ESL-TR-15-11-01

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 2014-December 2014

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November 2015

ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

TEXAS A&M ENGINEERING
EXPERIMENT STATION

Energy Systems Laboratory

November 13, 2015

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

Dear Chairman Shaw:

The Energy Systems Laboratory (ESL) at the Texas A&M Engineering Experiment Station of the Texas A&M University System is pleased to provide its annual report, "Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP)," as required under Texas Health and Safety Code 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

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

Enclosure

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

Disclaimer

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 A&M Engineering Experiment Station of The Texas A&M University System, in fulfillment of its responsibilities under Texas Health and Safety Code Ann. § 388.003 (e), submits 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.

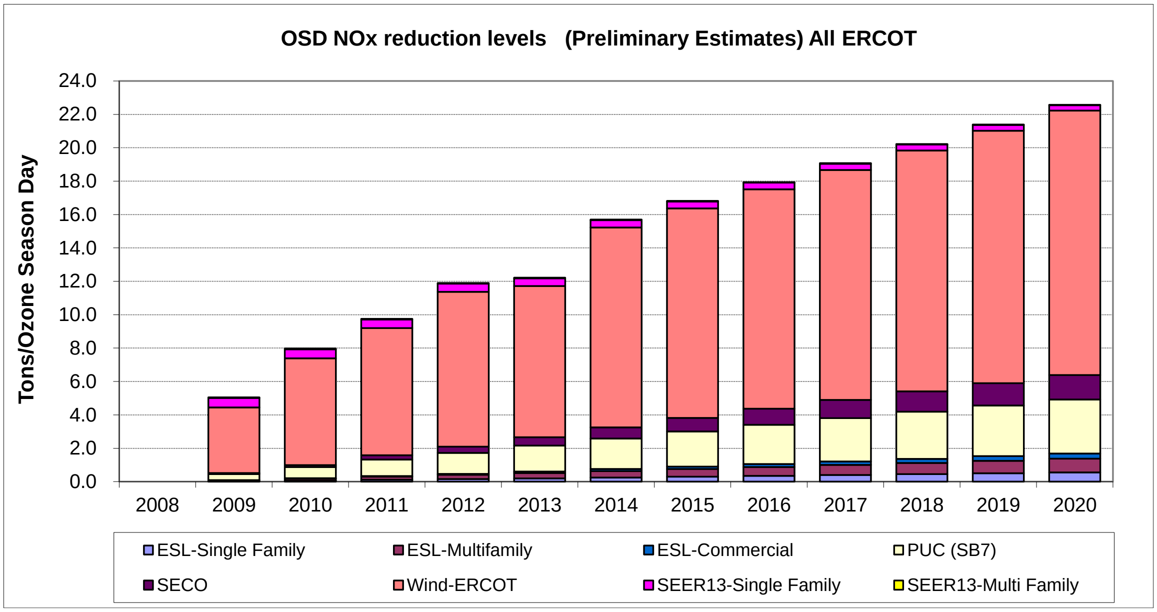

Figure 1: OSD NOx Emissions Reduction Projections through 2020 (Base Year 2008)

In 2014 (Table 1), the total integrated annual savings from all programs are 23,684,427 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction are 927,408 MWh/year (3.9% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program are 2,675,295 MWh/year (11.3%),
- Savings from SECO's Senate Bill 5 program are 936,047 MWh/year (4.0%),
- Electricity savings from green power purchases (wind) are 18,857,560 MWh/year (79.6%), and
- Savings from residential air conditioner retrofits[1] are 288,118 MWh/year (1.2%).

By 2020, the total integrated annual savings from all programs will be 34,278,170 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction will be 2,294,744 MWh/year (6.7% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program will be 4,728,263 MWh/year (13.8%),
- Savings from SECO's Senate Bill 5 program will be 2,098,664 MWh/year (6.1%),
- Electricity savings from green power purchases (wind) will be 24,944,707 MWh/year (72.8%), and
- Savings from residential air conditioner retrofits will be 211,793 MWh/year (0.6%).

In 2014 (Table 2), the total integrated annual NOx emissions reductions from all programs are 6,494 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 233 tons-NOx/year (3.6% of the total NOx savings),
- NOx emissions reductions from the PUC's Senate Bill 7 programs are 669 tons-NOx/year (10.3%),
- NOx emissions reductions from SECO's Senate Bill 5 program are 241 tons-NOx/year (3.7%),
- NOx emissions reductions from green power purchases (wind) are 5,283 tons-NOx/year (81.4%), and
- NOx emissions reductions from residential air conditioner retrofits are 68 tons-NOx/year (1.0%).

By 2020, the total integrated annual NOx emissions reductions from all programs will be 9,332 tons-NOx/year. The integrated annual NOx emissions reductions from all the different programs are:

[1] This assumes air conditioners in existing homes are replaced with the more efficient SEER 13 units, versus an average of SEER 11, which is slightly more efficient than the previous minimum standard of SEER 10.

- NOx emissions reductions from code-compliant residential and commercial construction will be 578 tons-NOx/year (6.2% of the total NOx savings),
- NOx emissions reductions from the PUC's Senate Bill 7 programs will be 1,183 tons-NOx/year (12.7%),
- NOx emissions reductions from SECO's Senate Bill 5 program will be 533 tons-NOx/year (5.7%),
- NOx emissions reductions from green power purchases (wind) will be 6,989 tons-NOx/year (74.9%), and
- NOx emissions reductions from residential air conditioner retrofits will be 50 tons-NOx/year (0.5%).

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	293,313	366,737	441,309	517,093	594,153	672,557	752,372
ESL-Multifamily (MWh)	0	50,218	94,867	167,566	262,939	357,717	463,922	569,704	675,096	780,131	884,845	989,268	1,093,435
ESL-Commercial (MWh)	0	0	25,750	54,550	87,230	126,228	170,173	214,773	260,065	306,088	352,880	400,483	448,937
PUC (SB7) (MWh)	0	538,841	976,984	1,437,883	1,831,318	2,267,414	2,675,295	3,062,781	3,430,894	3,780,601	4,112,822	4,428,433	4,728,263
SECO (MWh)	0	71,910	154,786	347,175	508,375	705,060	936,047	1,155,485	1,363,951	1,561,993	1,750,134	1,928,867	2,098,664
Wind-ERCOT (MWh)	0	3,273,150	8,135,429	10,995,427	13,049,580	15,723,534	18,857,560	19,757,605	20,700,609	21,688,621	22,723,790	23,808,366	24,944,707
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	23,684,427	25,400,797	27,131,950	28,881,552	30,653,297	32,450,913	34,278,170

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	1,002	1,199	1,400	1,604	1,811	2,022	2,237
ESL-Multifamily (MWh)	0	233	460	744	999	1,253	1,539	1,823	2,107	2,390	2,671	2,953	3,233
ESL-Commercial (MWh)	0	0	71	149	239	346	466	588	713	839	967	1,097	1,230
PUC (SB7) (MWh)	0	1,476	2,677	3,939	5,017	6,212	7,330	8,391	9,400	10,358	11,268	12,133	12,954
SECO (MWh)	0	197	424	951	1,393	1,932	2,565	3,166	3,737	4,279	4,795	5,285	5,750
Wind-ERCOT (MWh)	0	14,246	23,054	27,654	33,273	32,560	42,806	44,849	46,990	49,233	51,582	54,044	56,624
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	57,751	61,958	66,190	70,453	74,759	79,115	83,530

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	72	91	109	128	147	166	186
ESL-Multifamily	0	13	24	43	67	91	118	145	172	199	225	252	278
ESL-Commercial	0	0	6	14	22	32	43	54	66	77	89	101	114
PUC (SB7)	0	135	246	362	460	567	669	766	858	946	1,029	1,108	1,183
SECO	0	19	43	92	133	183	241	296	348	398	445	490	533
Wind-ERCOT	0	895	2,262	3,053	3,648	4,399	5,283	5,535	5,800	6,076	6,366	6,670	6,989
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	6,494	6,951	7,413	7,882	8,357	8,840	9,332

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	0.25	0.30	0.35	0.40	0.45	0.50	0.55
ESL-Multifamily	0	0.06	0.12	0.19	0.26	0.32	0.39	0.46	0.54	0.61	0.68	0.75	0.82
ESL-Commercial	0	0.00	0.02	0.04	0.06	0.09	0.12	0.15	0.18	0.21	0.24	0.28	0.31
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	0.66	0.81	0.95	1.09	1.22	1.34	1.46
Wind-ERCOT	0	3.93	6.40	7.62	9.28	9.06	11.97	12.55	13.15	13.77	14.43	15.12	15.84
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	15.70	16.81	17.94	19.08	20.23	21.39	22.58

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) 845-9213, or by email at terpinfo@tamu.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, Chunliu Mao, Sukjoon Oh and Yifu Sun.

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1 Overview

The Energy Systems Laboratory (Laboratory), at the Texas A&M 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; $434,481.91 in FY 2012 (with the 50% Legislature cut in ESL funding), and $447,907.94 in FY 2013. In FY 2014 the Laboratory expended $453,122.25. 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-Familyresidences, (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-Familyresidential was updated to Chapter 11 (Energy Efficiency) of the 2009 International Residential Code (IRC).

In the timeframe of 2012-2014, with the laboratory's recommendations and additional input from stakeholder meetings and public comment periods, the State of Texas did not adopt the 2012 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. As of the time of this report, SECO has not adopted the 2012.

1.4 Accomplishments since January 2014

Since January 2014, 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 and webpage.
- Continued development and testing of key procedures for validating simulations of building energy performance;
- Provided energy code training workshops, including: residential, commercial IECC/IRC energy code training sessions at the 22nd Building Professional Institute (BPI), UT Arlington;
- Provided energy code training workshops, including: residential, commercial IECC/IRC energy code training sessions at the 14th Building Professional Institute (BPI), Houston;
- Reviewed several local code proposed amendments and analyzed their stringency. For: the City of Houston and Austin Energy Green Building Program
- 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 November 2014, in Dallas, Texas. Conference sessions included key talks by the TCEQ, PUCT, ERCOT, EPA, SECO, several ISDs and cities, and the Laboratory about quantifying emissions reduction from EE/RE opportunities and guidance on key energy efficiency and renewable energy topics; the various topics covered: Learning from Green Schools and Exisiting Buildings; Innovative Technologies and Techniques; PACE as a New Program in Texas; Alternative Financing for Energy Efficiency; Commercial & Institutional Green Building Performance; Collaboration is the Key – Piblic/Private Partnerships; Utilities – Efficiency Resources; Energy Codes Discussion; and Regional Applications.
- Provided technical assistance to the TCEQ regarding specific issues, including:
  - Enhancement of the standardized, integrated NOx emissions reduction reporting procedures to the TCEQ for EE/RE projects, and
  - Enhancement of the procedures for weather normalizing NOx emissions reduction from renewable projects.
- Participated as exhibitors at several conferences, including at the Clean Air Through Energy Efficiency Conference in Dallas, 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-Familyresidential 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 October 2014;
- 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 the paper at the Annual ASHRAE Conference, held in Seattle, WA, June 2014

- Baltazar, J.C., Mao, C., and Haberl, J., 2014, "Verification of Energy Savings from the Implementation of the Residential Building Codes in Texas", Proceedings of the 2014 Annual ASHRAE Conference, Seattle, WA, June 2014.

Presentations of the paper at the 14th International Conference for Enhanced Building Operations, held in Beijing, China, September 2014

- Haberl, J.; Yazdani, B.; Baltazar, J.C.; Mukhopadhyay, J.; Zilbershtein, G.; Ellis, S.; Parker, P., 2014 "Calculation of Intergrated Nox Emissions Reductions from Energy Efficiency and Renewable Energy (EE/RE) Programs across State Agencies in Texas" Proceedings of the 14th International Conference for Enhanced Building Operations, Beijing, China, September 2014

Four presentations to the Clean Air Through Energy Efficiency Conference held in San Antonio, Texas, December 2014.

- Claridge, D., 2014 "Energy Efficiency and Energy Policy" *Clean Air Through Energy Efficiency Conference,* Dallas, Texas, November 2014
- Ellis, S., 2014 "2015 IECC: What's new in next edition" *Clean Air Through Energy Efficiency Conference,* Dallas, Texas, November 2014
- Ellis, S., 2014 "International Energy Conservation Code 2012 & 2015" *Clean Air Through Energy Efficiency Conference,* Dallas, Texas, November 2014
- Haberl, J.; Yazdani, B., 2014 "Energy Efficiency and Renewable Energy Impacts on Emission Reductions" *Clean Air Through Energy Efficiency Conference,* Dallas, Texas, November 2014

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

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

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

In 2014, the following savings were calculated:

- In 2014, the annual electricity savings from code-compliant residential and commercial Construction are 927,408 MWh/year (3.9% of the total electricity savings),
- Savings from residential air conditioner retrofits[2] are 288,118 MWh/year (1.2%).

- In 2014, the OSD electricity savings from code-compliant residential and commercial Construction are 3,007 MWh/day (5.2%),
- Savings from residential air conditioner retrofits are 2,043 MWh/day (3.5%).

- By 2020, the annual electricity savings from code-compliant residential and commercial Construction will be 2,294,744 MWh/year (6.7% of the total electricity savings),
- Savings from residential air conditioner retrofits will be 211,793 MWh/year (0.6%).

- By 2020, the OSD electricity savings from code-compliant residential and commercial Construction will be 6,700 MWh/day (8.0%),
- Savings from residential air conditioner retrofits will be 1,502 MWh/day (1.8%).

