0.01	1,303.95	0.01	0.01

Table 28: 2013 Annual NOx Reductions from New Residential and Commercial Constructions (Continued)

	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
County	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)
CHEROKEE	10.44	0.23	3.28	0.36	27.46	0.12	41.17	0.72	189.79	0.00	14,504.16	0.07	0.78
DIMMIT	4.72		0.00		17.08	0.00	21.80	0.00	47.79	0.00	2,044.37	0.01	0.01
FALLS	9.80		0.00		0.00	0.00	9.80	0.00	194.41	0.00	194.41	0.00	0.00
COLORADO	7.20		0.00		0.00	0.00	7.20	0.00	98.65	0.00	98.65	0.00	0.00
FRIO	10.30	0.00	0.00	0.00	0.00	0.00	10.30	0.00	139.77	0.00	139.77	0.00	0.00
MILAM	3.72	0.09	137.08	0.18	14.44	0.07	155.24	0.34	81.00	0.00	855.46	0.00	0.34
JACKSON	12.70		0.00		2.21	0.00	14.91	0.00	168.12	0.00	210.78	0.00	0.00
ANDERSON	3.21		3.28		0.00	0.00	6.49	0.00	59.08	0.00	59.08	0.00	0.00
HILL	8.91		0.00		49.75	0.00	58.65	0.00	176.74	0.00	29,773.64	0.14	0.14
CULBERSON	11.09		0.00		0.00	0.00	11.09	0.00	317.49	0.00	317.49	0.00	0.00
MASON	7.51		0.00		0.00	0.00	7.51	0.00	101.47	0.00	101.47	0.00	0.00
PECOS	7.14	0.00	0.00	0.00	9.37	0.00	16.51	0.01	122.23	0.00	1,907.31	0.01	0.02
RAINS	2.30		0.00		0.00	0.00	2.30	0.00	33.76	0.00	33.76	0.00	0.00
LAVACA	3.30		0.00		25.72	0.00	29.03	0.00	44.87	0.00	3,593.96	0.02	0.02
PALO PINTO	10.94	0.31	0.00	0.48	13.15	0.16	24.09	0.94	213.91	0.00	918.94	0.00	0.95
KIMBLE	2.04		0.00		0.00	0.00	2.04	0.00	34.92	0.00	34.92	0.00	0.00
MADISON	8.00		6.69		0.00	0.00	14.69	0.00	111.03	0.00	111.03	0.00	0.00
ARCHER	6.45		0.00		44.74	0.00	51.19	0.00	144.37	0.00	35,194.31	0.16	0.16
REFUGIO	2.54		0.00		14.09	0.00	16.63	0.00	33.62	0.00	408.73	0.00	0.00
LIMESTONE	1.78	0.00	0.00	0.00	0.00	0.00	1.78	0.00	35.35	0.00	35.35	0.00	0.00
CLAY	1.07		0.00		0.00	0.00	1.07	0.00	24.06	0.00	24.06	0.00	0.00
BEE	1.69		0.00		27.64	0.00	29.33	0.00	22.42	0.00	11,980.90	0.06	0.06
MARTIN	1.01		0.00		0.00	0.00	1.01	0.00	19.78	0.00	19.78	0.00	0.00
GONZALES	13.04		0.00		209.03	0.00	222.08	0.00	162.68	0.00	5,692.94	0.03	0.03
BURLESON	7.20		3.34		0.00	0.00	10.55	0.00	99.36	0.00	99.36	0.00	0.00
KARNES	55.72		21.01		16.88	0.00	93.61	0.00	759.41	0.00	3,745.52	0.02	0.02
KLEBERG	33.07		743.49		0.75	0.00	777.32	0.00	452.84	0.00	1,042.41	0.00	0.00
BREWSTER	4.08		20.90		0.00	0.00	24.98	0.00	258.57	0.00	258.57	0.00	0.00
WINKLER	0.00		0.00		26.34	0.00	26.34	0.00	0.00	0.00	20,634.95	0.09	0.09
FRANKLIN	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
YOUNG	35.79	0.60	0.00	0.94	0.00	0.32	35.79	1.86	700.08	0.00	700.08	0.00	1.86
HOUSTON	4.82		0.00		0.00	0.00	4.82	0.00	87.14	0.00	87.14	0.00	0.00
SCURRY	3.31		5.91		218.17	0.00	227.39	0.00	317.26	0.00	6,071.46	0.03	0.03
BOSQUE	2.67	0.19	0.00	0.29	4.33	0.10	7.00	0.58	53.02	0.00	3,443.05	0.02	0.60
COMANCHE	0.00		115.67		5.38	0.00	121.05	0.00	1,117.27	0.01	1,260.61	0.01	0.01
BRISCOE	8.83		0.00		0.00	0.00	8.83	0.00	270.66	0.00	270.66	0.00	0.00
CONCHO	1.02		0.00		9.51	0.00	10.53	0.00	17.46	0.00	270.58	0.00	0.00
ZAVALA	11.02		0.00		9.51	0.00	20.53	0.00	111.52	0.00	364.64	0.00	0.00
NOLAN	0.99	0.03	0.00	0.06	0.00	0.02	0.99	0.11	19.45	0.00	19.45	0.00	0.11
BROOKS	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROBERTSON	48.02	0.30	0.00	0.54	30.48	0.20	78.50	1.04	657.69	0.00	24,535.28	0.11	1.16
LIVE OAK	13.67		0.00		22.58	0.00	36.25	0.00	138.08	0.00	17,825.18	0.08	0.08
HAMILTON	0.89		0.00		0.00	0.00	0.89	0.00	17.67	0.00	17.67	0.00	0.00
JONES	1.99		0.00		11.40	0.00	13.39	0.00	38.89	0.00	1,082.85	0.00	0.00
REAGAN	5.02		10.78		0.00	0.00	15.79	0.00	209.46	0.00	209.46	0.00	0.00
WARD	7.07	0.23	64.65	0.40	1.88	0.14	73.61	0.76	786.41	0.00	2,260.33	0.01	0.77
RED RIVER	6.82		0.00		0.00	0.00	6.82	0.00	121.58	0.00	121.58	0.00	0.00
HASKELL	1.99		0.00		0.00	0.00	1.99	0.00	38.89	0.00	38.89	0.00	0.00
HOWARD	43.44	0.15	0.00	0.26	9.51	0.09	52.94	0.50	850.69	0.00	1,103.81	0.01	0.51
SAN SABA	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JACK	2.98	0.26	0.00	0.41	0.00	0.14	2.98	0.80	58.34	0.00	58.34	0.00	0.80
STEPHENS	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RUNNELS	1.02		0.00		0.00	0.00	1.02	0.00	17.46	0.00	17.46	0.00	0.00
REEVES	3.03		0.00		18.62	0.00	21.65	0.00	59.35	0.00	1,727.33	0.01	0.01
DE WITT	4.23		0.00		47.70	0.00	51.94	0.00	56.04	0.00	13,489.99	0.06	0.06
CHILDRESS	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CROSBY	5.79		0.00		0.00	0.00	5.79	0.00	416.36	0.00	416.36	0.00	0.00
DAWSON	8.32		0.00		0.00	0.00	8.32	0.00	584.09	0.00	584.09	0.00	0.00
MITCHELL	0.00	0.04	0.00	0.06	0.00	0.02	0.00	0.12	0.00	0.00	0.00	0.00	0.12
WILBARGER	1.07	1.52	0.00	2.37	0.00	0.81	1.07	4.70	24.06	0.00	24.06	0.00	4.70
COLEMAN	1.98		0.00		0.00	0.00	1.98	0.00	38.89	0.00	38.89	0.00	0.00
UPTON	1.00	0.00	0.00	0.01	0.00	0.00	1.00	0.01	20.11	0.00	20.11	0.00	0.01
COKE	0.00	0.00	0.00	0.00	9.51	0.00	9.51	0.00	0.00	0.00	253.12	0.00	0.00
CROCKETT	19.37		0.00		0.00	0.00	19.37	0.00	331.77	0.00	331.77	0.00	0.00
HARDEMAN	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BANDERA	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	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	9.03		0.00		8.04	0.00	17.07	0.00	180.95	0.00	1,790.82	0.01	0.01
DELTA	2.30		0.00		0.46	0.00	2.75	0.00	33.76	0.00	42.57	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		9.62	0.00	9.62	0.00	0.00	0.00	256.17	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	1.69		0.00		0.00	0.00	1.69	0.00	22.42	0.00	22.42	0.00	0.00
HALL	6.31		0.00		0.00	0.00	6.31	0.00	193.33	0.00	193.33	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		9.39	0.00	9.39	0.00	0.00	0.00	250.07	0.00	0.00
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	0.87		0.00		0.00	0.00	0.87	0.00	10.85	0.00	10.85	0.00	0.00
KNOX	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LA SALLE	7.87		30.82		22.27	0.00	60.96	0.00	82.75	0.00	3,142.48	0.01	0.01
LEON	0.00		0.00		9.16	0.00	9.16	0.00	0.00	0.00	243.97	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		21.79	0.00	21.79	0.00	0.00	0.00	17,068.05	0.08	0.08
MONTAGUE	5.73		0.00		12.89	0.00	18.62	0.00	84.48	0.00	333.01	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		9.62	0.00	9.62	0.00	0.00	0.00	256.17	0.00	0.00
SCHLEICHER	1.02		0.00		0.00	0.00	1.02	0.00	17.46	0.00	17.46	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	0.97		0.00		53.66	0.00	54.63	0.00	7.67	0.00	26,097.19	0.12	0.12
STERLING	0.00		0.00		9.51	0.00	9.51	0.00	0.00	0.00	253.12	0.00	0.00
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	**86,215.75**	**17.34**	**121,043.02**	**27.83**	**47,590.09**	**10.10**	**254,848.85**	**55.27**	**1,924,113.53**	**8.85**	**8,365,345.55**	**38.48**	**93.75**



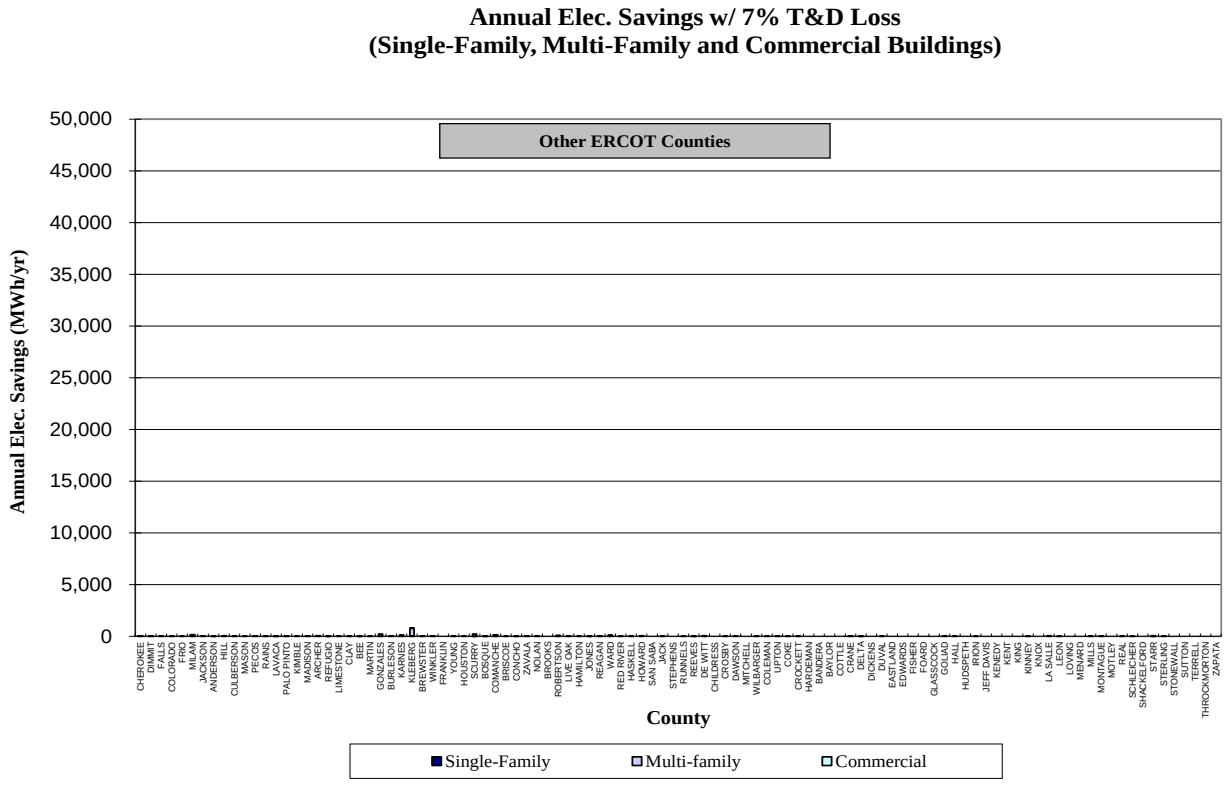


Figure 17: 2013 Annual Electricity Savings by County from New Residential and Commercial Constructions

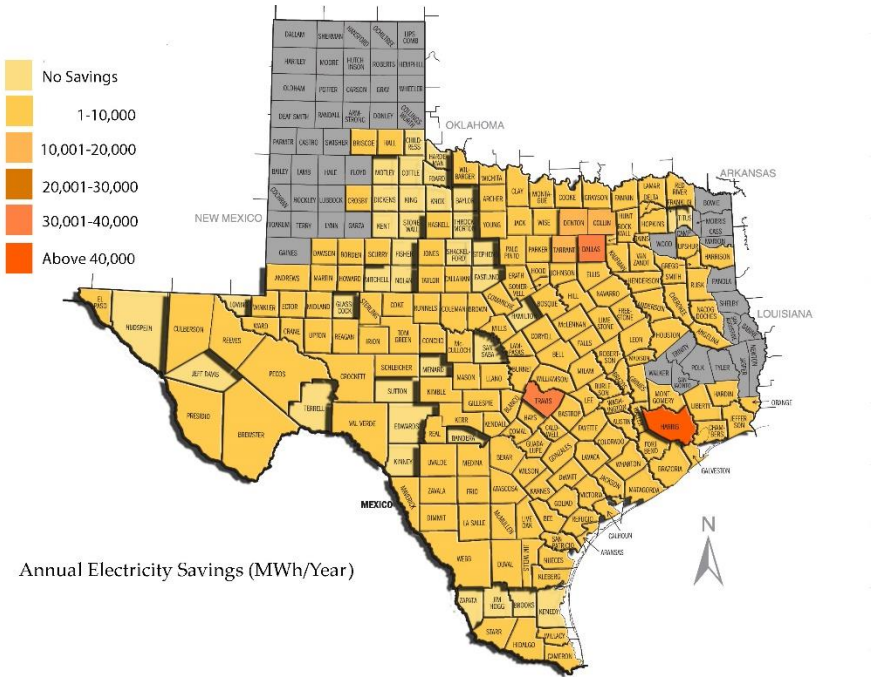
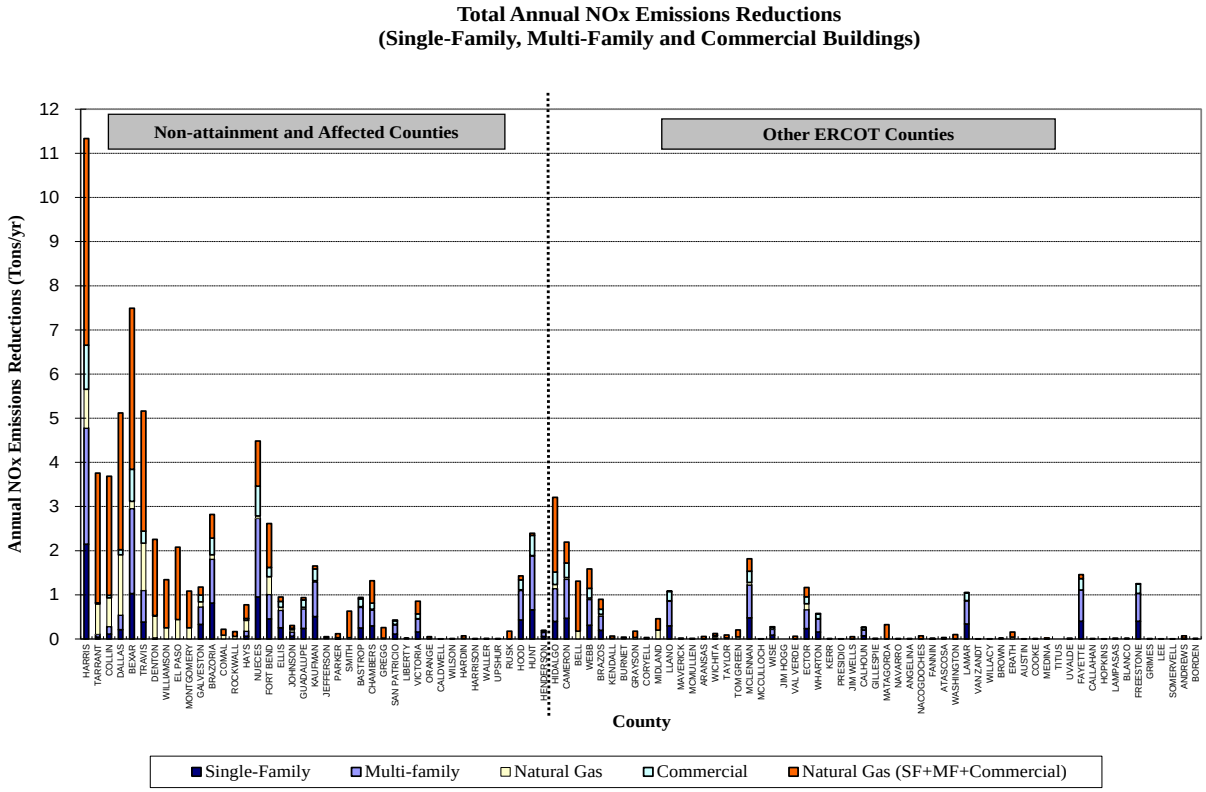


Figure 18: Map of 2013 Annual Electricity Savings by County from New Residential and Commercial Constructions



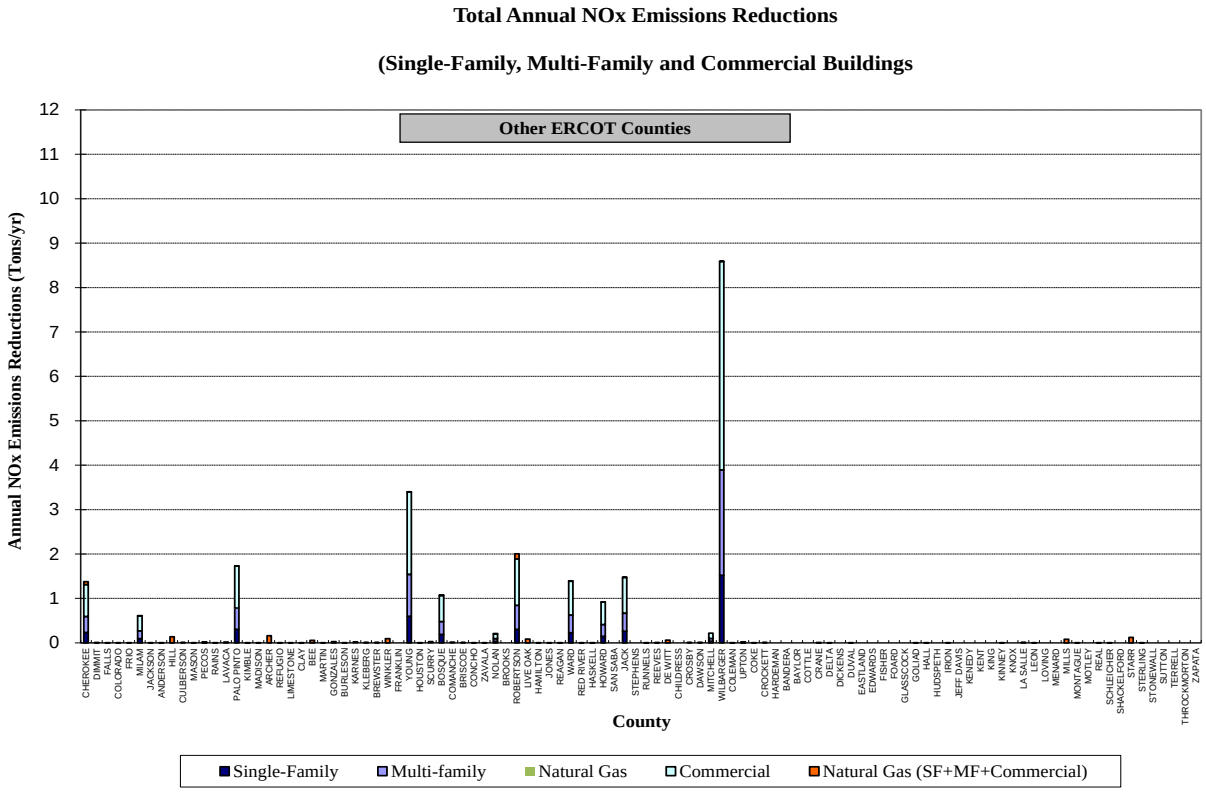


Figure 19: 2013 Annual NOx Reductions by County from New Residential and Commercial Constructions

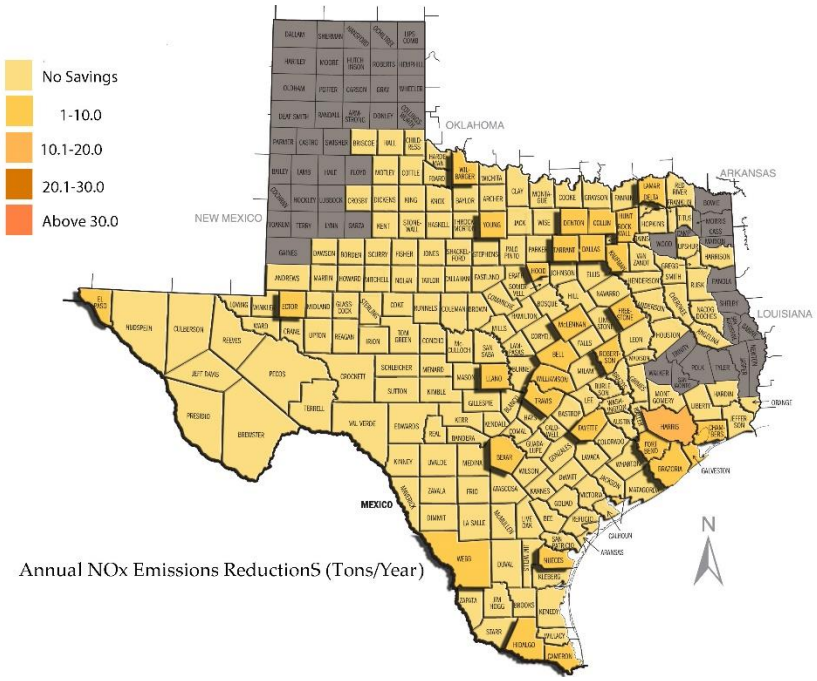


Figure 20: Map of 2013 Annual NOx Reductions by County from New Residential and Commercial Constructions

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 2020 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 2010 from the US Environmental Protection Agency (US EPA) eGRID database, which had been specially prepared for this purpose. The different programs included in this 2013 integrated analysis are:

- ESL Single-family new construction
- ESL Multi-family new construction
- ESL Commercial new construction
- PUC Senate Bill 7 Program
- SECO Senate Bill 5 Program
- Electricity generated by wind farms in Texas (ERCOT)[27]
- SEER 13 upgrades to Single-family and Multi-family residences

The Laboratory's single-family and multi-family programs include the energy savings attained by constructing new residences in Texas. The baseline to estimate energy savings uses the published data on residential construction characteristics by the 2008 National Association of Home Builders (NAHB 2008) based on the IECC 2006 building code (ICC 2006). Annual electricity savings (MWh) are obtained from the Laboratory's Annual Reports to the TCEQ (Haberl et al., 2002 - 2013).

The Laboratory's commercial program includes the energy savings attained by constructing new commercial buildings in Texas, including office, apartment, healthcare, education, retail, food and lodging as defined by Dodge building type (Dodge 2011). Energy savings were estimated from code compliant buildings (ASHRAE Standard 90.1-2007) against pre-code buildings (ASHRAE Standard 90.1-2004) using EUI in the USDOE report and constructed square footage in Dodge data (Dodge 2014).

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 2013.

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 2013 reporting year SECO submitted annual energy savings values for projects funded by SECO and by Energy Service projects.

The *Electric Reliability Council of Texas (ERCOT) electricity production from currently installed green power generation (wind)* in Texas is reported. Actual measured electricity productions for 2001 through 2013 were included. For projections to 2020, the annual growth factor was estimated using the last five years installed wind power capacity.

[27] ERCOT is the Electric Reliability Council of Texas.

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 Day (OSD) NOx emissions reductions were calculated for 2013 and integrated from 2009 to 2020 using several factors to discount the potential savings. These factors include an annual degradation factor, a transmission and distribution factor, a discount factor, and growth factors, as shown in Table 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 wind, an annual degradation factor of 2% was used for ESL Single-family, Multi-family, and Commercial programs and an annual degradation factor of 5% was used for all other programs[28]. The value of the 5% degradation factor was taken from a study by Kats et al. (1996).

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

Initial discount factor: This factor was used to discount the reported savings for any inaccuracies in the assumptions and methods employed in the calculation procedures. For the Laboratory's single, multi-family and commercial program, the discount factor was assumed to be 20%. For PUC's Senate Bill 7 program and electricity from wind, the discount factor was taken as 10%. For the savings in the SECO program, the discount factor was 60%. 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 (3.3%), multi-family residential (1.5%), and commercial (3.3%) construction are projections based on the average growth rate for these housing types from recent U.S. Census data for Texas. Growth factor for wind energy (3.9%) is a linear projection based on the installed wind power capacity for 2009 through 2012 from the Public Utility Commission of Texas. No growth was assumed for PUC programs, SECO, and SEER 13 entries.

Figure 21 shows the overall information flow that was used to calculate the NOx emissions savings from the annual and OSD electricity savings (MWh) from all programs. For the Laboratory's single-family and multi-family code-implementation programs, the annual and OSD were calculated from DOE-2 hourly simulation models[29]. The base case is taken as the average characteristics of single- and multi-family residences for Texas published by the National Association of Home Builders for 2008 (NAHB 2008). The annual electricity savings from PUC's energy efficiency programs were calculated using PUC approved demand savings calculations or tables or industry accepted measurement and verification methods (PUC 2014). The OSD consumption is the average daily consumption for the period between July 15 and September 15.

[28] A degradation of 5% per year would accumulate as a 5%, 10%, 15%...etc, degradation in performance. Although the assumption of this high level of degradation may not actually occur, it was chosen as a conservative estimate. For wind energy, a degradation factor of 0% was used. The choice of a 0% degradation factor for wind is based on two year's of analysis of measured wind data from all Texas wind farms that shows no degradation, on average, for a two year period after the wind farms became operational.

[29] 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.

The SECO electricity savings were submitted as annual savings by project[30]. A description of the measures completed for the project was also submitted for information purposes. The electricity production from wind farms in Texas was from the actual on-site metered data measured at 15-minute intervals.

Integration of the savings from the different programs into a uniform format allowed for creditable NOx emissions to be evaluated using different criteria as shown in Table 29. These include evaluation across programs, evaluation across individual counties by program, evaluation by SIP area, evaluation for all ERCOT counties except Houston/Galveston, and evaluation within a 200 km radius of Dallas/Ft.Worth.

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 based on the 2010 eGrid database which is using the four different Congestion Management (CM) zones: Houston, North, West, and South. This report calculates the OSD emissions reductions by dividing the annual emissions reductions with 365 since the 2010 eGrid estimates the annual emissions only. However, the OSD emissions reductions from the Electricity Generated by Wind Farms were estimated by actual measured data.

ESL Single-family and Multi-family. The calculation of the annual electricity savings reported for the years 2002 through 2013 included the savings from code-compliant new housing in all 41 non-attainment and affected counties as reported in the Laboratory's annual report submitted by the Laboratory to the Texas Commission of Environmental Quality (TCEQ). From 2009 to 2013, based on year 2008, the annual electricity savings were calculated for new residential construction in all the counties in ERCOT region, which includes the 41 non-attainment and affected counties. These savings were then tabulated by county and program. Using the calculated values through 2013, savings were then projected to 2020 by incorporating the different adjustment factors mentioned above.

In these calculations, it was assumed that the same amount of electricity savings from the code-complaint construction would be achieved for each year after 2013 through 2020[31]. The projected energy savings through 2020, according to county, were then divided into the CM zones in the 2010 eGRID. To determine which CM zone was to be used, or in counties with multiple CM zone, the allocation to each CM zone by county was obtained from CM zone's listing published in the Laboratory's 2010 annual report[32].

For the 2013 annual NOx emissions calculations, the US EPA's 2010 eGRID were used. An example of the eGRID spreadsheet[33] is given in the Table 30. The total electricity savings for each CM 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 2013 for commercial buildings were obtained from the annual reports for 2004 through 2013 submitted by the Laboratory to TCEQ[34]. From 2009 to 2013, based on year 2008, the annual electricity savings were also calculated for new commercial construction by county[35]. Using the calculated savings through 2013, savings were then projected to 2020 by incorporating the different adjustment factors mentioned above[36]. In the projected annual electricity savings, it was assumed that the same 2013 amount of electricity savings would be achieved for each year through 2020. Similarly to the single

[30] 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.
[31] This would include the appropriate discount and degradation factors for each year.
[32] Haberl et al., 2010, pp. 265.
[33] To use this spreadsheet electricity savings for each eGrid zone is entered in the bottom row of the spreadsheet (MWh). The spreadsheet then allocates the MWh of electricity savings according to the counties (blue columns) where the CM zone owned and operated a power plant. Totals for all CM zones are then listed on the far right columns (white columns). Similar spreadsheets for the 2010 eGRID exist for SOx and CO2.
[34] These savings include new construction in office, education, retail, food, lodging and warehouse construction as defined by Dodge building type (Dodge 2011), using energy savings from the US DOE's report (USDOE 2011), and data from CBECS (1995 - 2003) and Dodge (2014).
[35] The 2013 report included updated savings for the years of 2012 and 2013.
[36] This also includes the appropriate discount and degradation factors for each year.

family calculations, the projected energy saving numbers through 2020, by county, were allocated into the appropriate CM zones.

PUC-Senate Bill 7. For the PUC Senate Bill 7 program savings, the annual electricity savings for 2001 through 2013 were obtained from the Public Utility Commission of Texas. Using these values savings were projected through 2020 by incorporating the different adjustment factors mentioned above. Similar savings were assumed for each year after 2013 until 2020. The 2010 annual eGRID was also used to calculate the NOx emissions savings for the PUC-Senate Bill 7 program. The total electricity savings for each CM 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 39 counties through 2013 were obtained from the State Energy Conservation Office (SECO). Using the reported consumption, the annual and OSD electricity savings resulted from energy conservation projects were then calculated. To achieve this, the annual energy use intensity (EUI) for each county was estimated and the county's energy savings for each year against the baseline year of 2008 were then calculated[37]. In addition, the savings through 2020 were projected using the different adjustment factors mentioned above. In a similar fashion to the previous programs, it was assumed that the same amount of electricity savings will be achieved for each year through 2020. The 2010 annual eGRID was also used to calculate the NOx emissions savings for the SECO program.

Electricity Generated by Wind Farms. The measured electricity production from all the wind farms in Texas for 2001 through 2013 was obtained from the Energy Reliability Council of Texas (ERCOT). To obtain the annual production, the 15-minute data were summed for the 12 months. Using the reported numbers for 2013, savings through 2020 were projected incorporating the different adjustment factors mentioned above. The 2010 annual eGRID was then used to calculate the NOx emissions reductions for the electricity generated by Texas' wind farms[38]. The total electricity savings for each CM 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 OSD electricity savings from the replacement of the air conditioning units by air conditioners with an efficiency of SEER 13 in existing residences needed to be calculated.

In the 2013 report to the TCEQ, the annual and OSD electricity savings for all the counties in ERCOT region as well as the 41 non-attainment and affected counties were calculated. Using the numbers for 2006, the savings after 2006 until 2020 were projected by incorporating the appropriate adjustment factors[39]. 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. The total electricity savings for each CM zone were used to calculate the NOx emissions reductions for each of the different county using the emissions factors contained in the 2010 eGRID. Integrated NOx emissions reductions for each county by SIP area were also calculated.

[37] In the 2013 report, EUI values were used to calculate the electricity savings. This calculation method was also applied to savings estimation for the previous years from 2009 to 2012.
[38] This credited the electricity generated by the wind farm to the utility that either owned the wind farm or was associated with the wind farm owner.
[39] Additional details about this calculation are contained in the Laboratory's 2006 Annual Report to the TCEQ, available at the Senate Bill 5 web site "eslsb5.tamu.edu".

5.4 Results

The total integrated annual and OSD electricity savings for all the different programs in the integrated format were calculated for 2009 through 2020 as shown in Table 31, using the adjustment factors shown in Table 29. Annual and OSD 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 2013, the total integrated annual savings from all programs are 19,704,209 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction are 704,919 MWh/year (3.6% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program are 2,267,414 MWh/year (11.5%),
- Savings from SECO's Senate Bill 5 program are 705,060 MWh/year (3.6%),
- Electricity savings from green power purchases (wind) are 15,723,534 MWh/year (79.8%), and
- Savings from residential air conditioner retrofits[40] are 303,282 MWh/year (1.5%).

In 2013, the total integrated OSD savings from all programs are 45,262 MWh/day, which would be a 1,886 MW average hourly load reduction during the OSD period. The integrated OSD electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction are 2,407 MWh/day (5.3%),
- Savings from the PUC's Senate Bill 7 programs are 6,212 MWh/day (13.7%),
- Savings from SECO's Senate Bill 5 program are 1,932 MWh/day (4.3%),
- Electricity savings from green power purchases (wind) are 32,560 MWh/day (71.9%), and
- Savings from residential air conditioner retrofits are 2,151 MWh/day (4.8%).

By 2015, the total integrated annual savings from all programs will be 22,508,426 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction will be 1,111,655 MWh/year (4.9% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program will be 3,075,280 MWh/year (13.7%),
- Savings from SECO's Senate Bill 5 program will be 1,069,420 MWh/year (4.8%),
- Electricity savings from green power purchases (wind) will be 16,978,360 MWh/year (75.4%), and
- Savings from residential air conditioner retrofits will be 273,712 MWh/year (1.2%).

By 2015, the total integrated OSD savings from all programs will be 51,958 MWh/day, which would be a 2,165 MW average hourly load reduction during the OSD period. The integrated OSD electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction will be 3,503 MWh/day (6.7%),
- Savings from the PUC's Senate Bill 7 programs will be 8,425 MWh/day (16.2%),
- Savings from SECO's Senate Bill 5 program will be 2,930 MWh/day (5.6%),
- Electricity savings from green power purchases (wind) will be 35,158 MWh/day (67.7%), and
- Savings from residential air conditioner retrofits will be 1,941 MWh/day (3.7%).

In 2013, the total integrated annual NOx emissions reductions from all programs are 5,397 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 177 tons-NOx/year (3.3% of the total NOx savings),
- NOx emissions reductions from the PUC's Senate Bill 7 programs are 567 tons-NOx/year (10.5%),
- NOx emissions reductions from SECO's Senate Bill 5 program are 183 tons-NOx/year (3.4%),
- NOx emissions reductions from green power purchases (wind) are 4,399 tons-NOx/year (81.5%), and
- NOx emissions reductions from residential air conditioner retrofits are 71 tons-NOx/year (1.3%).

[40] 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 2013, the total integrated OSD NOx emissions reductions from all programs are 12.22 tons-NOx/day. The integrated OSD NOx emissions reductions from all the different programs are:

- NOx emissions reductions from code-compliant residential and commercial construction are 0.60 tons-NOx/day (4.9%),
- NOx emissions reductions from the PUC's Senate Bill 7 programs are 1.55 tons-NOx/day (12.7%),
- NOx emissions reductions from SECO's Senate Bill 5 program are 0.50 tons-NOx/day (4.1%),
- NOx emissions reductions from green power purchases (wind) are 9.06 tons-NOx/day (74.1%), and
- NOx emissions reductions from residential air conditioner retrofits are 0.50 tons-NOx/day (4.1%).

By 2015, the total integrated annual NOx emissions reductions from all programs will be 6,133 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 279 tons-NOx/year (4.6% of the total NOx savings),
- NOx emissions reductions from the PUC's Senate Bill 7 programs will be 766 tons-NOx/year (12.5%),
- NOx emissions reductions from SECO's Senate Bill 5 program will be 274 tons-NOx/year (4.5%),
- NOx emissions reductions from green power purchases (wind) will be 4,750 tons-NOx/year (77.4%), and
- NOx emissions reductions from residential air conditioner retrofits will be 64 tons-NOx/year (1.0%).

By 2015, the total integrated OSD NOx emissions reductions from all programs will be 13.96 tons-NOx/day. The integrated OSD NOx emissions reductions from all the different programs are:

- NOx emissions reductions from code-compliant residential and commercial construction will be 0.88 tons-NOx/day (6.3%),
- NOx emissions reductions from the PUC's Senate Bill 7 programs will be 2.10 tons-NOx/day (15.0%),
- NOx emissions reductions from SECO's Senate Bill 5 program will be 0.75 tons-NOx/day (5.4%),
- NOx emissions reductions from green power purchases (wind) will be 9.78 tons-NOx/day (70.1%), and
- NOx emissions reductions from residential air conditioner retrofits will be 0.45 tons-NOx/day (3.2%).

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

	ESL-Single Family	ESL-Multi Family	ESL-Commercial	PUC (SB7)	SECO	Wind-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%	10.0%	20.0%	20.0%
Growth Factor	3.3%	1.5%	3.3%	0.0%	0.0%	3.9%	N.A.	N.A.
Weather Normalized	Yes	Yes	Yes	No	No	No[1]	Yes	Yes

Note 1. For Wind-ERCOT, the OSD energy consumption is the average daily consumption of the measured data in the months of July, August and September.