- In 2014, the annual NOx emissions reduction from code-compliant residential and commercial Construction are 233 tons-NOx/year (3.6% of the total NOx savings),
- NOx emissions reductions from residential air conditioner retrofits are 68 tons-NOx/year (1.0%).

- In 2014, the OSD NOx emissions reduction from code-compliant residential and commercial Construction are 0.76 tons-NOx/day (4.8%)
- NOx emissions reductions from residential air conditioner retrofits are 0.47 tons-NOx/day (3.0%).

- By 2020, the NOx emissions reduction from code-compliant residential and commercial Construction will be 578 tons-NOx/year (6.2% of the total NOx savings),
- NOx emissions reductions from residential air conditioner retrofits will be 50 tons-NOx/year (0.5%).

- By 2020, the OSD NOx emissions reduction from code-compliant residential and commercial Construction will be 1.69 tons-NOx/day (7.5%),
- NOx emissions reductions from residential air conditioner retrofits will be 0.35 tons-NOx/day (1.5%).

[2] This assumes air conditioners in existing homes are replaced with the more efficient SEER 13 units, versus an average of SEER 11, which is slightly more efficient than the previous minimum standard of SEER 10.

1.7 Integrated NOx Emissions Reductions Reporting Across State Agencies

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

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

In 2014, the total integrated annual savings from all programs are 23,684,427 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction are 927,408 MWh/year (3.9% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program are 2,675,295 MWh/year (11.3%),
- Savings from SECO's Senate Bill 5 program are 936,047 MWh/year (4.0%),
- Electricity savings from green power purchases (wind) are 18,857,560 MWh/year (79.6%), and
- Savings from residential air conditioner retrofits[3] are 288,118 MWh/year (1.2%).

In 2014, the total integrated OSD savings from all programs are 57,751 MWh/day, which would be a 2,406 MW average hourly load reduction during the OSD period. The integrated OSD electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction are 3,007 MWh/day (5.2%),
- Savings from the PUC's Senate Bill 7 programs are 7,330 MWh/day (12.7%),
- Savings from SECO's Senate Bill 5 program are 2,565 MWh/day (4.4%),
- Electricity savings from green power purchases (wind) are 42,806 MWh/day (74.1%), and
- Savings from residential air conditioner retrofits are 2,043 MWh/day (3.5%).

By 2020, the total integrated annual savings from all programs will be 34,278,170 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction will be 2,294,744 MWh/year (6.7% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program will be 4,728,263 MWh/year (13.8%),
- Savings from SECO's Senate Bill 5 program will be 2,098,664 MWh/year (6.1%),
- Electricity savings from green power purchases (wind) will be 24,944,707 MWh/year (72.8%), and
- Savings from residential air conditioner retrofits will be 211,793 MWh/year (0.6%).

By 2020, the total integrated OSD savings from all programs will be 83,530 MWh/day, which would be a 3,480 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 6,700 MWh/day (8.0%),
- Savings from the PUC's Senate Bill 7 programs will be 12,954 MWh/day (15.5%),
- Savings from SECO's Senate Bill 5 program will be 5,750 MWh/day (6.9%),
- Electricity savings from green power purchases (wind) will be 56,624 MWh/day (67.8%), and
- Savings from residential air conditioner retrofits will be 1,502 MWh/day (1.8%).

[3] This assumes air conditioners in existing homes are replaced with the more efficient SEER 13 units, versus an average of SEER 11, which is slightly more efficient than the previous minimum standard of SEER 10.

In 2014, the total integrated annual NOx emissions reductions from all programs are 6,494 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 233 tons-NOx/year (3.6% of the total NOx savings),
- NOx emissions reductions from the PUC's Senate Bill 7 programs are 669 tons-NOx/year (10.3%),
- NOx emissions reductions from SECO's Senate Bill 5 program are 241 tons-NOx/year (3.7%),
- NOx emissions reductions from green power purchases (wind) are 5,283 tons-NOx/year (81.4%), and
- NOx emissions reductions from residential air conditioner retrofits are 68 tons-NOx/year (1.0%).

In 2014, the total integrated OSD NOx emissions reductions from all programs are 15.70 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 0.76 tons-NOx/day (4.8%),
- NOx emissions reductions from the PUC's Senate Bill 7 programs are 1.83 tons-NOx/day (11.7%),
- NOx emissions reductions from SECO's Senate Bill 5 program are 0.66 tons-NOx/day (4.2%),
- NOx emissions reductions from green power purchases (wind) are 11.97 tons-NOx/day (76.3%), and
- NOx emissions reductions from residential air conditioner retrofits are 0.47 tons-NOx/day (3.0%).

By 2020, the total integrated annual NOx emissions reductions from all programs will be 9,332 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 578 tons-NOx/year (6.2% of the total NOx savings),
- NOx emissions reductions from the PUC's Senate Bill 7 programs will be 1,183 tons-NOx/year (12.7%),
- NOx emissions reductions from SECO's Senate Bill 5 program will be 533 tons-NOx/year (5.7%),
- NOx emissions reductions from green power purchases (wind) will be 6,989 tons-NOx/year (74.9%), and
- NOx emissions reductions from residential air conditioner retrofits will be 50 tons-NOx/year (0.5%).

By 2020, the total integrated OSD NOx emissions reductions from all programs will be 22.58 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 1.69 tons-NOx/day (7.5%),
- NOx emissions reductions from the PUC's Senate Bill 7 programs will be 3.24 tons-NOx/day (14.4%),
- NOx emissions reductions from SECO's Senate Bill 5 program will be 1.46 tons-NOx/day (6.5%),
- NOx emissions reductions from green power purchases (wind) will be 15.84 tons-NOx/day (70.2%), and
- NOx emissions reductions from residential air conditioner retrofits will be 0.35 tons-NOx/day (1.5%).

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

	ESL-Single Family[16]	ESL[16]-Multifamily	ESL[16]-Commercial	PUC (SB7)[15]	SECO[15]	Wind-ERCOT[8]	SEER13 Single Family	SEER13 Multi Family
Annual Degradation Factor [11]	2.0%	2.0%	2.0%	5.0%	5.0%	0.0%	5.0%	5.0%
T&D Loss [9]	7.0%	7.0%	7.0%	7.0%	7.0%	0.0%	7.0%	7.0%
Initial Discount Factor [12]	20.0%	20.0%	20.0%	10.0%	60.0%	10.0%	20.0%	20.0%
Growth Factor	3.3%	1.5%	3.3%	0.0%	0.0%	4.8%	N.A.	N.A.
Weather Normalized	Yes	Yes	Yes	No	No	No	Yes	Yes

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

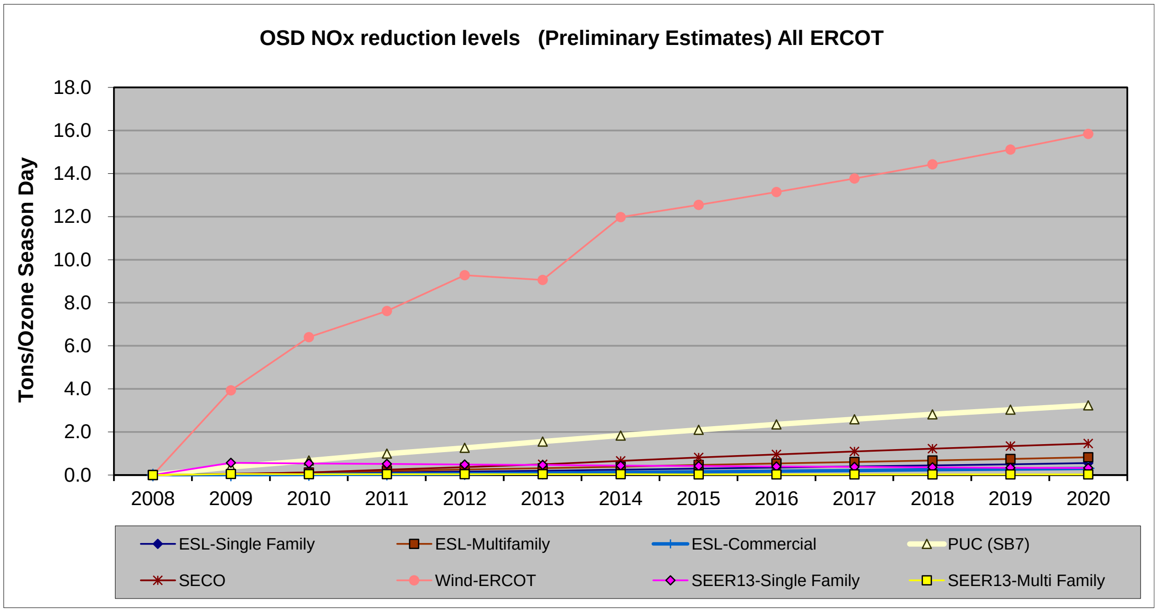

Figure 2: Integrated OSD Individual Programs NOx Emissions Reduction Projections through 2020 (Base Year 2008)

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 was being used to calculate emissions reduction for consideration for SIP credits from energy efficiency and renewable energy programs in the TERP.

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

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

In 2008, work on both web based calculators continued;

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

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

In 2009, IC3 developments included:

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

In 2010 there were several software updates including:

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

The 2011 software updates include:

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

The 2012 software updates include:

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

The 2013 software updates include:

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

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

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 2014, 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 2014 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 2015

In FY 2015, 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 Calculation Engine XML Interface Service (CEXIS) was developed. This is an API interface for our calculation engine. It generates the same results as the IC3 website, but allows for a direct programming interface, without having to manually enter the data into the IC3 website.
- We also begin work on IC3 version 4. This is to be a complete retooling of the website using ASP.NET 4.5 and using the CEXIS interface to run the projects. It will be limited to IECC 2015 or later and will run concurrently with version 3.14 for a time, as this will handle IECC 2009 and 2012 codes. We plan to retire version 3.14 when the state mandates the IECC 2015 code for new construction (September 2016).

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@tamu.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].

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[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.

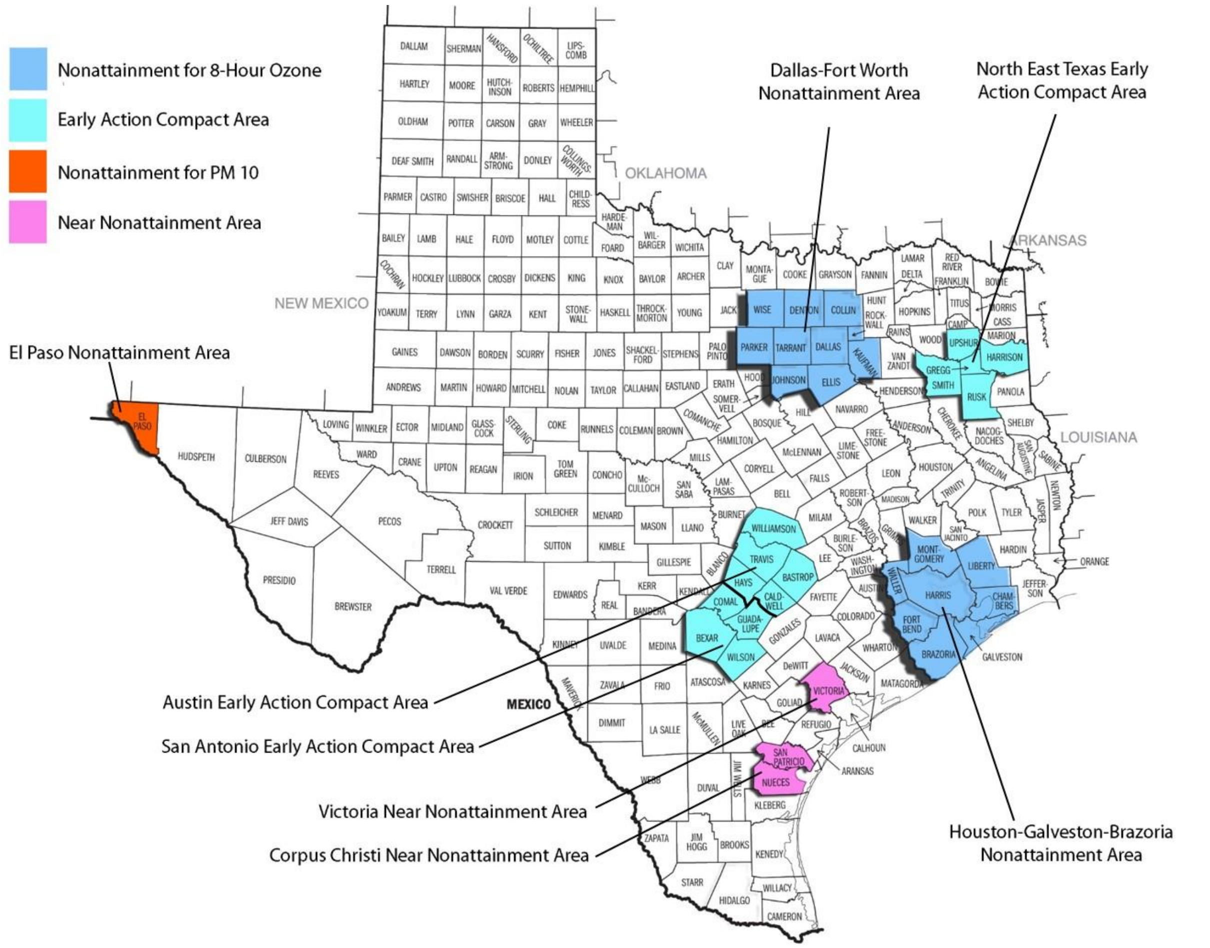


Figure 3: US EPA Nonattainment and Near Nonattainment

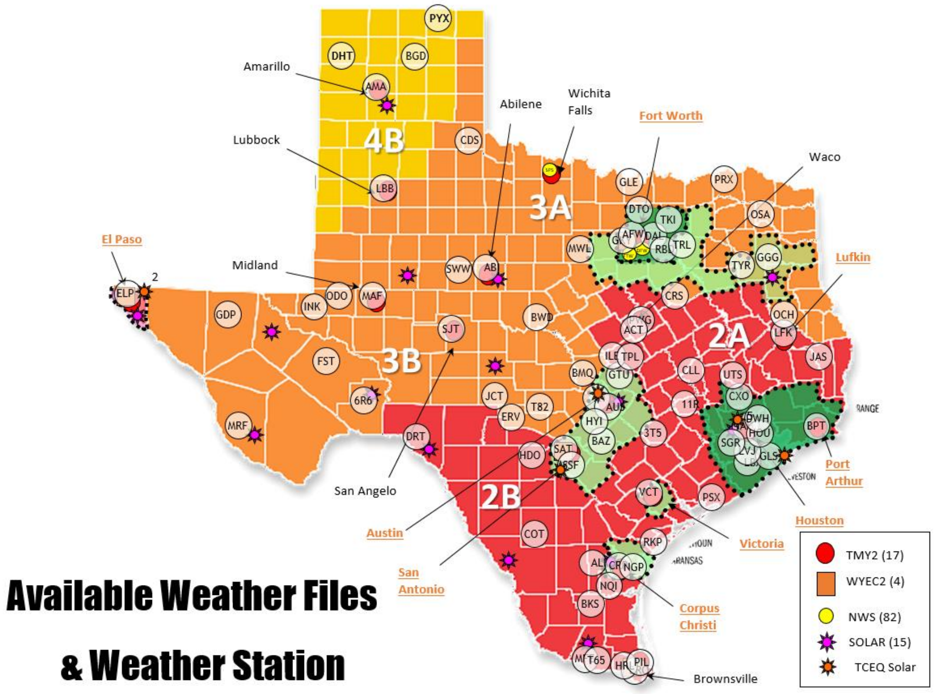
2.2 Energy Systems Laboratory's Responsibilities in the TERP

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 Brazori (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	Dryden Terrell County Airport (6R6)
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 FLD AIRPORT (ERV)
47	KILLEEN: KILLEEN MUNICIPAL AIRPORT (ILE)
48	KINGSVILLE: KINGSVILLE NAS AIRPORT (NQI)
49	LA GRANGE: FAYETTE REGIONAL AIR CENTER AIRPORT (3T5)
50	Longview E Tx 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 Mounta (GDP)
66	Port Arthur Se Tx Rgnl Airport (BPT)
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	Menard
12	Overton
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. They remained unchanged in 2013. They were not updated in 2014.

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

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

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

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

In 2003 and 2004, the Laboratory worked with the TCEQ to identify a method to help the PUCT more accurately report their deemed savings as peak-day savings in 1999, using the Laboratory's new emissions reductions calculator. In 2005, this method was implemented in the TCEQ's Integrated Emissions Calculations, which was reported in previous (from 2005-2013) annual reports.

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

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

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

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

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

- 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 tenth annual report, “Statewide Air Emissions Calculations from Wind and Other Renewables,” to the Texas Commission on Environmental Quality.

The report is organized in several deliverables:

- a summary report, which details the key areas of work
- supporting documentation
- supporting data files, including weather data, and wind production data, 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 2014 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 2014 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 2014 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 2014 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 two new wind farms which started operation in 2011 and 2014 were added, including Sherbino 2 and Goldthwaite 1 wind farms. The Sherbino 2 wind farm was added in this year’s report because the data of the wind farm was available from 2014 even though the operation started in 2011. In addition, Texas Wind Power Project and Delaware Mountain wind farms were removed in this year’s report because the two wind farms were shut down due to significant damage by ice storms in 2013. Figure 5 shows the measured annual wind power generation in 2014 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 2014 is 34,300,904 MWh/yr., which is 14.53% 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 2014 is 72,600 MWh/day, which is 30.17% higher than the 2008 OSP baseline wind production. For the analysis of this year, the measured 2014 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.

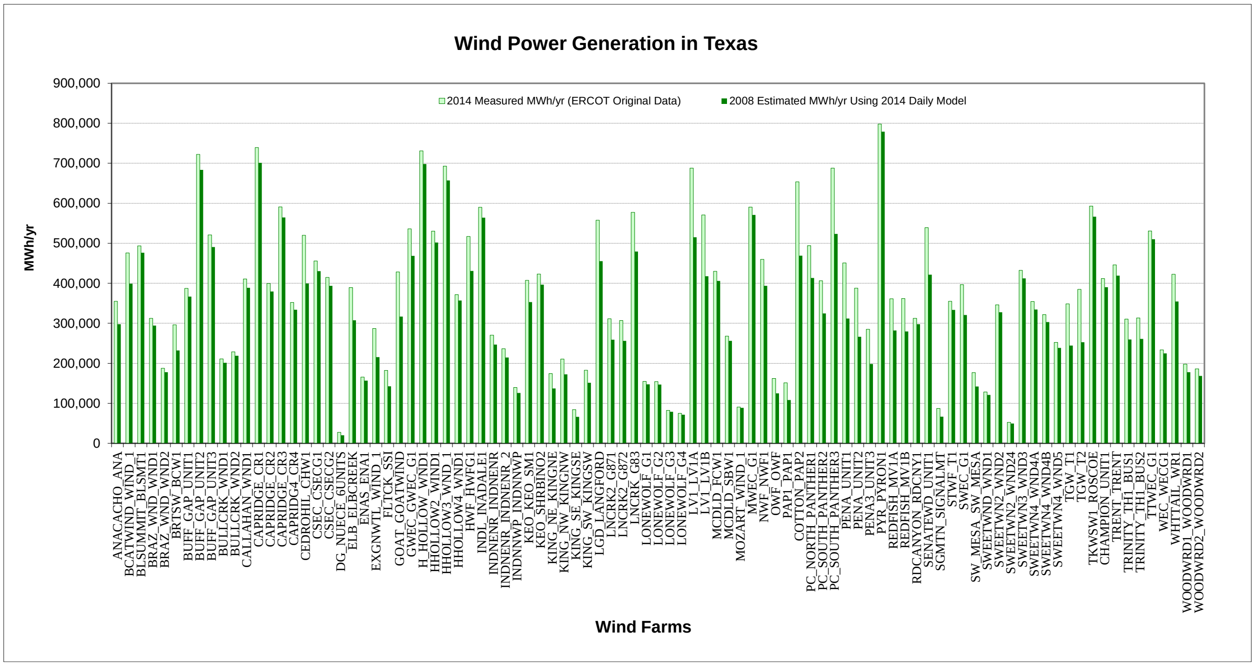


Figure 5: Comparison of 2014 Measured and 2008 Estimated Wind Power Production for Each Wind Farm

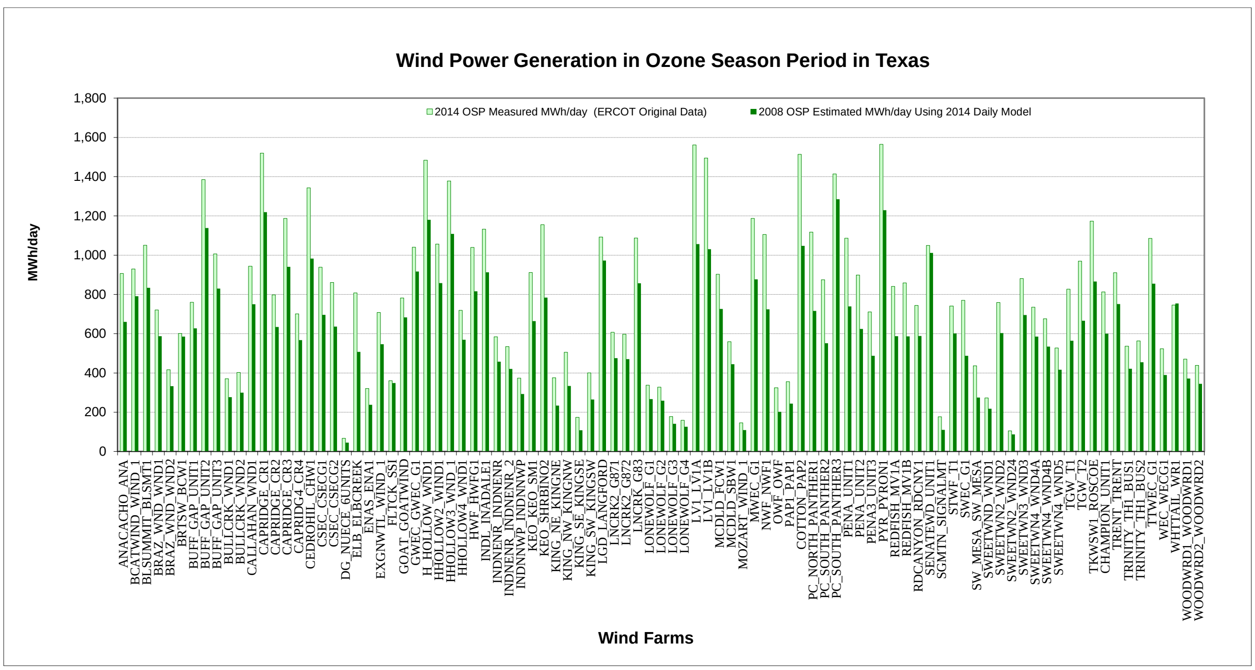


Figure 6: Comparison of 2014 OSP Measured and 2008 OSP Estimated Wind Power Production for Each Wind Farm