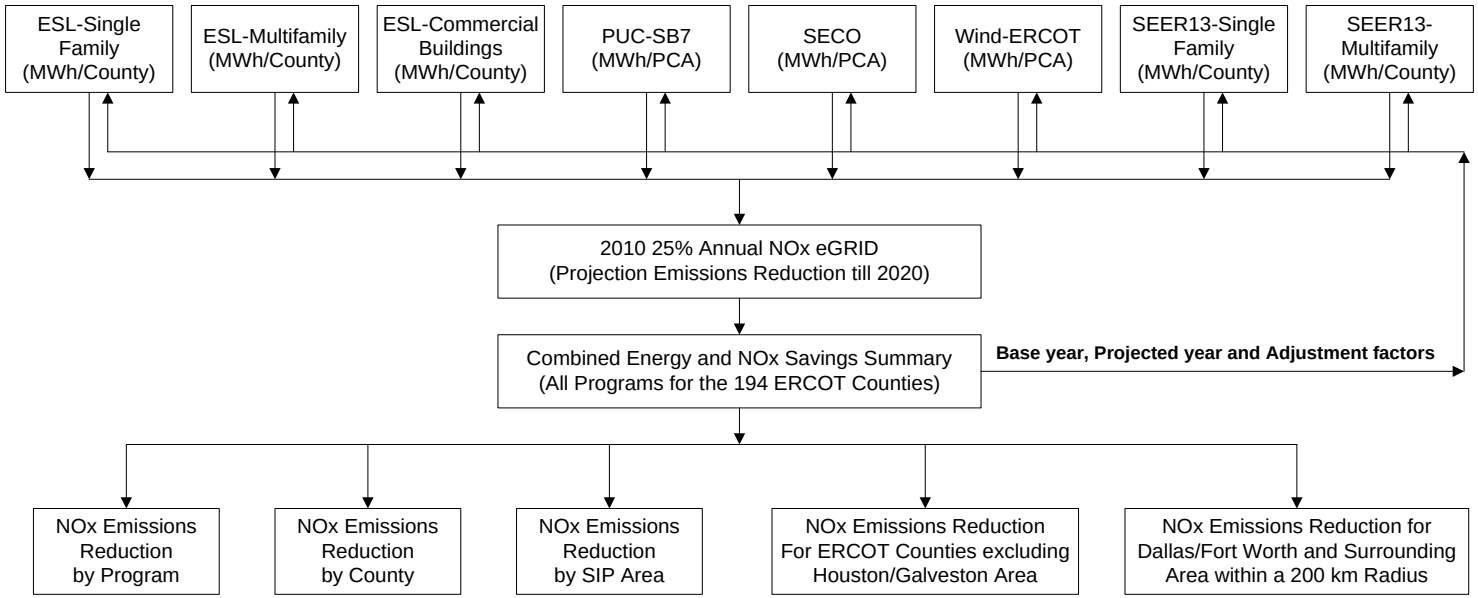


Figure 21: Process Flow Diagram of the NOx Emissions Reduction Calculations

Table 30: Example of NOx Emissions Reduction Calculations using 2010 eGRID

Area	County	CM Zones								Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
		H		N		W		S			
Houston-Galveston Area	Brazoria	0.0562032	347.6943	0.0000071	0.0710	0.0000003	0.0002	0.0005265	3.8055	351.57	0.18
	Chambers	0.0204500	126.5115	0.0000026	0.0258	0.0000001	0.0001	0.0001916	1.3847	127.92	0.06
	Fort Bend	0.0313463	193.9202	0.0000040	0.0396	0.0000002	0.0001	0.0002937	2.1224	196.08	0.10
	Galveston	0.0226620	140.1955	0.0000029	0.0286	0.0000001	0.0001	0.0002123	1.5344	141.76	0.07
	Harris	0.1486911	919.8596	0.0000189	0.1877	0.0000009	0.0006	0.0013930	10.0678	930.12	0.47
	Liberty	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Montgomery	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	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	0.0012932	8.0000	0.0079329	78.9444	0.0003832	0.2345	0.0000809	0.5849	87.76	0.04
	Dallas	0.0024826	15.3584	0.0152295	151.5565	0.0007356	0.4503	0.0001554	1.1230	168.49	0.08
	Denton	0.0001267	0.7836	0.0007770	7.7325	0.0000375	0.0230	0.0000079	0.0573	8.60	0.00
	Tarrant	0.0004742	2.9335	0.0029089	28.9476	0.0001405	0.0860	0.0000297	0.2145	32.18	0.02
	Ellis	0.0029920	18.5096	0.0183544	182.6530	0.0008865	0.5426	0.0001873	1.3534	203.06	0.10
	Johnson	0.0007256	4.4888	0.0044512	44.2958	0.0002150	0.1316	0.0000454	0.3282	49.24	0.02
	Kaufman	0.0059718	36.9441	0.0366343	364.5651	0.0017695	1.0831	0.0003738	2.7012	405.29	0.20
	Parker	0.0000012	0.0076	0.0000075	0.0751	0.0000004	0.0002	0.0000001	0.0006	0.08	0.00
	Rockwall	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Henderson	0.0006908	4.2734	0.0042376	42.1700	0.0002047	0.1253	0.0000432	0.3125	46.88	0.02
	Hood	0.0050771	31.4088	0.0311454	309.9429	0.0015044	0.9208	0.0003178	2.2965	344.57	0.17
	Hunt	0.0088463	54.7268	0.0047066	46.8380	0.0002273	0.1391	0.0652823	471.8144	573.52	0.29
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	0.0138906	85.9325	0.0009368	9.3227	0.0000452	0.0277	0.1109355	801.7639	897.05	0.45
	Comal	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Guadalupe	0.0032029	19.8143	0.0002160	2.1496	0.0000104	0.0064	0.0255795	184.8703	206.84	0.10
	Wilson	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
Austin Area	Bastrop	0.0033782	20.8990	0.0002278	2.2673	0.0000110	0.0067	0.0269798	194.9906	218.16	0.11
	Caldwell	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Hays	0.0008331	5.1541	0.0000562	0.5592	0.0000027	0.0017	0.0066537	48.0881	53.80	0.03
	Travis	0.0051785	32.0364	0.0003493	3.4756	0.0000169	0.0103	0.0413577	298.9044	334.43	0.17
	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	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	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	0.0128578	79.5431	0.0008672	8.6295	0.0000419	0.0256	0.1026870	742.1493	830.35	0.42
	San Patricio	0.0015100	9.3411	0.0001018	1.0134	0.0000049	0.0030	0.0120591	87.1543	97.51	0.05
Victoria Area	Victoria	0.0021192	13.1099	0.0001429	1.4223	0.0000069	0.0042	0.0169244	122.3174	136.85	0.07
Other ERCOT counties	Andrews	0.0000037	0.0232	0.0000230	0.2286	0.0039003	2.3873	0.0000002	0.0017	2.64	0.00
	Angelina	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Bosque	0.0022204	13.7364	0.0136212	135.5508	0.0006579	0.4027	0.0001390	1.0044	150.69	0.08
	Brazos	0.0024089	14.9022	0.0112305	111.7603	0.0005425	0.3320	0.0047829	34.5675	161.56	0.08
	Calhoun	0.0009466	5.8559	0.0000638	0.6353	0.0000031	0.0019	0.0075598	54.6366	61.13	0.03
	Cameron	0.0063536	39.3060	0.0004285	4.2642	0.0000207	0.0127	0.0507425	366.7307	410.31	0.21
	Cherokee	0.0027392	16.9455	0.0168033	167.2180	0.0008116	0.4968	0.0001714	1.2390	185.90	0.09
	Coke	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Coleman	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Crockett	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Ector	0.0019215	11.8872	0.0006604	6.5715	0.0911346	55.7813	0.0146527	105.8993	180.14	0.09
	Fannin	0.0000041	0.0251	0.0000249	0.2475	0.0000012	0.0007	0.0000003	0.0018	0.28	0.00
	Fayette	0.0051867	32.0869	0.0103217	102.7160	0.0004986	0.3052	0.0283993	205.2502	340.36	0.17
	Freestone	0.0047643	29.4740	0.0292268	290.8499	0.0014117	0.8641	0.0002982	2.1551	323.34	0.16
	Frio	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Grimes	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	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	0.0053716	33.2306	0.0003623	3.6051	0.0000175	0.0107	0.0428994	310.0466	346.89	0.17
	Howard	0.0002411	1.4916	0.0007641	7.6036	0.1283942	78.5870	0.0009490	6.8586	94.54	0.05
	Jack	0.0030783	19.0436	0.0188839	187.9227	0.0009121	0.5583	0.0001927	1.3924	208.92	0.10
	Jones	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Lamar	0.0040001	24.7464	0.0245388	244.1978	0.0011853	0.7255	0.0002504	1.8094	271.48	0.14
	Limestone	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Llano	0.0040314	24.9401	0.0002719	2.7057	0.0000131	0.0080	0.0321966	232.6946	260.35	0.13
	McLennan	0.0056576	35.0002	0.0347066	345.3824	0.0016764	1.0261	0.0003541	2.5591	383.97	0.19
	Milam	0.0012686	7.8481	0.0000856	0.8514	0.0000041	0.0025	0.0101316	73.2238	81.93	0.04
	Mitchell	0.0000311	0.1926	0.0001910	1.9003	0.0324260	19.8472	0.0000019	0.0141	21.95	0.01
	Nolan	0.0000293	0.1810	0.0001795	1.7860	0.0304745	18.6527	0.0000018	0.0132	20.63	0.01
	Palo Pinto	0.0036129	22.3510	0.0221635	220.5601	0.0010705	0.6552	0.0002261	1.6342	245.20	0.12
	Pecos	0.0000020	0.0122	0.0000121	0.1203	0.0020520	1.2560	0.0000001	0.0009	1.39	0.00
	Presidio	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Red River	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Robertson	0.0039506	24.4397	0.0055755	55.4842	0.0002693	0.1648	0.0246170	177.9140	258.00	0.13
	Taylor	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Titus	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Tom Green	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Upton	0.0000025	0.0157	0.0000156	0.1553	0.0026494	1.6217	0.0000002	0.0012	1.79	0.00
	Ward	0.0001995	1.2343	0.0012239	12.1801	0.2078335	127.2099	0.0000125	0.0902	140.71	0.07
	Webb	0.0042017	25.9935	0.0002834	2.8200	0.0000137	0.0084	0.0335565	242.5231	271.34	0.14
	Wharton	0.0021095	13.0502	0.0001423	1.4158	0.0000069	0.0042	0.0168474	121.7608	136.23	0.07
	Wichita	0.0000121	0.0749	0.0000743	0.7395	0.0126190	7.7238	0.0000008	0.0055	8.54	0.00
	Wilbarger	0.0179710	111.1755	0.1102430	1097.0811	0.0053249	3.2593	0.0011247	8.1288	1219.64	0.61
	Wise	0.0010202	6.3112	0.0062583	62.2792	0.0003023	0.1850	0.0000638	0.4615	69.24	0.03
	Young	0.0071054	43.9567	0.0435880	433.7654	0.0021054	1.2886	0.0004447	3.2140	482.22	0.24
	Total	**0.4414501**	**2730.9774**	**0.4812863**	**4789.5112**	**0.5345786**	**327.2027**	**0.6829349**	**4935.7718**	12783.46	**6.39**
Energy Savings (MWh)		6,186		9,951		612		7,227			

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

PROGRAM	ANNUAL												
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family (MWh)	0	21,748	55,268	93,760	153,171	220,975	289,761	359,587	430,512	502,596	575,901	650,492	726,432
ESL-Multifamily (MWh)	0	50,218	94,867	167,566	262,939	357,717	452,100	546,119	639,803	733,182	826,287	919,146	1,011,789
ESL-Commercial (MWh)	0	0	25,750	54,550	87,230	126,228	165,790	205,950	246,741	288,199	330,358	373,255	416,928
PUC (SB7) (MWh)	0	538,841	976,984	1,437,883	1,831,318	2,267,414	2,681,704	3,075,280	3,449,177	3,804,380	4,141,822	4,462,392	4,766,933
SECO (MWh)	0	71,910	154,786	347,175	508,375	705,060	891,911	1,069,420	1,238,053	1,398,254	1,550,445	1,695,027	1,832,380
Wind-ERCOT (MWh)	0	3,273,150	8,135,429	10,995,427	13,049,580	15,723,534	16,338,905	16,978,360	17,642,840	18,333,327	19,050,837	19,796,428	20,571,199
SEER13-Single Family (MWh)	0	343,330	326,163	309,855	294,362	279,644	265,662	252,379	239,760	227,772	216,383	205,564	195,286
SEER13-Multifamily (MWh)	0	29,021	27,569	26,191	24,881	23,637	22,456	21,333	20,266	19,253	18,290	17,376	16,507
Total Annual (MWh)	0	4,328,218	9,796,817	13,432,406	16,211,857	19,704,209	21,108,289	22,508,426	23,907,152	25,306,962	26,710,324	28,119,680	29,537,454

PROGRAM	OZONE SEASON DAY - OSD												
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family (MWh)	0	124	283	468	626	808	992	1,180	1,370	1,564	1,761	1,962	2,166
ESL-Multifamily (MWh)	0	233	460	744	999	1,253	1,507	1,759	2,010	2,261	2,511	2,760	3,009
ESL-Commercial (MWh)	0	0	71	149	239	346	454	564	676	790	905	1,023	1,142
PUC (SB7) (MWh)	0	1,476	2,677	3,939	5,017	6,212	7,347	8,425	9,450	10,423	11,347	12,226	13,060
SECO (MWh)	0	197	424	951	1,393	1,932	2,444	2,930	3,392	3,831	4,248	4,644	5,020
Wind-ERCOT (MWh)	0	14,246	23,054	27,654	33,273	32,560	33,834	35,158	36,534	37,964	39,450	40,994	42,598
SEER13-Single Family (MWh)	0	2,445	2,323	2,207	2,097	1,992	1,892	1,798	1,708	1,622	1,541	1,464	1,391
SEER13-Multifamily (MWh)	0	195	186	176	167	159	151	144	136	130	123	117	111
Total OSD (MWh)	0	18,918	29,477	36,289	43,812	45,262	48,621	51,958	55,277	58,584	61,887	65,189	68,498

Table 32: Annualand OSD NOx Emissions Reduction Values for the Different Programs (Base Year 2008)

PROGRAM	ANNUAL (in tons NOx)												
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family	0	5	14	23	38	54	71	89	106	124	142	160	179
ESL-Multifamily	0	13	24	43	67	91	115	139	163	187	210	234	257
ESL-Commercial	0	0	6	14	22	32	41	52	62	72	83	94	105
PUC (SB7)	0	135	246	362	460	567	669	766	858	945	1,028	1,107	1,182
SECO	0	19	43	92	133	183	230	274	317	357	395	432	466
Wind-ERCOT	0	895	2,262	3,053	3,648	4,399	4,571	4,750	4,936	5,129	5,330	5,538	5,755
SEER13-Single Family	0	81	77	73	69	66	62	59	56	53	51	48	46
SEER13-Multifamily	0	7	6	6	6	6	5	5	5	5	4	4	4
Total Annual (Tons NOx)	0	1,154	2,677	3,664	4,443	5,397	5,765	6,133	6,502	6,872	7,243	7,617	7,993

PROGRAM	OZONE SEASON DAY - OSD (in tons NOx/day)												
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family	0	0.03	0.07	0.11	0.15	0.20	0.24	0.29	0.34	0.39	0.43	0.48	0.53
ESL-Multifamily	0	0.06	0.12	0.19	0.26	0.32	0.38	0.45	0.51	0.57	0.64	0.70	0.76
ESL-Commercial	0	0.00	0.02	0.04	0.06	0.09	0.11	0.14	0.17	0.20	0.23	0.26	0.29
PUC (SB7)	0	0.37	0.67	0.99	1.26	1.55	1.83	2.10	2.35	2.59	2.82	3.03	3.24
SECO	0	0.05	0.12	0.25	0.37	0.50	0.63	0.75	0.87	0.98	1.08	1.18	1.28
Wind-ERCOT	0	3.93	6.40	7.62	9.28	9.06	9.41	9.78	10.16	10.56	10.98	11.40	11.85
SEER13-Single Family	0	0.57	0.54	0.51	0.49	0.46	0.44	0.42	0.40	0.38	0.36	0.34	0.32
SEER13-Multifamily	0	0.05	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03
Total OSD (Tons NOx)	0	5.05	7.97	9.76	11.90	12.22	13.09	13.96	14.83	15.69	16.56	17.43	18.30

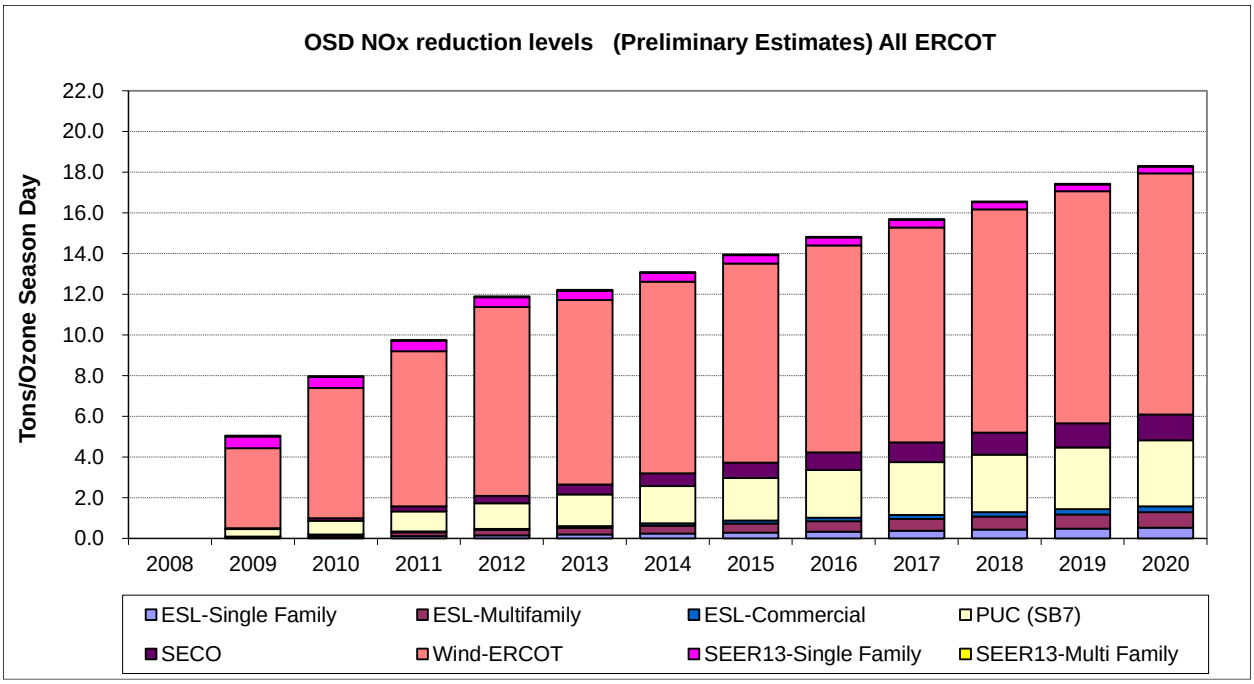


Figure 22: Integrated OSD NOx Emissions Reduction Projections through 2020 (Base Year 2008)

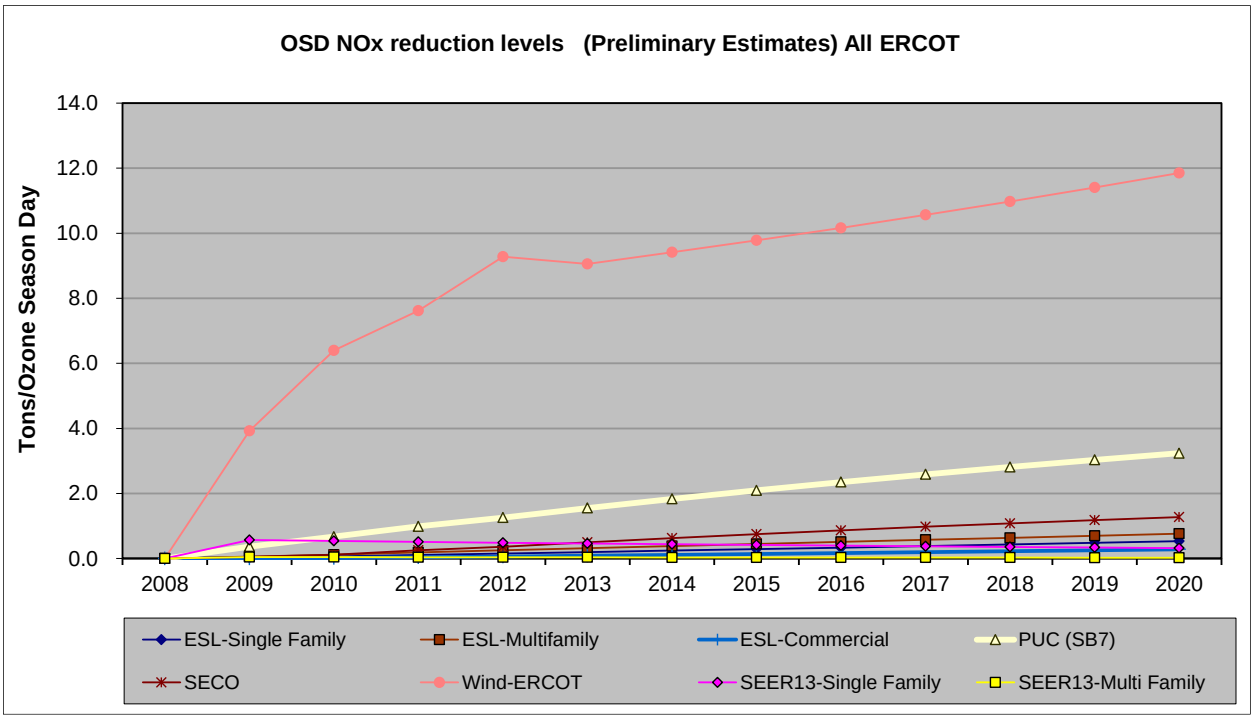


Figure 23: Integrated OSD Individual Programs NOx Emissions Reduction Projections through 2020 (Base Year 2008)

6 2013 Year Activities of Energy Systems Laboratory 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 Laboratory built the first version of the Registry in 2009. This preliminary version allowed The Laboratory to provide basic metrics on usage of the Laboratory's above code calculators, *IC3*[41] and *TCV*[42]. By running reports against the calculator's databases, The Laboratory 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 so the Laboratory could improve the calculators.

Figure 24 shows the Projects and Certificates issued each month since January 2013. A Project is a house plan, while Certificates are printed reports given to the building official - assuming that the house is at or above code. In 2013, some users entered a basic floor plan and re-cycled it to generate more certificates.

Figure 25 shows the cumulative Users and Certificates for 2013. The divergence between the two lines emphasizes the difference between the projects completed and certificates issued, showing that more projects were entered (and presumably did not pass) than certificates created.

Figure 26 shows that the largest adopter of the *IC3* software was the North Central Texas Council of Governments (NCTCOG) area, specifically, users building in Dallas, Collin, Denton, and Tarrant Counties.

Figure 27 shows the certifications issued by city.

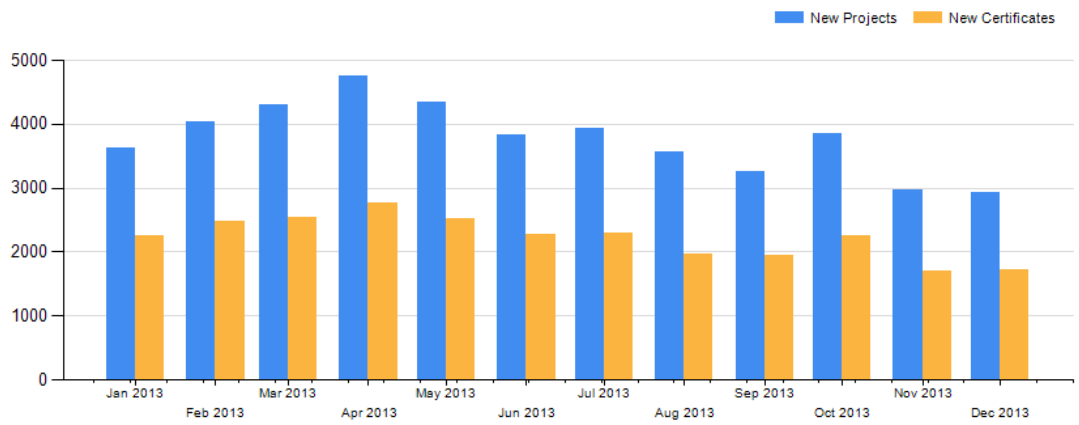


Figure 24: *IC3* 2013 Certificates and Projects

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

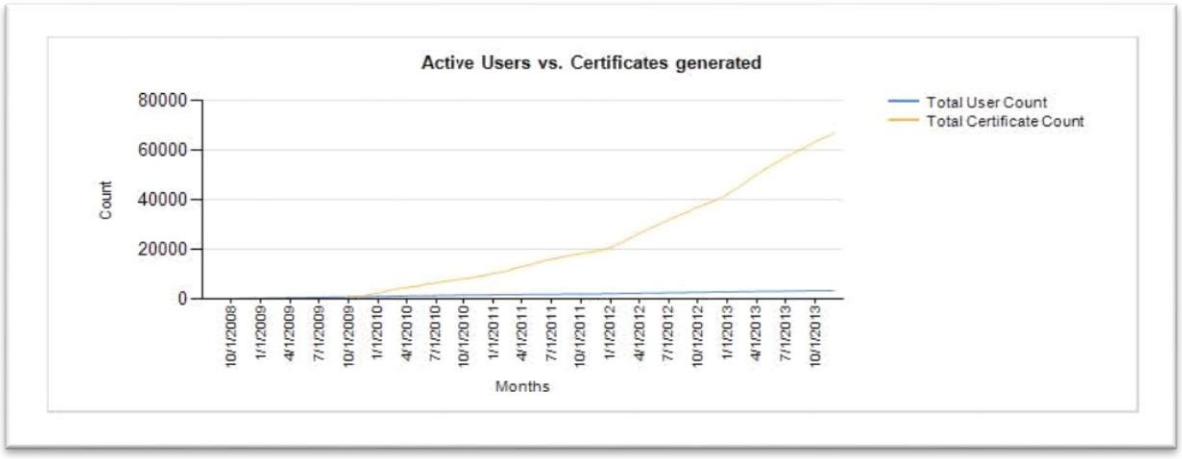


Figure 25: *IC3* 2013 Users vs. Certificates

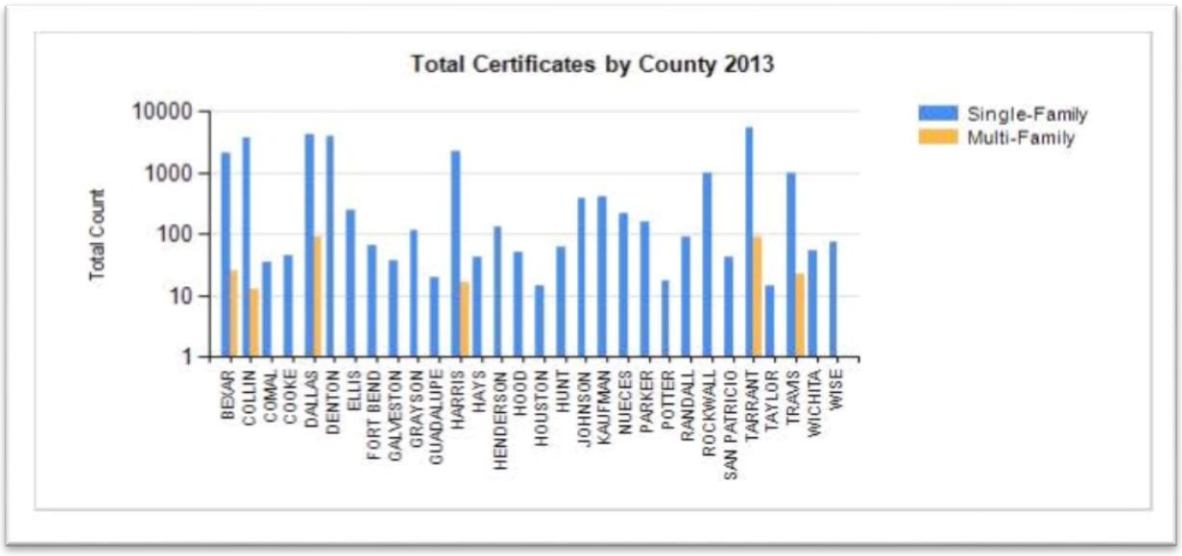


Figure 26: *IC3* 2013 Certificates – Counties with at least 10 Certificates

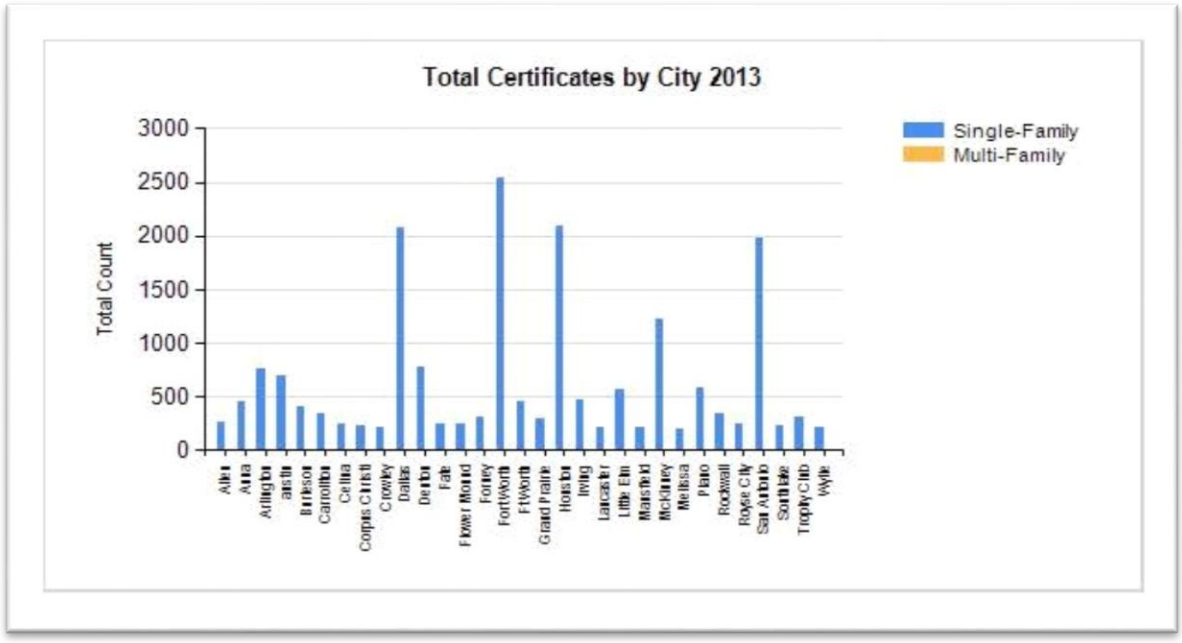


Figure 27: *IC3* 2013 Certificates – Cities with at least 200 Certificates

6.1.2 TBR Current Version

As illustrated below and a "*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 Laboratory 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 2008*. This product offers reporting capabilities through various tools.

Figure 28 shows the "layout" of the IC3 (v3.x) and TCV[43] (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.

[43] 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.

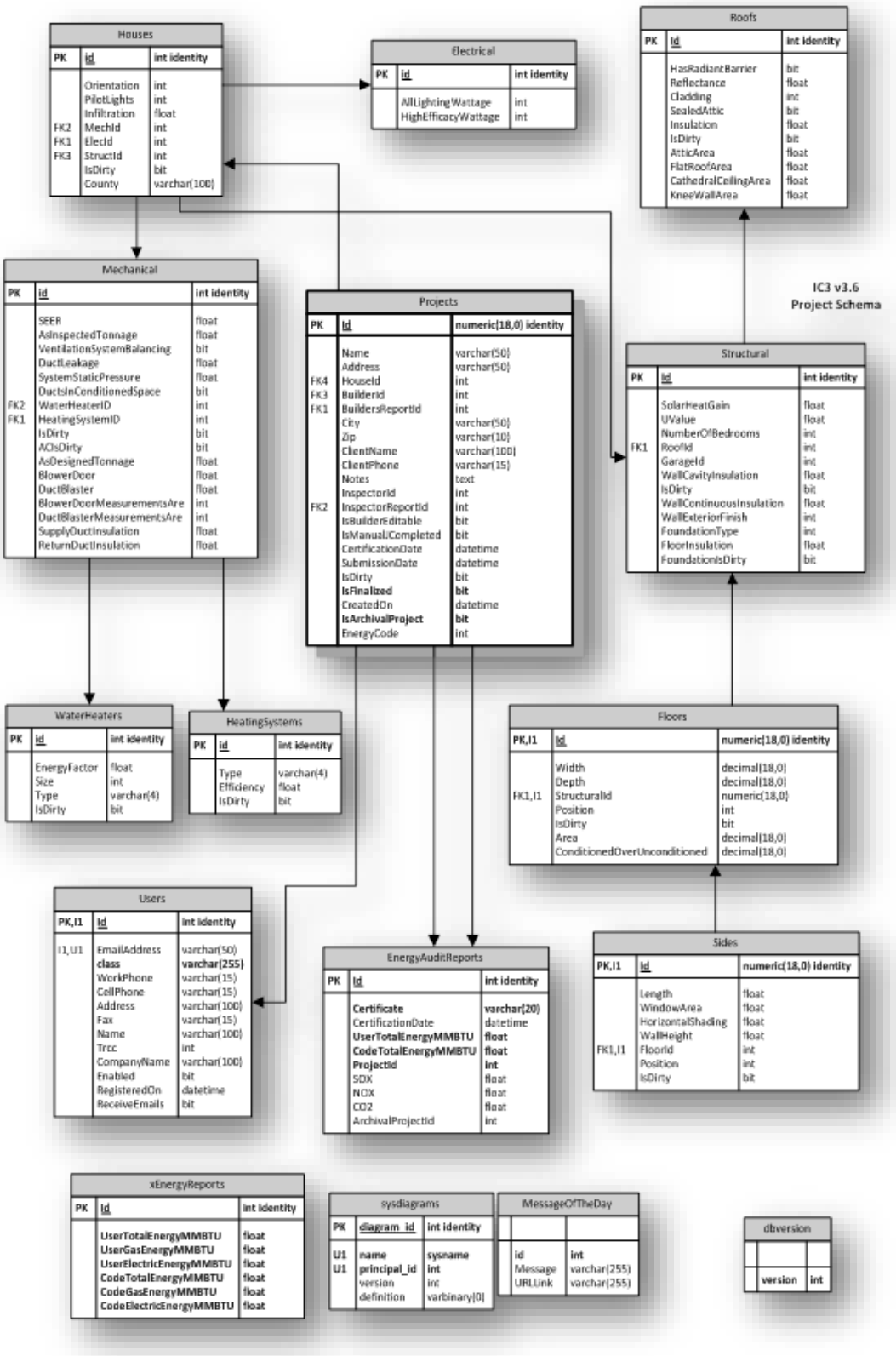


Figure 28: Database Schema

6.1.3 Usage Reports

Figure 29 shows a steady growth from the start of record keeping (July 2009) until the end of 2013. During this year, ESL conducted several workshops and was able to detect a correlation between workshops and IC3 usage.

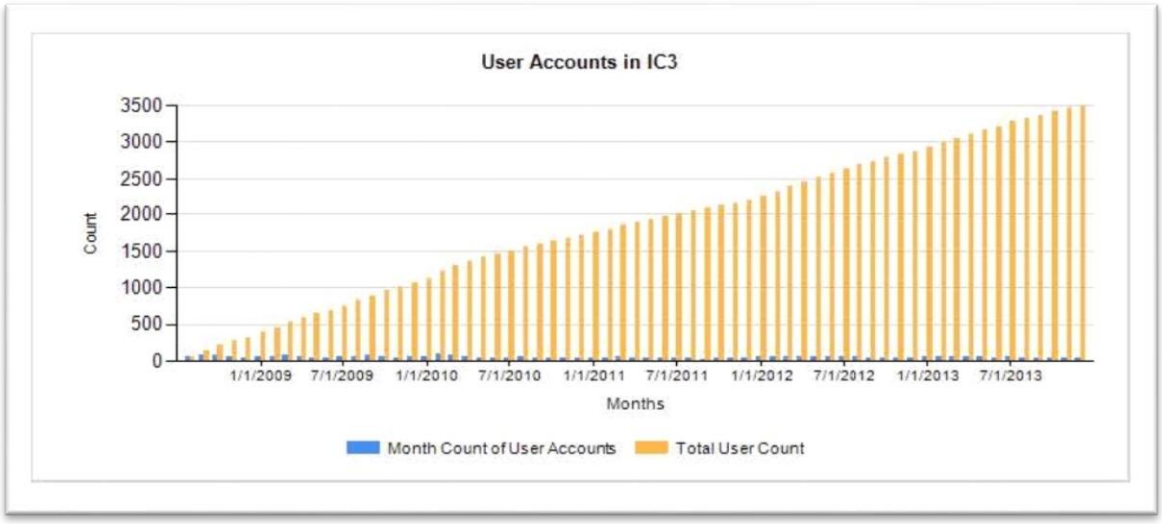


Figure 29: IC3 Usage Growth in 2013

Figure 30 shows the correlation between users and their successful projects (i.e. those that generate certificates). The graph shows that users were generating more certificates, and were doing so at a much faster rate than the rate of adding new users.

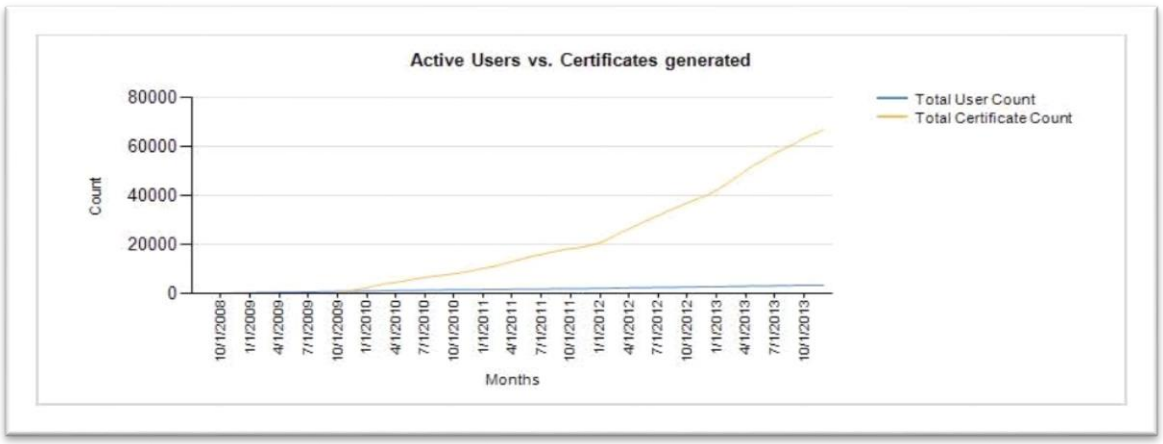


Figure 30: Users and Certificates 2013

Figure 31 through Figure 33 show where the usage was using Counties and Cities as the grouping entity. The North Central Texas Council of Governments (NCTCOG) led the way in usage during 2013.