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 29,950,120 MWh/yr and 55,772 MWh/day in the Ozone Season Period. The total NOx emissions reductions across all the counties amount are 8,217.00 tons/yr and 15.43 tons/day for the Ozone Season Period. Based on the 2014 measured ERCOT data, the total MWh savings for all the wind farms within the ERCOT region are 34,300,904 MWh/yr and 72,600 MWh/day in the Ozone Season Period. The total NOx emissions reductions in 2014 across all the counties amount are 9,473.45 tons/yr and 20.21 tons/day for the Ozone Season Period. Compared to the base year 2008, the total annual NOx emissions reductions increased by 15.29%, and the total NOx emissions reductions increase 30.99% 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 TCEQ request on reference to the degradation of the wind farm power output, the ESL has been evaluating any observed degradation from the measured data for all the 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 4, of the sixty nine sites analyzed, forty nine 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 0.1% to 296.7%. The remaining twenty sites showed a decrease from -0.1% to -15.2%. The weighted average of this increase across all wind farms is 18.9% (positive), which indicates that no degradation was observed from the aggregate energy production from these wind farms over the analyzed operation period. Similarly, the wind farms of Big Spring Wind Power (-14.4%) and Snyder Wind Project (-15.2%) 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 4: Summary of 90th Percentile Hourly Wind Power Analysis for Forty Five Wind Farms (69 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	127.4	-0.1%	93.5	-26.7%	139.4	9.3%	121	160
Barton Chapel Wind 1	Apr-09	60.0	79.5	32.5%	60.0	0.0%	89.1	48.5%	69	120
Buffalo Gap 1	Nov-06	100.9	98.5	-2.3%	75.4	-25.2%	105.7	4.8%	98	120
Buffalo Gap 2	Apr-08	183.4	172.8	-5.8%	104.9	-42.8%	207.6	13.2%	81	233
Buffalo Gap 3	Jun-09	86.4	136.8	58.3%	86.4	0.0%	152.1	76.0%	67	170
Bull Creek Wind Plant	Dec-09	93.9	87.9	-6.4%	41.5	-55.8%	130.4	38.9%	61	180
Big Spring Wind Power	Dec-02	27.2	23.3	-14.4%	16.3	-40.1%	27.2	0.0%	145	41
Callahan Divide Wind	Feb-06	93.3	95.3	2.1%	86.7	-7.1%	101.5	8.8%	107	114
Capricorn Ridge Wind 1&2	Aug-08	258.0	247.0	-4.3%	174.5	-32.4%	291.2	12.8%	77	364
Capricorn Ridge Wind 3	Jan-09	120.3	135.3	12.5%	97.9	-18.6%	153.5	27.6%	72	186
Capricorn Ridge Wind 4	Apr-09	85.2	84.5	-0.8%	67.6	-20.6%	92.8	9.0%	69	112.5
Camp Springs Wind Energy Center	Apr-08	111.3	106.0	-4.7%	95.0	-14.6%	120.9	8.6%	81	130
Camp Springs Energy Expension	Jan-09	94.0	96.8	3.0%	88.9	-5.4%	107.9	14.8%	72	120
Cedro Hill Wind	Dec-11	136.3	128.9	-5.4%	120.5	-11.6%	136.9	0.4%	37	150
Champion Wind Farm	Jan-09	89.4	103.0	15.2%	87.7	-1.9%	113.2	26.6%	72	126.5
Desert Sky	Dec-02	89.0	118.3	32.8%	83.1	-6.7%	134.4	50.9%	145	160.5
Elbow Creek Wind	Dec-09	94.5	98.4	4.1%	91.6	-3.1%	104.5	10.6%	61	121.9
Forest Creek Wind Farm	Dec-07	105.2	106.5	1.2%	97.3	-7.5%	111.2	5.7%	85	124.2
Goat Wind	Feb-09	61.4	91.9	49.8%	61.4	0.0%	122.6	99.8%	71	150
Gulf Wind 1	Dec-09	63.1	108.1	71.3%	63.1	0.0%	119.4	89.1%	61	141.6
Gulf Wind 2	Dec-09	74.7	118.3	58.2%	74.7	0.0%	126.3	69.0%	61	141.6
Hackberry Wind	Dec-09	138.0	125.1	-9.3%	105.8	-23.3%	140.6	1.9%	61	165.5
Horse Hollow Phase 1	Jun-06	157.0	165.3	5.3%	141.3	-10.0%	185.1	17.9%	103	213
Horse Hollow Phase 2	Aug-07	145.7	137.9	-5.4%	99.0	-32.1%	151.5	4.0%	89	184
Horse Hollow Phase 3	May-07	169.2	165.3	-2.3%	123.9	-26.8%	187.7	11.0%	92	223.5
Horse Hollow Phase 4	Jun-07	88.6	88.7	0.1%	80.9	-8.7%	94.8	6.9%	91	115
Inadale Wind	Dec-09	81.9	128.4	56.9%	81.9	0.0%	166.3	103.1%	61	197
Indian Mesa	Dec-02	48.0	59.4	23.8%	36.3	-24.4%	72.2	50.5%	145	82.5
King Mountain Wind Ranch-NE	Dec-02	41.8	47.3	13.0%	36.3	-13.2%	56.4	34.8%	145	79.3
King Mountain Wind Ranch-NW	Dec-02	44.7	55.7	24.7%	40.2	-10.1%	65.3	46.1%	145	79.3
King Mountain Wind Ranch-SE	Dec-02	21.6	23.9	10.5%	18.4	-15.0%	28.1	29.8%	145	40.3
King Mountain Wind Ranch-SW	Dec-02	41.6	47.3	13.8%	38.4	-7.6%	53.7	29.1%	145	79.3
Langford Wind	Dec-10	115.7	126.4	9.2%	114.4	-1.1%	134.3	16.0%	49	150
Lone Star - Post Oak Wind	Dec-08	126.5	157.1	24.2%	126.5	0.0%	170.5	34.8%	73	200
Lone Star - Mesquite Wind	Feb-08	106.1	150.9	42.3%	106.1	0.0%	168.1	58.5%	83	200
Loraine Windpark I	Dec-10	30.4	34.9	14.7%	25.9	-14.8%	42.3	39.2%	49	126
Loraine Windpark II	Dec-10	27.8	35.1	26.1%	25.7	-7.6%	43.3	55.7%	49	124.5
McAdoo Wind	Dec-09	111.7	135.6	21.4%	111.7	0.0%	143.6	28.5%	61	150
Notrees Windpower	Dec-09	97.8	113.2	15.7%	97.8	0.0%	122.9	25.7%	61	153
Ocotillo Windpower	Dec-09	39.1	42.6	8.8%	37.7	-3.6%	47.2	20.7%	61	58.8
Panther Creek 1	Dec-09	114.4	120.1	5.0%	107.8	-5.8%	128.9	12.7%	61	142.5
Panther Creek 2	Dec-09	91.8	96.2	4.8%	85.2	-7.2%	104.2	13.5%	61	115.5
Panther Creek 3	Dec-09	105.0	145.7	38.8%	105.0	0.0%	177.1	68.8%	61	199.5
Papalote Creek Wind Farm	Dec-10	150.1	135.7	-9.6%	39.6	-73.6%	157.9	5.2%	61	180
Papalote Creek Wind Farm II	Dec-11	174.2	170.0	-2.4%	162.8	-6.5%	176.4	1.2%	37	200.1
Penascal Wind 1	Dec-09	30.6	121.5	296.7%	30.6	0.0%	141.5	361.8%	61	161
Penascal Wind 2	Dec-09	83.3	113.3	36.0%	83.3	0.0%	125.4	50.5%	61	142
Penascal Wind 3	Dec-10	68.3	82.1	20.2%	68.3	0.0%	88.8	30.0%	61	101
Pyron Wind Farm	Dec-09	157.2	184.3	17.3%	151.4	-3.7%	219.5	39.7%	61	249
Red Canyon 1	Aug-07	75.8	76.4	0.7%	72.7	-4.1%	79.1	4.4%	89	84
Roscoe Wind Farm	Dec-08	169.4	160.2	-5.4%	131.6	-22.3%	179.8	6.2%	73	209
Sand Bluff Wind Farm	Dec-07	39.5	68.0	72.0%	39.5	0.0%	75.4	90.6%	85	90
Sherbino I Wind	Dec-09	104.7	112.6	7.6%	92.3	-11.8%	128.1	22.4%	61	150
Silver Star Wind	Apr-09	40.6	46.3	13.9%	39.5	-2.7%	50.5	24.4%	69	60
South Trent Wind Farm	Dec-09	67.7	84.5	24.8%	65.4	-3.5%	91.0	34.4%	61	101.2
Southwest Mesa Wind	Dec-02	51.1	47.5	-7.0%	37.2	-27.1%	56.5	10.6%	145	74.6
Stanton Wind Energy	Dec-08	79.4	95.2	19.9%	79.4	0.0%	107.0	34.7%	73	120
Sweetwater Wind 1	Dec-04	34.1	33.0	-3.0%	29.9	-12.2%	34.9	2.4%	121	37.5
Sweetwater Wind 2 (unit 1)	Jan-06	71.4	81.7	14.4%	71.4	0.0%	88.0	23.3%	108	97.5
Sweetwater Wind 2 (unit 2)	May-08	13.8	13.9	1.1%	12.0	-13.1%	14.8	7.8%	80	16
Sweetwater Wind 3	Dec-06	99.6	101.1	1.5%	67.1	-32.7%	111.2	11.6%	97	135
Sweetwater Wind 4	Mar-08	161.0	172.5	7.2%	156.5	-2.8%	182.2	13.2%	82	240.8
Sweetwater Wind 5	Dec-08	66.5	63.9	-4.0%	56.3	-15.3%	69.3	4.3%	73	80.5
Snyder Wind Project	Dec-08	52.9	44.9	-15.2%	36.1	-31.8%	52.9	0.0%	73	63
Trent Mesa	Dec-02	108.8	120.2	10.4%	90.7	-16.7%	132.8	22.0%	145	150
Turkey Track Wind Energy Center	Dec-09	77.4	124.0	60.3%	77.0	-0.5%	143.1	85.0%	61	169.5
Whirlwind	Dec-08	54.0	49.0	-9.3%	39.8	-26.3%	56.9	5.4%	73	60
Wolf Ridge Wind	Dec-09	105.9	106.3	0.3%	101.2	-4.5%	108.8	2.7%	61	112.5
Woodward Mountain Ranch	Dec-02	85.3	97.6	14.5%	80.4	-5.7%	112.4	31.8%	145	159.7
Weighted Average:				**18.9%**		**-12.9%**		**35.0%**	**Total:**	**9489.2**

3.4 Analysis of other renewable sources

Five specific renewable sources were determined: solar, biomass, hydroelectric, geothermal, and landfill gas-fired. To generate/save energy throughout the State of Texas, six types of renewable energy projects were identified: solar photovoltaic (PV) including solar power, solar thermal, biomass power, hydroelectric power, geothermal HVAC, and landfill gas-fired power projects. The solar photovoltaic project accounts for all PV installations in Texas whereas the solar power project accounts for only solar power plant Construction. Table 5 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 2014, the total annual/OSD energy savings from each renewable projects across all the counties were:

- solar photovoltaic projects with 7% T&D loss: 312,037 MWh/yr and 938 MWh/day;
  in addition, solar power projects only with 7% T&D loss: 291,121 MWh/yr and 798 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: 493,735 MWh/yr and 1,353 MWh/day, and
- hydroelectric projects with 7% T&D loss: 50,202 MWh/yr and 138 MWh/day.

In 2014, the annual NOx emission reductions from renewable projects across all the counties were:

- solar photovoltaic projects: 100.9 tons/yr;
  in addition, solar power projects only: 96.0 tons/yr,
- solar thermal projects: 0.1 tons/yr,
- biomass projects: 135.7 tons/yr, and
- hydroelectric projects: 16.6 tons/yr.

Table 5: Number of Identified Projects for Other Renewable Sources

Renewable Energy Projects	**Number of 2014 New Projects**	**Total Number of Projects**
Solar Photovoltaic[10]	113	4,647
(Solar Power)	(3)	(12)
Solar Thermal	0	38
Biomass[11]	1	20
Hydroelectric[12]	1	27
Geothermal	0	286
Landfill Gas-Fired[13]	2	34

[10] The Open PV project database of National Renewable Energy Laboratory (NREL) (https://openpv.nrel.gov/).
[11] This report includes one more biomass project information which was not identified in the previous year report; however, it does not mean the State of Texas has a new biomass power plant constructed in 2014.
[12] This report includes one more hydroelectric project information which was not identified in the previous year report; however, it does not mean the State of Texas has a new hydroelectric power plant constructed in 2014.
[13] Landfill gas-fired projects information from EPA have seven sub-categories for their status: operational, candidates, potential, construction, shutdown, planned, and other. EPA rearranged/added/removed some projects information within the seven sub-categories. Operational projects were considered for the number of the projects. This report includes four more (new) and two less (shutdown) operational landfill gas-fired project information which was not identified in the previous year report; however, the new operational projects do not mean the State of Texas has new landfill gas-fired projects constructed in 2014.

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 2014 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 6 contains the data reported by ERCOT from 2001 to 2014. Figure 7 is included to better illustrate the annual data collected by ERCOT.

Table 6: Annual Electricity Generation by Renewable Resources (MWh, ERCOT: 2001 - 2014)

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
2014	343,469	227,820	518,580	312,757	40,584,226	41,986,853

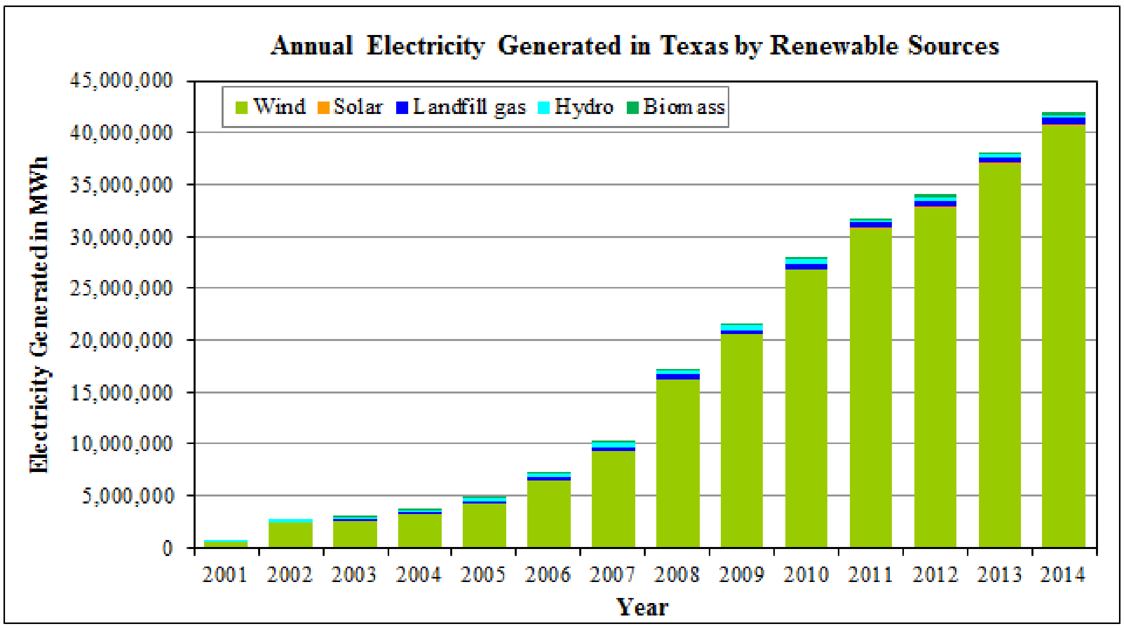


Figure 7: Electricity Generation by Renewable Resources (ERCOT: 2001–2014 Annual)

4 Calculated NOx Reductions Potential from Energy Savings of New Construction in 2014

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.

4.1 2014 Results for New Single-family Residential Construction

This section provides the potential electricity and natural gas savings and the associated NOx emissions reductions in 2014 using the 2008 base year which implemented the 2006 IECC for new single-family residences in the 36 non-attainment and affected counties as well as other counties in the ERCOT region[14]. 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 2014 building permits per county was obtained from the real estate center at Texas A&M University (REC 2015). 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 2014 Home Innovation Research Labs (HIRL) data[15] 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[16].

In Table 7[17], the 2014 new single-family and 2006 IECC code-compliant building characteristics are shown for each county. The building characteristics reflect those published by the HIRL, ARI, and GAMA for Texas. The 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 7, the rows are first sorted by the US EPA's non-attainment, affected designation, and then other ERCOT counties alphabetically. Next, in the fourth column, the HIRL's survey classification is listed. The fifth through eighth columns show the HIRL's survey data: average glazing U-value, Solar Heat Gain Coefficient (SHGC), roof insulation, and wall insulation, respectively. In addition, the ninth through twelfth columns show the 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[18], 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 7 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 2014 new single-family and the 2006 IECC code-compliant simulations. In cases where the 2014 values were more efficient than the 2006 IECC requirements, the 2014 values were used in the 2014 new single-family simulations. Otherwise, the 2006 IECC values were used in both simulations. For example, in the Collin County, according to the HIRL's survey data, the roof insulation is R-27.09, which is less than the code-required insulation of R-30. Therefore, R-30 was used in the 2014 simulation.