Counties Generating Single Family IC3 Certificates in 2013

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
BANDERA	0	0	0	0	0	0	0	0	0	0	0	0	2
BEXAR	293	152	182	318	142	186	76	168	205	159	155	133	2169
BLANCO	0	0	0	3	3	0	0	2	0	0	0	2	10
BRAZOS	0	0	0	0	0	0	0	0	4	4	0	0	8
CARSON	0	0	0	0	0	1	0	0	0	0	0	0	1
COLLIN	319	422	357	379	361	285	335	275	201	345	265	283	3827
COMAL	1	0	1	2	1	11	3	0	0	9	2	4	34
COOKE	1	2	6	3	3	11	3	6	6	1	0	2	46
DALLAS	326	399	464	367	381	401	419	299	292	433	235	243	4259
DENTON	260	313	343	443	348	382	357	287	347	304	248	274	3896
DICKENS	0	0	0	0	0	0	0	0	0	2	0	0	2
ELLIS	26	27	27	6	15	25	23	31	21	14	22	8	245
FORT BEND	3	5	18	10	5	3	5	3	4	5	5	3	87
GALVESTON	0	2	7	0	0	3	0	4	0	5	0	8	36
GILLESPIE	1	0	0	0	0	0	0	0	0	0	0	0	1
GRAY	5	0	0	0	0	0	0	0	1	0	1	0	7
GRAYSON	1	15	11	17	16	10	10	11	6	3	4	8	112
GUADALUPE	2	0	1	7	4	2	0	1	2	0	0	1	20
HARRIS	97	235	190	281	244	188	195	172	167	188	168	153	2259
HAYS	0	0	0	1	0	0	18	0	0	1	7	13	41
HENDERSON	8	6	7	20	54	11	8	9	3	4	0	0	128
HOOD	5	11	3	5	4	1	5	4	4	7	2	0	51
HOUSTON	0	1	11	0	0	0	0	2	0	0	0	0	14
HUNT	3	13	4	2	3	8	7	1	7	8	0	7	61
JOHNSON	30	37	33	33	44	31	25	24	32	29	36	29	383
KAUFMAN	30	17	27	36	44	43	27	23	25	20	83	44	419
KENDALL	0	7	2	0	1	0	0	0	0	0	0	0	10
LAMAR	0	0	0	0	1	0	0	0	0	0	0	0	1
MCLENNAN	0	0	0	1	0	0	0	0	0	0	0	0	1
MEDINA	0	0	0	0	8	1	0	0	0	0	0	0	9
MONTGOMERY	0	0	3	2	0	0	1	0	0	3	0	1	10
NUECES	14	17	17	23	23	19	13	31	20	19	13	16	224
PALO PINTO	0	0	0	0	1	0	0	0	0	0	0	2	3
PARKER	17	9	9	16	18	8	19	9	14	7	19	16	156
POTTER	4	3	2	2	1	1	0	1	0	3	0	0	17
RANDALL	18	17	16	14	4	4	3	5	9	0	0	2	92
ROBERTS	3	0	0	0	0	0	0	0	0	0	0	0	3
ROCKWALL	62	153	108	116	97	59	69	67	53	101	37	60	982
RUNNELS	0	1	0	0	0	0	0	0	0	0	0	0	1
RUSK	0	0	0	0	0	0	0	0	0	0	1	0	1
SAN PATRICIO	6	2	5	6	4	6	2	4	2	2	0	2	41
SMITH	0	0	0	0	0	6	0	0	0	2	0	0	8
SOMERVELL	0	0	0	0	1	3	0	0	0	0	0	0	4
STARR	0	2	0	0	0	0	0	0	0	0	0	0	2
TARRANT	466	500	575	518	575	421	441	408	381	483	301	289	5358
TAYLOR	1	0	3	2	1	1	1	1	1	2	0	1	14
TERRELL	0	2	0	0	0	0	0	0	0	0	0	0	2
TOM GREEN	0	0	0	0	0	3	2	0	0	0	0	0	5
TRAVIS	154	87	80	83	51	100	152	58	95	53	73	42	978
WALKER	0	0	0	0	0	0	0	2	2	0	0	0	4
WICHITA	8	7	0	4	3	5	4	5	4	2	0	12	54
WILLIAMSON	1	0	0	0	0	0	0	0	0	1	0	6	8
WISE	4	0	4	7	18	2	6	22	4	3	1	5	76
YOUNG	0	0	0	0	0	0	0	0	0	0	0	1	1

Figure 31: Counties Generating IC3 Certificates in 2013

Counties Generating Multi-Family IC3 Certificates in 2013

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
BEXAR	0	0	0	0	0	0	11	14	0	0	0	0	25
BRAZOS	1	0	0	0	0	2	1	0	0	0	0	0	4
COLLIN	0	0	6	0	0	0	0	0	0	0	0	7	13
DALLAS	17	0	1	1	5	4	25	5	0	8	0	24	90
GRAYSON	0	3	0	0	0	0	0	0	0	0	0	0	3
HARRIS	14	0	0	0	0	2	0	0	0	0	0	0	16
HUNT	0	0	0	7	0	0	0	0	0	0	0	0	7
JOHNSON	0	0	3	0	0	0	0	0	0	0	0	0	3
TARRANT	14	0	0	6	9	20	4	3	1	24	0	8	89
TRAVIS	0	1	3	2	1	0	2	1	1	1	9	2	23

Figure 31: Counties Generating IC3 Certificates in 2013 (Continued)

Cities Generating Single-Family IC3 Certificates in 2013

													Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Colleyville	0	0	0	0	0	0	0	0	0	4	0	0	4
Dallas	0	0	0	0	0	5	0	1	0	0	0	0	6
Fort Worth	0	0	0	0	0	0	0	0	0	5	0	0	5
Rockwall	0	3	0	0	0	0	0	0	0	0	0	0	3
San Antonio	0	1	0	0	2	0	0	0	0	1	5	1	10
75230	0	0	0	0	0	0	2	0	0	0	0	0	2
a	0	0	0	0	0	0	0	0	2	4	0	0	6
ABILENE	0	0	0	0	1	0	0	1	0	2	0	0	4
Abilene	1	0	3	0	0	0	1	0	0	0	0	0	5
Addison	0	0	0	0	0	2	0	0	0	1	0	0	3
Aledo	12	8	2	6	5	0	8	3	1	0	0	4	49
Aledo	0	0	0	0	0	0	0	0	0	0	4	0	4
Allen	28	37	0	26	29	16	19	9	12	19	11	18	224
Allen	0	0	30	0	0	0	0	0	0	0	0	0	30
Alvarado	4	4	1	3	2	4	1	2	1	2	0	2	26
Amarillo	14	11	3	4	1	0	0	1	0	0	0	0	34
Anna	18	61	49	73	48	39	21	25	19	28	58	20	459
Annetta	0	0	0	0	0	0	0	0	0	0	0	3	3
Aransas Pass	0	0	0	0	0	2	0	0	0	0	0	2	4
Argyle	2	2	4	4	0	3	0	1	1	1	2	4	24
Arlington	81	85	65	87	99	57	79	45	53	47	27	36	761
Asutin	0	0	0	0	0	0	0	0	0	1	0	0	1
Athens	0	0	0	0	2	0	1	0	0	0	0	0	3
Aubrey	4	3	7	18	11	7	7	4	7	3	4	5	80
Aurora	0	0	1	0	0	0	0	0	0	0	0	0	1
Auroroa	0	0	1	0	0	0	0	0	0	0	0	0	1
Ausin	0	0	0	0	0	0	1	0	0	0	0	0	1
Ausitn	0	0	0	0	0	0	0	0	0	0	0	1	1
Ausitn	0	0	0	0	1	0	0	0	0	0	0	0	1
Austin	49	61	48	78	43	96	120	49	47	0	0	32	623
Austin	0	0	0	0	0	0	0	0	0	42	30	0	72
Autin	0	3	2	0	0	0	3	0	1	1	2	0	12
Azle	8	0	2	3	12	17	6	13	4	6	7	0	78
Azle	0	0	0	0	0	0	0	0	0	0	0	6	6
Bacliff	0	0	0	0	0	0	0	1	0	0	0	0	1
Barrington	0	0	0	0	0	0	1	0	0	0	0	0	1
Bartonville	0	0	2	2	0	0	0	0	1	0	0	0	5
Baytown	0	0	0	5	0	0	0	2	1	0	0	0	8
Bedford	0	1	0	0	0	0	0	0	0	0	0	0	1
Bee Cave	1	1	0	5	0	0	0	0	37	0	8	0	52
BELLAIR	0	0	0	0	0	0	0	1	0	0	0	0	1

Figure 32: Cities Generating Single Family IC3 Certificates in 2013

Bellaire	0	2	3	0	2	0	3	1	0	0	3	0	14
Benbrook	13	6	6	10	4	7	2	5	8	7	3	2	73
Boerne	0	14	2	0	1	1	0	1	0	0	0	0	19
Bourne	0	3	0	0	0	0	0	0	0	0	0	0	3
Boyd	0	0	0	2	0	0	0	0	0	0	0	0	2
Bryan	0	0	0	0	0	0	0	0	4	4	0	0	8
Buda	0	0	0	0	0	0	0	0	0	1	0	0	1
Bulverde	1	0	0	0	0	0	2	0	0	0	0	0	3
Bunnker Hill Village	0	17	0	0	0	0	0	0	0	0	0	0	17
Burlenson	0	0	1	0	0	0	0	0	0	0	0	0	1
BURLESON	34	52	41	33	41	34	25	29	23	29	31	25	397
Burlesoon	0	0	0	2	0	0	0	0	0	0	0	0	2
Canyon	8	9	15	12	4	4	3	5	9	3	0	2	74
Carrollton	12	24	13	78	61	31	26	27	28	23	11	11	345
Carrolton	3	0	2	4	4	0	5	3	4	1	2	1	29
Castroville	0	0	0	0	8	1	0	0	0	0	0	0	9
Cedar Hill	10	9	9	7	7	21	0	0	5	15	8	2	93
Cedar Hill	0	0	0	0	0	0	5	2	0	0	0	0	7
Cedar Hills	0	0	1	0	0	0	0	0	0	0	0	0	1
Cedarhill	0	0	0	0	0	1	0	0	0	0	0	0	1
Celina	6	26	5	6	11	6	28	42	3	25	45	34	237
Chandler	0	4	0	0	0	0	1	0	1	0	0	0	6
Chapel Hill	0	0	0	0	0	0	0	0	1	0	0	0	1
Cibolo	0	0	1	6	0	0	0	0	0	0	0	0	7
City of Hunters Creek Village	0	0	0	3	0	0	0	0	0	0	0	0	3
Clear Lake Shores	0	0	0	0	8	4	0	0	0	0	0	1	13
Cleburne	2	0	0	0	5	0	0	0	3	0	0	3	13
College Station	0	0	0	0	0	5	0	0	8	0	0	0	13
Colleyville	20	14	11	10	20	0	12	9	17	8	0	2	123
Colleyville	0	0	0	0	0	14	0	0	0	0	10	0	24
Collinsville	0	0	0	0	2	0	0	0	0	0	0	0	2
Combine	0	1	0	0	0	0	1	0	2	0	0	0	4
Conroe	0	0	1	0	0	0	1	0	0	3	0	0	5
Converse	0	0	0	1	0	0	0	0	0	0	0	0	1
Copeville	0	0	0	3	4	0	4	0	0	0	1	1	13
Coppell	1	11	3	32	19	14	14	3	8	4	18	2	129
Copper Canyon	5	0	0	0	0	0	0	0	1	7	0	0	13
Corinth	2	7	0	3	3	4	2	0	6	8	3	0	38
Cornith	0	0	0	0	0	0	0	0	3	0	0	1	4
Corpus Christi	14	17	17	21	22	18	13	30	20	19	13	16	220
Crandall	18	0	6	20	8	22	5	3	1	0	1	1	85
Crandall	0	6	0	0	0	0	0	0	0	0	0	0	6

Figure 32: Cities Generating IC3 Certificates in 2013 (Continued)

Crandell	0	0	0	1	0	0	0	0	0	0	0	0	1
CROSBY	0	0	1	0	0	0	0	0	0	2	0	0	3
Cross Oaks	0	1	0	0	0	0	1	5	1	0	0	1	9
Cross Roads	0	8	8	1	0	8	1	47	4	0	5	5	87
Cross Roads	0	0	0	0	0	0	0	0	0	6	0	0	6
Crossroads	0	0	0	1	0	1	0	2	1	1	0	3	9
Crossroads	0	0	0	0	1	0	0	0	0	0	0	0	1
Crowley	12	85	14	19	7	19	13	6	6	15	6	9	211
Dalals	0	0	0	0	0	0	0	1	0	0	0	0	1
Dallas	152	204	226	175	170	167	199	0	152	285	132	109	1971
Dallas	0	0	0	0	0	0	0	108	0	0	0	0	108
Dalworthington Gardens	1	0	0	0	0	1	0	0	2	2	0	0	6
Decatur	3	0	0	2	6	0	0	0	0	0	0	1	12
DeCordova	0	0	0	0	0	0	0	0	0	3	0	0	3
Denison	0	2	0	0	0	0	4	0	0	0	0	0	6
Denton	39	74	70	52	44	43	60	65	143	66	47	75	778
Denton County	0	0	0	0	29	20	5	8	6	8	0	0	76
Desoto	6	3	37	6	0	13	6	10	8	8	10	11	118
Desoto	0	0	0	0	9	0	0	0	0	0	0	0	9
Dickinson	0	2	0	0	0	0	0	0	0	0	0	0	2
Dish	1	0	0	0	0	0	0	0	2	0	0	0	3
Double Oak	0	0	0	0	0	1	0	0	1	3	0	0	5
Driftwood	0	0	0	1	0	0	0	0	0	0	0	0	1
Duncanville	1	2	1	5	0	0	3	1	2	0	0	0	15
Duncaville	0	0	0	0	1	0	0	0	0	0	0	0	1
Ennis	0	0	0	0	0	0	3	1	5	0	0	1	10
Euless	0	7	17	7	11	3	4	7	2	17	0	0	75
Fair Oaks Ranch	0	0	0	0	0	0	0	2	0	0	0	0	2
Fair Oaks Ranch	2	2	1	0	0	1	0	2	0	0	1	0	9
Fair Oaks Ranch	0	0	0	0	0	0	0	0	0	1	0	0	1
Fair Oaks Ranck	0	1	0	0	0	0	0	0	0	0	0	0	1
Fairview	2	4	1	8	3	2	1	0	0	4	1	1	27
FARMERS BRANCH	10	0	0	1	2	5	3	5	0	0	0	0	26
Farmersville	0	0	0	0	2	0	3	2	2	0	0	5	14
Fate	12	18	29	24	16	32	17	10	19	42	5	16	240
Ferris	0	0	0	0	0	0	0	0	1	0	0	0	1
Flower Mound	19	14	24	41	21	17	45	6	20	18	11	10	246
Flower ound	0	0	0	0	1	0	0	0	0	0	0	0	1
Flowermound	1	1	0	0	0	1	0	1	0	0	0	0	4
Flower-Mound	0	0	0	0	0	0	0	0	0	2	0	0	2
Flowermound	0	0	0	0	2	0	0	0	0	5	0	0	7

Figure 32: Cities Generating IC3 Certificates in 2013 (Continued)

Foreny	0	0	0	0	1	1	0	0	0	0	0	0	2
Forest Hill	0	0	0	0	0	0	0	3	0	0	0	0	3
FOREST HILLS	0	2	2	0	0	0	0	0	0	0	0	0	4
Fomery	0	2	0	1	0	0	1	0	0	0	0	0	4
Forney	12	16	29	13	36	22	24	21	24	7	57	43	304
Fort Worth	239	191	272	246	257	197	217	190	172	262	0	132	2375
Fort Worth	0	0	0	0	0	0	0	0	0	0	165	0	165
fort worth tx	0	2	0	0	0	0	0	0	0	0	0	0	2
Fort Worth, Texas	0	0	0	0	0	0	0	0	0	0	0	2	2
Fort Worth, TX	2	0	0	0	0	0	0	0	0	0	0	0	2
Fort Worth, Tx.	0	0	0	0	0	0	0	0	0	0	0	1	1
Fortworth	0	5	19	0	7	4	3	1	2	0	0	0	41
Fredericksburg	1	0	0	0	0	0	0	0	0	0	0	0	1
Freeport	0	0	0	0	0	0	0	0	0	0	0	2	2
Frisco	0	3	10	0	16	25	0	0	3	13	0	0	70
Frisco	24	0	0	25	0	0	10	19	0	0	0	4	82
Front Gate	0	0	0	2	1	0	0	0	0	0	0	0	3
Ft Worth	0	28	62	43	38	25	0	0	34	0	30	53	313
Ft Worth	38	0	0	0	0	0	25	34	0	38	0	0	135
Ft. Worth	0	1	0	1	4	0	0	1	0	0	0	2	9
Gainesville	1	2	6	3	6	11	3	6	2	2	0	2	44
Gaineville	0	0	2	0	0	0	0	0	0	0	0	0	2
Galveston	0	0	0	0	0	0	0	3	0	4	0	4	11
Gapevine	0	0	0	0	0	1	0	0	0	0	0	0	1
Garland	34	20	10	23	8	25	35	10	5	2	1	5	178
Glen Heights	1	0	0	0	0	0	0	0	0	0	0	0	1
Glen Rose	0	0	0	0	0	3	0	0	0	0	0	0	3
Glen Rose	0	0	0	0	1	0	0	0	0	0	0	0	1
Glenn Heights	0	0	0	0	1	1	0	2	0	1	0	0	5
Gordon	0	0	0	0	1	0	0	0	0	0	0	2	3
GORDONVILLE	0	0	2	0	0	5	0	0	0	1	1	0	9
Granbury	5	11	3	5	2	1	5	4	4	4	2	0	46
Grand Prairie	0	0	0	0	0	0	2	0	0	0	0	0	2
Grand Prairie	23	27	26	32	19	49	23	22	19	14	21	13	288
Grandbury	0	0	0	0	4	0	0	0	0	0	0	0	4
Grapevine	5	0	5	1	7	5	2	15	1	9	2	5	57
Greenville	1	12	2	1	1	1	6	1	7	6	0	6	44
Gun Barrel	1	0	0	0	0	0	0	0	0	0	0	0	1
Gun Barrel City	7	1	7	20	52	5	4	0	2	4	0	0	102
Gun Barrel City	0	0	0	0	0	0	0	9	0	0	0	0	9
Gun Barrel City, TX	0	0	0	0	0	6	0	0	0	0	0	0	6

Figure 32: Cities Generating IC3 Certificates in 2013 (Continued)

Gunter	0	0	0	4	0	1	0	0	0	2	1	2	10
Hackberry	0	0	0	0	0	2	0	0	0	0	0	31	33
Haltom City	1	0	0	2	1	0	0	0	0	4	0	1	9
Harris	0	0	0	0	0	0	0	3	0	0	0	0	3
Haslet	2	2	0	2	3	1	2	7	8	9	5	0	41
Heath	8	11	20	15	9	7	3	8	10	14	8	11	124
Heath Tx.	0	0	0	0	0	0	0	0	8	0	0	0	8
HELOTES	88	0	0	7	0	6	1	3	6	0	8	4	123
Heltotes	0	0	0	0	0	0	0	0	1	0	0	0	1
Hewitt	0	0	1	0	0	0	0	0	0	0	0	0	1
Hickory Creek	5	0	0	0	0	0	0	0	0	4	0	0	9
Highland Park	1	6	25	8	0	6	11	12	12	14	5	6	106
Highland Park	0	0	0	0	4	0	0	0	0	0	0	0	4
Highland Village	3	2	2	11	7	0	1	0	5	2	2	0	35
Hitchcock	0	0	7	0	0	0	0	0	0	0	0	0	7
Houston	93	216	185	269	223	178	181	158	145	157	146	144	2095
Hudson Oaks	3	1	3	10	4	3	3	3	4	1	0	4	39
Huffman	0	0	0	0	0	0	0	0	0	0	2	0	2
HUMBLE	0	0	0	0	0	0	0	1	0	0	0	1	2
Huntsville	0	0	0	0	0	0	0	2	2	0	0	0	4
Hurst	0	3	0	0	0	0	0	2	4	1	0	1	11
Hutchins	0	0	0	0	0	0	0	0	0	0	0	1	1
Irving	41	55	53	39	67	34	42	31	28	34	19	25	468
Irving, TX	0	0	0	0	0	0	0	3	0	0	0	0	3
Jarrell	1	0	0	0	0	0	0	0	0	0	0	0	1
Josaphine	0	6	5	0	2	4	3	0	0	0	0	0	20
Josephine	0	1	5	1	1	0	6	0	0	0	0	2	16
Joshua	0	0	0	0	0	0	0	1	0	0	0	0	1
Justin	0	0	0	0	1	0	2	0	5	1	8	1	18
Katy	1	0	0	3	4	6	3	0	10	6	16	5	54
Kaufman	0	3	0	1	1	0	0	0	3	2	0	0	10
Keene	0	0	0	0	0	0	0	0	3	0	0	0	3
Keller	3	3	4	9	9	5	17	4	5	9	5	3	76
Kemp	0	0	0	0	0	0	0	1	0	0	0	0	1
Kennedale	0	0	0	0	2	0	0	0	0	0	0	2	4
Kingswood	0	0	2	0	0	0	0	0	0	0	0	0	2
Kingswood	0	0	0	0	2	0	1	0	0	0	0	0	3
Kingwood	3	0	4	1	11	2	5	6	2	3	3	0	40
Kingwood	0	0	0	0	0	0	0	0	0	0	0	1	1
Krugerville	3	3	0	2	0	0	0	0	0	0	0	0	8
Krum	6	7	14	32	25	17	16	3	4	13	0	2	139
Krum	0	0	0	0	0	0	0	0	0	0	3	0	3
Kyle	0	0	0	0	0	0	15	0	0	0	7	17	39
La Porte	0	0	0	0	0	0	0	1	0	0	0	0	1
Lake Dallas	0	0	1	5	0	11	0	0	0	0	0	0	17
Lake Worth	0	0	1	0	0	0	0	1	0	0	3	0	5

Figure 32: Cities Generating IC3 Certificates in 2013 (Continued)

Lancaster	13	10	25	19	28	36	16	21	7	13	3	15	206
Lancaster, TX	0	0	0	0	0	0	0	10	0	0	0	0	10
Lantana	1	1	1	1	5	0	3	0	0	6	1	1	20
Lavon	7	0	0	10	8	0	1	1	0	0	1	7	35
League City	0	0	0	0	0	0	0	0	3	1	0	1	5
Lewisville	12	22	9	18	7	19	16	21	4	9	14	9	160
Lindale	0	0	0	0	0	4	0	0	0	0	0	0	4
Little Elm	26	53	49	31	57	84	78	49	47	0	23	41	538
LIttle Elm	0	0	0	0	0	0	0	0	0	34	0	0	34
Live Oak	0	2	1	0	0	0	0	0	0	0	0	0	3
Lucas	7	3	3	12	7	5	18	15	11	6	9	5	101
Lukas	0	0	0	0	0	0	0	2	0	0	0	0	2
Magnolia	0	0	0	2	0	0	0	0	0	0	0	0	2
Malakoff	0	1	0	0	0	0	0	0	0	0	0	0	1
Manor	0	0	0	0	0	0	0	0	0	0	15	14	29
Mansfield	13	17	35	16	18	9	15	17	22	21	10	21	214
MASTER	1	9	0	0	0	0	0	0	2	0	0	0	12
Mc Kinney	9	0	0	0	0	0	0	0	0	3	0	3	15
McClendon Chisholm	0	0	0	0	0	0	0	1	0	1	0	0	2
McClendon Chisolm	0	0	0	0	0	0	0	3	0	1	0	0	4
McKineey	0	0	0	0	1	0	0	0	0	0	0	0	1
McKinney	0	0	127	100	96	87	94	80	59	156	70	70	939
McKinney	123	169	0	0	0	0	0	0	0	0	0	0	292
Mclendon Chisholm	0	0	0	0	2	0	1	0	0	1	0	0	4
McLendon-Chisholm	0	1	0	0	1	1	4	0	0	0	0	2	9
Melissa	10	15	26	19	40	21	5	9	20	13	19	4	201
Mequite	0	0	0	0	2	0	0	0	0	0	0	0	2
Mesquite	2	3	9	0	4	0	0	0	2	1	1	2	24
Miami	3	0	0	0	0	0	0	0	0	0	0	0	3
Mico	0	0	0	0	0	0	0	0	0	2	0	0	2
Midlothian	13	15	4	3	9	15	10	8	12	6	3	3	101
Missouri City	0	2	10	5	2	0	1	2	1	2	0	0	25
Montgomery	0	0	0	0	0	0	0	0	0	0	0	1	1
Murphy	37	1	5	6	2	3	0	3	2	0	2	6	67
N Richland Hills	0	0	0	0	0	2	0	0	0	0	0	0	2
N. Richland Hills	6	3	0	1	1	0	0	1	0	0	0	0	12
NEW BRAUNFELS	9	0	1	2	1	10	1	0	0	12	1	5	42
New Fairview	0	0	1	3	1	2	6	2	2	3	1	4	25
North Richland Hill	0	0	0	0	0	0	0	0	0	2	0	0	2

Figure 32: Cities Generating IC3 Certificates in 2013 (Continued)

North Richland Hills	8	10	11	17	21	7	9	8	10	1	3	1	106
Northlake	0	1	0	0	0	1	1	0	6	3	5	0	17
Oak Leaf	0	0	0	0	0	0	0	1	0	0	0	0	1
Oak Point	16	7	39	9	23	24	13	12	4	20	18	9	194
Oak Pointe	0	0	1	0	0	2	0	2	0	0	0	0	5
Olney	0	0	0	0	0	0	0	0	0	0	0	1	1
Omar	0	1	0	0	0	0	0	0	0	0	0	0	1
Ovilla	0	0	0	0	0	0	2	0	0	0	0	0	2
Paloma Creek	0	0	1	2	0	0	0	0	0	0	0	0	3
Pampa	5	0	0	0	0	0	0	0	1	0	1	0	7
Panhandle	0	0	0	0	0	1	0	0	0	0	0	0	1
Pantego	0	1	1	0	0	2	0	0	0	2	1	0	7
Paris	0	0	0	0	1	0	0	0	0	0	0	0	1
Parker	3	2	1	2	1	0	1	0	3	1	3	0	17
Pilot Point	0	0	1	0	0	0	0	0	0	0	0	0	1
Piney Point	0	0	0	0	0	0	0	0	1	0	0	0	1
Plano	21	52	43	66	45	40	91	42	42	55	30	47	574
Ponder	1	3	2	0	0	0	2	0	0	0	0	0	8
Porsper	0	0	0	0	0	0	0	0	0	1	0	1	2
Portland	6	2	5	8	5	4	2	5	2	2	0	0	41
Post Oak Bend	0	0	0	0	1	0	0	0	0	0	0	0	1
Princeston, TX	0	0	0	1	0	0	0	0	0	0	0	0	1
Princeton	8	12	14	16	18	13	7	6	4	11	3	45	157
Prnceton	0	1	0	0	0	0	0	0	0	0	0	0	1
Prosper	1	4	9	0	1	1	8	12	5	12	8	13	74
Prosper	0	0	0	3	0	0	0	0	0	0	0	0	3
Providence	6	13	14	30	13	27	11	5	14	11	13	6	163
Quinlan	0	0	1	0	2	0	1	0	0	0	0	0	4
Red Oak	1	2	9	1	3	1	0	0	0	1	0	0	18
Reno	0	0	0	0	0	0	0	0	0	0	1	0	1
Rhome	0	0	0	0	0	0	0	0	3	0	0	0	3
Richardon	0	4	0	0	0	0	0	0	0	0	0	0	4
Richardson	21	29	19	9	9	25	11	3	2	15	14	8	165
Richland Hills	0	0	0	0	0	0	0	2	0	0	0	0	2
Rio Grande City	0	2	0	0	0	0	0	0	0	0	0	0	2
Roanoke	0	0	0	0	1	7	10	0	2	2	29	9	60
Roanoke Tx.	0	0	0	0	0	0	0	0	0	0	0	5	5
Rockwall	23	43	32	59	33	21	29	30	22	31	19	6	348
Rockwall County	0	0	0	0	0	0	0	0	0	0	0	1	1
Rowlett	4	5	5	4	3	1	2	32	4	7	2	6	75
Royce City	0	0	0	0	0	0	0	0	0	0	0	1	1
Royce City	5	8	2	1	0	1	1	1	2	0	0	0	21
Roysce City	3	0	0	0	0	0	0	0	0	0	0	0	3

Figure 32: Cities Generating Certificates in 2013 (Continued)

Royse City	15	70	27	21	44	10	14	10	1	0	0	22	234
Royse City	0	0	0	0	0	0	0	0	0	7	6	0	13
Royse City tx	0	0	0	0	0	0	0	5	0	5	0	2	12
Runaway Bay	1	0	1	0	11	0	0	20	2	0	0	0	35
Sachse	5	2	1	3	2	3	8	14	3	4	2	3	50
Saginaw	3	0	1	0	0	4	0	3	0	0	5	3	19
San Antonio	1	0	5	5	3	3	5	2	12	1	2	0	39
San Angelo	0	0	0	0	0	3	2	0	0	0	0	0	5
San Antnoio	0	1	0	0	2	2	0	0	0	1	2	0	8
San Antoni	0	0	1	0	0	0	0	0	0	0	0	0	1
SAN ANTONIO	287	125	170	301	0	173	68	149	179	137	129	119	1837
San Antonio	0	0	0	0	136	0	0	0	0	0	0	0	136
San Antonio,	0	0	0	0	0	1	0	0	0	0	1	0	2
Sanger	12	1	0	29	16	5	3	3	2	3	0	5	79
Sanger	0	0	10	0	0	0	0	0	0	0	0	0	10
Savannah	8	16	10	3	3	3	0	1	1	10	11	0	66
Schertz	0	0	0	5	1	0	2	12	7	14	6	9	56
Schertz	4	11	2	0	0	0	0	0	0	0	0	0	17
Seagoville	1	4	0	5	1	11	32	0	2	0	4	14	74
Seguin	0	0	0	1	0	0	0	0	0	0	0	1	2
Selma	2	0	1	0	4	2	0	0	2	0	0	0	11
Seymour	0	0	0	0	0	0	0	0	0	0	2	0	2
Shady Shores	0	0	2	0	0	1	0	1	0	0	0	0	4
Sheman	0	0	0	0	0	0	0	0	0	0	1	0	1
Shendandoah	0	0	2	0	0	0	0	0	0	0	0	0	2
Sherman	0	6	0	1	0	2	3	9	2	0	0	2	25
Silver Ridge	0	0	1	0	0	0	0	0	0	0	0	0	1
South Houston	0	0	2	0	0	0	0	0	0	0	0	0	2
South Lake	0	0	1	0	0	0	0	1	0	0	1	0	3
South Lake	3	0	0	0	0	0	0	0	0	0	0	0	3
Southlake	19	11	29	27	32	14	23	15	29	15	7	7	228
Southlake, TX	0	0	0	0	0	0	0	0	0	0	0	2	2
Spicewood	0	0	0	0	0	0	25	3	0	0	7	0	35
Spring	0	0	0	0	0	0	0	1	0	0	0	0	1
Spring Branch	0	0	0	0	0	1	0	0	0	0	2	0	3
Spring Branch	0	0	0	0	0	0	0	0	0	0	0	1	1
Springtown	0	0	0	0	0	0	0	0	0	0	0	1	1
St. Paul	0	0	0	0	0	0	0	0	0	0	0	1	1
Sugar Land	0	0	0	0	2	0	0	0	0	0	4	0	6
Sugarland	3	3	6	5	1	3	4	1	3	3	1	1	34
Sunnyvale	2	0	2	8	0	1	1	2	3	0	2	0	21
Sunnyvale	0	0	0	0	14	0	0	0	0	3	0	2	19
Terrell	0	0	0	3	3	1	0	1	0	11	25	0	44
test	2	0	0	0	0	0	0	0	0	0	0	0	2
Texas City	0	0	0	0	0	0	0	0	0	0	1	0	1
THE COLONY	2	1	1	2	1	3	2	8	3	1	4	3	31

Figure 32: Cities Generating IC3 Certificates in 2013 (Continued)

The Woodlands	0	0	0	0	0	0	0	0	4	2	2	1	9
TIOGA	0	1	2	0	0	0	2	0	0	0	0	0	5
Trophy Club	43	29	41	25	29	10	46	25	15	12	19	17	311
Tuscola	0	0	0	0	0	1	0	0	0	0	0	0	1
Tyler	0	0	0	0	0	2	0	0	0	2	0	0	4
Univeristy Park	0	0	0	0	0	1	0	0	0	0	0	0	1
University Park	2	12	10	11	6	5	5	2	13	14	8	4	92
Univesity Park	0	0	0	0	0	0	0	0	0	1	0	0	1
Van Alstyne	1	6	7	12	14	3	1	2	4	0	1	3	54
VanAlstyne	0	0	0	0	0	0	0	0	0	0	0	1	1
Venus	2	0	0	3	2	4	3	0	5	2	5	0	26
Waco	0	0	0	1	0	0	0	0	0	0	0	0	1
Watauga	0	0	0	0	0	0	0	0	0	0	1	0	1
Waxachie	0	2	4	1	0	2	0	1	1	0	8	3	22
Waxahachie	11	8	0	0	2	4	8	16	1	7	11	1	69
Waxahachie	0	0	9	1	0	0	0	0	0	0	0	0	10
Weaherford	2	0	1	0	0	1	1	1	0	1	0	0	7
Weatherford	0	0	3	0	3	2	7	4	9	0	13	1	42
Webster	0	0	0	0	0	0	1	0	0	0	0	1	2
West University	0	1	5	2	2	0	0	0	0	0	0	0	10
Westlake	1	0	3	1	7	3	5	9	6	4	6	1	46
Weston	0	0	0	0	0	0	1	0	0	0	0	0	1
Westover Hills	1	0	0	0	0	0	0	0	0	0	0	0	1
Westworth Village	0	0	0	0	0	0	0	0	0	2	0	0	2
White Settlement	0	0	0	0	0	0	3	0	0	0	0	0	3
Wichita Falls	8	7	0	4	0	5	4	5	4	2	0	12	51
Wichita Falls	0	0	0	0	3	0	0	0	0	0	0	0	3
Willow Park	0	0	0	0	4	0	0	0	0	0	0	3	7
Wilmer	0	0	0	0	0	0	0	3	0	0	0	12	15
Wylie	16	25	35	23	15	16	13	12	15	16	10	16	212

Figure 32: Cities Generating IC3 Certificates in 2013 (Continued)

Cities Generating Multi-Family IC3 Certificates in 2013

													Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0	0	0	0	0	0	0	0	0	0	4	0	4
Austin	0	1	3	2	1	0	2	1	1	1	5	2	19
Benbrook	0	0	0	0	0	0	0	0	0	2	0	6	8
Burleson	0	0	3	0	0	0	0	0	0	0	0	0	3
College Station	1	0	0	0	0	2	1	0	0	0	0	0	4
Dallas	17	0	0	1	5	4	25	5	0	8	0	24	89
Fort Worth	12	0	0	2	4	16	4	3	0	22	0	2	65
Greenville	0	0	0	7	0	0	0	0	0	0	0	0	7
houston	14	0	0	0	0	2	0	0	0	0	0	0	16
Keller	2	0	0	0	5	0	0	0	1	0	0	0	8
McKinney	0	0	6	0	0	0	0	0	0	0	0	0	6
Princeton	0	0	0	0	0	0	0	0	0	0	0	7	7
San Antonio	0	0	0	0	0	0	11	14	0	0	0	0	25
Sherman	0	3	0	0	0	0	0	0	0	0	0	0	3
Southlake	0	0	0	4	0	4	0	0	0	0	0	0	8
University Park	0	0	1	0	0	0	0	0	0	0	0	0	1

Figure 32: Cities Generating IC3 Certificates in 2013 (Continued)

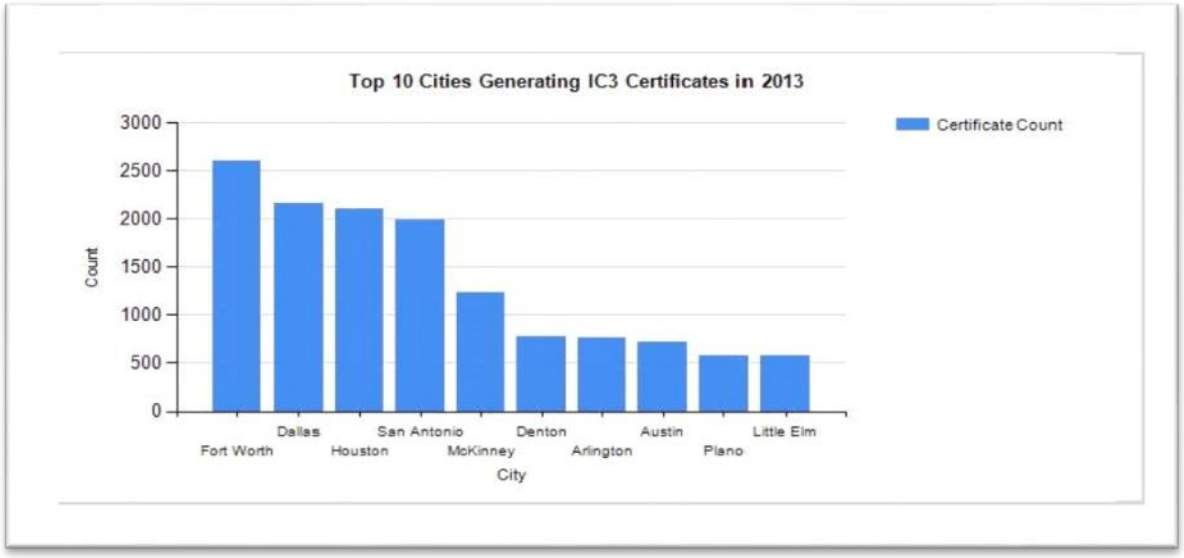
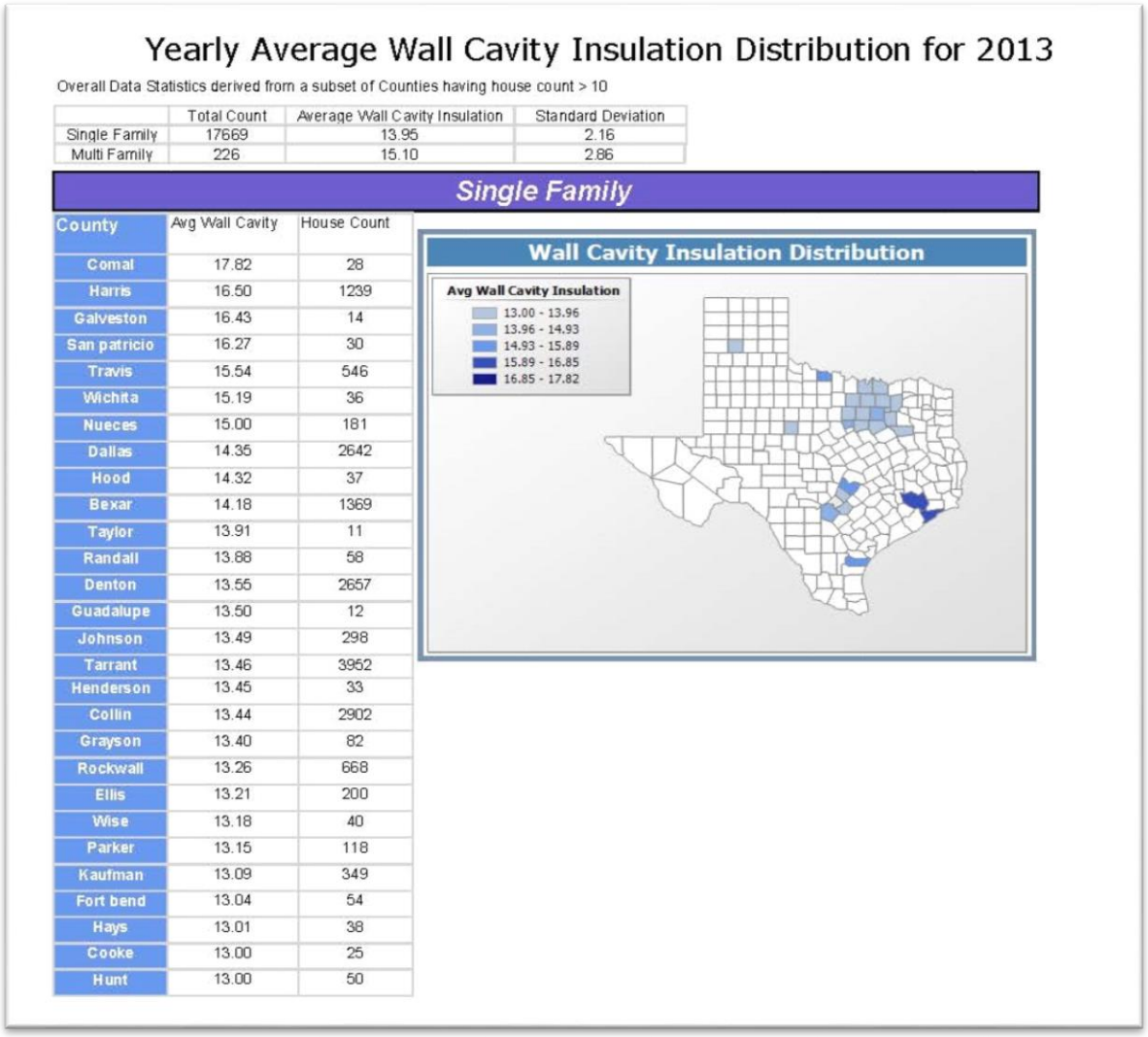


Figure 33: Top 10 Cities Generating Certificates in 2013

6.1.4 Parameter Reports

A unique and valuable use of the Registry is to look at building trends across the state.