[14] The three new counties added in the 2003 Legislative session (i.e., Henderson, Hood, and Hunt) were included in the ERCOT region.
[15] For the 2014 report, the 2014 HIRL data (previously, NAHB data) were used. In 2013, the NAHB Research Center announced that it has changed its name to Home Innovation Research Labs (HIRL). See more at: http://www.homeinnovation.com
[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 utility service districts as indicated.
[17] Hardin, Jefferson, and Orange Counties were removed from Table 7 and Table 8 because since 2012 they are not in the category of "Nonattainment County" based on [http://www.tceq.texas.gov/airquality/sip/bpa/bpa-status], and these counties do not belong to ERCOT region.
[18] Based on the regulation effective.

In Table 8, the code-traceable simulation results for single-family residences are shown for each county. In a similar fashion to Table 7, Table 8 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[19] in the fourth column. In the fifth column, the total simulated energy use is listed if all new Construction had been built to pre-code specifications. In the sixth column, the total county-wide energy use for code-compliant Construction is shown. The values in the fifth and sixth columns come from the associated 24 simulation runs for each county, which were then distributed according to the HIRL's survey data to account for 1 story, 2 story, slab-on-grade, crawlspace, and three different system types (i.e., central air conditioning with electric resistance heating, heat pump heating, or a natural gas-fired furnace). In the seventh column, the total annual electricity savings are shown for each county. A 7% transmission and distribution loss is used in the 2014 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

[19] The number of the new housing units in 2014 were obtained from the Real Estate Center at Texas A&M University.

Table 9, the Congestion Management (CM) Zones[20] assignments for each county are shown. In Table 10, the annual electricity savings are assigned to CM Zones provider(s) according to

[20] 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).

Table 9[21]. The total electricity savings for each CM Zone, as shown in Table 10, then entered into the bottom row of Table 11, which is the 2010 US EPA's eGRID database[22] 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.

[21] 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.
[22] 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 7: 2014 and 2006 IECC Code-compliant Building Characteristics Used in the DOE-2 Simulations for New Single-family Residences

	County	Climate Zone	Division	2014 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)
	BRAZORIA	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	CHAMBERS	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	COLLIN	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	DALLAS	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	DENTON	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	EL PASO	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	ELLIS	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	FORT BEND	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	GALVESTON	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
Non-attainment	HARRIS	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	JOHNSON	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	KAUFMAN	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	LIBERTY	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	MONTGOMERY	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	PARKER	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	ROCKWALL	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	TARRANT	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	WALLER	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	WISE	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	BASTROP	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	BEXAR	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	CALDWELL	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	COMAL	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	GREGG	3	East Texas	0.39	0.53	26.12	13.55	0.65	0.4	30	13
	GUADALUPE	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	HARRISON	3	East Texas	0.39	0.53	26.12	13.55	0.65	0.4	30	13
	HAYS	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
Affected	NUECES	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	RUSK	3	East Texas	0.39	0.53	26.12	13.55	0.65	0.4	30	13
	SAN PATRICIO	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	SMITH	3	East Texas	0.39	0.53	26.12	13.55	0.65	0.4	30	13
	TRAVIS	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	UPSHUR	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	VICTORIA	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	WILLIAMSON	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	WILSON	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	ANDERSON	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	ANDREWS	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	ANGELINA	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	ARANSAS	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	ARCHER	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	ATASCOSA	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	AUSTIN	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	BANDERA	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	BASTROP	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	BAYLOR	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	BEE	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	BELL	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	BEXAR	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	BLANCO	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	BORDEN	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	BOSQUE	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	BRAZORIA	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	BRAZOS	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	BREWSTER	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	BRISCOE	4	West Texas	0.39	0.53	27.09	13.56	0.4	NR	38	13
	BROOKS	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	BROWN	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	BURLESON	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	BURNET	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	CALDWELL	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	CALHOUN	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	CALLAHAN	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	CAMERON	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	CHAMBERS	2	East Texas	0.39	0.53	26.119	13.548	0.75	0.4	30	13
	CHEROKEE	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	CHILDRESS	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	CLAY	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	COKE	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
ERCOT	COLEMAN	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	COLLIN	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	COLORADO	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	COMAL	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	COMANCHE	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	CONCHO	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	COOKE	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	CORYELL	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	COTTLE	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	CRANE	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	CROCKETT	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	CROSBY	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	CULBERSON	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	DALLAS	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	DAWSON	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	DE WITT	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	DELTA	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	DENTON	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	DICKENS	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	DIMMIT	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	DUVAL	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	EASTLAND	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	ECTOR	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	EDWARDS	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	ELLIS	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	ERATH	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	FALLS	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	FANNIN	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	FAYETTE	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	FISHER	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	FOARD	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	FORT BEND	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	FRANKLIN	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	FREESTONE	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13

Table 7: 2014 and 2006 IECC Code-compliant Building Characteristics Used in the DOE-2 Simulations for New Single-family Residences (Continued)

	County	Climate Zone	Division	2014 Average				2006 IECC			
			East or West	Glazing U-value ($Btu/hr\text{-}ft^2\text{-}F$)	SHGC	Roof Insulation ($hr\text{-}ft^2\text{-}F/Btu$)	Wall Insulation ($hr\text{-}ft^2\text{-}F/Btu$)	Glazing U-value ($Btu/hr\text{-}ft^2\text{-}F$)	SHGC	Roof Insulation ($hr\text{-}ft^2\text{-}F/Btu$)	Wall Insulation ($hr\text{-}ft^2\text{-}F/Btu$)
	FRIO	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	GALVESTON	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	GILLESPIE	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	GLASSCOCK	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	GOLIAD	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	GONZALES	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	GRAYSON	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	GRIMES	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	GUADALUPE	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	HALL	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	HAMILTON	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	HARDEMAN	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	HARRIS	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	HASKELL	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	HAYS	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	HENDERSON	3	East Texas	0.39	0.53	26.12	13.55	0.65	0.4	30	13
	HIDALGO	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	HILL	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	HOOD	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	HOPKINS	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	HOUSTON	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	HOWARD	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	HUDSPETH	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	HUNT	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	IRION	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	JACK	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	JACKSON	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	JEFF DAVIS	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	JIM HOGG	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	JIM WELLS	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	JOHNSON	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	JONES	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	KARNES	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	KAUFMAN	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	KENDALL	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	KENEDY	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	KENT	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	KERR	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	KIMBLE	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	KING	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	KINNEY	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	KLEBERG	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	KNOX	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	LA SALLE	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	LAMAR	3	East Texas	0.39	0.53	26.12	13.55	0.65	0.4	30	13
	LAMPASAS	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	LAVACA	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	LEE	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	LEON	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	LIMESTONE	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	LIVE OAK	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	LLANO	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	LOVING	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	MADISON	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	MARTIN	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	MASON	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	MATAGORDA	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	MAVERICK	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	MCCULLOCH	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	MCLENNAN	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	MCMULLEN	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	MEDINA	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	MENARD	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
ERCOT	MIDLAND	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	MILAM	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	MILLS	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	MITCHELL	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	MONTAGUE	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	MONTGOMERY	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	MOTLEY	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	NACOGDOCHES	3	East Texas	0.39	0.53	26.12	13.55	0.65	0.4	30	13
	NAVARRO	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	NOLAN	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	NUECES	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	PALO PINTO	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	PARKER	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	PECOS	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	PRESIDIO	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	RAINS	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	REAGAN	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	REAL	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	RED RIVER	3	East Texas	0.39	0.53	26.12	13.55	0.65	0.4	30	13
	REEVES	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	REFUGIO	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	ROBERTSON	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	ROCKWALL	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	RUNNELS	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	RUSK	3	East Texas	0.39	0.53	26.12	13.55	0.65	0.4	30	13
	SAN PATRICIO	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	SAN SABA	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	SCHLEICHER	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	SCURRY	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	SHACKELFORD	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	SMITH	3	East Texas	0.39	0.53	26.12	13.55	0.65	0.4	30	13
	SOMERVELL	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	STARR	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	STEPHENS	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	STERLING	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	STONEWALL	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	SUTTON	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	TARRANT	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	TAYLOR	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	TERRELL	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	THROCKMORTON	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	TITUS	3	East Texas	0.39	0.53	26.12	13.55	0.65	0.4	30	13
	TOM GREEN	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	TRAVIS	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	UPTON	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	UVALDE	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	VAL VERDE	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	VAN ZANDT	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	VICTORIA	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	WALLER	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	WARD	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	WASHINGTON	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	WEBB	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	WHARTON	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	WICHITA	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	WILBARGER	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	WILLACY	2	East Texas	0.39	0.53	26.12	13.55	0.75	0.4	30	13
	WILLIAMSON	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	WILSON	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	WINKLER	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	WISE	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	YOUNG	3	West Texas	0.39	0.53	27.09	13.56	0.65	0.4	30	13
	ZAPATA	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13
	ZAVALA	2	West Texas	0.39	0.53	27.09	13.56	0.75	0.4	30	13

Table 8: 2014 Annual Electricity Savings from New Single-family Residences

2014 Summary TRY 2008									
	County	Climate Zone	No. of Projected Units (2014)	Precode Total Annual Elec. Use (MWh/yr)	Code-compliant Total Annual Elec. Use (MWh/yr)	Total Annual Elec. Savings (MWh/yr) w/ 7% of T&D Loss	Precode Total NG Use (Therm/yr)	Code-compliant Total NG Use (Therm/yr)	Total Annual NG Savings (Therm/yr)
Nonattain-ment County	BRAZORIA	3	2,466	33,761	31,919	**1,970**	489,792	462,185	**27,607**
	CHAMBERS	3	377	5,045	4,777	**287**	77,223	73,242	**3,980**
	COLLIN	3	7,115	122,535	114,903	**8,166**	1,053,412	933,308	**120,103**
	DALLAS	3	3,974	68,375	64,120	**4,553**	590,991	523,442	**67,549**
	DENTON	3	5,041	86,817	81,409	**5,786**	746,346	661,252	**85,094**
	EL PASO	2	2,260	34,407	32,308	**2,245**	420,172	367,061	**53,111**
	ELLIS	3	1,096	18,633	17,412	**1,306**	182,913	162,293	**20,620**
	FORT BEND	3	8,465	111,235	105,176	**6,483**	1,978,372	1,844,161	**134,211**
	GALVESTON	3	2,638	34,661	32,774	**2,019**	617,658	574,707	**42,950**
	HARRIS	2	18,533	243,534	230,268	**14,194**	4,331,385	4,037,548	**293,837**
	JOHNSON	2	775	13,176	12,313	**924**	129,341	114,760	**14,581**
	KAUFMAN	2	239	4,066	3,800	**285**	39,729	35,239	**4,491**
	LIBERTY	2	300	3,944	3,729	**230**	70,110	65,276	**4,833**
	MONTGOMERY	3	5,511	72,418	68,473	**4,221**	1,287,987	1,200,611	**87,376**
	PARKER	2	382	6,499	6,073	**456**	63,501	56,323	**7,178**
	ROCKWALL	2	965	16,419	15,342	**1,152**	160,414	142,281	**18,133**
	TARRANT	2	5,282	89,800	83,916	**6,296**	881,521	782,145	**99,376**
	WALLER	2	5	66	62	**4**	1,169	1,089	**79**
	WISE	3	53	902	843	**63**	8,810	7,814	**996**
Affected County	BASTROP	2	167	2,464	2,319	**154**	43,844	38,834	**5,010**
	BEXAR	2	3,324	52,370	49,669	**2,890**	345,874	309,824	**36,050**
	CALDWELL	3	258	4,285	4,027	**277**	33,192	29,422	**3,770**
	COMAL	3	1,624	25,586	24,267	**1,412**	168,983	151,370	**17,613**
	GREGG	3	197	2,913	2,737	**188**	64,159	59,719	**4,440**
	GUADALUPE	2	766	11,714	11,081	**676**	87,885	78,457	**9,428**
	HARRISON	2	53	782	735	**50**	17,404	16,209	**1,195**
	HAYS	2	1,757	24,090	22,626	**1,566**	218,321	193,149	**25,173**
	NUECES	3	1,262	17,226	16,228	**1,068**	249,929	234,329	**15,600**
	RUSK	2	3	39	37	**2**	879	813	**66**
	SAN PATRICIO	2	236	3,221	3,035	**200**	46,738	43,821	**2,917**
	SMITH	2	383	5,645	5,309	**360**	126,030	117,393	**8,637**
	TRAVIS	3	5,729	90,976	85,448	**5,915**	824,498	729,432	**95,066**
	UPSHUR	3	13	195	182	**13**	4,424	3,918	**506**
	VICTORIA	2	163	2,189	2,065	**133**	37,819	35,193	**2,626**
	WILLIAMSON	3	3,931	62,424	58,631	**4,058**	565,736	500,505	**65,230**
	WILSON	2	34	520	492	**30**	3,901	3,482	**418**
ERCOT	ANDERSON	2	3	39	37	**2**	879	813	**66**
	ANDREWS	3	53	853	806	**50**	9,662	8,491	**1,171**
	ANGELINA	2	77	1,007	950	**61**	22,572	20,872	**1,700**
	ARANSAS	2	169	2,444	2,300	**154**	29,705	28,150	**1,556**
	ARCHER	3	9	158	149	**10**	1,757	1,540	**217**
	ATASCOSA	2	67	1,011	962	**53**	7,326	6,489	**838**
	AUSTIN	2	24	329	311	**19**	4,761	4,498	**263**
	BANDERA	2	1	16	15	**1**	98	87	**11**
	BAYLOR	3	0	0	0	**0**	0	0	**0**
	BEE	2	11	154	145	**9**	2,178	2,055	**123**
	BELL	2	1,848	29,850	28,311	**1,646**	270,041	237,380	**32,661**
	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	955	13,077	12,363	**764**	189,457	178,989	**10,468**
	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	72	1,163	1,103	**64**	10,521	9,249	**1,272**
	BURLESON	2	8	110	104	**6**	1,587	1,499	**88**
	BURNET	3	261	4,335	4,073	**280**	33,492	29,709	**3,783**
	CALHOUN	2	74	1,036	977	**63**	14,653	13,824	**829**
	CALLAHAN	3	5	83	79	**5**	834	737	**97**
	CAMERON	2	1,179	17,595	16,530	**1,140**	166,678	157,636	**9,042**
	CHEROKEE	2	6	78	74	**5**	1,759	1,626	**133**
	CHILDRESS	3	0	0	0	**0**	0	0	**0**
	CLAY	3	5	88	83	**5**	976	856	**120**
	COKE	3	0	0	0	**0**	0	0	**0**
	COLEMAN	3	0	0	0	**0**	0	0	**0**
	COLORADO	2	10	137	129	**8**	1,984	1,874	**110**
	COMANCHE	3	3	48	46	**3**	438	385	**53**
	CONCHO	3	1	17	16	**1**	145	127	**17**
	COOKE	3	26	448	420	**30**	3,858	3,419	**439**
	CORYELL	2	114	1,841	1,746	**102**	16,658	14,644	**2,015**
	COTTLE	3	0	0	0	**0**	0	0	**0**
	CRANE	3	1	17	16	**1**	166	146	**20**
	CROCKETT	3	19	315	297	**19**	2,750	2,419	**332**
	CROSBY	3	5	71	67	**4**	2,426	2,129	**297**
	CULBERSON	3	1	15	14	**1**	163	141	**21**
	DAWSON	3	7	195	184	**12**	6,452	5,634	**818**
	DE WITT	2	5	67	63	**4**	1,160	1,080	**81**
	DELTA	3	2	34	32	**2**	296	262	**34**
	DICKENS	3	0	0	0	**0**	0	0	**0**
	DIMMIT	2	5	79	75	**4**	428	388	**40**
	DUVAL	2	0	0	0	**0**	0	0	**0**
	EASTLAND	3	0	0	0	**0**	0	0	**0**
	ECTOR	3	430	6,923	6,541	**409**	78,392	68,888	**9,504**
	EDWARDS	2	0	0	0	**0**	0	0	**0**
	ERATH	3	42	678	641	**39**	7,804	6,889	**915**
	FALLS	2	3	175	166	**10**	1,824	1,604	**220**
	FANNIN	3	10	170	159	**12**	1,668	1,478	**190**
	FAYETTE	2	6	79	75	**5**	1,402	1,307	**95**
	FISHER	3	0	0	0	**0**	0	0	**0**
	FOARD	3	0	0	0	**0**	0	0	**0**
	FRANKLIN	3	1	17	16	**1**	166	147	**19**
	FREESTONE	2	7	112	106	**6**	1,161	1,021	**140**
	FRIO	2	11	196	187	**10**	1,422	1,259	**163**