Yearly Average Wall Cavity Insulation Distribution for 2013

Overall Data Statistics derived from a subset of Counties having house count > 10

	Total Count	Average Wall Cavity Insulation	Standard Deviation
Single Family	17669	13.95	2.16
Multi Family	226	15.10	2.86

Single Family

County	Avg Wall Cavity	House Count
Comal	17.82	28
Harris	16.50	1239
Galveston	16.43	14
San patricio	16.27	30
Travis	15.54	546
Wichita	15.19	36
Nueces	15.00	181
Dallas	14.35	2642
Hood	14.32	37
Bexar	14.18	1369
Taylor	13.91	11
Randall	13.88	58
Denton	13.55	2657
Guadalupe	13.50	12
Johnson	13.49	298
Tarrant	13.46	3952
Henderson	13.45	33
Collin	13.44	2902
Grayson	13.40	82
Rockwall	13.26	668
Ellis	13.21	200
Wise	13.18	40
Parker	13.15	118
Kaufman	13.09	349
Fort bend	13.04	54
Hays	13.01	38
Cooke	13.00	25
Hunt	13.00	50

Figure 34: Average Wall Cavity Insulation by County 2013

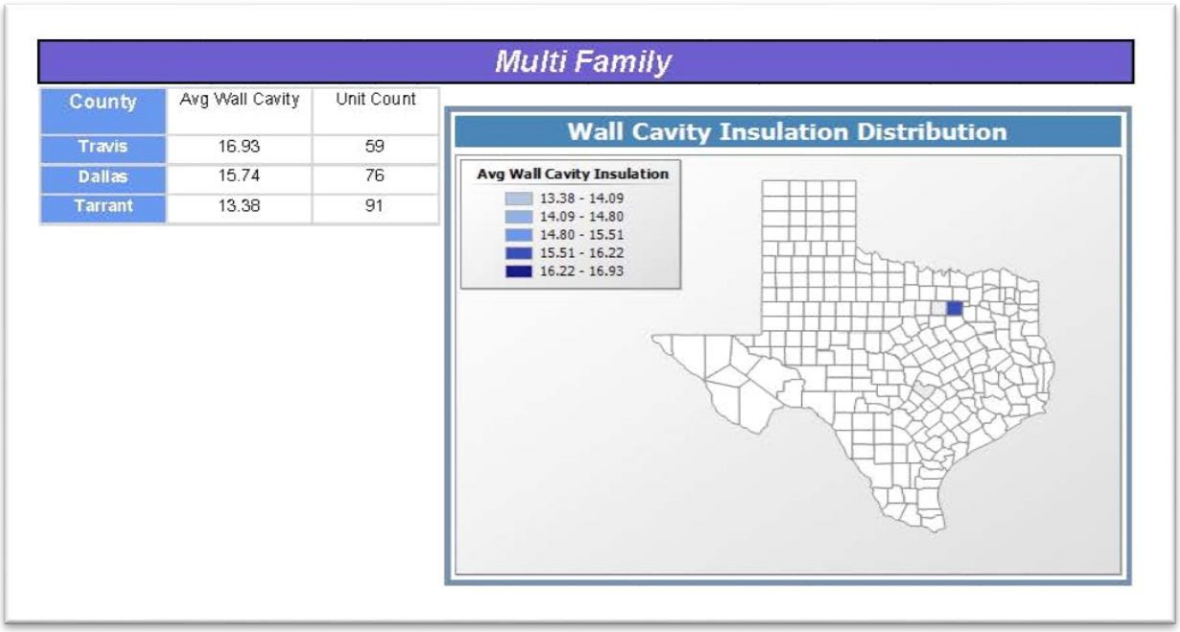


Figure 34: Average Wall Cavity Insulation by County 2013 (Continued)

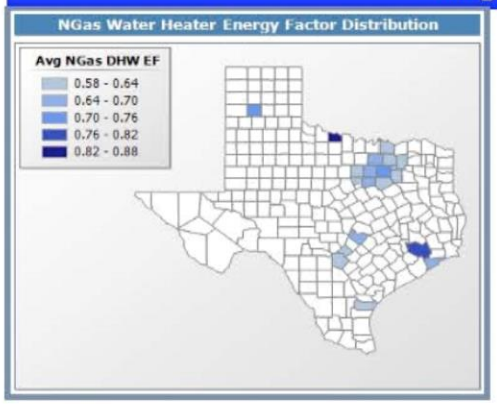
Yearly Average Water Heater Energy Factor Distribution for 2013

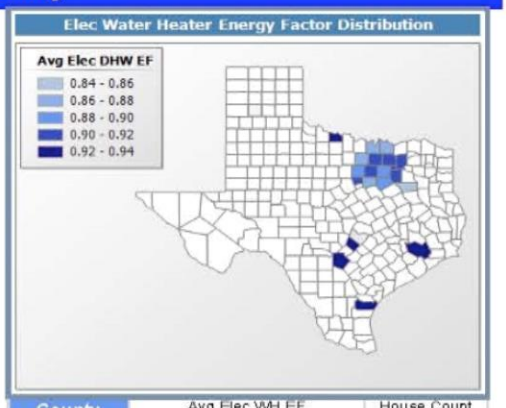
Overall Data Statistics derived from a subset of Counties having house count > 10

	Total Count	Average NGas EF	Standard Deviation
Single Family	5545	0.90	0.05
Multi Family	126	0.74	0.16

	Total Count	Average Elec EF	Standard Deviation
Single Family	12138	0.68	0.12
Multi Family	112	0.86	0.10

Single Family

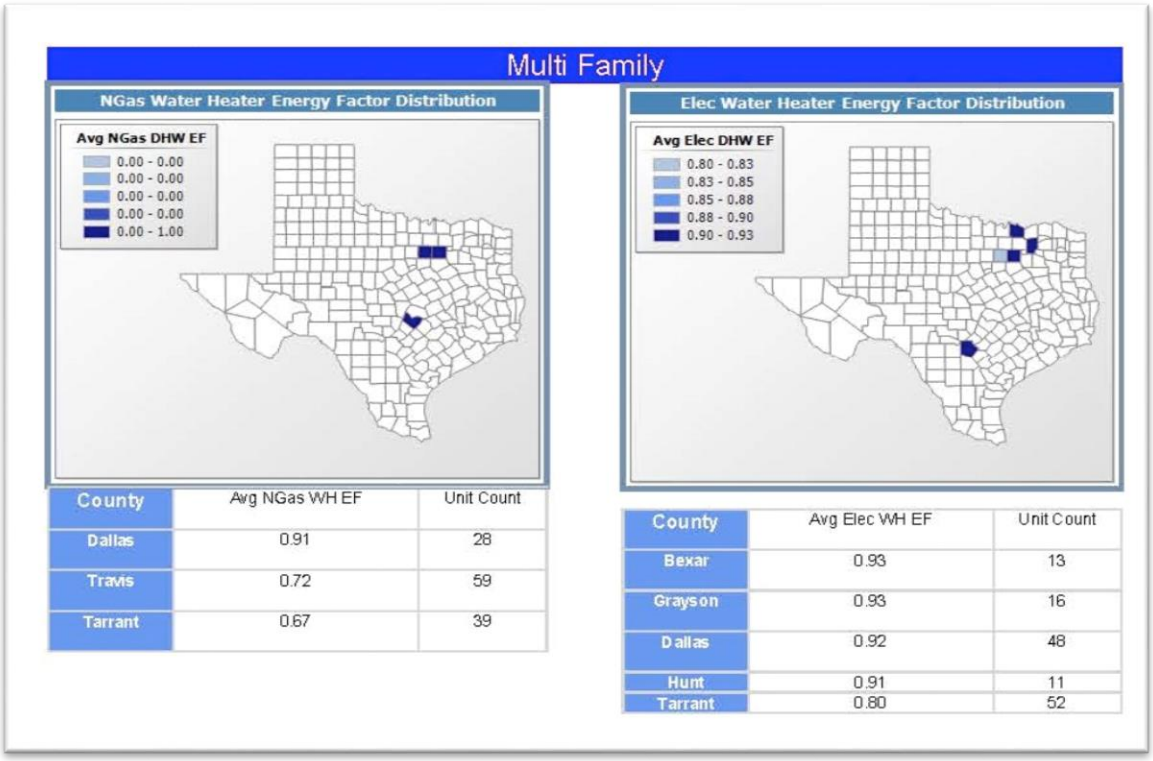




County	Avg NGas WH EF	House Count
Wichita	0.88	24
Fort bend	0.82	54
Harris	0.81	1160
Randall	0.72	40
Dallas	0.71	1942
Tarrant	0.70	1701
Travis	0.69	468
Galveston	0.68	13
Johnson	0.68	76
Denton	0.65	1622
Grayson	0.64	67
Hood	0.63	22
Bexar	0.63	1293
Collin	0.63	2449
Kaufman	0.62	306
Parker	0.62	62
Ellis	0.62	105
Comal	0.62	25
Rockwall	0.61	536
Hunt	0.60	16
Nueces	0.58	119

County	Avg Elec WH EF	House Count
Travis	0.94	78
Hays	0.93	37
Bexar	0.93	76
San Patricio	0.93	26
Nueces	0.93	62
Harris	0.93	79
Wichita	0.92	12
Hunt	0.92	34
Hood	0.91	15
Kaufman	0.91	43
Denton	0.91	1035
Collin	0.91	453
Rockwall	0.90	132
Tarrant	0.90	2251
Ellis	0.90	95
Parker	0.90	56
Dallas	0.89	700
Johnson	0.88	222
Wise	0.88	37
Grayson	0.88	15
Cooke	0.87	21
Henderson	0.85	32
Randall	0.84	18

Figure 35: Average Water Heater Efficiencies 2013



County	Avg NGas WH EF	Unit Count
Dallas	0.91	28
Travis	0.72	59
Tarrant	0.67	39

County	Avg Elec WH EF	Unit Count
Bexar	0.93	13
Grayson	0.93	16
Dallas	0.92	48
Hunt	0.91	11
Tarrant	0.80	52

Figure 35: Average Water heater Efficiencies 2013 (Continued)

This report shows both natural gas and electric water heater efficiencies across Texas in 2013.

Average Window to Wall Area Ratio across Counties for 2013

Overall data Statistics derived from a subset of Counties having house count > 10

	Average	Standard Deviation
Single Family	11.89	3.73
Multi Family	18.06	7.94

Single Family

County	Avg Window To Wall Area	House Count
Comal	18.25	28
Galveston	14.61	14
Bexar	13.57	1369
Ellis	13.50	200
Fort bend	13.07	54
Guadalupe	12.34	12
Dallas	12.32	2642
Henderson	12.22	33
Rockwall	12.12	668
Travis	12.08	546
Denton	11.97	2657
Hood	11.90	37
Taylor	11.76	11
Tarrant	11.69	3952
Johnson	11.51	298
Collin	11.46	2902
San patricio	11.40	30
Grayson	11.38	82
Hays	11.13	38
Parker	11.11	118
Harris	11.03	1239
Nueces	10.96	181
Wise	10.78	40
Kaufman	10.71	349
Hunt	10.40	50
Randall	9.57	58
Cooke	9.18	25
Wichita	8.40	36

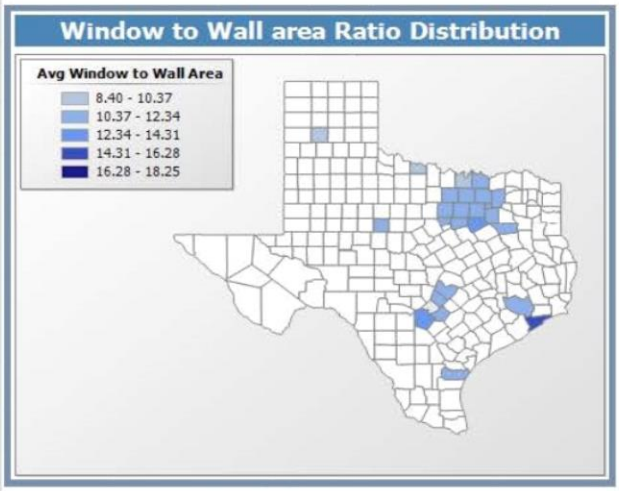


Figure 36: Average Window to Wall Ratio 2013

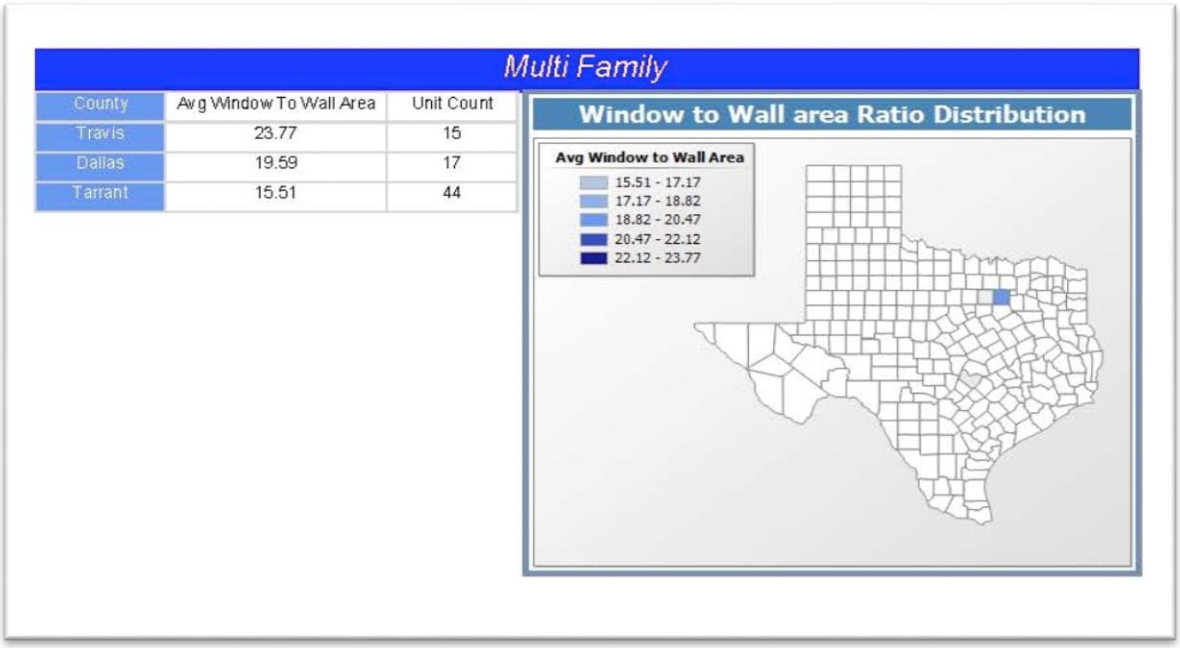


Figure 36: Average Window to Wall Ratio 2013 (Continued)

Here is an analysis of the window to wall ratio across Texas in 2013.
The formula used is: 100 * <total window area sq. ft.> / <total wall area sq. ft.>

Average A/C SEER across Counties for 2013

Overall data Statistics derived from a subset of Counties having house count > 10

	Average	Standard Deviation
Single Family	14.68	1.10
Multi Family	14.55	1.44

Single Family

County	Avg SEER Value	House Count
Fort bend	15.93	54
Comal	15.72	28
Wichita	15.65	36
Travis	15.31	546
Bexar	15.27	1369
Harris	15.23	1239
San patricio	15.10	30
Nueces	15.05	181
Johnson	14.92	298
Henderson	14.75	33
Dallas	14.71	2642
Hunt	14.70	50
Guadalupe	14.67	12
Taylor	14.65	11
Galveston	14.64	14
Collin	14.60	2902
Denton	14.59	2657
Tarrant	14.44	3952
Ellis	14.40	200
Rockwall	14.28	668
Kaufman	14.23	349
Grayson	14.22	82
Hays	14.21	38
Wise	14.19	40
Parker	13.97	118
Hood	13.94	37
Cooke	13.92	25
Randall	13.21	58

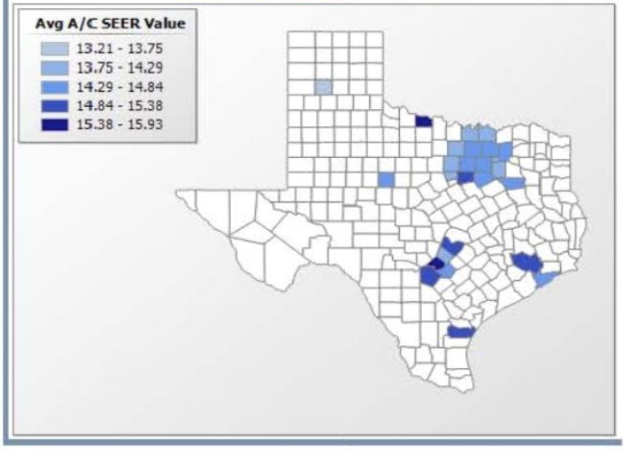


Figure 37: Average SEER 2013

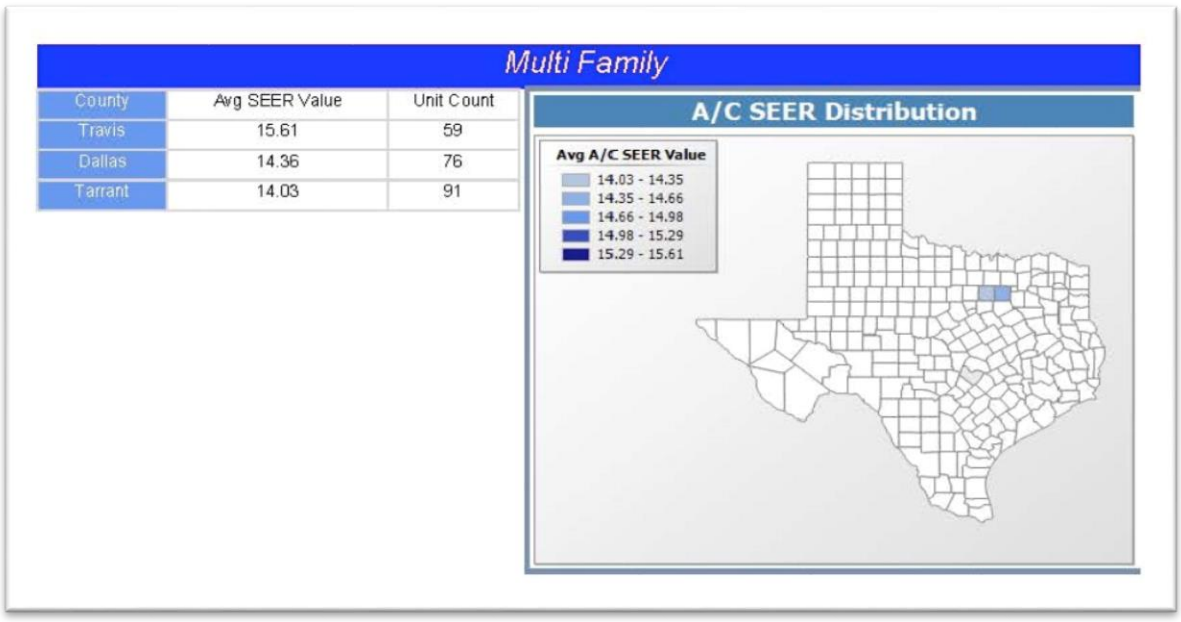


Figure 37: Average SEER 2013 (Continued)

The efficiency (and sizing) of air conditioning is a vital component of energy efficiency in Texas.

Average Ceiling Insulation across Counties for 2013

Overall data Statistics derived from a subset of Counties having house count > 10

	Average	Standard Deviation
Single Family	34.18	5.16
Multi Family	35.02	4.11

Single Family

County	Avg Ceiling Insulation	House Count
Randall	39.93	58
Wichita	38.97	36
Fort bend	37.56	54
Kaufman	37.53	349
Cooke	37.04	25
Hunt	36.72	50
Comal	36.57	28
Rockwall	36.31	668
Grayson	36.05	82
Henderson	35.94	33
Ellis	35.85	200
Guadalupe	35.83	12
Collin	35.80	2902
Travis	34.94	546
Parker	34.92	118
Bexar	34.75	1369
Wise	34.70	40
Denton	34.68	2657
Johnson	34.64	298
Hood	34.54	37
Dallas	34.25	2642
Galveston	32.71	14
Tarrant	32.36	3952
Harris	31.31	1239
San patricio	30.67	30
Nueces	30.00	181
Taylor	29.55	11
Hays	29.47	38

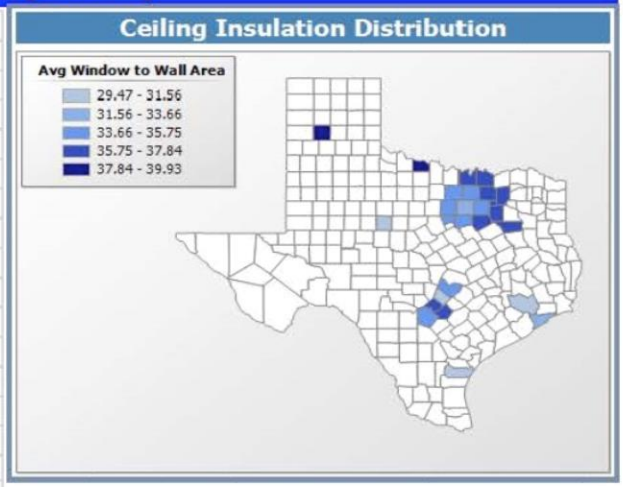


Figure 38: Average Ceiling Insulation 2013

Multi Family

County	Avg Ceiling Insulation	House Count
Travis	38.00	59
Tarrant	35.14	91
Dallas	33.45	76

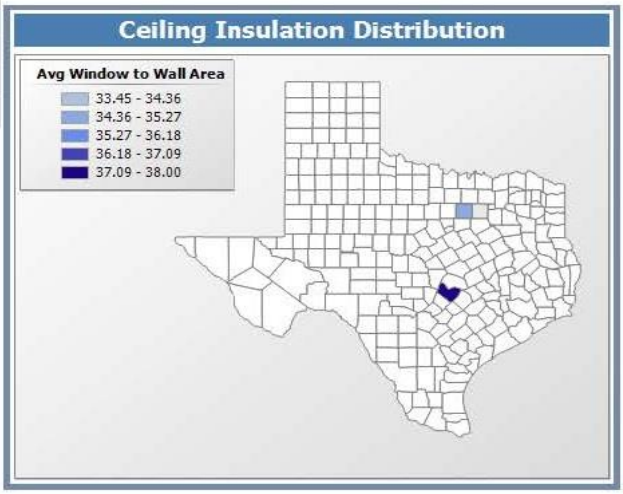


Figure 38: Average Ceiling Insulation 2013 (Continued)

Average Heating Efficiency across Counties for 2013

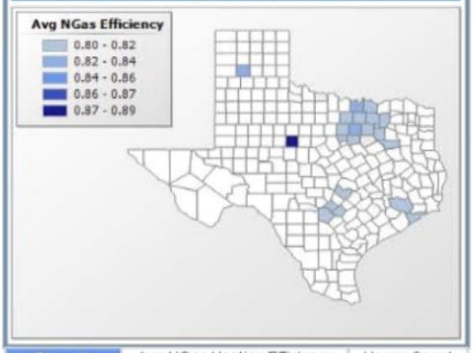
Overall Data Statistics derived from a subset of Counties having house count > 10

	Total Count	Average NGas Efficiency	Standard Deviation
Single Family	11795	0.81	0.04
Multi Family	114	0.81	0.04

	Total Count	Average Heat Pump Efficiency	Standard Deviation
Single Family	5849	8.39	0.62
Multi Family	112	8.47	1.20

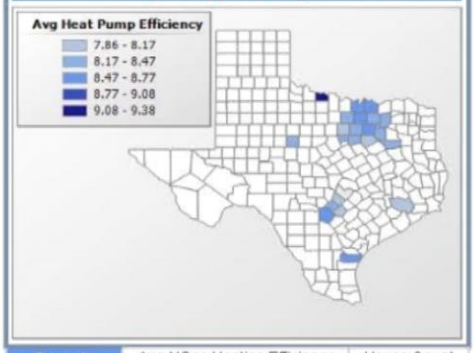
Single Family

NGas Heating Efficiency Distribution



County	Avg NGas Heating Efficiency	House Count
Wichita	0.89	23
Taylor	0.89	7
Cooke	0.83	4
Randall	0.83	34
Tarrant	0.82	1627
Hood	0.82	17
Johnson	0.81	68
Denton	0.81	1618
Dallas	0.81	1870
Harris	0.81	1158
Parker	0.81	58
Galveston	0.81	14
Travis	0.80	469
Collin	0.80	2454
Grayson	0.80	67
Rockwall	0.80	546
Bexar	0.80	1259
Kaufman	0.80	296
Comal	0.80	25
Hunt	0.80	15
Henderson	0.80	1
San patricio	0.80	2
Wise	0.80	1
Guadalupe	0.80	6
Fort bend	0.80	54
Ellis	0.80	102

Heat Pump Heating Efficiency Distribution



County	Avg NGas Heating Efficiency	House Count
Travis	9.38	77
Wichita	9.32	13
Cooke	8.77	21
Nueces	8.70	181
San patricio	8.70	27
Dallas	8.55	762
Bexar	8.54	109
Grayson	8.49	15
Denton	8.47	1038
Comal	8.47	3
Wise	8.44	39
Collin	8.44	448
Kaufman	8.38	53
Taylor	8.38	4
Rockwall	8.37	120
Tarrant	8.29	2318
Henderson	8.25	32
Johnson	8.24	229
Hood	8.23	20
Hunt	8.21	35
Parker	8.17	60
Guadalupe	8.13	6
Hays	8.12	38
Harris	8.10	79
Ellis	8.08	98
Randall	7.86	24

Figure 39: Average Heating Efficiency 2013

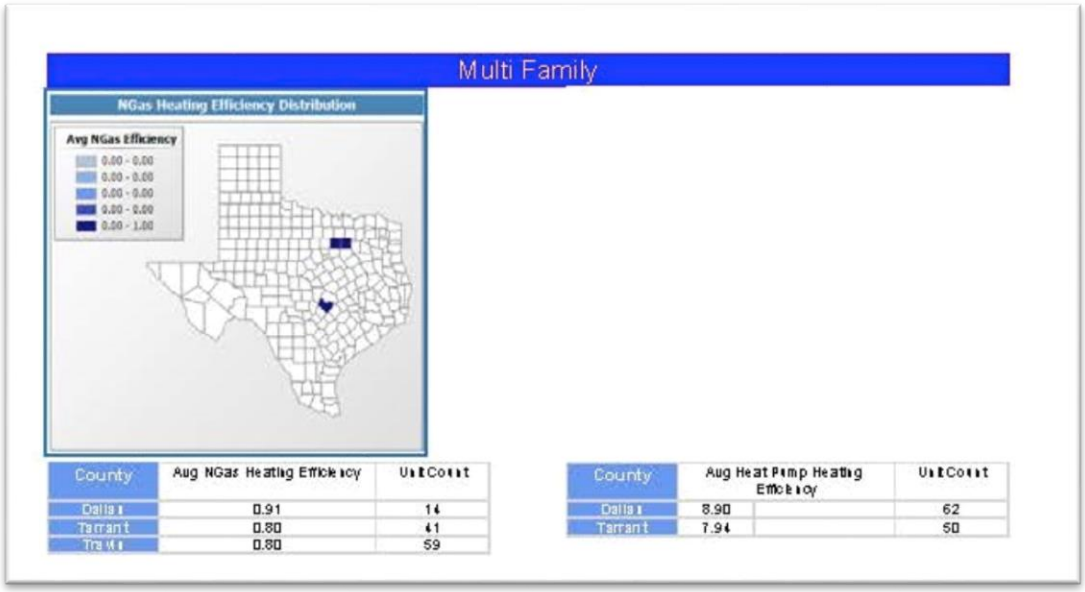


Figure 39: Average Heating Efficiency 2013 (Continued)

Here we examine space heating efficiency in 2013 using both natural gas and heap pump heating.

Average SHGC across Counties for 2013

Overall data Statistics derived from a subset of Counties having house count > 10

	Average	Standard Deviation
Single Family	0.27	0.04
Multi Family	0.25	0.03

Single Family

County	Avg SHGC Value	House Count
Henderson	0.32	33
Hays	0.30	38
Wise	0.29	40
Parker	0.29	118
Wichita	0.28	36
Tarrant	0.28	3952
Cooke	0.28	25
Randall	0.28	58
Rockwall	0.28	668
Dallas	0.27	2642
Galveston	0.27	14
Harris	0.27	1239
Taylor	0.27	11
Ellis	0.27	200
Hood	0.27	37
Johnson	0.26	298
Denton	0.26	2657
Travis	0.26	546
Collin	0.26	2902
Grayson	0.26	82
Kaufman	0.25	349
Hunt	0.25	50
Bexar	0.24	1369
Guadalupe	0.24	12
San Patricio	0.24	30
Nueces	0.23	181
Comal	0.23	28
Fort Bend	0.21	54

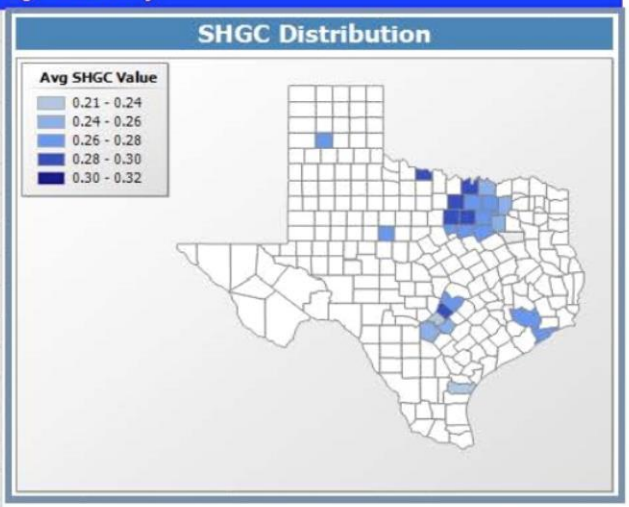


Figure 40: Average SHGC 2013

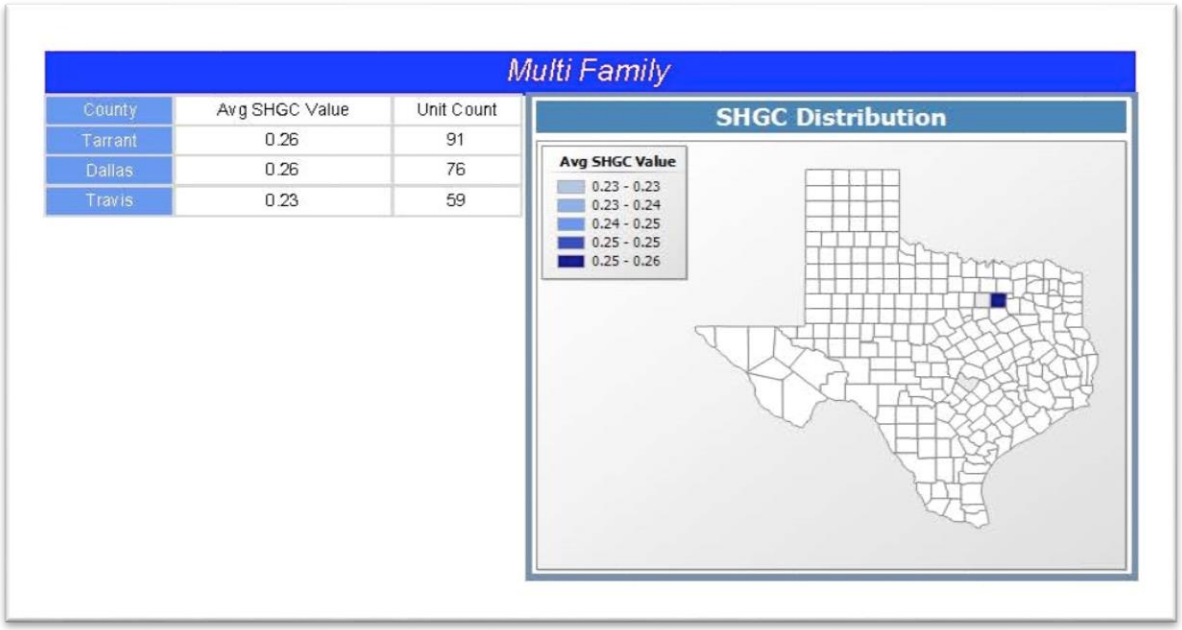


Figure 40: Average SHGC 2012 (Continued)

Average HVAC across Counties for 2013

Overall data Statistics derived from a subset of Counties having house count > 10

	Average	Standard Deviation
Single Family	574.56	149.00
Multi Family	977.85	390.06

Single Family

County	Avg Sqft Tonnage Value	House Count
Travis	726.53	546
Galveston	706.80	14
Nueces	705.57	181
San Patricio	680.78	30
Hays	622.36	38
Taylor	618.90	11
Rockwall	603.35	668
Bexar	599.84	1369
Harris	585.34	1239
Dallas	569.51	2642
Tarrant	565.70	3952
Collin	562.30	2902
Johnson	561.63	298
Denton	559.03	2657
Hood	555.80	37
Wichita	553.24	36
Ellis	542.99	200
Guadalupe	541.64	12
Kaufman	537.20	349
Randall	537.07	58
Grayson	536.70	82
Wise	535.66	40
Parker	525.05	118
Henderson	502.56	33
Cooke	495.90	25
Comal	484.88	28
Fort Bend	468.09	54
Hunt	461.20	50

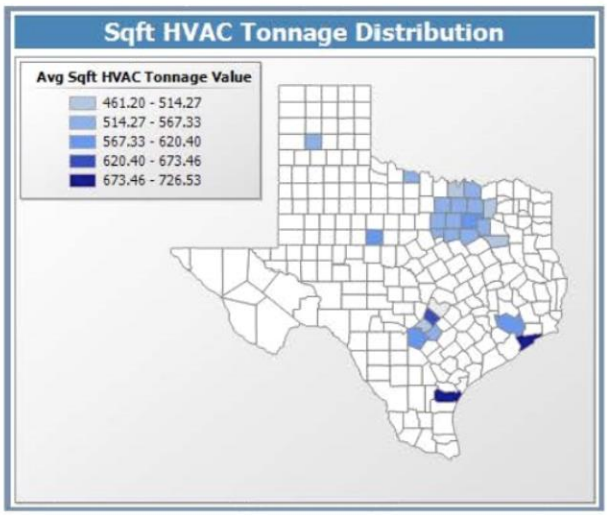


Figure 41: Average HVAC Tonnage to Sq Ft 2013

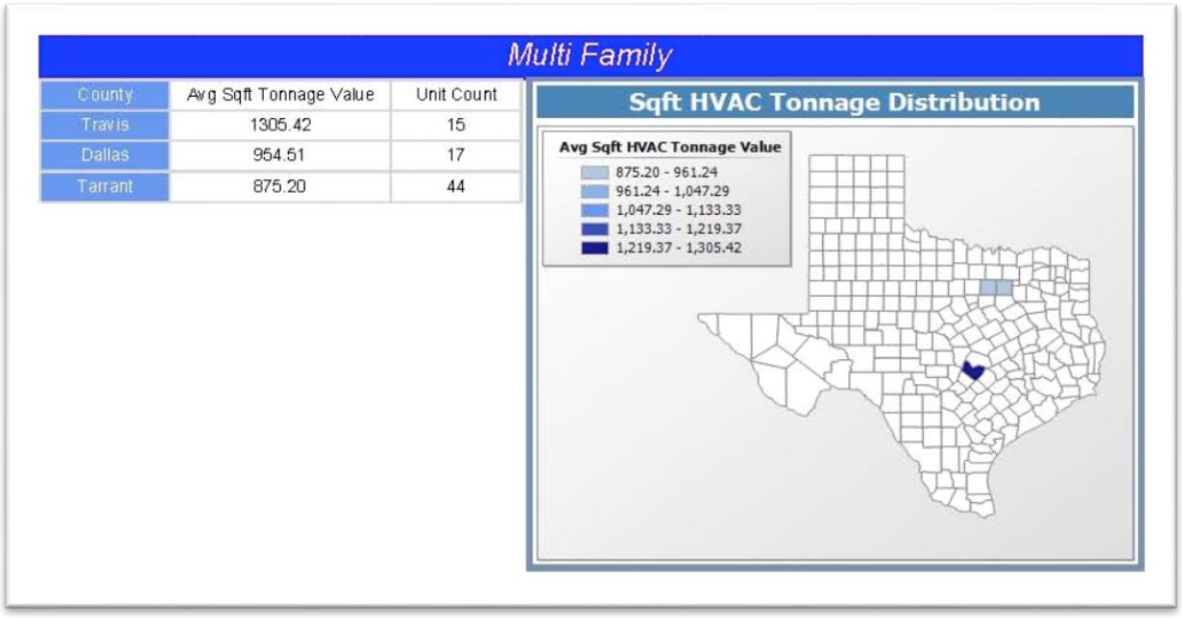


Figure 41: Average HVAC Tonnage to Sq Ft 2013 (Continued)

Another way to evaluate high performing houses is how much air conditioning they have per sq. ft. of house. Here we see ranges, for single family homes, of 475 to 741 sq. ft. per ton with an average of 565 sq. ft. per ton. Last year's average was 558 sq. ft. per ton. Thus, Texas is becoming more efficient.

Average U Factor across Counties for 2013

Overall data Statistics derived from a subset of Counties having house count > 10

	Average	Standard Deviation
Single Family	0.36	0.06
Multi Family	0.36	0.07

Single Family

County	Avg U Factor	House Count
Wise	0.49	40
Hays	0.47	38
Cooke	0.47	25
Henderson	0.40	33
Tarrant	0.37	3952
Harris	0.36	1239
Guadalupe	0.36	12
Ellis	0.36	200
Rockwall	0.36	668
Travis	0.36	546
Bexar	0.36	1369
Kaufman	0.35	349
Denton	0.35	2657
Dallas	0.35	2642
Collin	0.35	2902
Parker	0.35	118
Hood	0.35	37
Hunt	0.35	50
Grayson	0.35	82
Johnson	0.35	298
Comal	0.34	28
Taylor	0.32	11
Wichita	0.32	36
Nueces	0.32	181
San Patricio	0.32	30
Randall	0.31	58
Galveston	0.31	14
Fort Bend	0.30	54

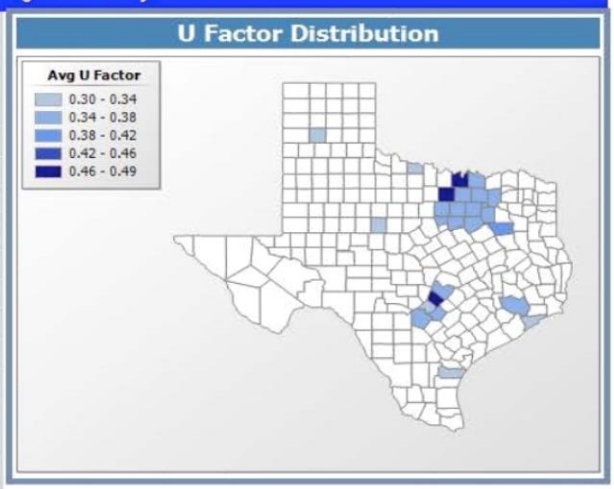


Figure 42: Average U Factor 2013

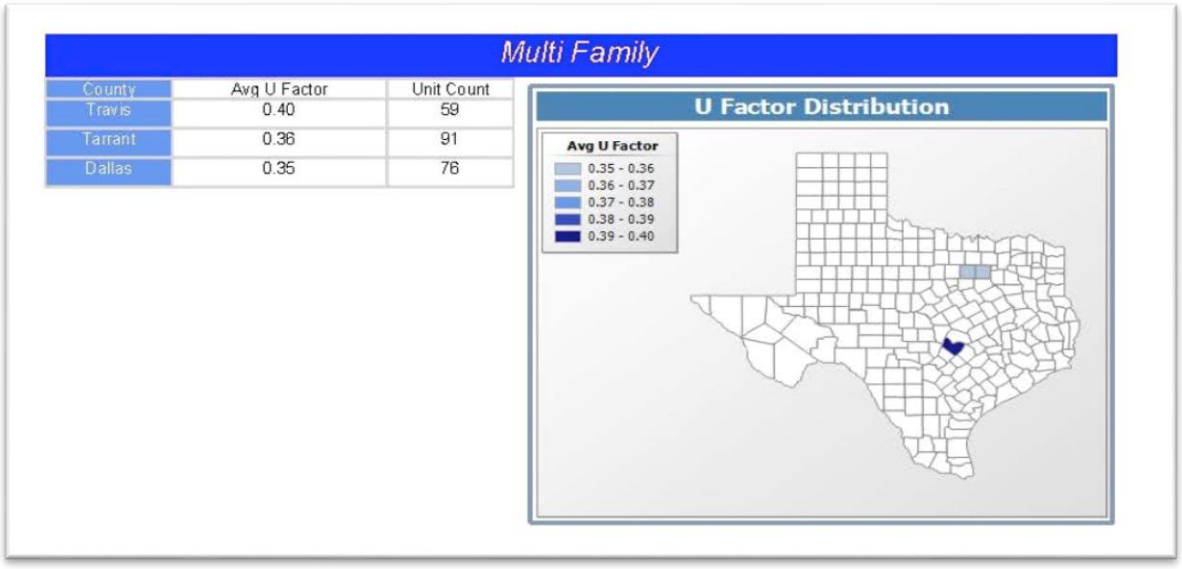


Figure 42: Average U Factor 2013 (Continued)

The U Factor applies to the heat transfer of a window caused by temperature, no direct solar radiation.

6.2 IC3 Enhancements

6.2.1 History of IC3 Enhancements

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

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 3.12.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 3.11 (December 2011)

- Added support for IECC 2009 Austin Amendments

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 3.9.x (October 2010)

- Added slab insulation
- Updated the 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 3.7.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 3.6.2 (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 3.6.1 (December 2009)

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

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

6.2.2 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

Note: Cited BDL code marked in red indicates changes to the described version.

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[44]. 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 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).

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

The heat rate values of 7,700 Btu/hr are adopted from EnergyGauge regardless of the size of the tank[45].

[44] It should be noted that loads from occupants were included in the loads for equipment.
[45] Email correspondence with Jeff Myron, EnergyGauge Technical Support (10/18/2013).

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)[46].

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.

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 2010, the Laboratory redesigned its website to make navigation easier. On the navigation bar is a tab that links to the TERP homepage (Figure 43). The homepage contains the following items:

- Definition of the Texas Emissions Reduction Plan
- Texas Work
  - TERP Objectives
  - TERP Elements
  - ESL's TERP Responsibilities
  - The CATEE Conference
  - Links to
    - Texas Legislative Testimony by the ESL
    - TERP Legislative History
- National Work
  - National Center of Excellence on Displaced Emission Reductions (CEDER)
  - Links to
    - CEDER Program
    - EPA Recognizes ESL and Dallas Partners
- Latest articles and news on the right sidebar

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

- Code Compliance Calculator
  - IC3
    - Help and Support – contains IC3 Help Resources including
      - Supplemental Release Notes
      - What's New in this Version?
      - Manual
      - Detailed Release Notes for current release of IC3
      - Aggregate Reports from IC3 – Location, parameters and maps.
      - Contact information
      - Workshops

[46] 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.

        - FAQ
        - RESNET Certification Resources
            - Report
    - News – includes information about improvements and fixes to IC3 Workshops – description of IC3 Workshops, including contact information
    - FAQs
    - IC3 Reports – contains data from ESL's research and software projects
        - IC3 – Registry House Parameters (updated monthly)
            - Envelope
            - Systems
            - Mixed
        - Texas Building Registry Demographics
            - Texas
            - Counties
            - Cities
            - TCV (Travis County & Austin)
        - Weather Data
- TCV
    - Help & Support – contains TCV Help & Support and contact information
    - News – includes TCV News including
        - What's New in Version 1.1
        - What is the Difference between TCV v1.1 and IC3 v3.x?
    - FAQs
- Other Legacy calculators
    - AIM Calculator
    - eCalc 1.x Calculator
- Credits
- Letters and Reports
    - Legislative Documents
    - Builders Information
    - EPA/CEDER Work
        - Background
        - Reports provided to US EPA as part of CEDER Program
    - Reports – listed by year from 2002-2012
- About
    - Legislative Testimony
    - Legislative Documents
    - Legislative History
- TERP Data Sets
    - Weather Data
    - Texas Building Registry
        - IC3/TCV Usage Reports
        - IC3 House Construction Trends
- TERP Links
    - eCalc Emissions & Energy Calculator
    - International Code Compliance Calculator (ICCC)
    - Public Utility Commission of Texas (PUCT)
    - U.S. Department of Energy (DOE)

  - Texas State 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
  - Texas Home Energy Rating Organization (TxHERO)
- Other Publications
  - Builders Information
  - Digital Library
  - Presentations
  - Proceedings
    - Air Quality (CATEE)
    - Hot & Humid
    - IBPSA
    - ICEBO
    - IETC
- Workshops
  - IC3
  - IECC Residential
  - IECC Commercial
  - ASHRAE

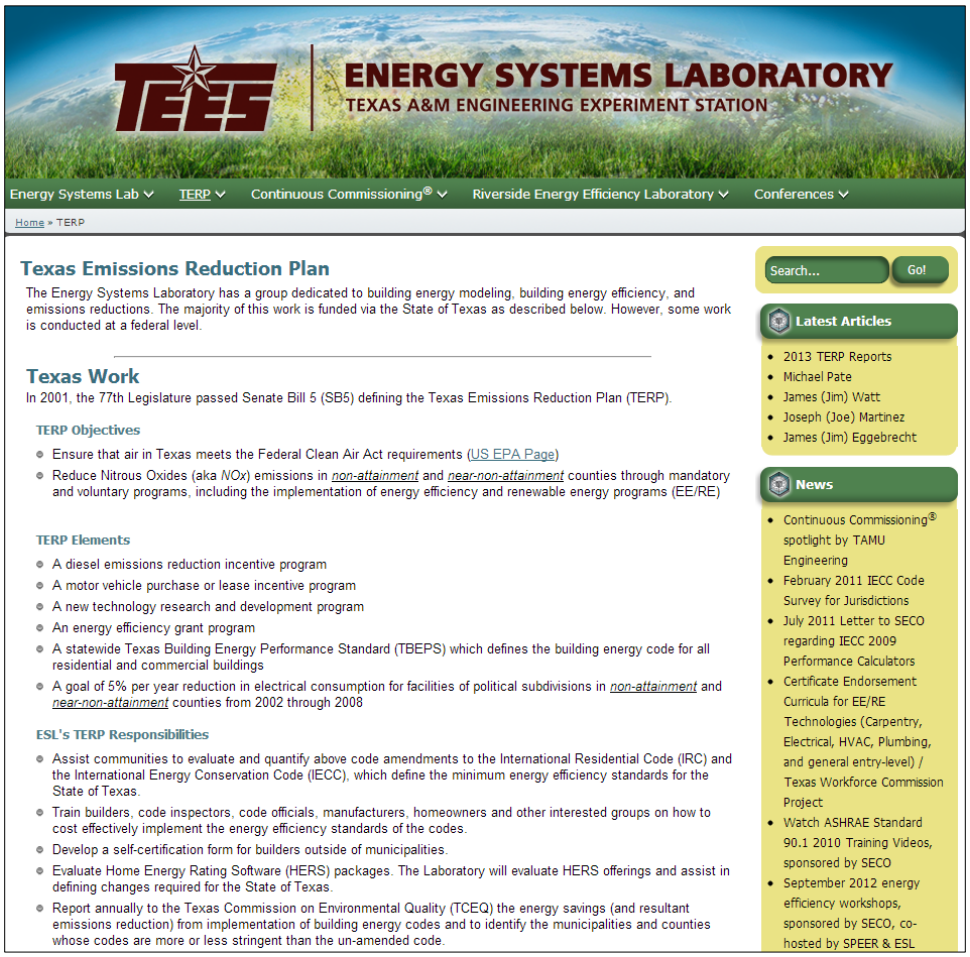


Figure 43. TERP Home Page

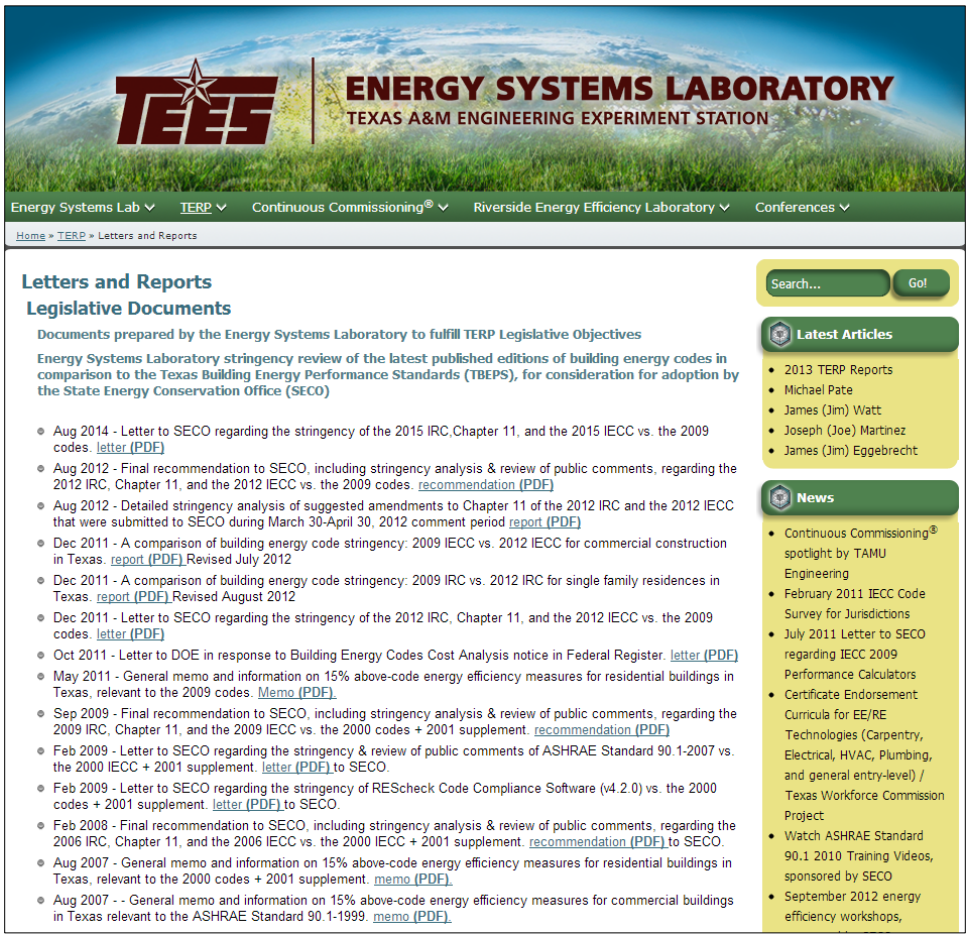


Figure 44: TERP –Letters and Reports

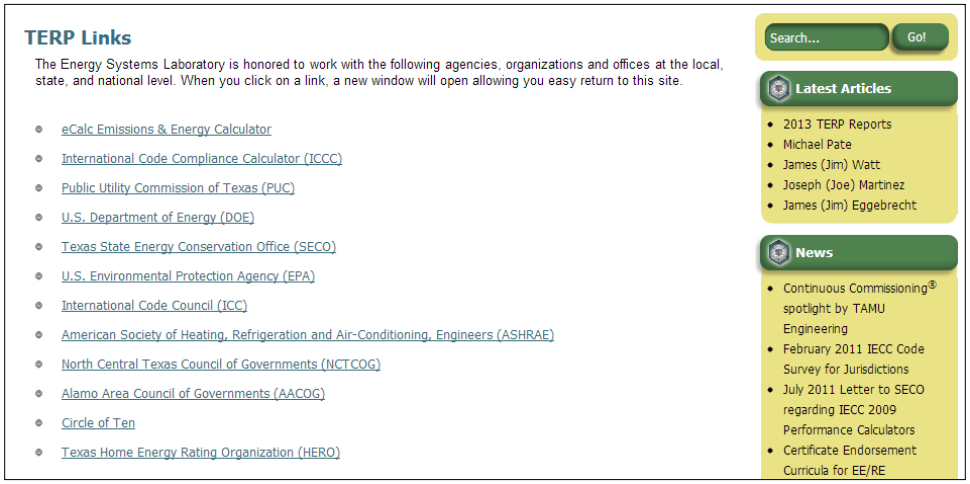
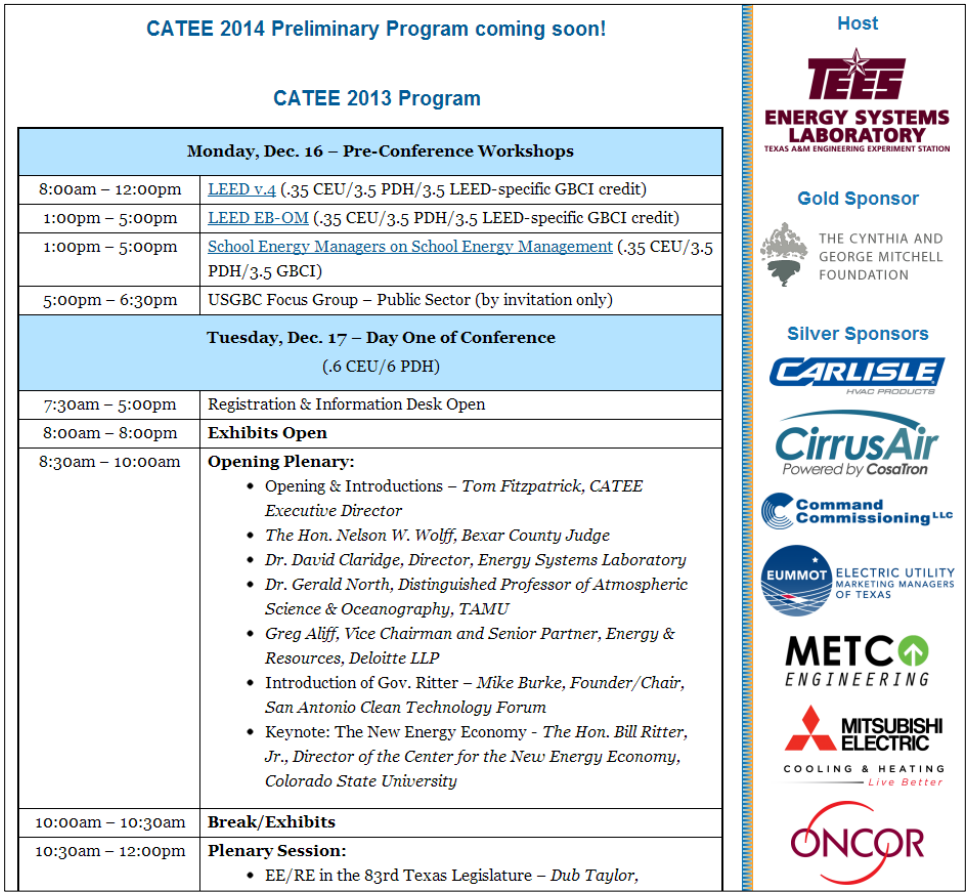


Figure 45: TERP Links

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



CATEE 2014 Preliminary Program coming soon!

CATEE 2013 Program

Monday, Dec. 16 – Pre-Conference Workshops	
8:00am – 12:00pm	LEED v.4 (.35 CEU/3.5 PDH/3.5 LEED-specific GBCI credit)
1:00pm – 5:00pm	LEED EB-OM (.35 CEU/3.5 PDH/3.5 LEED-specific GBCI credit)
1:00pm – 5:00pm	School Energy Managers on School Energy Management (.35 CEU/3.5 PDH/3.5 GBCI)
5:00pm – 6:30pm	USGBC Focus Group – Public Sector (by invitation only)
Tuesday, Dec. 17 – Day One of Conference (.6 CEU/6 PDH)	
7:30am – 5:00pm	Registration & Information Desk Open
8:00am – 8:00pm	**Exhibits Open**
8:30am – 10:00am	**Opening Plenary:** • Opening & Introductions – *Tom Fitzpatrick, CATEE Executive Director* • *The Hon. Nelson W. Wolff, Bexar County Judge* • *Dr. David Claridge, Director, Energy Systems Laboratory* • *Dr. Gerald North, Distinguished Professor of Atmospheric Science & Oceanography, TAMU* • *Greg Aliff, Vice Chairman and Senior Partner, Energy & Resources, Deloitte LLP* • Introduction of Gov. Ritter – *Mike Burke, Founder/Chair, San Antonio Clean Technology Forum* • Keynote: The New Energy Economy - *The Hon. Bill Ritter, Jr., Director of the Center for the New Energy Economy, Colorado State University*
10:00am – 10:30am	**Break/Exhibits**
10:30am – 12:00pm	**Plenary Session:** • EE/RE in the 83rd Texas Legislature – *Dub Taylor,*

Host

ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

Gold Sponsor

THE CYNTHIA AND GEORGE MITCHELL FOUNDATION

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CARLISLE HVAC PRODUCTS

CirrusAir Powered by CosaTron

Command Commissioning LLC

EUMMOT ELECTRIC UTILITY MARKETING MANAGERS OF TEXAS

METCO ENGINEERING

MITSUBISHI ELECTRIC COOLING & HEATING Live Better

ONCOR

Figure 46: CATEE Conference

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 and 2011 by the Laboratory, PUC, SECO, and Wind-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 2009 IECC, and developed 2012 code workshops.

In 2013, the Laboratory provided 2009 code trainings at the two BPI annual conferences, and a 2012 code training in El Paso.

The total number of workshops held by the Energy Systems Laboratory for the year 2013 was six with 156 participants.

Table 34: List of all short courses/workshops conducted in 2013

Short Courses/Workshops				
Course Title	**Description**	**Date**	**Location**	**Attendance**
2009 IECC – Commercial Provisions	Full Day training	3/4/2013	Houston, TX (13th Annual Building Professional Institute)	16
2009 IECC – Residential Provisions	Full Day training	3/5/2013	Houston, TX (13th Annual Building Professional Institute)	10
ASHRAE Standard 90.0-2007 with 2010 Previews	Full day training	5/20/2013	UT Arlington (21st Building Professional Institute)	20
2009 IECC Commercial Provisions	Full day training	5/21/2013	Arlington, TX (21th Annual Building professional Institute)	25
2009 IECC Residential Provisions	Full day training	5/22/2013	Arlington, TX (21h Annual Building professional Institute)	40
2012 International Energy Conservation Code	Full day training	8/14/2013	El Paso	45

6.4.3 ASHRAE Standard 90.1 Standards Committee Activities

The following paragraphs track the changes and discussion in the ASHRAE 90.1 Standard at the ASHRAE winter conference in Dallas Texas and ASHRAE summer conference in Denver Colorado. Both the conferences took place in 2013.

1) SSPC 90.1 at the ASHRAE Winter Conference in Dallas, Texas, January 26-28, 2013

INTERNATIONAL ENERGY STANDARDS:

Jaap Hoegling, the liaison for this working group proposed an EU Mandate (M480) for CEN to develop the second generation CEN-EPBD standards supporting the implementation of the Energy Performance Buildings Directive (EPBD) Recast. The proposal includes calculated and measured energy ratings, weighted energy savings, passive cooling techniques, and expansion of the procedures to achieve net-zero energy buildings. First phase is proposed to be completed in March 2013; second phase to be complete by mid-2013.

SUBCOMMITTEE REPORTS:

REPORT FROM ENVELOPE SUB-COMMITTEE:

a) Addendum "an", which rewrites entire Appendix C to use a simulation based trade-off approach was discussed. The proposal was to reject comment by a public review commenter, which addressed energy price data. The decision was passed unanimously.
b) Addendum "ba", which adds requirements for door switches to disable or reset mechanical heating or cooling when doors are left open was discussed. The addendum was proposed for public review.
c) Addendum "bb", which updates the building envelope requirements for opaque elements and fenestration was discussed. The addendum also updates the NFRC 301 reference and modifies two metal building roof assemblies.
d) Addendum "bg", which describes requirements for low-E storm window retrofits was passed for public review.

In addition, a new proposal on high speed doors was proposed. Actions on this proposal are to be determined. New definitions in Chapter 3 regarding roof covering, roof recovering and roof membrane were added.

REPORT FROM ECB SUB-COMMITTEE:

a) Addendum 'bm", which requires ASHAE Standard 90.1-2013 is to be targeted at 45% savings compared with version 90.1-2004 was discussed. The committee also discussed responses to commenters on proposed Addendum "bm" .First commenter objects to using 90.1-2004 as baseline for comparison. Reject comment passed 21-5-5. Next commenter, same objections to the 2004 baseline – Vote committee response to "reject" comment passed 23-6-4
b) Vote on "reject" response to first commenter. Passed 21-8-3. Vote on "reject" response to second commenter, Passed 28-2-1.
c) Addendum "ce", which establishes a baseline system type for retail occupancies less than 3 stories in Appendix G was discussed. The committee voted for publication of this addendum with knowledge of unresolved objectors.
d) Addendum "cn", which establishes modeling rules for laboratories with 100% OA in Appendix G was discussed. The committee voted for publication of this addendum with knowledge of unresolved objectors. The committee also voted on responses to commenters.
e) Addendum "bb", which updates the building envelope requirements for opaque elements and fenestration in Standard 90.1-2010 was approved for publication for public review.
f) Addendum "bl", which provides rules for removing fan energy from efficiency metrics when modeling in ECB or Appendix G was passed for publication and public review.

In addition, certain new proposals were discussed. The first new proposal requires reclassifying systems 9 and 10 to be zonal in Appendix G, Table G3.1.1A 'Baseline HVAC System Type'. The proposal was voted for publication for public review. Another new proposal describing assembly spaces in Appendix G was also discussed.

REPORT FROM MECHANICAL SUB-COMMITTEE:

a) Addendum "ba", which has been described in section on notes from the envelope sub-committee was discussed.
b) Addendum "aa" was discussed and approved for 2nd Public Review. The addendum eliminates the dependence on setpoint overlap restrictions, humidification and dehumidification controls, VAV fan control setpoint reset, multiple-zone VAV system ventilation optimization control, hydronic system design and control, and instead specifies hot the system must perform. This requires DDC for systems where controls are needed.
c) Addendum "as", which addressed the avoidance of simultaneous heating and cooling at AHU was discussed. The committee proposed the amendment for publication and public review.
d) Addendum "bo", which requires buildings with service water capacity greater than or equal to 1 MMBtu/hr to have average efficiency of at least 90% was discussed. The addendum updates Table 7.8 (Performance Requirements for Water Heating Equipment) to reflect federal requirements for electric water heaters. The addendum also updates the reference standard for swimming pool water heaters to ASHRAE Standard 146. The committee passed a vote for public review.
e) Addendum "aq", which makes changes to the requirements for fan control for both constant volume and VAV units including extending the fan part load power requirements down to ¼ HP was discussed. The addendum also defines the requirements for integrated economizer control and defines DX unit capacity staging requirements. The committee recommended the addendum for publication and public review.
f) Addendum "bs", which reduces occupancy threshold for demand controlled ventilation from greater than 40 people per 1000 ft2 to equal to or greater than 25 people per 100 ft2 with exemptions for certain occupancies was passed by a voice vote.
g) Addendum "bf", which addresses Section 8.4.2 on automatic receptacle control was voted for public review. The addendum also increases the spaces where plug shutoff control is required. In addition, the addendum also clarifies the application of this requirement for furniture systems, states a labeling requirement to distinguish controlled and uncontrolled receptacles and restricts the use of plug-in devices to comply with this requirement.
h) Addendum "bi", which increases SEER and HSPF requirements for air-cooled commercial air-conditioners and heat pumps below 65,000 Btu/hr was passed for public review. The new values will become effective starting 1/1/2015.
i) Addendum "bp", which describes efficiency requirements for evaporative condensers with ammonia refrigerants was voted for public review.

Several new proposals were discussed. These include proposals for: pump isolation; new elevator standards, which included discussions of elevator energy, ventilation power limitations, standby requirements, lighting and travel energy ratings of freight elevators; energy recovery ventilation standards; automatic water temperature control for boilers.

In addition, several internally generated proposals were discussed. These include: changing efficiency values for air conditioner equipment for computer rooms; water economizers (cooling towers and dry coolers) for data centers; use of fossil fuels for humidification or dehumidification; and reducing limits on hot gas bypass as a means of cooling capacity control.

REPORT FROM LIGHTING SUB-COMMITTEE:

a) Addendum "by", which describes improved lighting control requirements was discussed. Changes were approved for publication and public review.
b) Addendum "bd", which adds more specific requirements for functional testing of lighting controls, specifically, occupancy sensors, automatic time switches and daylighting controls was recommended for publication and public review.

c) Addendum "bv", which reduces the threshold at which skylights and daylighting controls are required for high bay spaces was discussed. Changes resulting from the discussion were recommended for publication and public review.
d) Addendum "bn", which established electric and fuel metering has been send out for public review.
e) Addendum "bh", which proposes modifications to Table 9.6.1 Space-by-Space Lighting Power Density allowances was discussed. A response to a commenter to revise Table 9.6.1, Electrical/Mechanical room, changing LPD to 0.42 w/s.f was prepared. In addition, a footnote was added.
f) Addendum "bk", which eliminates the exemption for wattage used in spaces where lighting is specifically designed for those with age related eye conditions or other medical conditions related to the eye, where special lighting or light levels might be needed was discussed. Section 9.4.2 on Exit Signs was removed. The committee voted on publication and public review of this addendum.
g) Addendum "co.", which describes comprehensive updates of LDPs in Table 9.5.1, Building Area Method was reviewed. Changes in motel/hotel LPD's and manufacturing was also discussed. The committee voted to send the amendment for publication and public review.

A new proposal modifying the LPD in motel and hotel guest rooms was discussed and modifications were proposed to Table 9.6.1.

2) SSPC 90.1 at the ASHRAE Summmer Conference in Denver, Colorado, June 22-24, 2013

Progress Report Indicator report was presented by Bing Liu at Pacific Northwest National Laboratory (PNNL). The report presents the energy and cost savings analysis that the PNNL conducted to measure the potential energy savings of 90.1-2013 relative to 90.1-2004. The analysis is performed for 16 prototype buildings, 17 climate locations, 90.1-2004, 90.1-2007, 90.1-2010 and 90.1-2013 compliant simulation models and EnergyPlus weather files. A total of 22 addenda to the 90.1-2010 code were evaluated. Not all addenda assessed impacted energy savings. When considering whole building energy consumption, the 90.1-2013 showed 26.5% site energy savings over the 90.1-2004 version of the code. When considering energy consumption from regulated loads, the 90.1-2013 showed 33.8% site energy savings over the 90.1-2004 version of the code.

The report also presented impact of '50% concept ideas' components for envelope, lighting, mechanical equipment and performance sections of the code on the resultant energy consumption. When considering whole building energy consumption, combined impact of package savings showed 43.2% site energy savings over the 90.1-2004 version of the code. When considering energy consumption from regulated loads, combined impact of package savings showed 53.2% site energy savings over the 90.1-2004 version of the code.

SUBCOMMITTEE REPORTS:

REPORT FROM ENVELOPE SUB-COMMITTEE:

a) Addendum "a", which specifies the nominal efficiencies for motors are required to be established in accordance with DOE 10 CFR 431 instead NEMA Standards was discussed. The envelope sub-committee chair Len Sciarra made a motion for publication and public review of the addendum.
b) Addendum "ca", which describes the control requirements for heating systems in vestibules was voted for publication with knowledge of unresolved objectors.

In addition, John Hogan presented a newly revised Table 3.1 Heated Space Criteria by climate zone and Section 5.1.2.1 on envelope. Martha VanGeem presented three proposed responses to IECC comments. CE 54, Liner System/Filled Cavity definitions. CE 90, opaque assemblies. CE191, vestibules. PLen Sciarra presented interpretation request regarding a roof underneath a greenhouse.

REPORT FROM MECHANICAL SUB-COMMITTEE:

a) Addendum "ba", which adds requirements for door switches to disable or reset mechanical heating or cooling when doors are left open was passed for publication with knowledge of unresolved objectors.
b) Addendum "bs", which reduces occupancy threshold for demand controlled ventilation from greater than 40 people per 1000 ft2 to equal to or greater than 25 people per 100 ft2 with exemptions for certain occupancies was passed for publication with knowledge of unresolved objectors.

The mechanical sub-committee submitted 42 proposals to the IECC, 29 of which were recommended for approval and 11 were disapproved. Full SSPC approved all the comments, but removed 325 and 326 from the list because they depend on the Lighting sub-committee involvement before comment. In addition, ICC issue (CE258) pertaining to fractional horsepower motors. (C405.8 in IECC) was discussed.

REPORT FROM ECB SUB-COMMITTEE:

a) Addendum "bm", which requires ASHAE Standard 90.1-2013 is to be targeted at 45% savings compared with version 90.1-2004 was passed for publication with knowledge of unresolved objectors.
b) Addendum "ag", which establishes a method for gaining credit in Appendix G for buildings that undergo whole building air leakage testing to demonstrate that they have an air-tight building was passed for publication with knowledge of unresolved objectors.

REPORT FROM LIGHTING SUB-COMMITTEE:

a) Addendum "bh", which proposes modifications to Table 9.6.1 Space-by-Space Lighting Power Density allowances was passed for publication with knowledge of unresolved objectors.
b) Addendum "by"' which reduces the threshold at which skylights and daylighting controls are required for high bay spaces was passed for publication with knowledge of unresolved objectors.

6.5 Solar Test Bench

This section introduces the activities that were carried out to STB during the calendar year of 2013, and the activities summary is listed as follow:

- Regular maintenance,
- Weekly report, and
- Relocation of the STB power outlets.

6.5.1 Solar Test Bench Setup

The whole STB setup was previously described in detail in the 2010 annual report. Thus, no more full description about the STB setup is stated here, but the updated summary table for the installed sensors is presented in Table 35 including the sensor name, make, model, serial number, multiplier, offset, and unit.

Table 35: List of the sensors updated to the end of 2013

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[1]	Licor	Li-cor	PY24908	72.59	NA	W/m^2
6	LICOR[3]	Licor	Li-cor	PY15L25	75.59	NA	W/m^2
7	LICOR[4]	Licor	Li-cor	PY49745	75.03	NA	W/m^2
8	LICOR[5]	Licor	Li-cor	PY 74409	200	NA	W/m^2
9	LICOR[6]	Licor	Li-cor	PY 74438	200	NA	W/m^2
10	LICOR[7]	Licor	Li-cor	PY 74439	200	NA	W/m^2
11	LICOR[8]	Licor	Li-cor	PY 474450	200	NA	W/m^2
12	PSP[1]	Eppley	PSP	13673F3	125.63	NA	W/m^2
13	PSP[2]	Eppley	PSP	16881F3	103.09	NA	W/m^2
14	PSP[3]	Eppley	PSP	35417F3	112.74	NA	W/m^2
16	NIP[1]	Eppley	NIP	14851E6	118.06	NA	W/m^2
15	NIP[2]	Eppley	NIP	16620E6	117.79	NA	W/m^2
17	BW[1]	Eppley	8-48	20226	96.99	NA	W/m^2
18	BW[2]	Eppley	8-48	33886	98.62	NA	W/m^2

6.5.2 2013 STB Activities

6.5.2.1 Regular Maintenance

Every two weeks, the desiccants for PSPs, B&Ws and the junction boxes were replaced, and the used desiccants were recycled. In addition, the alignment for the solar tracker and the shading covers for the B&Ws were checked, and the occurred problems were fixed by restarting the solar tracker and manually adjusting the devices.

6.5.2.2 Weekly Report

The STB data downloaded from the data logger were checked/analyzed every week, and the weekly STB report was generated by comparing the STB data against the NOAA data.

6.5.2.3 STB Power Outlets Relocation

Before relocating the STB power outlets, the power outlet (GFCI) was directly exposed to outdoor. As a result, a fault at the power outlet sometimes occurred due to high humidity (e.g., rain). To resolve the issue of the trip switch, a new junction box containing the power outlets was relocated under the bench.

6.5.3 Future Work Plan

6.5.3.1 Camera Installation

The solar tracker may stop working sometimes due to several known/unknown reasons, and the shading covers occasionally need realignment to perfectly shade the B&Ws as well. To identify causes of devices' malfunction and better maintain them, it is planned to install a camera, which allows to remotely monitor the sensors and devices on the Solar Test Bench. The camera not only needs to be installed close enough for clear observation, but also avoids shading on bench as much as possible.

6.5.3.2 Wire Protection in Mechanical Room

In the mechanical room, some wires are outside the junction boxes. By using conduits, the exposed wires will be rearranged for wire protection.

6.5.4 Acknowledgements

This task could not be completed without the help of many students/staffs among another Dr. Keehan Kim, Dr. Sunglok Do, Ms. Chunliu Mao, Mr. Sukjoon Oh, Ms. Hongyun Zhou, Mr. Yifu Sun, and Mr. Stephen O' Neal from ESL, TAMU. Also the advice of Mr. Tom Kirk from EPPLEY Inc. was well appreciated.

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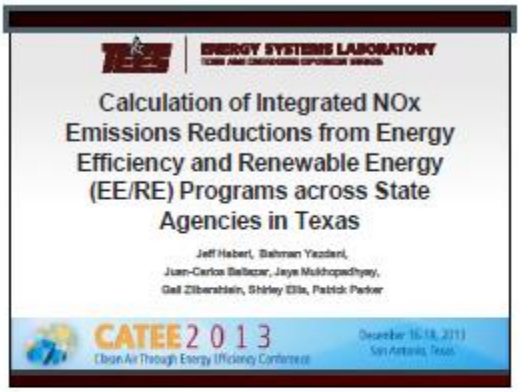
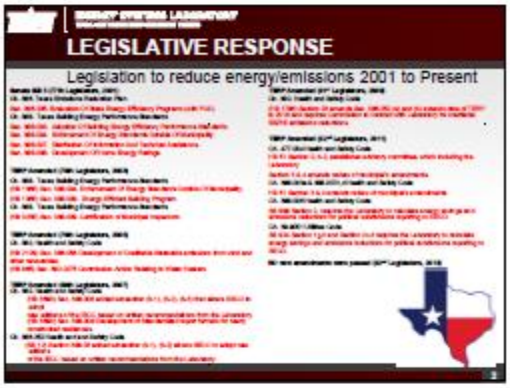
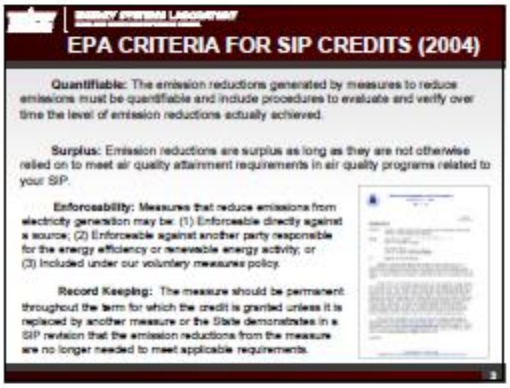
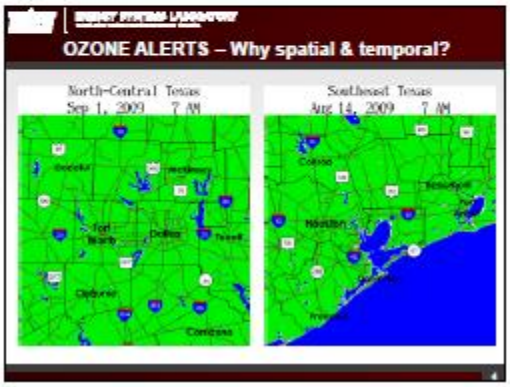
Appendix: Presentations to Various Entities at Conferences and Workshops in 2013

The Energy Systems Laboratory made presentations at several conferences and workshops about ways to save energy, and the appendix shows the presentation slides.