Table 8: 2014 Annual Electricity Savings from New Single-family Residences (Continued)

2014 Summary TRY 2008									
	County	**Climate Zone**	**No. of Projected Units (2014)**	**Precode Total Annual Elec. Use (MWh/yr)**	**Code-compliant Total Annual Elec. Use (MWh/yr)**	**Total Annual Elec. Savings (MWh/yr) w/ 7% of T&D Loss**	**Precode Total NG Use (Therm/yr)**	**Code-compliant Total NG Use (Therm/yr)**	**Total Annual NG Savings (Therm/yr)**
	GILLESPIE	3	39	619	582	**40**	5,613	4,966	**647**
	GLASSCOCK	3	0	0	0	**0**	0	0	**0**
	GOLIAD	2	0	0	0	**0**	0	0	**0**
	GONZALES	2	27	413	391	**24**	3,098	2,765	**332**
	GRAYSON	3	203	3,453	3,226	**242**	33,855	29,998	**3,858**
	GRIMES	2	15	197	186	**11**	3,506	3,268	**238**
	HALL	3	0	0	0	**0**	0	0	**0**
	HAMILTON	3	2	32	30	**2**	332	292	**40**
	HARDEMAN	3	0	0	0	**0**	0	0	**0**
	HASKELL	3	2	32	31	**2**	372	328	**44**
	HENDERSON	2	71	1,047	984	**67**	23,363	21,762	**1,601**
	HIDALGO	2	2,871	39,865	37,476	**2,557**	434,889	407,676	**27,213**
	HILL	2	6	160	151	**9**	1,658	1,458	**200**
	HOPKINS	3	8	136	127	**10**	1,330	1,180	**150**
	HOUSTON	2	5	65	62	**4**	1,466	1,355	**110**
	HOWARD	3	30	713	672	**43**	7,123	6,273	**851**
	HOOD	2	117	1,989	1,859	**139**	19,526	17,325	**2,201**
	HUDSPETH	3	0	0	0	**0**	0	0	**0**
	HUNT	2	69	1,174	1,097	**82**	11,507	10,196	**1,311**
	IRION	3	0	0	0	**0**	0	0	**0**
	JACK	3	5	81	76	**5**	929	820	**109**
	JACKSON	2	16	215	203	**13**	3,712	3,455	**258**
	JEFF DAVIS	3	0	0	0	**0**	0	0	**0**
	JIM HOGG	2	0	0	0	**0**	0	0	**0**
	JIM WELLS	2	26	355	334	**22**	5,149	4,828	**321**
	JONES	3	1	16	15	**1**	186	164	**22**
	KARNES	2	70	1,049	999	**54**	7,791	6,931	**860**
	KENDALL	3	380	5,741	5,460	**301**	41,427	36,756	**4,671**
	KENEDY	2	0	0	0	**0**	0	0	**0**
	KENT	3	0	0	0	**0**	0	0	**0**
	KERR	3	65	1,032	969	**67**	9,355	8,276	**1,079**
	KIMBLE	3	2	32	30	**2**	322	283	**39**
	KING	3	0	0	0	**0**	0	0	**0**
	KINNEY	2	1	15	14	**1**	115	102	**12**
	KLEBERG	2	36	488	461	**30**	6,693	6,248	**445**
	KNOX	3	0	0	0	**0**	0	0	**0**
	LA SALLE	2	11	165	157	**8**	1,028	929	**99**
	LAMAR	3	27	395	373	**23**	8,557	7,942	**615**
	LAMPASAS	3	155	2,473	2,343	**139**	25,699	22,601	**3,099**
	LAVACA	2	11	147	139	**9**	2,416	2,237	**179**
	LEE	2	3	48	45	**3**	432	383	**49**
	LEON	2	0	0	0	**0**	0	0	**0**
	LIMESTONE	2	4	64	60	**4**	663	583	**80**
	LIVE OAK	2	12	164	154	**10**	2,377	2,228	**148**
	LLANO	3	202	3,208	3,013	**209**	29,071	25,719	**3,352**
	LOVING	3	0	0	0	**0**	0	0	**0**
	MADISON	2	4	53	50	**3**	935	871	**63**
	MARTIN	3	3	48	46	**3**	547	481	**66**
	MASON	3	4	64	60	**4**	576	509	**66**
	MATAGORDA	2	222	2,982	2,812	**181**	51,509	47,932	**3,577**
	MAVERICK	2	70	1,052	1,002	**54**	6,542	5,913	**629**
	MCCULLOCH	3	0	0	0	**0**	0	0	**0**
	MCLENNAN	2	606	9,668	9,161	**542**	100,476	88,361	**12,115**
ERCOT	MCMULLEN	2	0	0	0	**0**	0	0	**0**
	MEDINA	2	26	398	376	**23**	2,983	2,663	**320**
	MENARD	3	0	0	0	**0**	0	0	**0**
	MIDLAND	3	917	14,764	13,949	**872**	167,176	146,907	**20,269**
	MILAM	2	10	147	140	**7**	1,118	995	**123**
	MILLS	3	0	0	0	**0**	0	0	**0**
	MITCHELL	3	5	81	76	**5**	929	820	**109**
	MONTAGUE	3	11	187	175	**13**	1,835	1,625	**209**
	MOTLEY	3	0	0	0	**0**	0	0	**0**
	NACOGDOCHES	3	32	418	395	**25**	9,381	8,674	**707**
	NAVARRO	3	23	367	348	**21**	3,813	3,354	**460**
	NOLAN	3	0	0	0	**0**	0	0	**0**
	PALO PINTO	3	5	81	76	**5**	929	820	**109**
	PECOS	3	7	111	105	**7**	1,129	991	**137**
	PRESIDIO	3	9	143	135	**8**	1,451	1,275	**176**
	RAINS	3	3	51	48	**4**	499	442	**56**
	REAGAN	3	1	16	15	**1**	182	160	**22**
	REAL	2	0	0	0	**0**	0	0	**0**
	RED RIVER	3	8	117	111	**7**	2,535	2,353	**182**
	REEVES	3	3	48	46	**3**	547	481	**66**
	REFUGIO	2	6	81	76	**5**	1,392	1,295	**97**
	ROBERTSON	2	51	670	634	**39**	11,919	11,111	**809**
	RUNNELS	3	4	64	60	**4**	645	567	**78**
	SAN SABA	3	0	0	0	**0**	0	0	**0**
	SCHLEICHER	3	1	16	15	**1**	161	142	**20**
	SCURRY	3	8	112	105	**6**	4,207	3,689	**518**
	SHACKELFORD	3	0	0	0	**0**	0	0	**0**
	SOMERVELL	3	18	306	286	**21**	3,004	2,665	**339**
	STARR	2	0	0	0	**0**	0	0	**0**
	STEPHENS	3	0	0	0	**0**	0	0	**0**
	STERLING	3	0	0	0	**0**	0	0	**0**
	STONEWALL	3	0	0	0	**0**	0	0	**0**
	SUTTON	3	0	0	0	**0**	0	0	**0**
	TAYLOR	3	278	4,487	4,244	**260**	51,656	45,601	**6,055**
	TERRELL	3	0	0	0	**0**	0	0	**0**
	THROCKMORTON	3	0	0	0	**0**	0	0	**0**
	TITUS	3	22	322	304	**19**	6,972	6,471	**501**
	TOM GREEN	3	229	3,643	3,442	**215**	36,921	32,435	**4,486**
	UPTON	3	1	16	15	**1**	182	160	**22**
	UVALDE	2	13	199	188	**11**	1,492	1,332	**160**
	VAL VERDE	2	81	1,239	1,172	**72**	9,293	8,296	**997**
	VAN ZANDT	3	9	153	143	**11**	1,496	1,327	**169**
	WARD	3	19	306	289	**18**	3,464	3,044	**420**
	WASHINGTON	2	83	1,091	1,031	**64**	19,398	18,082	**1,316**
	WEBB	2	954	14,344	13,657	**735**	89,165	80,590	**8,574**
	WHARTON	2	90	1,209	1,140	**74**	20,882	19,432	**1,450**
	WICHITA	3	93	1,630	1,534	**103**	20,331	17,867	**2,464**
	WILBARGER	3	2	35	33	**2**	437	384	**53**
	WILLACY	2	98	1,361	1,279	**87**	14,845	13,916	**929**
	WINKLER	3	0	0	0	**0**	0	0	**0**
	WISE	3	53	902	843	**63**	8,810	7,814	**996**
	YOUNG	3	33	533	504	**31**	6,132	5,413	**719**
	ZAPATA	2	0	0	0	**0**	0	0	**0**
	ZAVALA	2	11	173	165	**9**	941	853	**88**
	TOTAL		**99,567**			**92,459**			**1,586,334**

Table 9: Allocation of CM Zones for Each of Applicable ERCOT Counties

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

Table 9: 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 9: 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				
	Newgulf 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 10: 2014 Totalized Annual Electricity Savings by CM Zone from New Single-family Residences

CM Zone	Total Electricity Savings by CM Zone (MWh) 2014-TRY 2008
Houston (H)	30,589
North (N)	24,177
West (W)	1,784
South (S)	16,062
Total	72,612

Table 11: 2014 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	1719.22	0.0000071	0.17	0.0000003	0.00	0.0005265	8.46	1727.85	0.86
	Chambers	0.0204500	625.55	0.0000026	0.06	0.0000001	0.00	0.0001916	3.08	628.69	0.31
	Fort Bend	0.0313463	958.87	0.0000040	0.10	0.0000002	0.00	0.0002937	4.72	963.68	0.48
	Galveston	0.0226620	693.22	0.0000029	0.07	0.0000001	0.00	0.0002123	3.41	696.70	0.35
	Harris	0.1486911	4548.38	0.0000189	0.46	0.0000009	0.00	0.0013930	22.37	4571.21	2.29
Dallas/ Fort Worth Area	Collin	0.0012932	39.56	0.0079329	191.79	0.0003832	0.68	0.0000809	1.30	233.34	0.12
	Dallas	0.0024826	75.94	0.0152295	368.20	0.0007356	1.31	0.0001554	2.50	447.95	0.22
	Denton	0.0001267	3.87	0.0007770	18.79	0.0000375	0.07	0.0000079	0.13	22.85	0.01
	Tarrant	0.0004742	14.50	0.0029089	70.33	0.0001405	0.25	0.0000297	0.48	85.56	0.04
	Ellis	0.0029920	91.52	0.0183544	443.75	0.0008865	1.58	0.0001873	3.01	539.87	0.27
	Johnson	0.0007256	22.20	0.0044512	107.62	0.0002150	0.38	0.0000454	0.73	130.92	0.07
	Kaufman	0.0059718	182.68	0.0366343	885.71	0.0017695	3.16	0.0003738	6.00	1077.54	0.54
	Parker	0.0000012	0.04	0.0000075	0.18	0.0000004	0.00	0.0000001	0.00	0.22	0.00
	Henderson	0.0006908	21.13	0.0042376	102.45	0.0002047	0.37	0.0000432	0.69	124.64	0.06
	Hood	0.0050771	155.31	0.0311454	753.00	0.0015044	2.68	0.0003178	5.10	916.10	0.46
	Hunt	0.0088463	270.60	0.0047066	113.79	0.0002273	0.41	0.0652823	1048.55	1433.35	0.72
San Antonio Area	Bexar	0.0138906	424.91	0.0009368	22.65	0.0000452	0.08	0.1109355	1781.82	2229.46	1.11
	Guadalupe	0.0032029	97.97	0.0002160	5.22	0.0000104	0.02	0.0255795	410.85	514.07	0.26
Austin Area	Bastrop	0.0033782	103.34	0.0002278	5.51	0.0000110	0.02	0.0269798	433.34	542.21	0.27
	Hays	0.0008331	25.48	0.0000562	1.36	0.0000027	0.00	0.0066537	106.87	133.72	0.07
	Travis	0.0051785	158.41	0.0003493	8.44	0.0000169	0.03	0.0413577	664.28	831.16	0.42
Corpus Christi Area	Nueces	0.0128578	393.31	0.0008672	20.97	0.0000419	0.07	0.1026870	1649.34	2063.69	1.03
	San Patricio	0.0015100	46.19	0.0001018	2.46	0.0000049	0.01	0.0120591	193.69	242.35	0.12
Victoria Area	Victoria	0.0021192	64.82	0.0001429	3.46	0.0000069	0.01	0.0169244	271.84	340.13	0.17
Other ERCOT counties	Andrews	0.0000037	0.11	0.0000230	0.56	0.0039003	6.96	0.0000002	0.00	7.63	0.00
	Bosque	0.0022204	67.92	0.0136212	329.32	0.0006579	1.17	0.0001390	2.23	400.65	0.20
	Brazos	0.0024089	73.69	0.0112305	271.52	0.0005425	0.97	0.0047829	76.82	423.00	0.21
	Calhoun	0.0009466	28.96	0.0000638	1.54	0.0000031	0.01	0.0075598	121.42	151.93	0.08
	Cameron	0.0063536	194.35	0.0004285	10.36	0.0000207	0.04	0.0507425	815.01	1019.77	0.51
	Cherokee	0.0027392	83.79	0.0168033	406.25	0.0008116	1.45	0.0001714	2.75	494.24	0.25
	Ector	0.0019215	58.78	0.0006604	15.97	0.0911346	162.58	0.0146527	235.35	472.67	0.24
	Fannin	0.0000041	0.12	0.0000249	0.60	0.0000012	0.00	0.0000003	0.00	0.73	0.00
	Fayette	0.0051867	158.66	0.0103217	249.55	0.0004986	0.89	0.0283993	456.14	865.24	0.43
	Freestone	0.0047643	145.74	0.0292268	706.62	0.0014117	2.52	0.0002982	4.79	859.66	0.43
	Hidalgo	0.0053716	164.31	0.0003623	8.76	0.0000175	0.03	0.0428994	689.04	862.14	0.43
	Howard	0.0002411	7.38	0.0007641	18.47	0.1283942	229.05	0.0009490	15.24	270.14	0.14
	Jack	0.0030783	94.16	0.0188839	456.56	0.0009121	1.63	0.0001927	3.09	555.44	0.28
	Lamar	0.0040001	122.36	0.0245388	593.28	0.0011853	2.11	0.0002504	4.02	721.77	0.36
	Llano	0.0040314	123.32	0.0002719	6.57	0.0000131	0.02	0.0321966	517.14	647.05	0.32
	McLennan	0.0056576	173.06	0.0347066	839.10	0.0016764	2.99	0.0003541	5.69	1020.84	0.51
	Milam	0.0012686	38.81	0.0000856	2.07	0.0000041	0.01	0.0101316	162.73	203.61	0.10
	Mitchell	0.0000311	0.95	0.0001910	4.62	0.0324260	57.85	0.0000019	0.03	63.45	0.03
	Nolan	0.0000293	0.89	0.0001795	4.34	0.0304745	54.37	0.0000018	0.03	59.63	0.03
	Palo Pinto	0.0036129	110.52	0.0221635	535.85	0.0010705	1.91	0.0002261	3.63	651.91	0.33
	Pecos	0.0000020	0.06	0.0000121	0.29	0.0020520	3.66	0.0000001	0.00	4.02	0.00
	Robertson	0.0039506	120.85	0.0055755	134.80	0.0002693	0.48	0.0246170	395.39	651.52	0.33
	Upton	0.0000025	0.08	0.0000156	0.38	0.0026494	4.73	0.0000002	0.00	5.18	0.00
	Ward	0.0001995	6.10	0.0012239	29.59	0.2078335	370.77	0.0000125	0.20	406.67	0.20
	Webb	0.0042017	128.53	0.0002834	6.85	0.0000137	0.02	0.0335565	538.98	674.38	0.34
	Wharton	0.0021095	64.53	0.0001423	3.44	0.0000069	0.01	0.0168474	270.60	338.58	0.17
	Wichita	0.0000121	0.37	0.0000743	1.80	0.0126190	22.51	0.0000008	0.01	24.69	0.01
	Wilbarger	0.0179710	549.72	0.1102430	2665.35	0.0053249	9.50	0.0011247	18.07	3242.63	1.62
	Wise	0.0010202	31.21	0.0062583	151.31	0.0003023	0.54	0.0000638	1.03	184.08	0.09
	Young	0.0071054	217.35	0.0435880	1053.83	0.0021054	3.76	0.0004447	7.14	1282.08	0.64
	Total	**0.4414501**	**13503.71**	**0.4812863**	**11636.06**	**0.5345786**	**953.68**	**0.6829349**	**10969.15**	**37062.60**	**18.53**

Energy Savings by PCA (MWh)									
		30,589		24,177		1,784		16,062	

4.2 2014 Results for New Multi-family Residential Construction

This section provides the potential electricity and natural gas savings and the associated NOx emissions reductions in 2014 using the 2008 base year which implemented the 2006 IECC for new multi-family residences in the 36 non-attainment and affected counties as well as other counties in the ERCOT region[23]. 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 2014 building permits per county was obtained from the real estate center at Texas A&M University (REC 2015). 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 2014 HIRL's survey data[24] 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[25].

In

[23] The three new counties added in the 2003 Legislative session (i.e., Henderson, Hood, and Hunt) were included in the ERCOT region.
[24] For the 2014 report, the 2014 HIRL data (previously, NAHB data) were used. The NAHB Research Center announced that it has changed its name to Home Innovation Research Labs (HIRL). See more at: http://www.homeinnovation.com
[25] This analysis assumes transmission and distribution losses of 7%. Counties were assigned to utility service districts as indicated.

Table 12[26], the 2014 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

[26] Hardin, Jefferson, and Orange Counties were removed from Table 12 and Table 13 because since 2012 they are not in the category of "Nonattainment County" based on [http://www.tceq.texas.gov/airquality/sip/bpa/bpa-status], and these counties do not belong to ERCOT region.

Table 12, the rows are first sorted by the US EPA's non-attainment, affected designation, and other ERCOT counties, alphabetically. Next, in the fourth column, the HIRL's survey classification is listed. The fifth through eighth columns show the HIRL's survey data including: average glazing U-value, Solar Heat Gain Coefficient (SHGC), roof insulation, and wall insulation, respectively. In addition, the ninth through twelfth columns show the 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 12 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 2014 new multi-family and the 2006 IECC code-compliant simulations. In cases where the 2014 new multi-family values were more efficient than the 2006 IECC requirements, the 2014 new multi-family values were used in 2014 new multi-family simulations. Otherwise, the 2006 IECC values were used in both simulations.

In Table 13, the code-traceable simulation results for multi-family residences are shown for each county. In a similar fashion to

Table 12, Table 13 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[27] in the fourth column. In the fifth column, the total simulated energy use is listed if all new Construction had been built to pre-code specifications. In the sixth column, the total county-wide energy use for code-compliant Construction is shown. The values in the fifth and sixth columns come from the associated 144 simulation runs for each county, which were then distributed according to the HIRL's survey data to account for 1, 2 or 3 story, and 3 different fuel options (i.e., central air conditioning with electric resistance heating, heat pump heating, or a natural gas-fired furnace). In the seventh column, the total annual electricity savings are shown for each county. A 7% transmission and distribution loss is used, which represents a fixed 1.07 multiplier for the electricity use. In the eighth and ninth columns, the total annual pre-code and code-compliant natural gas use is shown for those residences that had natural gas-fired furnaces and domestic water heaters. Finally, in the tenth column, the total annual natural gas savings are shown for each county.

The annual electricity savings from Table 13 are assigned to CM Zones[28] provider(s) in a similar fashion to the single-family residential assignments. The total electricity savings for each CM Zone, as shown in Table 14, are then entered into the bottom row of Table 15, 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 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.

[27] The number of the new housing units in 2014 were obtained from the Real Estate Center at Texas A&M University.
[28] 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).

Table 12: 2014 and 2006 IECC Code-compliant Building Characteristics Used in the DOE-2 Simulations for New Multi-family Residences

	County	Climate Zone	Division	2014 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)
	BRAZORIA	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	CHAMBERS	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	COLLIN	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	DALLAS	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	DENTON	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	EL PASO	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	ELLIS	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	FORT BEND	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	GALVESTON	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
Non-attainment	HARRIS	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	JOHNSON	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	KAUFMAN	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	LIBERTY	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	MONTGOMERY	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	PARKER	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	ROCKWALL	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	TARRANT	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	WALLER	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	WISE	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	BASTROP	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	BEXAR	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	CALDWELL	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	COMAL	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	GREGG	3	East Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	GUADALUPE	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	HARRISON	3	East Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	HAYS	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
Affected	NUECES	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	RUSK	3	East Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	SAN PATRICIO	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	SMITH	3	East Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	TRAVIS	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	UPSHUR	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	VICTORIA	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	WILLIAMSON	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	WILSON	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	ANDERSON	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	ANDREWS	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	ANGELINA	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	ARANSAS	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	ARCHER	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	ATASCOSA	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	AUSTIN	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	BANDERA	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	BASTROP	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	BAYLOR	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	BEE	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	BELL	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	BEXAR	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	BLANCO	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	BORDEN	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	BOSQUE	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	BRAZORIA	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	BRAZOS	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	BREWSTER	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	BRISCOE	4	West Texas	0.39	0.53	29.81	14.86	0.4	NR	38	13
	BROOKS	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	BROWN	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	BURLESON	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	BURNET	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	CALDWELL	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	CALHOUN	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	CALLAHAN	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	CAMERON	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	CHAMBERS	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	CHEROKEE	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	CHILDRESS	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	CLAY	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	COKE	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
ERCOT	COLEMAN	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	COLLIN	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	COLORADO	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	COMAL	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	COMANCHE	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	CONCHO	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	COOKE	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	CORYELL	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	COTTLE	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	CRANE	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	CROCKETT	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	CROSBY	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	CULBERSON	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	DALLAS	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	DAWSON	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	DE WITT	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	DELTA	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	DENTON	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	DICKENS	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	DIMMIT	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	DUVAL	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	EASTLAND	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	ECTOR	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	EDWARDS	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	ELLIS	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	ERATH	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	FALLS	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	FANNIN	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	FAYETTE	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	FISHER	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	FOARD	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	FORT BEND	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	FRANKLIN	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	FREESTONE	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13

Table 12: 2014 and 2006 IECC Code-compliant Building Characteristics Used in the DOE-2 Simulations for New Multi-family Residences (Continued)

	County	Climate Zone	Division	2014 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)
	FRIO	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	GALVESTON	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	GILLESPIE	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	GLASSCOCK	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	GOLIAD	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	GONZALES	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	GRAYSON	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	GRIMES	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	GUADALUPE	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	HALL	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	HAMILTON	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	HARDEMAN	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	HARRIS	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	HASKELL	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	HAYS	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	HENDERSON	3	East Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	HIDALGO	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	HILL	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	HOOD	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	HOPKINS	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	HOUSTON	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	HOWARD	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	HUDSPETH	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	HUNT	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	IRION	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	JACK	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	JACKSON	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	JEFF DAVIS	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	JIM HOGG	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	JIM WELLS	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	JOHNSON	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	JONES	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	KARNES	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	KAUFMAN	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	KENDALL	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	KENEDY	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	KENT	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	KERR	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	KIMBLE	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	KING	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	KINNEY	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	KLEBERG	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	KNOX	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	LA SALLE	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	LAMAR	3	East Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	LAMPASAS	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	LAVACA	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	LEE	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	LEON	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	LIMESTONE	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	LIVE OAK	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	LLANO	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	LOVING	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	MADISON	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	MARTIN	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	MASON	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	MATAGORDA	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	MAVERICK	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	MCCULLOCH	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	MCLENNAN	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	MCMULLEN	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	MEDINA	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	MENARD	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
ERCOT	MIDLAND	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	MILAM	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	MILLS	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	MITCHELL	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	MONTAGUE	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	MONTGOMERY	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	MOTLEY	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	NACOGDOCHES	3	East Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	NAVARRO	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	NOLAN	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	NUECES	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	PALO PINTO	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	PARKER	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	PECOS	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	PRESIDIO	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	RAINS	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	REAGAN	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	REAL	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	RED RIVER	3	East Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	REEVES	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	REFUGIO	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	ROBERTSON	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	ROCKWALL	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	RUNNELS	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	RUSK	3	East Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	SAN PATRICIO	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	SAN SABA	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	SCHLEICHER	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	SCURRY	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	SHACKELFORD	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	SMITH	3	East Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	SOMERVELL	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	STARR	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	STEPHENS	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	STERLING	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	STONEWALL	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	SUTTON	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	TARRANT	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	TAYLOR	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	TERRELL	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	THROCKMORTON	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	TITUS	3	East Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	TOM GREEN	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	TRAVIS	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	UPTON	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	UVALDE	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	VAL VERDE	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	VAN ZANDT	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	VICTORIA	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	WALLER	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	WARD	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	WASHINGTON	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	WEBB	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	WHARTON	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	WICHITA	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	WILBARGER	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	WILLACY	2	East Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	WILLIAMSON	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	WILSON	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	WINKLER	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	WISE	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	YOUNG	3	West Texas	0.39	0.53	29.81	14.86	0.65	0.4	30	13
	ZAPATA	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13
	ZAVALA	2	West Texas	0.39	0.53	29.81	14.86	0.75	0.4	30	13