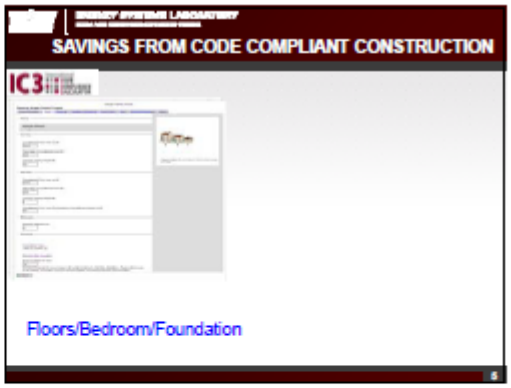








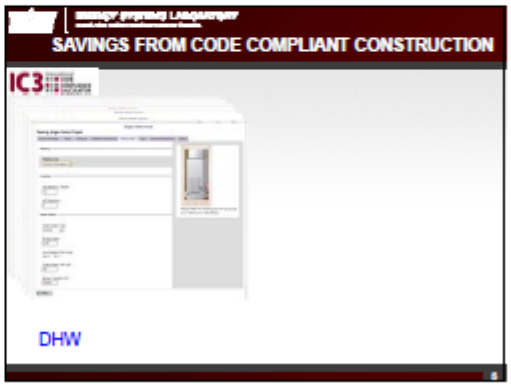
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3
Energy Code/Site Address/ Project Detail


SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3
Floors/Bedroom/Foundation

SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3
Windows

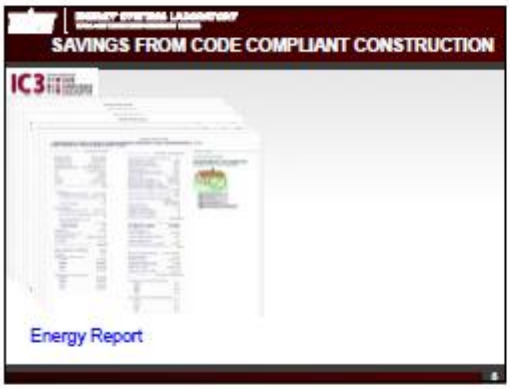
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3
Insulation

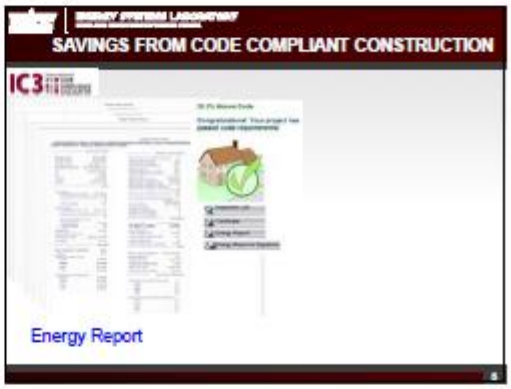
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3
Mechanical System

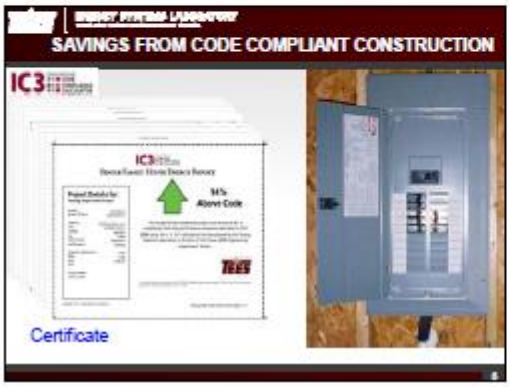

SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3
DHW

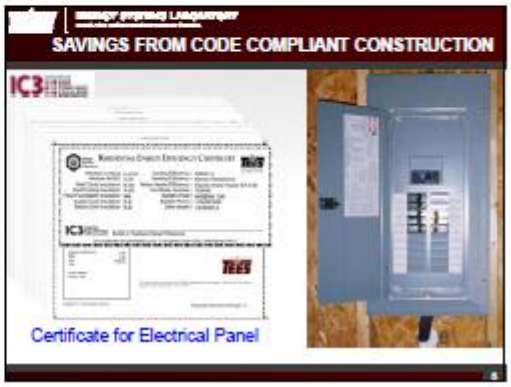
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3
Roof Ceiling

SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3
Shading

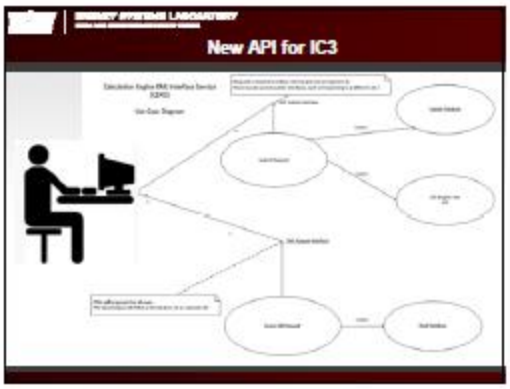

SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3
Energy Report


SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3
Energy Report

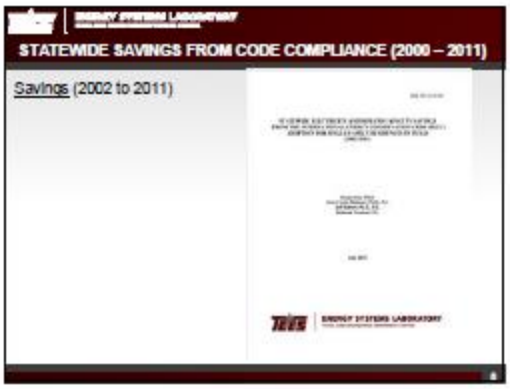

SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3
Certificate


SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3
Certificate for Electrical Panel

IC3 REGISTRATION
Sep. 2012 to Date: 19,706 Certificates
Total to Date : 43,783 Certificates
Top 10 Counties for last 3 years
Average SEER Across Counties


New API for IC3

STATEWIDE SAVINGS FROM CODE COMPLIANCE (2000 – 2011)
How much electricity has been saved from residential code compliance for all single-family housing 2000-2011?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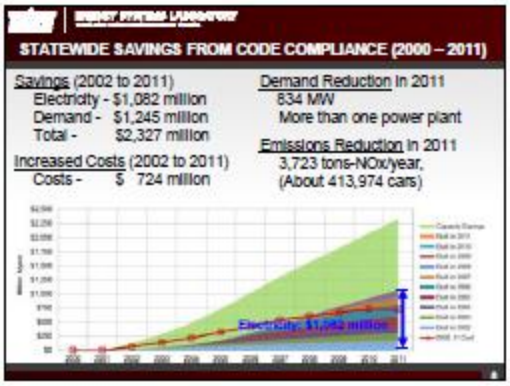
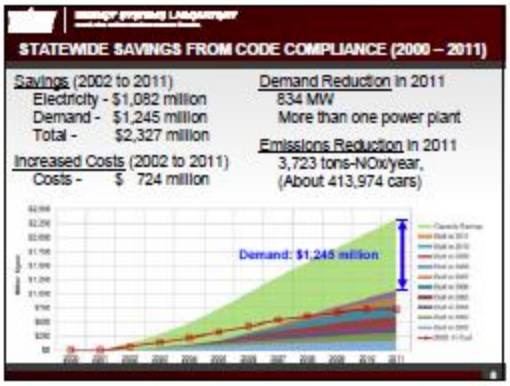
Savings (2002 to 2011)


STATEWIDE SAVINGS FROM CODE COMPLIANCE (2000 – 2011)
Savings (2002 to 2011)
Electricity - $1,082 million
Demand - $1,245 million
Total - $2,327 million
Increased Costs (2002 to 2011)
Costs - $ 724 million
Demand Reduction in 2011
834 MW
More than one power plant
Emissions Reduction in 2011
3,723 tons-NOx/year,
(About 413,974 cars)
Electricity: $1,082 million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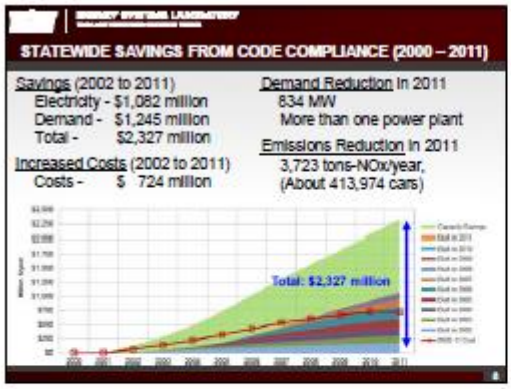
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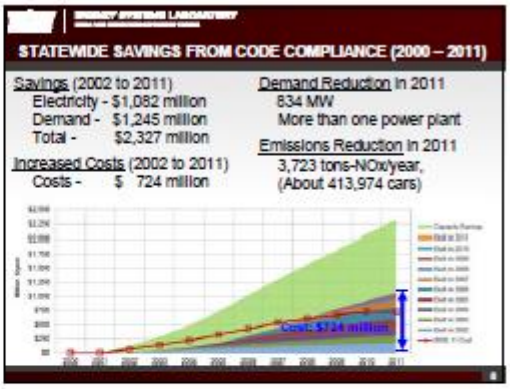
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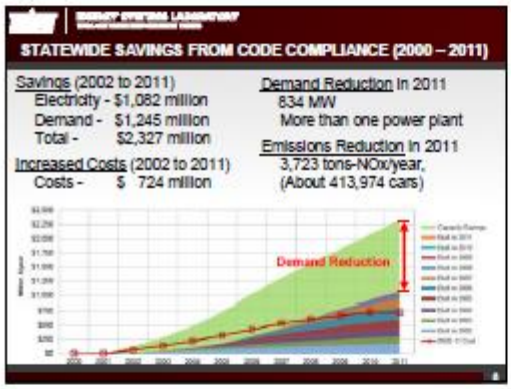
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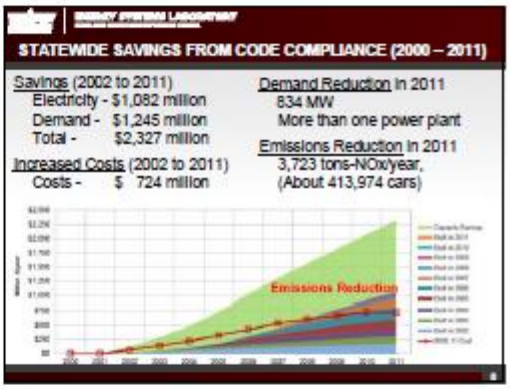
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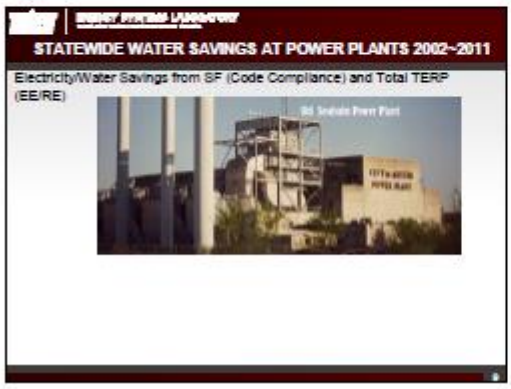
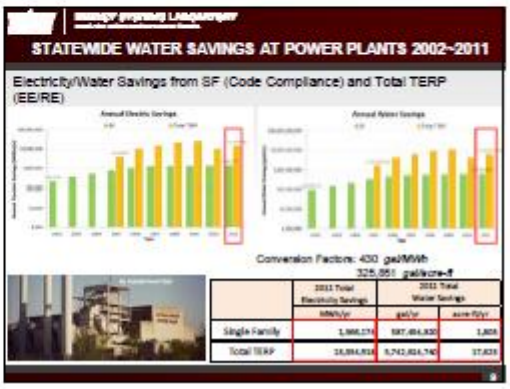
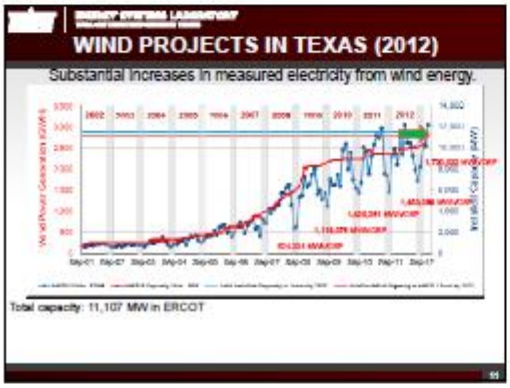
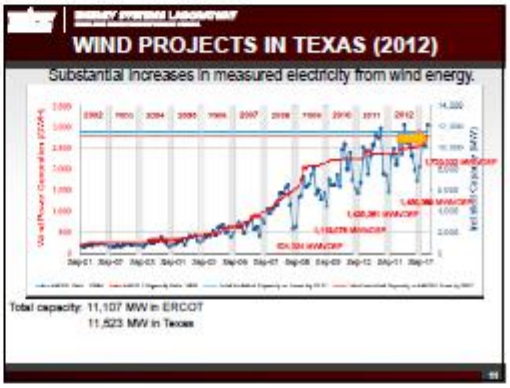

STATEWIDE WATER SAVINGS AT POWER PLANTS 2002~2011
Electricity/Water Savings from SF (Code Compliance) and Total TERP (EE/RE)


STATEWIDE WATER SAVINGS AT POWER PLANTS 2002~2011
Electricity/Water Savings from SF (Code Compliance) and Total TERP (EE/RE)
Conversion Factors: 430 gal/MWh
325,851 gal/acre-ft

SAVINGS FROM RENEWABLES
Solar PV
Solar Thermal
Hydro
Biomass
Landfill Gas
Geothermal

SAVINGS FROM RENEWABLES
Wind
Solar
Hydro
Biomass
Landfill Gas
Geothermal


WIND PROJECTS IN TEXAS (2012)
Substantial increases in measured electricity from wind energy.
Total capacity: 11,107 MW in ERCOT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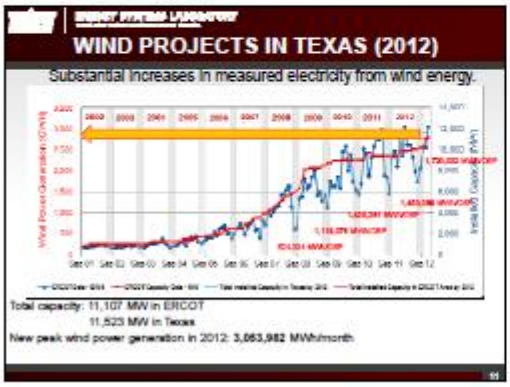
11,523 MW in Texas


WIND PROJECTS IN TEXAS (2012)
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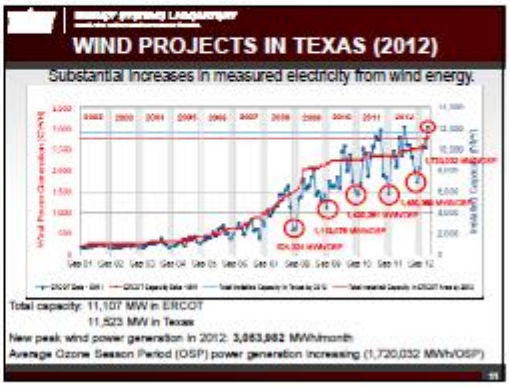
New peak wind power generation in 2012: 3,063,982 MWh/month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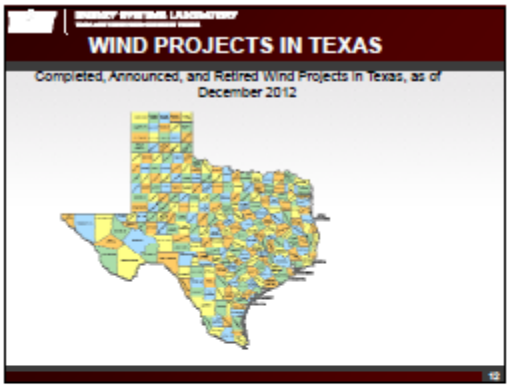
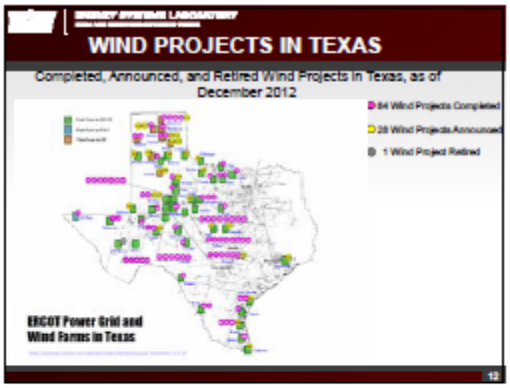
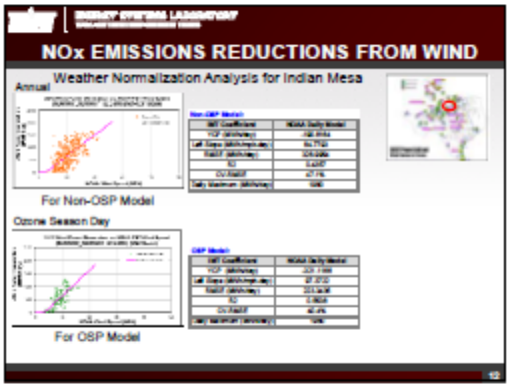
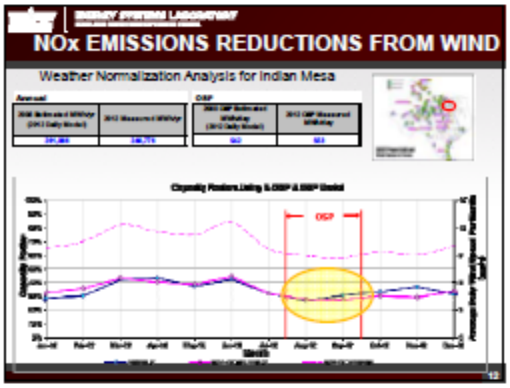
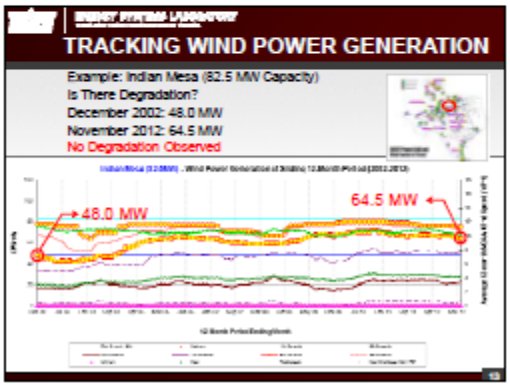
Total capacity: 11,107 MW in ERCOT
11,523 MW in Texas
New peak wind power generation in 2012: 3,063,982 MWh/month
Average Ozone Season Period (OSP) power generation increasing (1,720,032 MWh/OSP)

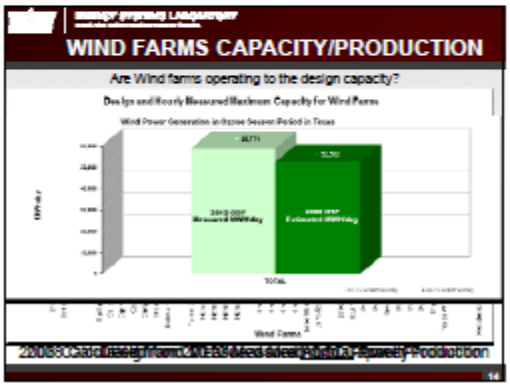

WIND PROJECTS IN TEXAS
Completed, Announced, and Retired Wind Projects in Texas, as of December 2012

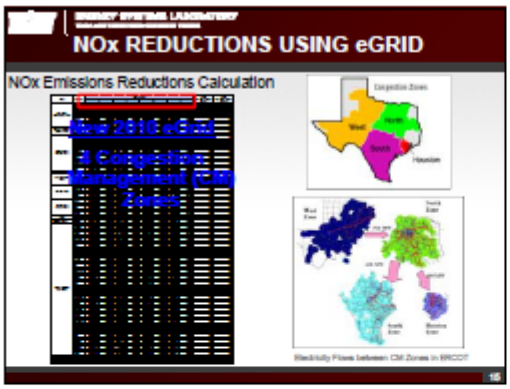

WIND PROJECTS IN TEXAS
Completed, Announced, and Retired Wind Projects in Texas, as of December 2012
84 Wind Projects Completed
28 Wind Projects Announced
1 Wind Project Retired
ERCOT Power Grid and Wind Farms in Texas

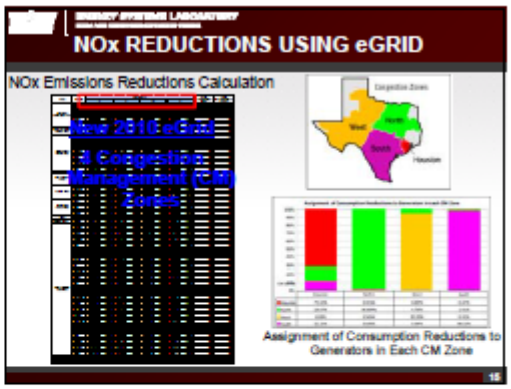

NOx EMISSIONS REDUCTIONS FROM WIND
Weather Normalization Analysis for Indian Mesa
Annual
For Non-OSP Model
Ozone Season Day
For OSP Model


NOx EMISSIONS REDUCTIONS FROM WIND
Weather Normalization Analysis for Indian Mesa
OSP


TRACKING WIND POWER GENERATION
Example: Indian Mesa (82.5 MW Capacity)
Is There Degradation?
December 2002: 48.0 MW
November 2012: 64.5 MW
No Degradation Observed
48.0 MW
64.5 MW


WIND FARMS CAPACITY/PRODUCTION
Are Wind farms operating to the design capacity?


NOx REDUCTIONS USING eGRID
NOx Emissions Reductions Calculation
New 2010 eGrid
4 Congestion Management (CM) Zones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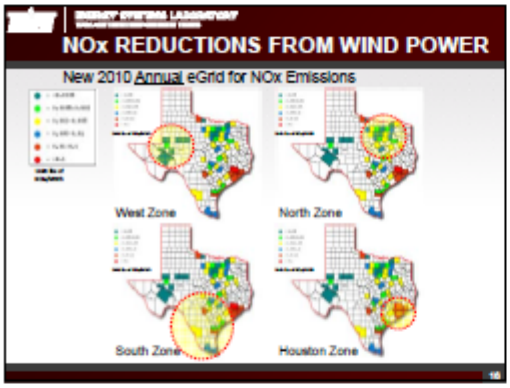
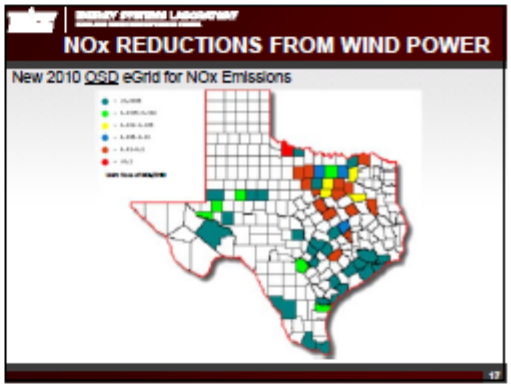
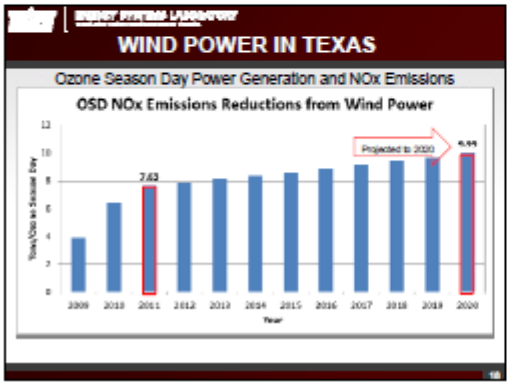
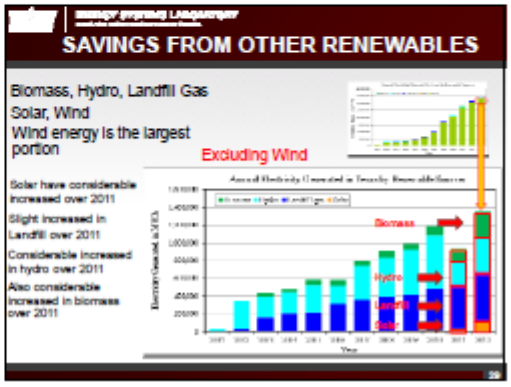
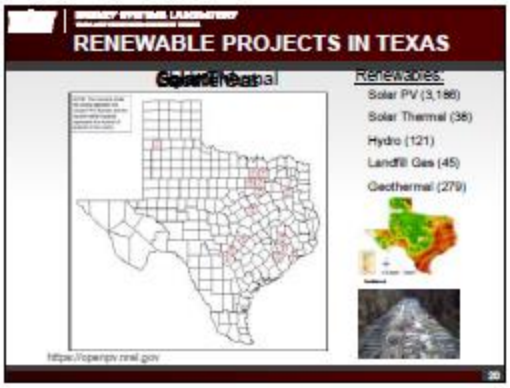
Assignment of Consumption Reductions to Generators in Each CM Zone

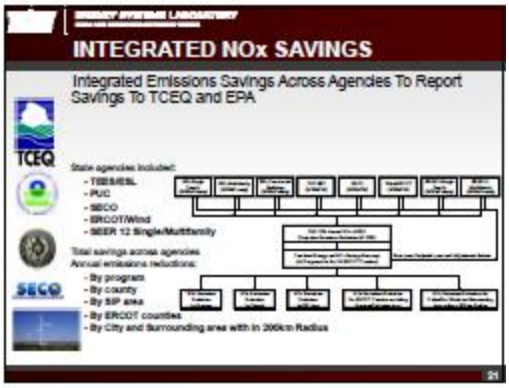

NOx REDUCTIONS FROM WIND POWER
New 2010 Annual eGrid for NOx Emissions
West Zone
North Zone
South Zone
Houston Zone


NOx REDUCTIONS FROM WIND POWER
New 2010 OSD eGrid for NOx Emissions


WIND POWER IN TEXAS
Ozone Season Day Power Generation and NOx Emissions
OSD NOx Emissions Reductions from Wind Power
Projected to 2020
7.63
4.44


SAVINGS FROM OTHER RENEWABLES
Biomass, Hydro, Landfill Gas
Solar, Wind
Wind energy is the largest portion
Excluding Wind
Solar have considerable increased over 2011
Slight increased in Landfill over 2011
Considerable increased in hydro over 2011
Also considerable increased in biomass over 2011
Biomass
Hydro
Landfill
Solar


RENEWABLE PROJECTS IN TEXAS
Renewables:
Solar PV (3,186)
Solar Thermal (38)
Hydro (121)
Landfill Gas (45)
Geothermal (279)
https://openei.nrel.gov


INTEGRATED NOx SAVINGS
Integrated Emissions Savings Across Agencies To Report Savings To TCEQ and EPA
TCEQ
SECO
State agencies included:
- TEES/ESL
- PUC
- SECO
- ERCOT/Wind
- SEER 12 Single/Multifamily
Total savings across agencies
Annual emissions reductions:
- By program
- By county
- By SIP area
- By ERCOT counties
- By City and Surrounding area with in 200km Radius

INTEGRATED NOx SAVINGS
2011 Integrated Emissions Savings
Savings projected to 2020
2011 Integrated Emissions savings are calculated using new 2010 eGrid
ESL Code Compliance (0.34 tons/day)
PUC SBT programs (0.93 tons/day)
SECO Political Sub. (0.44 tons/day)
Green Power (Wind) (7.62 tons/day)
Residential AC Retrofits (0.56 tons/day)
Total (2011) (9.89 tons/day)

REPORTS: TERP
ESL Homepage: http://esl.eslwin.tamu.edu/
ENERGY SYSTEMS LABORATORY
2012 Reports:
• IC3 Validation with EnergyPlus /TRNSYS (Stage 3 & 4)
• Recommendations for15% above Code for Small Office and Retail
• 2011 Renewable Report
2013 Reports
• State wide savings from IECC code
• Methodology for Calculating Cooling and Heating Energy-Input-Ratio (EIR) from the Rated Seasonal Performance Efficiency (SEER OR HSPF)
• A Simplified Residential Base-case Model

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ESL Contact Information
Jeff Haberl: jeffhaberl@tees.tamus.edu
Bahman Yazdani: bahmanyazdani@tees.tamus.edu
http://esl.tamu.edu/terp

IMPROVED METHODOLOGY TO MEASURE NORMAL INCIDENT SOLAR RADIATION WITH A MULTI-PYRANOMETER ARRAY

Juan-Carlos Baltazar Ph.D., P.E.,
Yifu Sun EIT, and Jeff Haberl Ph.D., P.E.

Solar World Congress 2013 ° Cancún, Q.R., Mexico

Outline

- Introduction
- Measurement Test Rig Setup
- Sensor Calibration
- Methodology and Improvement
- Result and Analysis

Introduction

- Global solar radiation can be separated into beam and diffuse components.
- Two categories of sensor: thermopile and photovoltaic detectors.

Measurement Test Rig Setup

Measurement Test Rig Setup

- Weather Parameters Measured on STB:
  - Temperature
  - Relative Humidity
  - Wind Speed
  - Wind Direction
  - CO_2
  - Solar Radiation, Norma Direct, Global and Diffuse
    - Global: Precision Spectral Pyranometer (PSP) or LI-cor sensor
    - Normal Direct: Normal Incidence Pyrheliometer (NIP) mounted on a solar tracker
    - Diffuse: Black and White Pyranometer (B&W) shaded by shading disk.

Measurement Test Rig Setup

- Eppley Laboratory SMT-3 make Solar Tracker.
- The control system is supported by a HP palmtop and a continuously running Quickbasic program.
- Hold two NIP's and two B&W's.

Measurement Test Rig Setup

- Multi-Pyranometer Array (MPA) consists four photovoltaic sensors.
  - Horizontal
  - Tilted 40°and Azimuth angle of - 60°
  - Tilted 40° and Azimuth angle of 0°
  - Tilted 40° and Azimuth angle of 60°
- Artificial horizon blocks the ground reflected radiation.

Measurement Test Rig Setup

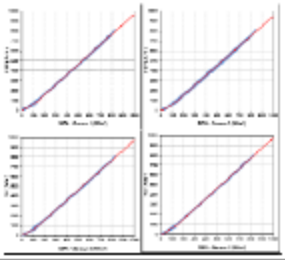
- Multi-pyranometer Array

Sensor Calibration

- Spectrum calibration
  - Locate the MPA four sensors horizontal.
  - Select clear-sky days within a selected period.
  - Compare their values with spectral PSP measured data.
  - Find a correlation function, f_1 (four parameter change-point model).

Sensor Calibration

- Spectrum calibration function (f_1)



Sensor Calibration

- Incidence angle correction is determined by cosine correlation f_2.

$$f_2 = -0.0000004504 \cdot \theta^3 - 0.00001357 \cdot \theta^2 + 0.0006074 \cdot \theta + 1$$

- θ is the incidence angle of the beam radiation
- The calibrated tilted solar irradiance is expressed as following.

$$I_{beam} = \frac{f_1(I_t)}{f_2}$$

Methodology and Improvement

Incident solar radiation calculation:

- Total incident solar radiation includes three components: direct beam, sky diffuse and reflection from ground.
- Artificial horizon eliminates reflection portion.
- Temps-Coulson model is used for sky diffuse estimation.
- Beam component corresponds to incidence angle.

Methodology and Improvement

- Four equations express the relations of the incident solar radiation with direct beam and sky diffuse.
- Two solutions for normal incident solar radiation estimation:
  - Equations for Horizontal and South sensors
  - Equations for Southwest and Southeast sensors
    - Mirror according to solar noon to have two extra groups data.
    - Two sub-solutions from original and mirrored data.
    - Sum numerators and denominators of the two sub-solutions.

Methodology and Improvement

- Expressions for incident global solar radiation for four sensors

$$I_{T,h} = I_{b,n} \cdot R_{b,h} + I_{d,h}$$
$$I_{T,se} = I_{b,n} \cdot R_{b,se} + I_{d,h} \cdot R_{d,se}$$
$$I_{T,s} = I_{b,n} \cdot R_{b,s} + I_{d,h} \cdot R_{d,s}$$
$$I_{T,sw} = I_{b,n} \cdot R_{b,sw} + I_{d,h} \cdot R_{d,sw}$$

Methodology and Improvement

- The beam coefficients for each of the surface are calculated, λ indicates any surface in the MPA

$$R_{b,\lambda} = \cos(\theta_{i,\lambda})$$

- Incidence angles in horizontal and other surfaces are determined as following.

$$\cos(\theta_{i,h}) = \cos(\phi)\cos(\delta)\cos(\omega) + \sin(\phi)\sin(\delta)$$

$$\cos(\theta_{i,\lambda}) = \sin(\delta)\sin(\phi)\cos(\beta_\lambda) - \sin(\delta)\cos(\phi)\sin(\beta_\lambda)\cos(\gamma_\lambda) + \cos(\delta)\cos(\phi)\cos(\beta_\lambda)\cos(\omega) + \cos(\delta)\sin(\phi)\sin(\beta_\lambda)\cos(\gamma_\lambda)\cos(\omega) + \cos(\delta)\sin(\beta_\lambda)\sin(\gamma_\lambda)\sin(\omega)$$

Methodology and Improvement

- The diffuse coefficients are calculated based on Temps-Coulson model.

$$R_{d,se} = \frac{1+\cos(\beta_{se})}{2} \cdot [1 + \sin^3(\frac{\beta_{se}}{2})][1 + \cos^3(\theta_{i,se}) \cdot \sin^3(\theta_{i,h})]$$
$$R_{d,s} = \frac{1+\cos(\beta_s)}{2} \cdot [1 + \sin^3(\frac{\beta_s}{2})][1 + \cos^3(\theta_{i,s}) \cdot \sin^3(\theta_{i,h})]$$
$$R_{d,sw} = \frac{1+\cos(\beta_{sw})}{2} \cdot [1 + \sin^3(\frac{\beta_{sw}}{2})][1 + \cos^3(\theta_{i,sw}) \cdot \sin^3(\theta_{i,h})]$$

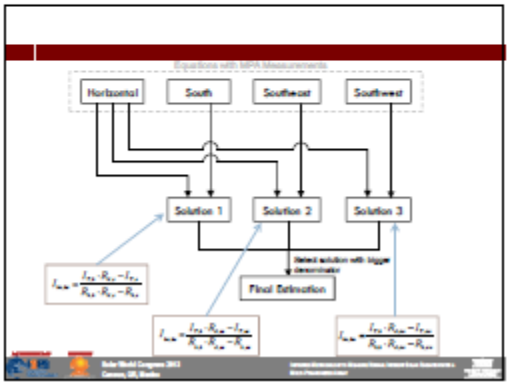
Methodology and Improvement

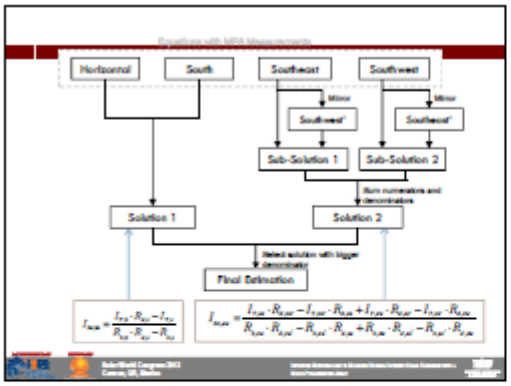
- Expression for Normal incident solar radiation estimated by horizontal and south facing sensor.

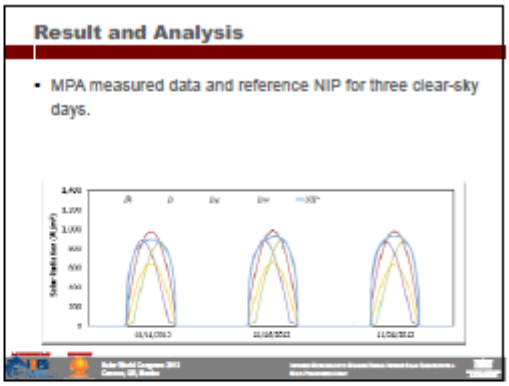
$$I_{nor} = \frac{I_{T,h} \cdot R_{d,s} - I_{T,s}}{R_{b,h} \cdot R_{d,s} - R_{b,s}}$$

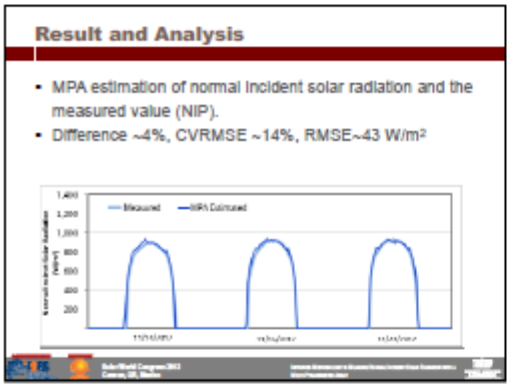
- Expression for Normal incident solar radiation estimated using southeast and southwest facing sensor and their corresponding mirrored value.

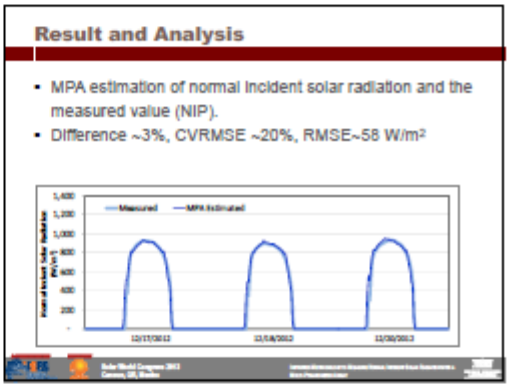
$$I_{ter} = \frac{I_{T,se} \cdot R_{d,sw} - I_{T,sw} \cdot R_{d,se} + I_{T,se} \cdot R_{d,se} - I_{T,sw} \cdot R_{d,se}}{R_{b,se} \cdot R_{d,sw} - R_{b,sw} \cdot R_{d,se} + R_{b,se} \cdot R_{d,se} - R_{b,sw} \cdot R_{d,se}}$$

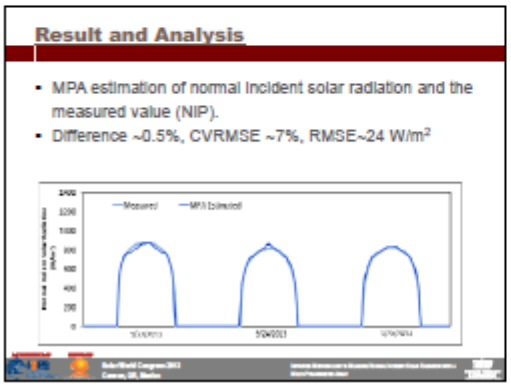


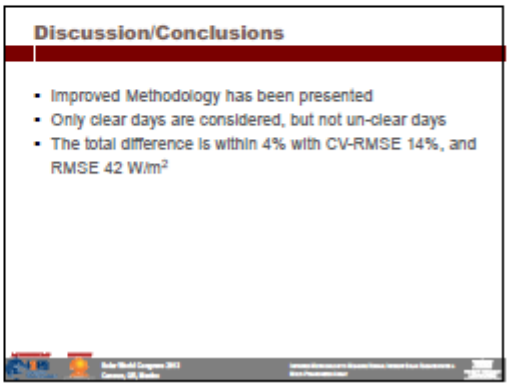

Horizontal
South
Southeast
Southwest
Mirror
Southeast'
Mirror
Southwest'
Sub-Solution 1
Sub-Solution 2
Sum numerators and denominators
Solution 1
Solution 2
Select solution with bigger denominator
Final Estimation


Result and Analysis
MPA measured data and reference NIP for three clear-sky days.


Result and Analysis
MPA estimation of normal incident solar radiation and the measured value (NIP).
Difference ~4%, CVRMSE ~14%, RMSE~43 W/m²


Result and Analysis
MPA estimation of normal incident solar radiation and the measured value (NIP).
Difference ~3%, CVRMSE ~20%, RMSE~58 W/m²


Result and Analysis
MPA estimation of normal incident solar radiation and the measured value (NIP).
Difference ~0.5%, CVRMSE ~7%, RMSE~24 W/m²


Discussion/Conclusions
Improved Methodology has been presented
Only clear days are considered, but not un-clear days
The total difference is within 4% with CV-RMSE 14%, and RMSE 42 W/m²

Thank You

2012 INTERNATIONAL ENERGY CONSERVATION CODE

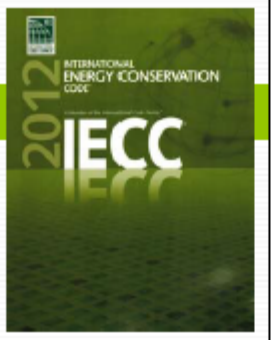
Significant Changes – Residential

Shirley Ellis

Energy Codes Specialist
Energy Systems Laboratory
Texas A&M Engineering Experiment Station

3

2012 IECC



Agenda

4

1. Introduction/Goals/Agenda
2. El Paso adoption
3. 2012 IECC – Significant Changes
   a) Organizational
   b) Commercial
   c) Residential

Seminar Goal

5

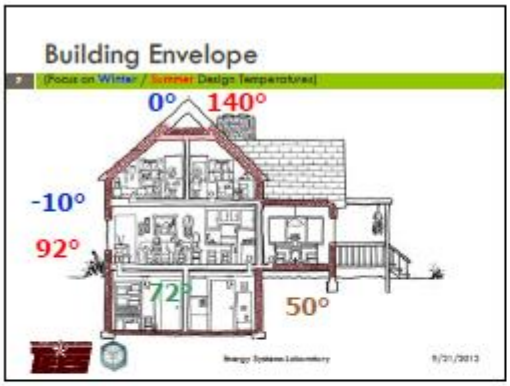
The goal of this seminar is for participants to understand the significant changes in the residential section of 2012 IECC.

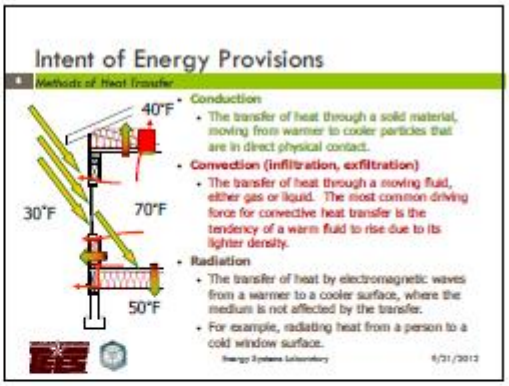
Seminar Objectives

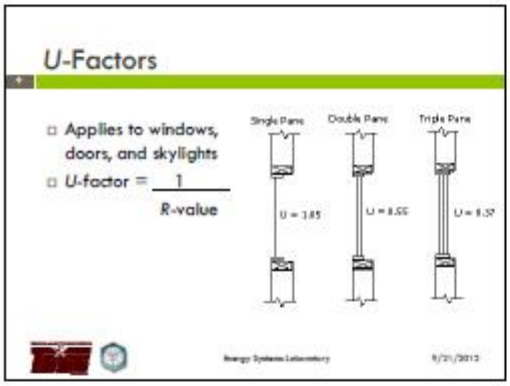
6

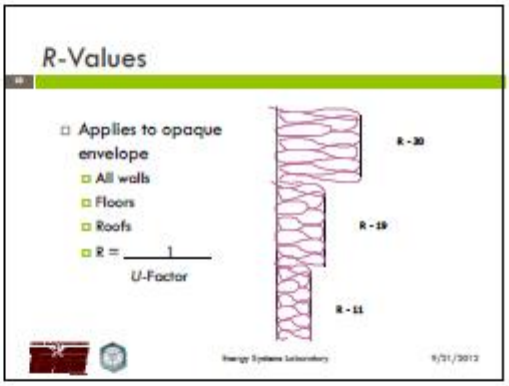
Upon completion of this seminar, participants will be better able to:

- Understand the differences between the 2009 and the 2012 IECC.
- Locate changes on the applicable tables in the 2012 IECC for specific situations.
- Apply code requirements to real-world situations.
- Explain the intent behind a code change.


Building Envelope
(Focus on Winter / Summer Design Temperatures)
0°
140°
-10°
92°
72°
50°


Intent of Energy Provisions
Methods of Heat Transfer
40°F
30°F
70°F
50°F
Conduction
The transfer of heat through a solid material, moving from warmer to cooler particles that are in direct physical contact.
Convection (infiltration, exfiltration)
The transfer of heat through a moving fluid, either gas or liquid. The most common driving force for convective heat transfer is the tendency of a warm fluid to rise due to its lighter density.
Radiation
The transfer of heat by electromagnetic waves from a warmer to a cooler surface, where the medium is not affected by the transfer.
For example, radiating heat from a person to a cold window surface.


U-Factors
Applies to windows, doors, and skylights
U-factor = 1 / R-value
Single Pane
Double Pane
Triple Pane


R-Values
Applies to opaque envelope
All walls
Floors
Roofs
R = 1 / U-Factor
R - 30
R - 19
R - 11

°C
-5
-10
-15
-20

2012 IECC
2012
INTERNATIONAL ENERGY CONSERVATION CODE
IECC
ICC publishes a new edition, which triggers the SECO review and energy codes update process.
May, 2011: 2012 IECC published
July, 2011: 2012 IECC available
Dec, 2011: ESL provided a written recommendation to SECO
SECO: 30 day public comment period on code recommendation
Aug, 2012: ESL review and recommendation on comments
SECO holds stakeholder meetings
SECO will provide ruling in Texas Register

El Paso Adoption

El Paso Details

- Incentives
  - First 100 entitled to a 50% reduced permit fee
  - Second 100 entitled to a 20% reduced permit fee

Objectives of the Code

The following are regulated:

- Building Envelope
- Mechanical Systems
- Electrical Systems
- Service Water Heating Systems

Code Compliance Process

1. Determine if the project must comply with the IECC
2. Determine if the project is residential or commercial
3. Compliance documentation
4. Plan reviewer is to ensure the documentation is clearly identified
5. Confirm that energy-using features of the building are installed per the approved plans and documentation

Organizational Changes

- Two separate sets of provisions
  - Commercial
    - All buildings except for residential buildings 3 stories or less in height
  - Residential
    - Detached one- and two-family dwellings
    - Multiple single family dwellings
    - Group R-2, R-3 and R-4 buildings 3 stories or less in height

Table of Contents

- Chapter 1 – Scope and Administration
- Chapter 2 - Definitions
- Chapter 3 – General Requirements
- Chapter 4 – Energy Efficiency
  - Commercial
  - Residential
- Chapter 5 – Referenced Standards

Each code section is preceded by a letter. "C" for Commercial provisions and "R" for Residential provisions

Chapter 4 (CE) – Table C402.2

Chapter 1 (RE) Scope and Administration

- R101.2 Scope
  - Applies to Residential buildings
- R101.3 – Intent
  - Added - over the useful life of each building
- *R104 – Applicability*
  - *Existing buildings*
  - *Historic buildings*
  - *Additions, alterations and repairs to existing buildings*
  - *Change in occupancy or use*
  - *Change in space conditioning*
  - *Mixed use buildings*

Chapter 1 (RE) Scope and Administration

- R106.1 – Referenced codes and standards
  - Adds two subsections and clarifies when standards are to be considered
    - R106.1.1 Conflicts
    - R106.1.2 Provision in referenced codes and standards

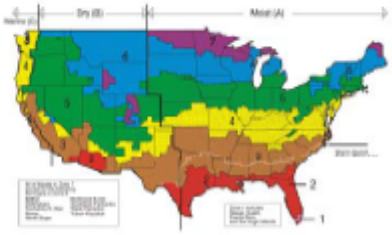
Chapter 2 (RE) Definitions

- Revised definitions
  - Buildings – added - including any mechanical systems, service water heating systems and electric power and lighting systems located on the building site and supporting the building
  - Residential Building – rewritten - For this code, includes detached one- and two-family dwellings and multiple single-family dwellings (townhouses), as well as Group R-2, R-3 and R-4 buildings three stories or less in height above grade plane
  - Skylight – changed measurement from a slope of 15 degrees or more from vertical to 60 degrees or less from horizontal.

Chapter 2 (RE) Definitions

- New definitions
  - Building Site
  - Continuous Air Barrier
  - Demand Recirculation Water System
  - Fenestration Product, Site-Built
  - Visible Transmittance (VT)
  - Whole House Mechanical Ventilation System

Three separate moisture regimes overlay the eight climate zones



Chapter 3 (RE) General Requirements

- Revised R303.1.3 Fenestration product rating
  - Added Visible Transmittance (VT) to the NFRC 200

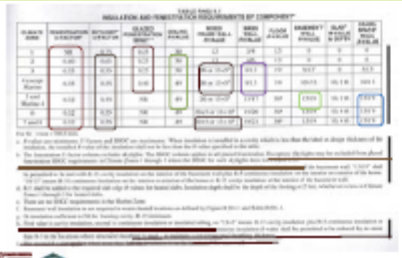
TABLE R303.1.3(1)
DEFAULT GLAZED FENESTRATION SHGC AND VT

	SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
	Clear	Tinted	Clear	Tinted	
SHGC	0.8	0.7	0.7	0.6	0.6
VT	0.6	0.3	0.6	0.3	0.6

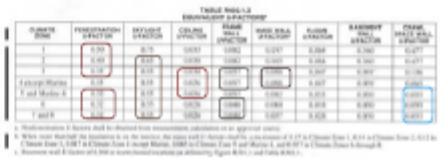
Chapter 4 (RE) Residential Energy Efficiency

- R401.2 Compliance – simplified
  - Projects shall comply with Sections identified as "mandatory" and with either sections identified as "prescriptive" or the performance approach in Section R405
- R401.3 Certificate
  - Added provisions to include - the results from any required duct system and building envelope air leakage testing done on the building

Chapter 4 (RE) – Table R402.1.1



Chapter 4 (RE) Table R402.1.3



Chapter 4 (RE) Building Thermal Envelope

- R402.2.3 Eave baffle
  - For air permeable insulations in vented attics, a baffle shall be installed adjacent to soffit and eave vents. Baffles shall maintain an opening equal or greater than the size of the vent. The baffle shall extend over the top of the attic insulation. The baffle shall be permitted to be any solid material.

Chapter 4 (RE) Table R402.2.6

- R402.2.6 Steel-frame ceilings, walls, and floors

Chapter 4 (RE) Building Thermal Envelope

- R402.2.12 Sunroom insulation (reorganized)
  - All sunrooms must meet the insulation requirements of this chapter
  - Exceptions – with thermal isolation
    - Minimum ceiling insulation R-values remain the same
    - Minimum Wall R-values remain the same
      - ~~New~~ walls separating the sunroom with a thermal isolation from conditioned space shall meet the building thermal envelope requirements of this code

Chapter 4 (RE) Building Thermal Envelope

- R402.2.3.5 Sunroom *U*-factor
  - All sunrooms enclosing conditioned space must meet the fenestration requirements of this chapter
  - Exception – sunrooms with thermal isolation and enclosing conditioned space
    - Climate Zones 4 – 8
      - Maximum *U*-factor 0.45
      - Maximum skylight *U*-factor 0.70
    - New fenestration separating the sunroom from the conditioned space shall meet the building thermal envelope requirements

Chapter 4 (RE) Air Leakage

- R402.4 Air leakage
  - R402.4.1 Building thermal envelope shall comply with Sections R402.4.1.1 and R402.4.1.2.
    - The sealing methods between dissimilar material shall allow for differential expansion and contraction
    - Removed – the itemized list of where to caulk, gasket, weatherstrip or otherwise seal with an air barrier material, suitable film or solid material

Chapter 4 (RE) Building Thermal Envelope

- R402.4.1.1 Installation. The components of the building thermal envelope as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of construction
  - Where required by the code official, an approved third party shall inspect all components and verify compliance

Chapter 4 (RE) Building Thermal Envelope

- R402.4.1.1 Installation.

Chapter 4 (RE) Table R402.4.1.1

Chapter 4 (RE) Air Leakage

- R402.4.1.2 Testing
  - The building or dwelling unit shall be tested with a blower door at a pressure of 0.2 w.g.(50 Pa)and verified as having an air leakage rate of not exceeding
    - 5 air changes per hour – Climate Zones 1 and 2
    - 3 air changes per hour – Climate Zones 3 through 8
  - Where required by the code official, testing shall be conducted by an approved third party
  - A written report of the results shall be signed by the party conducting the test and provided to the code official

Chapter 4 (RE) Air Leakage

- R402.4.1.2 Testing shall be performed at any time after the creating of all penetrations of the building thermal envelope. During testing:
  - Exterior windows and doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures;
  - Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures;
  - Interior doors, if installed at the time of the test, shall be open
  - Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
  - Heating and cooling systems, if installed at the time of the test, shall be turned off; and
  - Supply and return register, if installed at the time of the test, shall be fully open
- ~~402.4.2.2 Visual inspection option~~

Chapter 4 (RE) Air Leakage

- R402.4.2 Fireplaces. New wood-burning fireplaces shall have tight-fitting flue dampers and outdoor combustion air

Chapter 4 (RE) Air Leakage

- R402.4.4 Recessed lighting
  - Removed wording – having an air leakage rate not more than 2.0 cfm ~~of air movement from the conditioned space to the ceiling cavity~~

Chapter 4 (RE) Systems

- R403.2.2 Duct Sealing
- Added Exceptions
  - Air-impermeable spray foam permitted without additional joint seals
  - For a duct connection that is partially inaccessible
    - Three screws equally spaced on the exposed portion of the joint so as to prevent a hinge effect
  - Continuously welded and locking-type longitudinal joints and seams
    - Ducts operation at static pressures less than 2" w.g. (500 Pa)

Chapter 4 (RE) Systems

- R403.2.2 Duct Sealing
  - Post-Construction test
    - Removed leakage to outdoors test
    - Changed leakage rate from 12 cfm to 4 cfm, with air handler
  - Rough-in test
    - Changed leakage rate
      - Total leakage from 6 cfm to 4 cfm, with air handler
      - Total leakage from 4 cfm to 3 cfm, without air handler
  - Exception changed
    - Air handler and ducts located entirely within the building thermal envelope

Chapter 4 (RE) Systems

- R403.2.2.1 Sealed air handler (new)
  - Manufacturer's designation for air leakage of no more than 2% of the design flow rate required
    - ASHRAE 193
- R403.2.3 Use of building cavities as ducts or plenums prohibited

Chapter 4 (RE) Systems

- R403.3.1 Protection of piping insulation (new)
  - Piping insulation exposed to weather shall be protected from damage, including that caused by sunlight, moisture, equipment maintenance, and wind, and shall provide shielding from solar radiation that can cause degradation of the material
  - Adhesive tape shall not be permitted

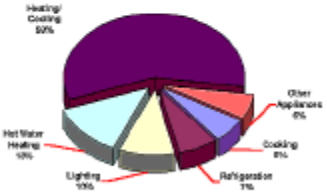
Chapter 4 (RE) Systems

- R403.4 Service hot water systems
  - R403.4.1 Circulating hot water systems
    - Removed insulation requirements

Chapter 4 (RE) Systems

- R403.4 Service hot water systems
  - R403.4.2 Hot water pipe insulation (Prescriptive) (new)
    - R3 required on piping
      - Larger than ¾" diameter
      - Serving more than one dwelling unit
      - From the water heater to kitchen outlets
      - Located outside the conditioned space
      - From the water heater to a distribution manifold
      - Located under a floor slab
      - Buried
      - Recirculation systems except demand recirculation system
      - Run lengths greater than the maximum in Table R403.4.2

Where Your Energy Goes



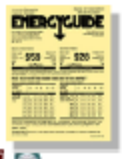
Chapter 4 (RE) Systems

- R403.5 Mechanical ventilation
  - Meets IRC or IMC or other approved means

Chapter 4 (RE) Systems

- R403.5.1 Whole-house mechanical ventilation system fan efficacy (new)
  - Meet efficacy requirements of Table R403.5.1
    - Exception – fans integral to HVAC equipment

Terminology



- Annual Fuel Utilization Efficiency - AFUE
- Heating Seasonal Performance Factor - HSPF
- Seasonal Energy Efficiency Ratio - SEER

HVAC Efficiency Requirements

- Pre-empted by the National Appliance Energy Conservation Act (NAECA)
- Applies to heating and cooling and water heating systems

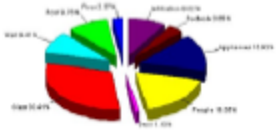
Chapter 4 (RE) Systems

- R403.6 Equipment Sizing
  - Sized in accordance with ACCA Manual S
  - Based on loads calculated with ACCA Manual J

HVAC Sizing

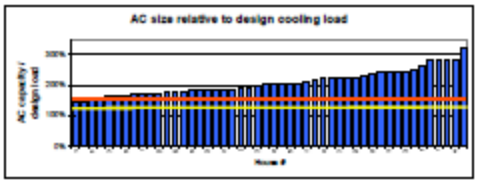
Submit load calculation for A/C Sizing

- Reduced initial cost to builder
- Improved comfort for owner
- Better IAQ, filtration, moisture control
- Lower utility bills/electrical demand
- Less noise



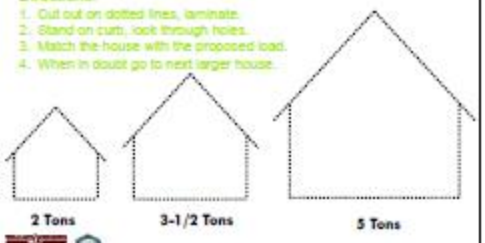
Equipment Sizing – Case Study

Average AC size ~ 2x what's needed



How to Use Your "Rule-of-Thumb" Load Calculator

Directions:
1. Cut out on dotted lines, laminate.
2. Stand on curb, look through holes.
3. Match the house with the proposed load.
4. When in doubt go to next larger house.



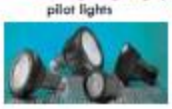
How to Use Your "Rule-of-Thumb" Load Calculator

Chapter 4 (RE) Systems

- R403.9 Pools and inground permanently installed spas
  - R403.9.1 Heaters
    - On-off switch to be mounted outside of the heater
  - R403.9.2 Time switches
    - Heaters, pumps and motors with built in times shall be deemed in compliance
  - R403.9.3 Covers
    - Added Inground permanently installed spas
    - Removed R-value requirements for pools heated to more than 90°F

Chapter 4 (RE) Electrical Power and Lighting

- R404.1 Lighting equipment
  - Increased minimum of high-efficacy lamps to 75%
  - Added exception for low-voltage lighting
  - Added R404.1.1 Lighting equipment
    - Fuel gas lighting systems shall not have continuously burning pilot lights

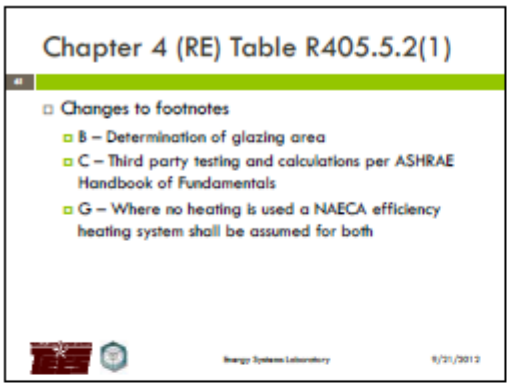


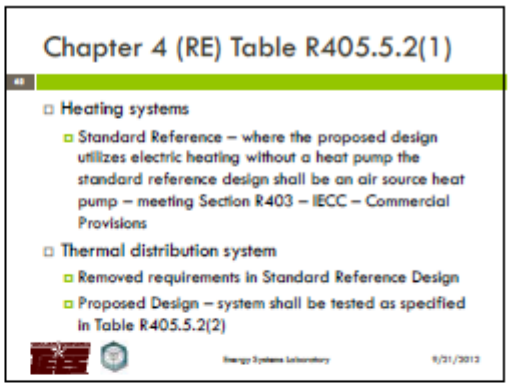
Chapter 4 (RE) Simulated Performance Alternative

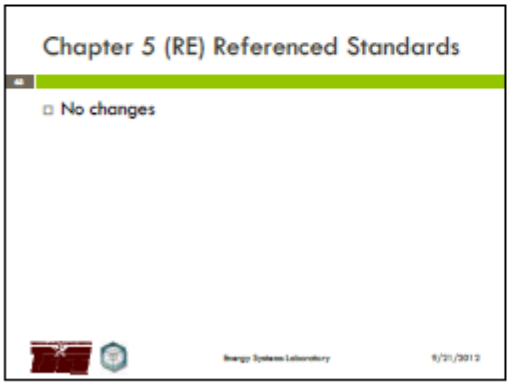
- R405.4 Documentation and R405.5 Calculation procedure had language added for clarification
- R405.6 Calculation software tools
  - Calculation of whole-building sizing for HVAC equipment in the standard reference design in accordance with R403.6 not IRC

Chapter 4 (RE) Table R405.5.2(1)

- Glazing
  - Changed - Interior shade fraction: 0.92-(0.21 x SHGC for the standard reference design) – same for Standard Reference and Proposed Designs
- Air exchange rate
  - Changes to both Standard Reference and Proposed Designs


Chapter 4 (RE) Table R405.5.2(1)
Changes to footnotes
B – Determination of glazing area
C – Third party testing and calculations per ASHRAE Handbook of Fundamentals
G – Where no heating is used a NAECA efficiency heating system shall be assumed for both


Chapter 4 (RE) Table R405.5.2(1)
Heating systems
Standard Reference – where the proposed design utilizes electric heating without a heat pump the standard reference design shall be an air source heat pump – meeting Section R403 – IECC – Commercial Provisions
Thermal distribution system
Removed requirements in Standard Reference Design
Proposed Design – system shall be tested as specified in Table R405.5.2(2)


Chapter 5 (RE) Referenced Standards
No changes

2009 IECC®
Commercial Provisions
Based on the 2009 International
Energy Conservation Code
Energy Systems Laboratory

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Texas A&M Engineering Experiment Station
Texas A&M University System
Energy Systems Laboratory

Seminar Goal
The goal of this seminar is for participants to apply the 2009 IECC to increase the efficient use of energy in the construction of new buildings and alterations to existing buildings.
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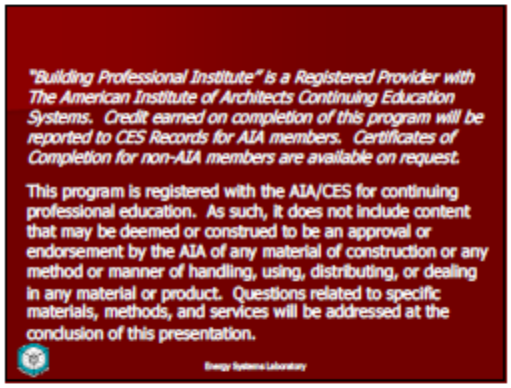
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Seminar Objectives
Upon completion of this seminar, participants will be better able to:
Locate general topics in the 2009 IECC.
Locate applicable tables in the 2009 IECC for specific situations.
Apply code requirements to real-world situations.
Explain the intent behind a code requirement.
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Seminar Objectives (cont.)
Upon completion of this seminar, participants will be better able to:
Identify borderline scenarios as compliant or noncompliant
Identify essential code compliant for designing energy-efficient building thermal envelopes, energy-efficient mechanical design principles and electrical power and lightning systems.
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IECC General Organization

Chapter 1 – Administration and Enforcement
Chapter 2 – Definitions
Chapter 3 – Design Conditions
Chapter 4 – Residential Energy Efficiency
Chapter 5 – Commercial Energy Efficiency
Chapter 6 – Referenced Standards

Objectives of the Code

The following are regulated:

- Building Envelope
- Mechanical Systems
- Electrical Systems
- Service Water Heating Systems

Code Compliance Process

1. Determine if the project must comply with the IEOC
2. Determine if the project is residential or commercial
3. Compliance documentation
4. Plan reviewer is to ensure the documentation is clearly identified.
5. Confirm that energy-using features of the building are installed per the approved plans and documentation

IECC Commercial Compliance Process

Chapter 1 Administration and Enforcement

101 – Scope and General Requirements

- 101.2 – Scope

The provisions apply to several different project types:

- Newly conditioned space
- New construction in existing buildings
- Additions, alterations and repairs to existing buildings
- Mixed use buildings
- Change in occupancy

101 – Scope and General Requirements

Newly Conditioned Space – New Buildings

New Construction - Hotel

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101 – Scope and General Requirements

Newly Conditioned Space – Previously Unconditioned

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101 – Scope and General Requirements

101.3 – Intent

Life safety, health and environmental requirements take precedence over energy provisions.

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101 – Scope and General Requirements

- 101.4 – Applicability
- 101.4.2 – Historic buildings

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101 – Scope and General Requirements

101.4.3 – Additions, alterations, renovations or repairs

- Where change increases energy use
- Applies to alteration as if it were new construction
- Exceptions
  - Storm windows over existing fenestration.
  - Glass only replacements in existing frame.
  - Existing ceiling, wall or floor cavities filled with insulation.
  - Where existing roof, wall or floor cavity is not exposed.

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101 – Scope and General Requirements

101.4.3 – Additions, alterations, renovations or repairs (cont.)

Exceptions

- Reroofing.
- Replacement of existing doors
- Alterations that replace less than 50% of the luminaires in a space provided that there is no increase in installed lighting power.
- Alterations that replace only the bulb and ballast with the existing luminaires.

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101 – Scope and General Requirements

101.4.4 – Change in Occupancy

An alteration that increases demand for fossil fuel or electrical energy onsite as a result of a change must comply with the code.

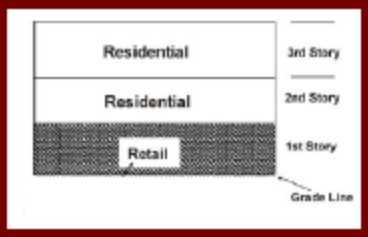
101 – Scope and General Requirements

101.4.5 – Change in space conditioning

Any nonconditioned space that is altered to become conditioned space, must meet the requirements of the code.

101 – Scope and General Requirements

101.4.6 – Mixed Occupancy Mixed-use building



101 – Scope and General Requirements

101.5.2 – Low Energy Buildings

- Buildings designated as exempt include buildings that use less than 1 watt/ft² or 3.4 Btu/h ft² for space conditioning.
- Buildings, or portions thereof, that are not conditioned are exempt from thermal envelope requirements.

102 Alternative Materials – Methods of Construction Design or Insulating Systems

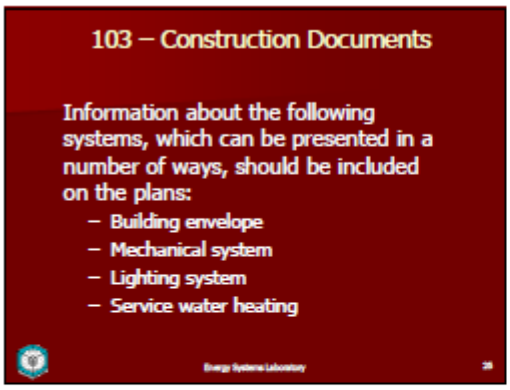
102.1.1 – Above code program

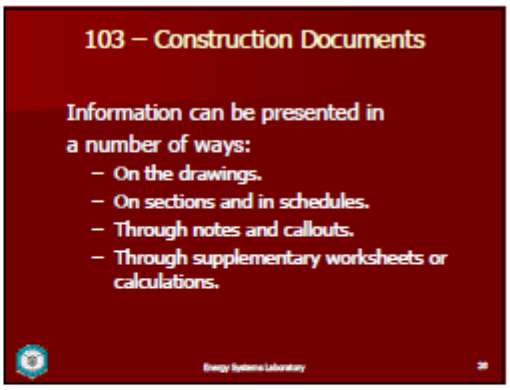
- Authority to approve "above code" program is vested in the code official.
- Language does not guarantee alternative programs exceed the performance required by IECC
- Burden of proof to establish equivalency is on the applicant.

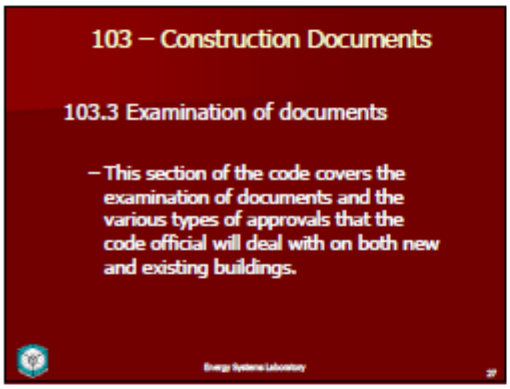
103 – Construction Documents

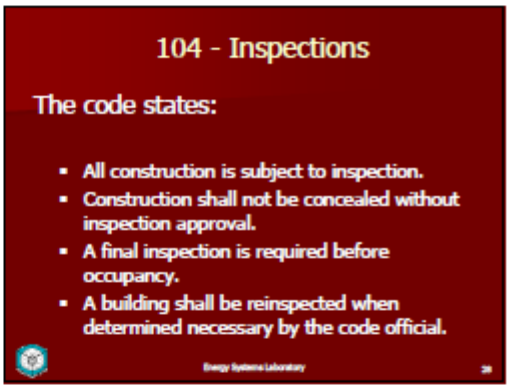
103.2 – Information on Construction Documents

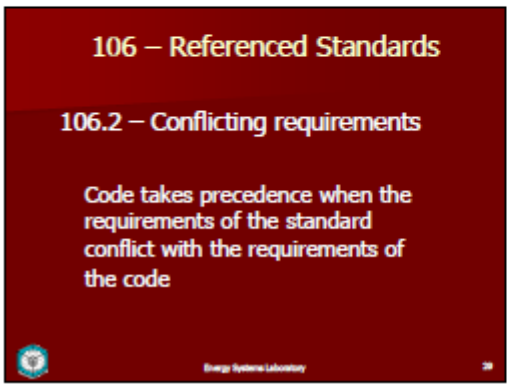
- Level of efficiency used to demonstrate compliance with the code must be clearly identified
- Complete set of building plans with efficiency requirements clearly labeled

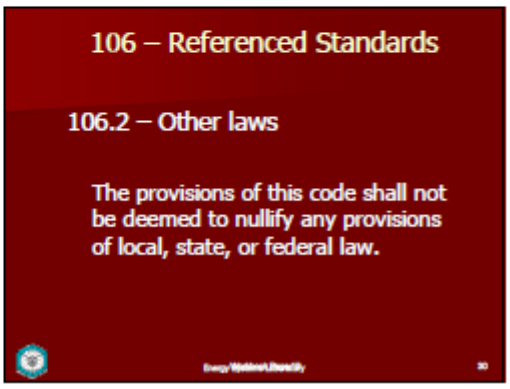

103 – Construction Documents
Information about the following systems, which can be presented in a number of ways, should be included on the plans:
– Building envelope
– Mechanical system
– Lighting system
– Service water heating


103 – Construction Documents
Information can be presented in a number of ways:
– On the drawings.
– On sections and in schedules.
– Through notes and callouts.
– Through supplementary worksheets or calculations.


103 – Construction Documents
103.3 Examination of documents
– This section of the code covers the examination of documents and the various types of approvals that the code official will deal with on both new and existing buildings.


104 - Inspections
The code states:
▪ All construction is subject to inspection.
▪ Construction shall not be concealed without inspection approval.
▪ A final inspection is required before occupancy.
▪ A building shall be reinspected when determined necessary by the code official.


106 – Referenced Standards
106.2 – Conflicting requirements
Code takes precedence when the requirements of the standard conflict with the requirements of the code


106 – Referenced Standards
106.2 – Other laws
The provisions of this code shall not be deemed to nullify any provisions of local, state, or federal law.

Chapter 2
Definitions

202 – General Definitions

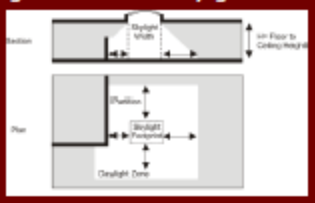
- Building Thermal Envelope
- Commercial Building
- Conditioned Space
- Exterior Wall
- Residential Building

202 – New Definitions

- Air barrier
- *C*-factor (thermal conductance)
- Daylight zone
- Demand control ventilation
- Entrance door
- Fan systems
- *F*-factor
- High-efficacy lamps
- Nameplate horsepower

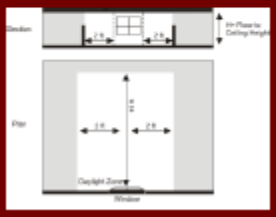
202 – General Definitions

- Day light Zone Under Skylight



202 – General Definitions

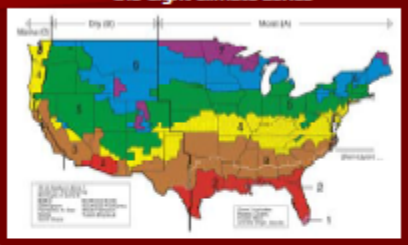
- Day light Zone Adjusted to Vertical Fenestration



Chapter 3
Design Conditions

Design Conditions

Three separate moisture regimes overlay the eight climate zones



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303 – Materials, Systems, and Equipment

303.1 – Identification

Requires materials to be labeled on site with the rated *R*-value

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303 – Materials, Systems, and Equipment

303.1.3 – Fenestration product rating

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303 – Materials, Systems, and Equipment

Table 303.1.3(1) Default Window *U*-Factors

TABLE 303.1.3(1)
DEFAULT GLAZED FENESTRATION *U*-FACTOR

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

Fenestration maximum *U*-factor is the Laboratory measurement of the overall thermal performance of a fenestration product

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303 – Materials, Systems, and Equipment

Table 303.1.3(2) Default Door *U*-Factors

TABLE 303.1.3(2)
DEFAULT DOOR *U*-FACTORS

DOOR TYPE	*U*-FACTOR
Uninsulated Metal	1.20
Insulated Metal	0.60
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

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303 – Materials, Systems, and Equipment

Table 303.1.3(3) Default Glazed Fenestration SHGC

TABLE 303.1.3(3)
DEFAULT GLAZED FENESTRATION SHGC

SINGLE GLAZED		DOUBLE GLAZED		
Clear	Tinted	Clear	Tinted	GLAZED BLOCK
0.8	0.7	0.7	0.6	0.6

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Chapter 5
Commercial Energy Efficiency

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501 - General

501.1 – Scope

Standard 90.1

Commercial buildings shall meet either the requirements of ASHRAE/IESNA Standard 90.1 or the requirements contained in this chapter.

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ASHRAE 90.1 General Organization

Section 1 – Purpose
Section 2 – Definitions
Section 3 – Design Conditions
Section 4 – Residential Energy Efficiency
Section 5 – Commercial Energy Efficiency
Section 6 – Referenced Standards
Section 7 – Service Water Heating
Section 8 – Power
Section 9 – Lighting
Section 10 – Other Equipment
Section 11 –Energy Cost Budget Method

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ASHRAE 90.1 Appendix

Appendix A – Rated R-value of Insualtion Assembly U-, C-, and F-factor determinations
Appendix B – Building Envelope Climate Criteria
Appendix C – Building Envelope Trade Off Option
Appendix D – Climatic data
Appendix E – Informative References
Appendix F – Addenda Description Information
Appendix G – Performance Rating Method

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ASHRAE 90.1 Organization

x.1 – Scope
x.2 – Compliance Paths
x.3 – Simplified Building
x.4 – Mandatory Provisions
x.5 – Prescriptive Provisions
x.6 – Alternative Compliance Path
x.7 – Submittals
x.8 – Product Information

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502 - Building Envelope Requirements

The building envelope requirements focus on three types of provisions:

- Air leakage
- Moisture protection
- Building envelope insulation and glazing requirements

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502 - Building Envelope Requirements

502.2 – Specific insulation requirements (prescriptive)

Based on:

- Climate zone
- Window wall ratio and
- Construction assembly

All components must meet or exceed building envelope requirements.

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502 - Building Envelope Requirements

Table 502.2(1)– Building envelope requirements – Opaque assemblies

- Determine the climate zone
- Each assembly will have maximum *U*-factor and SHGC requirements and minimum *R*-value requirements
- *R*-value requirements apply to the insulation only

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502 - Building Envelope Requirements

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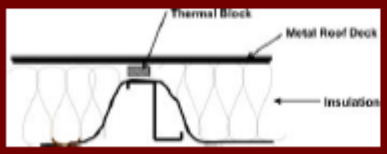
502 - Building Envelope Requirements

Metal buildings



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Building Envelope Requirements

502.2.7 – Opaque doors

All are required to meet the *U*-factor requirement for doors as specified in Table 502.2(1).

Includes overhead coiling and metal roll-up doors used for conditioned loading docks.

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502 - Building Envelope Requirements

Table 502.3 – Building Envelope Requirements: Fenestration

The gross wall area includes:

- Above-grade walls
- Band and rim joists and spandrel area between floors
- Area of all doors and windows

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502 - Building Envelope Requirements

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502 - Building Envelope Requirements

Skylights

- A skylight *U*-factor is based on the interior surface area of the entire skylight assembly, including glazing, sash, curbing and other framing elements.

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502 - Building Envelope Requirements

502.4 – Air Leakage (mandatory)

502.4.1 – Window and door assemblies

502.4.2 – Curtain wall, storefront glazing, and commercial entrance doors

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502 - Building Envelope Requirements

502.4.3 – Sealing of the building envelope

- Exterior joints around windows and door frames.
- Between wall sole plates, floors, and exterior wall panels.
- Openings for plumbing, electricity, refrigerant and gas lines in exterior walls, floors, and roofs.

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502 - Building Envelope Requirements

- Openings in the attic floor (such as where ceiling panels meet interior and exterior walls and masonry fireplaces).
- Service and access doors or hatches.
- All similar openings in the building envelope.

Sealing the building envelope reduces air infiltration in the building.

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502 - Building Envelope Requirements

Sealing of the building envelope

502.4.6 Loading Dock Weatherseals

- Equip cargo doors and loading dock doors with weatherseals
- Restrict infiltration

502 - Building Envelope Requirements

502.4.7 – Vestibules

502 – Building Envelope Requirements

502.4.8 – Recessed luminaries

502 - Building Envelope Requirements

Moisture control (See IBC Sections 1405.3 and IRC Section R601.3)

- General requirements for control of moisture vapor entering the building have been relocated to the construction requirements of the IBC.

503 - Building Mechanical Systems

Seven key elements to ensure HVAC system design is efficient:

- Equipment efficiency
- Proper equipment sizing and selection
- Distribution losses
- Transmission losses
- Controls
- Free-cooling
- Heat recovery

503 - Building Mechanical Systems

- Building Mechanical Systems requirements are detailed in the afternoon session instructed by Tom Patterson, Retired Fort Worth Mechanical Chief Inspector

503 - Building Mechanical Systems

- 503.2.1 – Calculation of heating and cooling loads
  - Designers must perform heating and cooling load calculations before sizing and selecting HVAC
  - HVAC systems must be sized based on the heating and cooling loads calculated in Section 503.2.1.
  - When the cooling load is predominant the system must be sized to not exceed that load.

503 – Building Mechanical Systems

503.2.2 – Equipment and system sizing
- "Shall not exceed the loads calculated."
- Standby equipment to have controls and devices to operate automatically when primary equipment is not operating.
- Multiple units with combined capacities that exceed design load shall have controls to sequence operation.

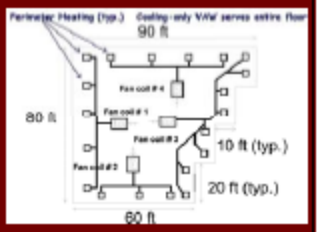
503 – Building Mechanical Systems

503.2.3 – HVAC equipment performance requirements
- Equipment efficiency

Table 503.2.3(7) – Water Chilling Packages, Minimum Efficiency Requirements

503.2.4 – HVAC system controls

503.2.4.1 – Thermostatic controls



503 – Building Mechanical Systems

503.2.4.4 – Shutoff damper controls

503.2.4.5 – Snow melt system controls

503.2.5 –Ventilation

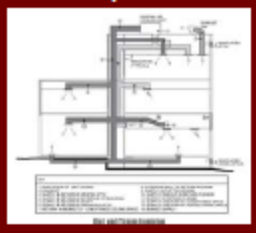
503 – Building Mechanical Systems

503.2.5.1 – Demand control ventilation

503.2.6 – Energy Recovery Ventilation System

503 – Building Mechanical Systems

503.2.7 – Ducts and plenum insulation and sealing



503 – Building Mechanical Systems

503.2.8 – Piping insulation

- Piping serving as part of heating or cooling systems must be insulated according to Table 503.2.8.

503 – Building Mechanical Systems

503.2.9 – HVAC system completion

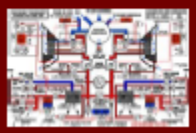
503.2.9.1 – Air system balancing

503 – Building Mechanical Systems

503.2.9.2 – Hydronic system balancing

- Individual hydronic heating and cooling coils to be equipped with means for balancing and pressure test connectors.

503.2.9.3 - Manuals



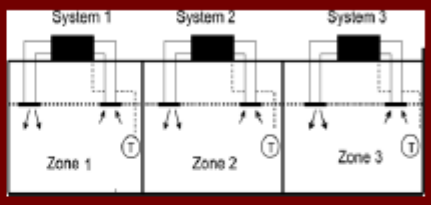
503 – Building Mechanical Systems

503.3 – Simple HVAC systems and equipment

Simple systems are served by unitary or packaged HVAC equipment, each serving one zone and controlled by a single thermostat in the zone served. It also applies to two-pipe heating system, where no cooling system is installed.

503 – Building Mechanical Systems

503.3 – Simple HVAC systems and equipment



503 – Building Mechanical Systems

503.3.1 – Economizers

TABLE 503.3.1(1)
ECONOMIZER REQUIREMENTS

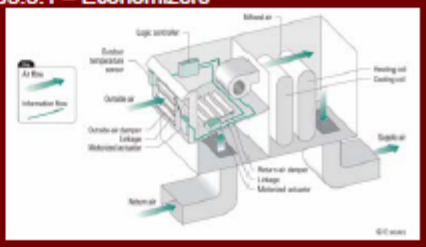
CLIMATE ZONES	ECONOMIZER REQUIREMENT
1A, 1B, 2A, 7, 8	No requirement
2B, 3A, 3B, 3C, 4A, 4B, 4C, 5A, 5B, 5C, 6A, 6B	Economizers on all cooling systems ≥ 54,000 Btu/h[a]

For SI: 1 British thermal unit per hour = 0.293 W.

a. The total capacity of all systems without economizers shall not exceed 480,000 Btu/h per building, or 20 percent of its air economizer capacity, whichever is greater.

503 – Building Mechanical Systems

503.3.1 – Economizers



503 – Building Mechanical Systems

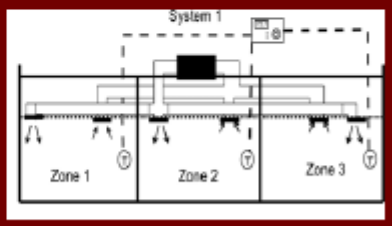
503.4 – Complex HVAC systems and equipment

Includes:

- Systems serving multiple zones.
- Hydronic steam heating and water chilling packages.
- Variable air volume (VAV) systems.
- Two-pipe changeover.
- Four-pipe systems.
- Hydronic (water loop) heat pump systems.

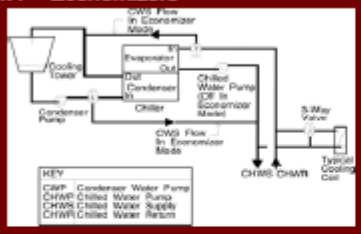
503 – Building Mechanical Systems

503.4 – Complex HVAC systems and equipment



503 – Building Mechanical Systems

503.4.1 – Economizers



503 – Building Mechanical Systems

503.4.2 – Variable air volume (VAV) fan control

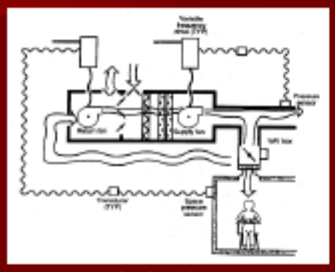
Individual VAV fan motors ≥10 Hp (7.5 kW)

- Driven by mechanical or electrical variable speed drive,

or

- Have controls or devices resulting in a fan motor demand ≤50% of the design wattage at 50% of design airflow when static pressure set point = 1/3 of the total design static pressure

Variable Air Volume



503 – Building Mechanical Systems

503.4.3 – Hydronic systems controls

503.4.3.1 – Three-pipe systems

503.4.3.2 – Two-pipe changeover system

503 – Building Mechanical Systems

503.4.3.3 – Hydronic (water loop) heat pump systems

- Heat pumps connected to a water loop with central heat rejection and heat addition.
- Controls capable of providing 20ºF dead band outside air temperature between initiation of heat rejection and heat addition.

503 – Building Mechanical Systems

503.4.3.4 – Part load controls

503.4.3.5 – Pump isolation

- Chilled water plants with multiple chillers must have the capability to reduce flow automatically when a chiller shut down.
- Boiler plants must have the capability to reduce flow automatically when a boiler is shut down.

503 – Building Mechanical Systems

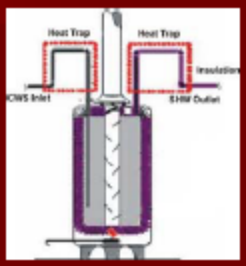
503.4.6 – Heat recovery for service water heating

Condenser heat recovery required for heating or reheating service hot water where

- Facility operates 24 hours a day, and
- Total installed heat capacity of water cooled systems >6,000,000 Btu/hr of heat rejection, and
- Design service water heating load exceed 1,000,000 Btu/h

504 – Service Water Heating

504.4 – Heat traps



504.5 – Pipe insulation

- Circulating systems
  - 1" of insulation on piping
  - R-3.5/inch minimum
- Noncirculating systems
  - without integral heat traps
    - 1/2" for first 8 feet
    - R-3.5/inch minimum

504.6 – Hot water system controls

Automatic circulating hot water systems and heat trace

Turned off automatically or manually when the system is not in operation

504.7 – Pools

Pool Heaters

- Readily accessible On/Off switch on heater
- Natural gas heaters shall not have continuously burning pilot lights

Time switches

- All – Heated and Unheated
  - Time clocks for circulation pumps according to a preset schedule
    - Exception
      - Where 24 hour operation is required for public health standards
      - Where pumps are required to operate solar and waste-heat recovery pool heating systems

Pool Covers

- Pool Covers
  - Required on heated pools
    - 90°F requires R-12 minimum
  - Vapor retardant, on or at the pool surface
  - Exception
    - 60% of the energy for heating is from site-recovered or site-solar energy

505 – Electrical Power and Lighting Systems

Interior lighting plays a major role in the energy usage of a commercial building. An increased lighting load increases the capacity requirements for the cooling system.

The lighting requirements focus on these elements:

- Controls
- Light reduction methods
- Tandem wiring
- Interior and exterior lighting power

505 – Electrical Power and Lighting Systems

505.1 – General

The lighting requirements apply to the design of:

- New lighting systems in conditioned or unconditioned spaces
- Altered components/systems as part of alteration

505 – Electrical Power and Lighting Systems

505.1 – General

The lighting requirements apply to the design of:

- Altered system that increases the lighting load resulting from change of occupancy
- Exterior lighting systems

505.2.1 – Interior lighting controls

505 – Electrical Power and Lighting Systems

505.2.2.1 – Light reduction controls

Light reduction controls differ from switching controls in that instead of turning the lights off after a period of inactivity, these controls lower the light output, and therefore the energy consumed, when areas are unoccupied or when there is suitable light supplied from another source such as windows or skylights.

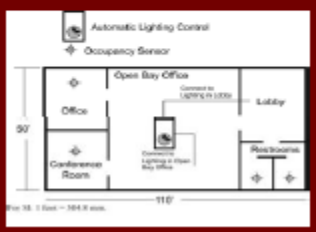
These controls can be either "dimming" or "switching" depending on the light source you are controlling and the area being controlled.

505 – Electrical Power and Lighting Systems

505.2.2 – Additional controls

505 – Electrical Power and Lighting Systems

505.2.2.2 – Automatic lighting shutoff



505 – Electrical Power and Lighting Systems

- 505.2.2.2.1 – Occupant override

If an automatic time switch control is installed, it must have an occupant override, be readily accessible, and have the following:

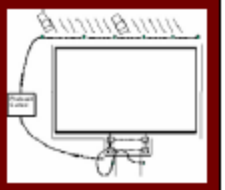
- Be in view of the lights.
- Manually operated.
- Two-hour override limit.
- Controls area less than 5,000 square feet.
- Holiday scheduling feature.

505 – Electrical Power and Lighting Systems

505.2.3 – Sleeping units

505 – Electrical Power and Lighting Systems

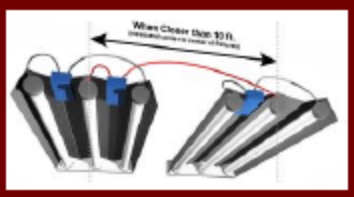
505.2.4 – Exterior lighting controls



- Must be controlled so they are automatically shut off during daylight hours
- Seven day/seasonal daylight program
- Minimum 4-hour battery backup

505 – Electrical Power and Lighting Systems

505.3 – Tandem wiring



505 – Electrical Power and Lighting Systems

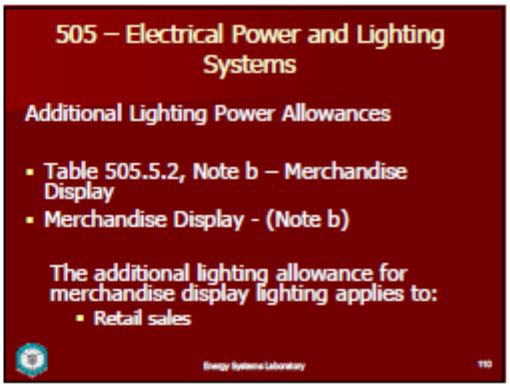
505.4 – Exit signs

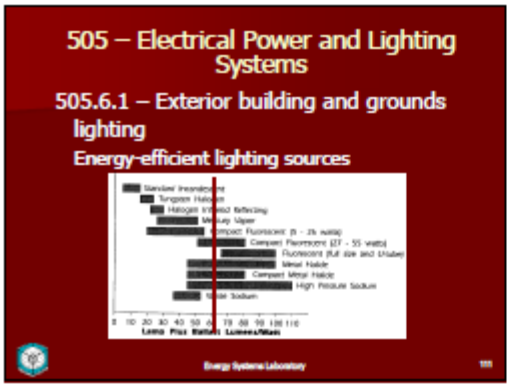
505 – Electrical Power and Lighting Systems

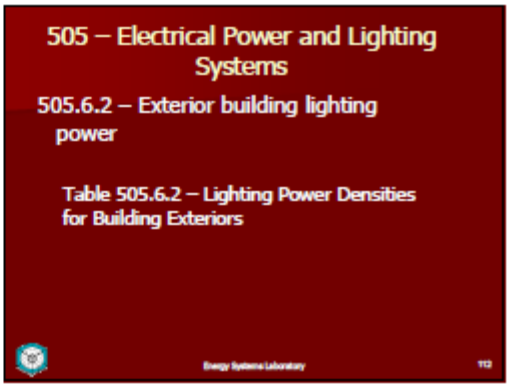
505.5 – Interior lighting power requirement

505.5.1 – Total connected interior lighting power

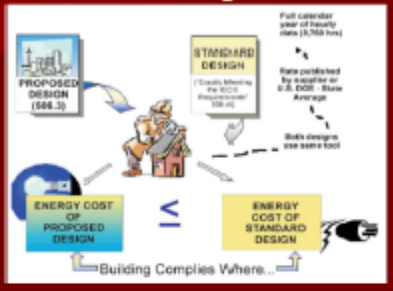
Building Area Type	(W/ft²)
Transportation	1.0
Warehouse	0.8
Workshop	1.4







506 – Total Building Performance



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506 – Total Building Performance

506.4 – Documentation

The documentation that is required to support the analysis must provide the following information:

- Annual energy use and cost.
- List of building features.
- Output files showing energy use totals.
- Energy use by source and end use.
- Total hours that the space conditioning loads were not met.
- Software error messages or warnings.
- Written explanations of any error messages or warnings.

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Questions and Answers

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SEMINAR GOAL

The goal of this seminar is for participants to apply the 2009 IECC to increase the efficient use of energy in the construction of new residential buildings and alterations to existing residential buildings.

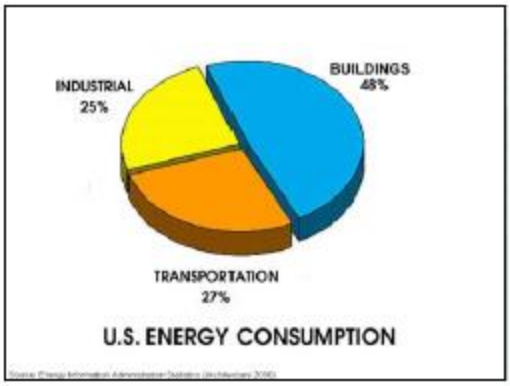
OBJECTIVES

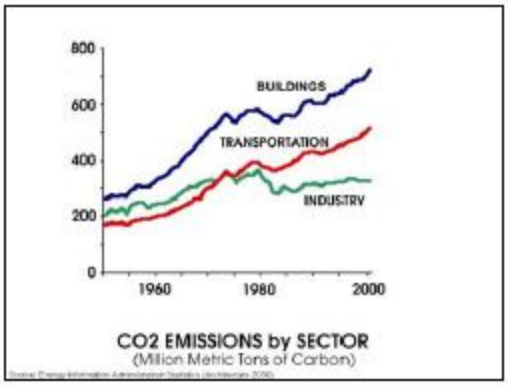
Upon completion of this seminar, participants will be able to:

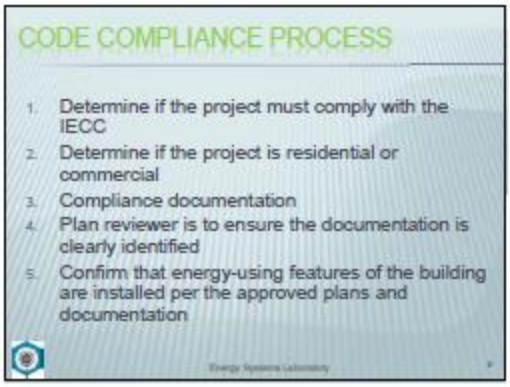
- Locate general topics in the 2009 IECC
- Locate applicable tables in the 2009 IECC for specific situations
- Apply code requirements to real-world situations
- Explain the intent behind a code requirement
- Identify borderline scenarios as compliant or noncompliant
- Identify essential code compliant for designing energy-efficient building thermal envelopes, energy-efficient mechanical design principles and electrical lighting systems in residential construction.

INTERNATIONAL ENERGY CONSERVATION CODE

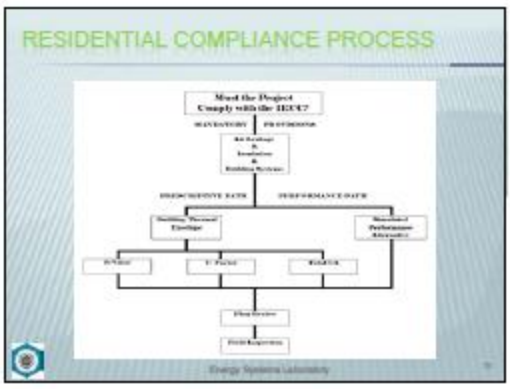
- Recognized as the national model energy code of choice for U.S. cities, counties and states that adopt codes
- Cited throughout Federal law for national private and public housing initiatives
- Serves as the basis for federal tax credits for energy efficient homes, energy efficiency standards for federal residential buildings and manufactured housing

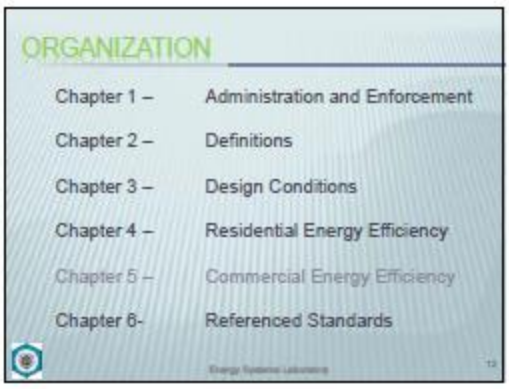

INDUSTRIAL
25%
BUILDINGS
48%
TRANSPORTATION
27%
U.S. ENERGY CONSUMPTION


800
600
400
200
0
BUILDINGS
TRANSPORTATION
INDUSTRY
1960
1980
2000
CO2 EMISSIONS by SECTOR
(Million Metric Tons of Carbon)


CODE COMPLIANCE PROCESS
1. Determine if the project must comply with the IECC
2. Determine if the project is residential or commercial
3. Compliance documentation
4. Plan reviewer is to ensure the documentation is clearly identified
5. Confirm that energy-using features of the building are installed per the approved plans and documentation

THE FOLLOWING ARE REGULATED:
- Building Envelope
- Mechanical Systems
- Electrical Systems
- Service Water Heating Systems


RESIDENTIAL COMPLIANCE PROCESS


ORGANIZATION
Chapter 1 – Administration and Enforcement
Chapter 2 – Definitions
Chapter 3 – Design Conditions
Chapter 4 – Residential Energy Efficiency
Chapter 5 – Commercial Energy Efficiency
Chapter 6- Referenced Standards

Chapter 1
Administration and Enforcement

101.2 SCOPE

The code applies to:

- Residential Buildings
  - One- and two-family dwellings, townhomes (not-IRC buildings)
  - Multifamily dwellings three stories or less in height
- Commercial Buildings
  - Multifamily dwellings four stories or greater in height

101.3 – INTENT

- The IECC continues to emphasize both prescriptive and performance-related provisions for both commercial and residential buildings
- Provide flexibility to permit the use of innovative approaches and techniques

101.3 – INTENT

101.3 – Intent

Life safety, health and environmental requirements take precedence over energy provisions.

101.4 – APPLICABILITY

The provisions apply to several different project types:

- Newly conditioned space
- Existing buildings
- Additions, alterations, renovations or repairs
- Change in occupancy or use
- Change in space conditioning
- Mixed occupancy

101 – NEWLY CONDITIONED SPACE

New buildings

101.4 – APPLICABILITY

- 101.4.1 – Existing Buildings
- 101.4.2 – Historic buildings

101.4.3 – ADDITIONS, ALTERATIONS, RENOVATIONS OR REPAIRS

- Where change increases energy use
- Applies to alteration as if it were new construction
- Exceptions
  - Storm windows over existing fenestration
  - Glass only replacements in existing frame
  - Existing ceiling, wall or floor cavities filled with insulation
  - Where existing roof, wall or floor cavity is not exposed
  - Reroofing
  - Replacement of existing doors
  - Replacement of less than 50 percent of the luminaires do not increase the lighting power.
  - Replacement of only the bulb and ballast of the luminaires provided they do not increase the lighting power

101 – SCOPE AND GENERAL REQUIREMENTS

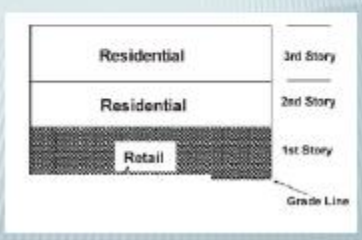
101.4.4 – Change in Occupancy

An alteration that increases demand for fossil fuel or electrical energy onsite as a result of a change must comply with the code

101 – NEWLY CONDITIONED SPACE

Any unconditioned space that is altered to become conditioned space shall be required to be brought into full compliance with this code

101.4.6 – MIXED USE BUILDING



102.1.1 – ABOVE CODE PROGRAM

- Authority to approve "above code" program is vested in the code official.
- Language does not guarantee alternative programs exceed the performance required by IECC
- Burden of proof to establish equivalency is on the applicant

101.5.2 – LOW ENERGY BUILDINGS

Buildings that are exempt from the building envelope provisions are:

- Buildings with a peak design rate of energy use less than 3.4 Btu/h ft^2 or 1 watt/ft^2 of floor area for space conditioning purposes
- Those that do not contain conditioned space

MATERIALS, SYSTEMS AND EQUIPMENT

Section 102 is now found in Section 303 - Materials, Systems and Equipment

Provisions applicable to the identification, installation and use of energy efficient materials, systems and equipment are moved from Section 102 to Section 303. These are general technical requirements, not administrative requirements.

103 – CONSTRUCTION DOCUMENTS

- Level of efficiency used to demonstrate compliance with the code must be clearly identified
- Complete set of building plans with efficiency requirements clearly labeled

CONSTRUCTION DOCUMENT INFORMATION

Information about the following systems should be included on the plans:

- Building envelope
- Mechanical system
- Lighting system
- Service water heating

103 – CONSTRUCTION DOCUMENTS

Information can be presented in a number of ways:

- On the drawings.
- On sections and in schedules.
- Through notes and callouts.
- Through supplementary worksheets or calculations.

103.3 – PLAN REVIEW

103.3 Examination of documents

- This section of the code covers the examination of documents and the various types of approvals that the code official will deal with on both new and existing buildings

104 - INSPECTIONS

The code states:

- All construction is subject to inspection.
- Construction shall not be concealed without inspection approval.
- A final inspection is required before occupancy.
- A building shall be reinspected when determined necessary by the code official.

106 – REFERENCED STANDARDS

106.2 – Conflicting requirements

Code takes precedence when the requirements of the standard conflict with the requirements of the code

106.2 – Other laws

The provisions of this code shall not be deemed to nullify any provisions of local, state, or federal law

Chapter 2
Definitions

202 – GENERAL DEFINITIONS

- Building Thermal Envelope
- Commercial Building
- Conditioned Space
- Exterior Wall
- Residential Building

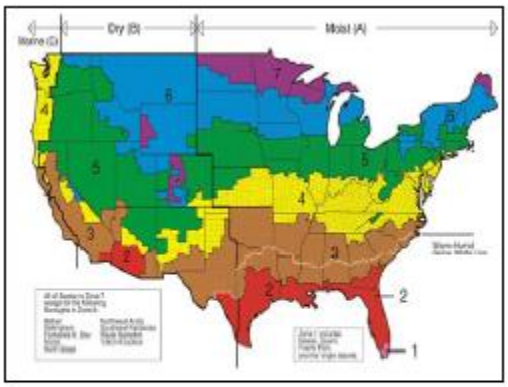
NEW DEFINITIONS

- Air barrier
- *C*-factor (thermal conductance)
- Daylight zone
- Demand control ventilation
- Entrance door
- Fan systems
- *F*-factor
- High-efficacy lamps
- Nameplate horsepower

REVISED DEFINITIONS

- Labeled
- Listed
- Storefront

Chapter 3
Design Conditions



INSULATION PRODUCT RATING

Section 303.1.4

Provides reference to the specific standards and rating conditions for the testing and listing of insulation *R*-values specific to the type of insulation and intended use

303 – IDENTIFICATION

303.1 – Materials to be labeled on site with the rated *R*-value

303 – FENESTRATION LABELS

303.1.3 – Fenestration product rating

303 – DEFAULT FENESTRATION VALUES

- Table 303.1.3(1)
  Default Glazed Fenestration *U*-Factor
- Table 303.1.3(2)
  Default Door *U*-Factors
- Table 303.1.3(3)
  Default Glazed Fenestration SHGC

TABLE 303.1.3(1) GLAZED FENESTRATION VALUES

TABLE 303.1.3(1)
DEFAULT GLAZED FENESTRATION *U*-FACTOR

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal-Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

TABLE 303.1.3(2) DOOR VALUES

TABLE 303.1.3(2)
DEFAULT DOOR *U*-FACTORS

DOOR TYPE	*U*-FACTOR
Uninsulated Metal	1.20
Insulated Metal	0.60
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

TABLE 303.1.3(3) – SOLAR HEAT GAIN COEFFICIENT

TABLE 303.1.3(3)
DEFAULT GLAZED FENESTRATION SHGC

SINGLE GLAZED		DOUBLE GLAZED		
Clear	Tinted	Clear	Tinted	GLAZED BLOCK
0.8	0.7	0.7	0.6	0.6

Chapter 4
Residential Energy Efficiency

RESIDENTIAL ENERGY EFFICIENCY

Contains requirements for the building envelope, heating and cooling systems, and water heating systems in residential buildings

COMPLIANCE METHODS

402.1.2 – Compliance by *R*-value computation

Table 402.1.1 – Insulation and Fenestration Requirements by Component

402.1.3 – *U*-factor alternative

Table 402.1.3 – Equivalent *U*-Factors

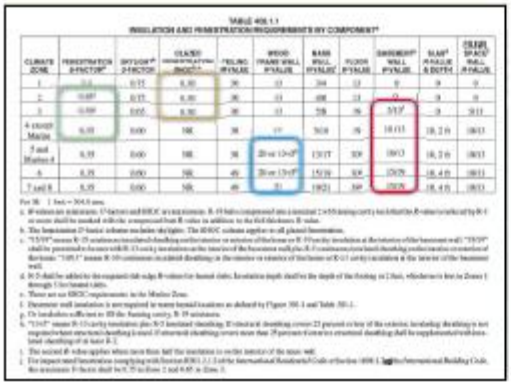


TABLE 402.1.3
EQUIVALENT U-FACTORS[a]

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR[b]	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
1	1.20	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.65	0.75	0.035	0.082	0.165	0.064	0.360	0.477
3	0.50	0.65	0.035	0.082	0.141	0.047	0.091[c]	0.136
4 except Marine	0.35	0.60	0.030	0.082	0.141	0.047	0.059	0.065
5 and Marine 4	0.35	0.60	0.030	0.057	0.082	0.033	0.050	0.065
6	0.35	0.60	0.026	0.057	0.060	0.033	0.050	0.065
7 and 8	0.35	0.60	0.026	0.057	0.057	0.028	0.050	0.065

a. Nonfenestration U-factors shall be obtained from measurement, calculation or an approved source.
b. When more than half the insulation is on the interior the mass wall U-factors shall be determined from the tables for the same wall type in the adjacent climate zone.
c. Basement wall U-factor of 0.360 in warm-humid locations as defined by Figure 301.1 and Table 301.2.
d. Foundation U-factor requirements shall be determined in accordance with Section 402.1.3 using the basement wall U-factor.

DETERMINING COMPLIANCE

An assembly *U*-factor must be calculated for each applicable assembly type proposed for the project.

The ASHRAE *Handbook of Fundamentals* is an excellent source of information on how to calculate an assembly *U*-factor.

CALCULATING ASSEMBLY *U*-FACTORS

- The calculation must include the effects of framing
- An *R*-value must be determined for each different material in the assembly
- The *R*-values are then totaled to determine the total *R*-value through each thermal path of the assembly
- The total *R*-values are then converted to *U*-factors by taking the reciprocal of the *R*-value
- An area-weighted average *U*-factor is calculated for the wall system that takes into account the effects of framing

SAMPLE CALCULATION—WALLS

$$U_{ow} = \frac{(U_{w1} \times A_{w1}) + (U_{w2} \times A_{w2}) + \ldots}{A_{wT} + A_{w2} + \ldots}$$

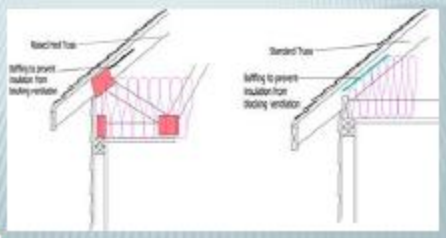
Where

- U_{w1} = *U*-factor of opaque wall number 1
- A_{w1} = Area of opaque wall number 1
- U_{w2} = *U*-factor of opaque wall number 2
- A_{w2} = Area of opaque wall number 2

402.1.4 – TOTAL UA ALTERNATIVE

- The building envelope design is permitted to deviate from *R*-values or *U*-factors in Tables 402.1.1 or 402.1.3, respectively, provided the total thermal transmittance (*UA*) is the same or less as the very same building envelope geometry designed to code

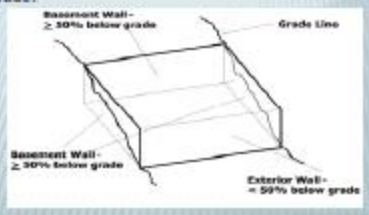
402.2.1 – CEILINGS WITH ATTIC SPACES



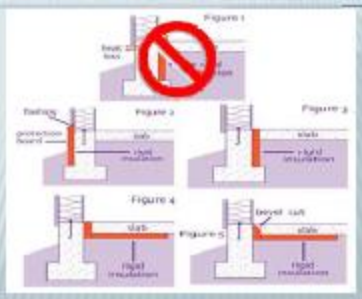
EXAMPLES OF WALL INSULATION

402.2.7 – BASEMENT WALLS

- Defined as walls greater than or equal to 50 percent below grade.



402.2.7 – SLAB-ON-GRADE FLOORS



402.2.9 – CRAWL SPACE WALLS

Criteria:

- Must be insulated to the *R*-value specified in the energy code
- May not have ventilation openings that communicate directly with outside air
- Must be mechanically ventilated or supplied with conditioned air
- Exposed earth floors must be covered with an approved vapor retarder material, which extends up the stem wall and then sealed and taped to the wall

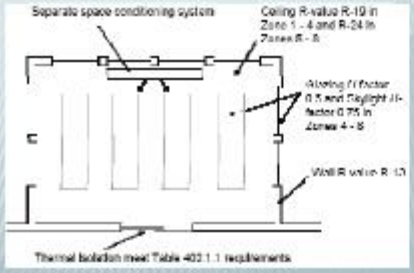
402.2.11, 402.3.5 – THERMALLY ISOLATED SUNROOMS

Thermal Isolation - A separation of conditioned spaces between a sunroom addition and a dwelling unit consisting of existing or new wall(s), doors and/or windows

Requirements:

- A separate space conditioning system
- The glass used must have a maximum *U*-factor of 0.75 in climate zones 1-3 and 0.50 inches in climate zones 4-8
- Minimum ceiling *R*-value shall be R-19 in zones 1-4 and R-24 in zones 5-8
- Minimum wall *R*-value shall be R-13
- Must maintain thermal isolation

THERMALLY ISOLATED SUNROOMS



402.3 – FENESTRATION

402.3.1 *U*-factor

- Area weighted average *U*-factors and SHGCs may be used to comply with Table 402.1.1.
- Up to 15 ft^2 of glazed fenestration per dwelling unit can be exempted from *U*-factor and SHGC requirements.

402.3.2 – GLAZED FENESTRATION SHGC

The SHGC measures how well a window or translucent product blocks heat caused by sunlight. SHGC is expressed as a number between 0 and 1. The lower the number, the lower the amount of heat that passes into the building through the glazing.

Fenestration must be rated using NFRC 200 or a default SHGC value is to be assigned from Table 303.1.3(3).

EXEMPTION

- 402.3.3 Glazed fenestration SHGC & 402.3.3 Glazed fenestration exemption
  - Up to 15 square feet (1.4 m2) of glazed fenestration per dwelling unit can be exempted from *U*-factor and SHGC requirements
- 402.3.4 Opaque door
  - One hinged opaque door up to 24 square feet (2.22m2) is also exempt
- 402.3.6 Replacement fenestration
  - Replacement windows and skylights must comply with the fenestration *U*-factor requirements of Table 402.1.1.

402.4, 402.5, 402.6, 403 – MANDATORY REQUIREMENTS

402.4 – Air Leakage (mandatory)
402.4.1 – Building thermal envelope
402.4.2 – Air Sealing and Insulation

- Building envelope air tightness and insulation shall be demonstrated in one of two ways.

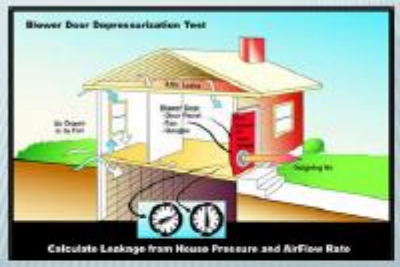
402.4.2.1 TESTING OPTION

Requires testing at specific air changes per hour at a specific air pressure

There are seven requirements

1. Exterior windows and doors, fireplaces and stove doors closed, but not sealed
2. Dampers shall be closed but not sealed
3. Interior doors open
4. Exterior openings for continuous ventilation systems and heat recovery ventilators closed and sealed
5. Heating and cooling systems turned off
6. HVAC shall not be sealed
7. Supply and return registered shall not be sealed.

BLOWER DOOR TESTING



402.4.2.2 VISUAL INSPECTION OPTION

+ The Building Official may require an approved party independent from the installer of insulation to inspect the air barriers and insulation.

402.4.3 – FIREPLACES

New wood-burning fireplaces shall have gasketed doors and outdoor combustion air

402.4.4 – FENESTRATION AIR LEAKAGE

Sets the testing requirements for air leakage rates in windows, skylights and sliding glass and swinging doors

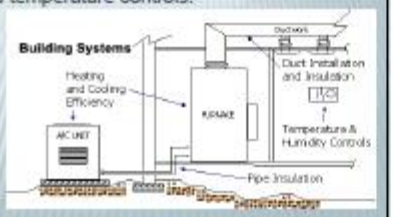
402.4.5 – RECESSED LIGHTING

402.5 – MAXIMUM FENESTRATION U-FACTOR AND SHGC (MANDATORY)

Limits the maximum area-weighted *U*-factor and SHGC that can be traded-off among opaque envelope components for the purpose of envelope compliance

403 – BUILDING SYSTEMS

The building systems addressed consist of a heating and/or cooling system, a distribution system and temperature controls.



THERMOSTAT AND CONTROLS

- 403.1.1 – Programmable Thermostat
- 403.1.2 – Heat pump supplementary heat (Mandatory)

403.2 – DUCTS

- 403.2.1 – Insulation
  - Supply ducts in attics shall be R-8 min
  - All other ducts shall be R-6 min
  - Exception
    - Ducts located completely inside the building thermal envelope
- 403.2.2 – Sealing
  - All ducts, air handlers, filter boxes and building cavities used as ducts shall be sealed in accordance with Section M1601.4.1 IRC
  - Duct tightness shall be verified by testing
    - Postconstruction or rough-in
    - The test is not required where the air handler and entire duct system are located within conditioned space.

403.4 – CIRCULATING HOT WATER

- Insulation
  - All hot water piping shall be R-2 min
- Controls
  - Automatic controls OR
  - Readily accessible manual switch

403.6 AND 403.7 – SIZING, MULTIPLE UNITS

- Sizing
  - Heating and cooling equipment shall be sized in accordance with Section M1401.3 of the IRC
    - Use Design conditions specified in IECC Chapter 3
    - "Part IV—Mechanical" of the IRC refers specifically to the Air Conditioning Contractors of America (ACCA) Manual J for building loads (IRC Section M1401.3).
    - "Part IV—Mechanical" of the IRC refers specifically to the Air Conditioning Contractors of America (ACCA) Manual S for sizing equipment (IRC Section M1401.3).
- Multiple Units
  - All systems serving multiple dwelling units shall comply with Sections 503 and 504 in lieu of Section 403

OVERSIZING = SHORT CYCLING

Oversized Air Conditioning Equipment Results in Short Cycling

Impacts of oversizing are:

- Reduces equipment life
- Reduces efficiency (SEER)
- Results in poor dehumidification
- Reduces filter effectiveness

403.8 - SNOWMELT SYSTEMS

- Snow and ice-melting equipment controls
  - Automatic controls capable of shutting down the system when
    - The pavement temperature is above 50°F and no precipitation is falling AND
    - An automatic or manual control that will allow shutoff when the outdoor temperature is above 40°F

403.9 – POOLS

Energy conservation requirements are required for residential pools the same as commercial pools. These include pool heaters, time switches to control circulation pumps and heaters and vapor retardant pool covers

403.9.1 POOL HEATERS

- All pool heaters shall be equipped with a readily accessible on-off switch to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fired by natural gas shall not have continuously burning pilot lights.

403.9.2 TIME SWITCHES.

- Time switches to automatically turn off and on heaters and pumps according to a preset schedule shall be installed on swimming pool heaters and pumps. The two exceptions address public health standards and circumstances where the pumps serve pools with solar-waste-heat recovery heating systems.

403.9.3 POOL COVERS

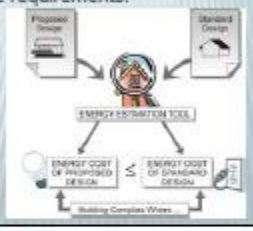
- Heated pools shall have a vapor-retardant pool cover on or at the water surface
- Pools heated to more than 90°F shall have a R-12 min value pool cover
- Exception
  - Pools deriving over 60 percent of the energy for heating from site-recovered or solar energy source

404.1 - LIGHTING EQUIPMENT

A minimum of fifty percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps.

405 – SIMULATED PERFORMANCE ALTERNATIVE

An energy estimation tool is used to compare the energy use of the proposed design with that of the standard design building, just meeting the minimum code requirements.



405.4 – DOCUMENTATION

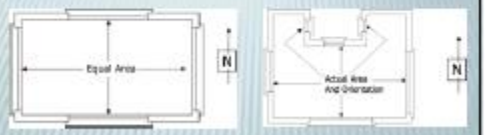
A comparative compliance report which clearly depicts the annual energy costs of both standard and proposed designs must accompany all submittals demonstrating compliance under the simulated performance alternative.

405.5.2 – RESIDENCE SPECIFICATIONS

Table 405.5.2(1) - Specifications for the Standard Reference and Proposed Designs

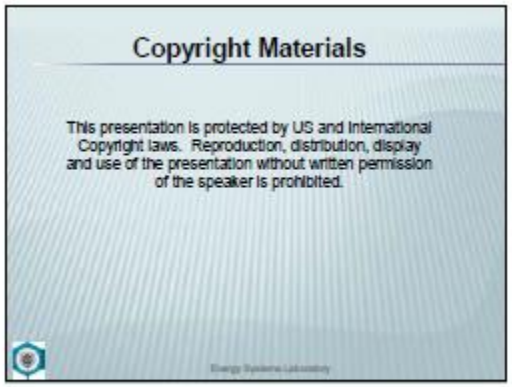
- Building Component
- Standard Reference Design
- Proposed Design

TABLE 405.5.2(1) – GLAZING



DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES
Proposed Design

QUESTIONS AND ANSWERS
Q&A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