Table 13: 2014 Annual Electricity Savings from New Multi-family Residences

	2014 Summary TRY 2008								
	County	Climate Zone	No. of Projected Units (2013)	Precode Total Annual Elec. Use (MWh/yr)	Code-compliant Total Annual Elec. Use (MWh/yr)	Total Annual Elec. Savings (MWh/yr) w/ 7% of T&D Loss	Precode Total NG Use (Therm/yr)	Code-compliant Total NG Use (Therm/yr)	Total Annual NG Savings (Therm/yr)
Nonattainment County	BRAZORIA	2	1,014	45,664	44,083	1,691.83	219,991	219,688	302.39
	CHAMBERS	2	0	0	0	0.00	0	0	0.00
	COLLIN	2	3,915	195,172	185,685	10,151.29	1,146,748	1,064,571	82,176.63
	DALLAS	2	10,386	517,216	492,126	26,846.02	3,049,191	2,828,964	220,227.70
	DENTON	2	669	33,351	31,730	1,734.67	195,958	181,915	14,042.44
	EL PASO	3	783	34,913	33,269	1,760.06	260,489	237,048	23,440.76
	ELLIS	3	0	0	0	0.00	0	0	0.00
	FORT BEND	2	803	34,772	33,643	1,208.53	186,400	186,639	-239.47
	GALVESTON	2	368	15,933	15,416	553.25	85,482	85,533	-51.02
	HARRIS	2	21,527	932,176	901,897	32,398.59	4,997,051	5,003,471	-6,419.67
	JOHNSON	3	186	9,085	8,621	495.87	59,477	55,034	4,443.21
	KAUFMAN	2	0	0	0	0.00	0	0	0.00
	LIBERTY	3	0	0	0	0.00	0	0	0.00
	MONTGOMERY	3	1,634	73,599	71,046	2,731.60	354,501	353,925	576.37
	PARKER	2	0	0	0	0.00	0	0	0.00
	ROCKWALL	2	0	0	0	0.00	0	0	0.00
	TARRANT	3	3,705	184,506	175,556	9,576.79	1,087,739	1,009,177	78,561.88
	WALLER	2	77	3,468	3,348	128.72	16,705	16,678	27.16
	WISE	3	0	0	0	0.00	0	0	0.00
Affected County	BASTROP	3	0	0	0	0.00	0	0	0.00
	BEXAR	3	3,635	167,938	161,274	7,130.69	826,787	784,278	42,509.65
	CALDWELL	3	0	0	0	0.00	0	0	0.00
	COMAL	3	451	20,836	20,010	884.72	102,581	97,307	5,274.24
	GREGG	2	69	3,321	3,205	123.32	20,297	20,312	-14.74
	GUADALUPE	3	0	0	0	0.00	0	0	0.00
	HARRISON	3	26	1,248	1,206	45.71	7,689	7,695	-5.55
	HAYS	3	549	25,196	23,971	1,310.66	152,703	141,184	11,518.59
	NUECES	2	1,190	55,082	52,940	2,292.59	236,344	236,114	229.87
	RUSK	2	0	0	0	0.00	0	0	0.00
	SAN PATRICIO	3	7	324	311	13.49	1,390	1,389	1.35
	SMITH	3	14	688	663	25.89	3,818	3,818	-0.46
	TRAVIS	3	6,948	333,473	317,850	16,716.09	1,773,810	1,650,383	123,426.74
	UPSHUR	3	8	399	379	20.73	2,350	2,178	171.35
	VICTORIA	2	672	30,630	29,530	1,176.70	142,878	142,697	180.50
	WILLIAMSON	2	937	44,972	42,865	2,254.31	239,214	222,569	16,645.20
	WILSON	2	0	0	0	0.00	0	0	0.00
ERCOT	ANDERSON	2	0	0	0	0.00	0	0	0.00
	ANDREWS	3	102	4,901	4,633	287.14	35,061	32,120	2,940.14
	ANGELINA	2	10	439	425	15.08	2,623	2,626	-2.98
	ARANSAS	2	0	0	0	0.00	0	0	0.00
	ARCHER	3	0	0	0	0.00	0	0	0.00
	ATASCOSA	2	2	92	89	3.90	461	436	25.35
	AUSTIN	2	3	135	130	5.02	651	650	1.06
	BANDERA	2	0	0	0	0.00	0	0	0.00
	BAYLOR	3	0	0	0	0.00	0	0	0.00
	BEE	2	0	0	0	0.00	0	0	0.00
	BELL	2	143	6,815	6,493	344.60	42,424	39,095	3,328.54
	BLANCO	3	32	1,536	1,464	76.99	8,170	7,601	568.46
	BORDEN	3	0	0	0	0.00	0	0	0.00
	BOSQUE	2	0	0	0	0.00	0	0	0.00
	BRAZOS	2	831	37,430	36,132	1,389.21	180,288	179,995	293.12
	BREWSTER	3	7	337	320	18.29	2,082	1,917	165.13
	BRISCOE	4	0	0	0	0.00	0	0	0.00
	BROOKS	2	0	0	0	0.00	0	0	0.00
	BROWN	3	6	286	272	14.46	1,780	1,640	139.66
	BURLESON	2	0	0	0	0.00	0	0	0.00
	BURNET	3	0	0	0	0.00	0	0	0.00
	CALHOUN	2	7	319	308	12.26	1,488	1,486	1.88
	CALLAHAN	3	0	0	0	0.00	0	0	0.00
	CAMERON	2	238	11,228	10,779	481.24	43,756	43,613	142.79
	CHEROKEE	2	0	0	0	0.00	0	0	0.00
	CHILDRESS	3	0	0	0	0.00	0	0	0.00
	CLAY	3	0	0	0	0.00	0	0	0.00
	COKE	3	0	0	0	0.00	0	0	0.00
	COLEMAN	3	0	0	0	0.00	0	0	0.00
	COLORADO	2	0	0	0	0.00	0	0	0.00
	COMANCHE	3	0	0	0	0.00	0	0	0.00
	CONCHO	3	0	0	0	0.00	0	0	0.00
	COOKE	3	0	0	0	0.00	0	0	0.00
	CORYELL	2	32	1,525	1,453	77.11	9,493	8,749	744.85
	COTTLE	3	0	0	0	0.00	0	0	0.00
	CRANE	3	0	0	0	0.00	0	0	0.00
	CROCKETT	3	0	0	0	0.00	0	0	0.00
	CROSBY	3	0	0	0	0.00	0	0	0.00
	CULBERSON	3	0	0	0	0.00	0	0	0.00
	DAWSON	3	0	0	0	0.00	0	0	0.00
	DE WITT	2	0	0	0	0.00	0	0	0.00
	DELTA	3	0	0	0	0.00	0	0	0.00
	DICKENS	3	0	0	0	0.00	0	0	0.00
	DIMMIT	2	0	0	0	0.00	0	0	0.00
	DUVAL	2	0	0	0	0.00	0	0	0.00
	EASTLAND	3	0	0	0	0.00	0	0	0.00
	ECTOR	3	126	6,055	5,723	354.71	43,310	39,678	3,631.93
	EDWARDS	2	0	0	0	0.00	0	0	0.00
	ERATH	3	43	2,063	1,951	119.60	14,955	13,728	1,226.67
	FALLS	2	0	0	0	0.00	0	0	0.00
	FANNIN	3	20	978	927	53.53	6,385	5,917	468.11
	FAYETTE	2	0	0	0	0.00	0	0	0.00
	FISHER	3	0	0	0	0.00	0	0	0.00
	FOARD	3	0	0	0	0.00	0	0	0.00
	FRANKLIN	3	0	0	0	0.00	0	0	0.00
	FREESTONE	2	0	0	0	0.00	0	0	0.00
	FRIO	2	0	0	0	0.00	0	0	0.00

Table 13: 2014 Annual Electricity Savings from New Multi-family Residences (Continued)

2014 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	0	0	0	0.00	0	0	0.00
	GLASSCOCK	3	0	0	0	0.00	0	0	0.00
	GOLIAD	2	0	0	0	0.00	0	0	0.00
	GONZALES	2	8	357	342	16.09	1,951	1,839	111.44
	GRAYSON	3	68	3,324	3,153	182.01	21,709	20,117	1,591.58
	GRIMES	2	0	0	0	0.00	0	0	0.00
	HALL	3	0	0	0	0.00	0	0	0.00
	HAMILTON	3	0	0	0	0.00	0	0	0.00
	HARDEMAN	3	0	0	0	0.00	0	0	0.00
	HASKELL	3	0	0	0	0.00	0	0	0.00
	HENDERSON	2	0	0	0	0.00	0	0	0.00
	HIDALGO	2	633	28,059	26,962	1,174.13	118,630	118,677	-47.75
	HILL	2	0	0	0	0.00	0	0	0.00
	HOOD	3	4	195	185	10.66	1,279	1,184	95.55
	HOPKINS	3	0	0	0	0.00	0	0	0.00
	HOUSTON	2	0	0	0	0.00	0	0	0.00
	HOWARD	3	4	192	182	11.26	1,375	1,260	115.30
	HUDSPETH	3	0	0	0	0.00	0	0	0.00
	HUNT	2	3	147	139	8.03	958	888	70.22
	IRION	3	0	0	0	0.00	0	0	0.00
	JACK	3	0	0	0	0.00	0	0	0.00
	JACKSON	2	2	88	85	3.21	456	455	0.94
	JEFF DAVIS	3	0	0	0	0.00	0	0	0.00
	JIM HOGG	2	0	0	0	0.00	0	0	0.00
	JIM WELLS	2	0	0	0	0.00	0	0	0.00
	JONES	3	0	0	0	0.00	0	0	0.00
	KARNES	2	8	351	339	12.82	1,824	1,820	3.76
	KENDALL	3	0	0	0	0.00	0	0	0.00
	KENEDY	2	0	0	0	0.00	0	0	0.00
	KENT	3	0	0	0	0.00	0	0	0.00
	KERR	3	26	1,193	1,135	62.07	7,232	6,686	545.51
	KIMBLE	3	3	143	135	8.08	955	878	76.90
	KING	3	0	0	0	0.00	0	0	0.00
	KINNEY	2	0	0	0	0.00	0	0	0.00
	KLEBERG	2	0	0	0	0.00	0	0	0.00
	KNOX	3	0	0	0	0.00	0	0	0.00
	LA SALLE	2	13	572	550	22.79	2,714	2,714	-0.27
	LAMAR	3	16	782	742	42.86	5,106	4,724	382.01
	LAMPASAS	3	81	3,801	3,611	203.44	25,694	23,656	2,037.89
	LAVACA	2	0	0	0	0.00	0	0	0.00
	LEE	2	0	0	0	0.00	0	0	0.00
	LEON	2	0	0	0	0.00	0	0	0.00
	LIMESTONE	2	0	0	0	0.00	0	0	0.00
	LIVE OAK	2	0	0	0	0.00	0	0	0.00
	LLANO	3	0	0	0	0.00	0	0	0.00
	LOVING	3	0	0	0	0.00	0	0	0.00
	MADISON	2	0	0	0	0.00	0	0	0.00
	MARTIN	3	0	0	0	0.00	0	0	0.00
	MASON	3	0	0	0	0.00	0	0	0.00
	MATAGORDA	2	0	0	0	0.00	0	0	0.00
	MAVERICK	2	29	1,275	1,228	50.84	6,054	6,055	-0.61
	MCCULLOCH	3	0	0	0	0.00	0	0	0.00
	MCLENNAN	2	864	41,179	39,233	2,082.08	256,322	236,211	20,110.91
ERCOT	MCMULLEN	2	0	0	0	0.00	0	0	0.00
	MEDINA	2	24	1,109	1,065	47.08	5,459	5,178	280.67
	MENARD	3	0	0	0	0.00	0	0	0.00
	MIDLAND	3	636	52,473	49,600	3,074.13	375,354	343,877	31,476.75
	MILAM	2	0	0	0	0.00	0	0	0.00
	MILLS	3	0	0	0	0.00	0	0	0.00
	MITCHELL	3	0	0	0	0.00	0	0	0.00
	MONTAGUE	3	0	0	0	0.00	0	0	0.00
	MOTLEY	3	0	0	0	0.00	0	0	0.00
	NACOGDOCHES	3	36	1,620	1,565	58.97	8,647	8,630	17.69
	NAVARRO	3	0	0	0	0.00	0	0	0.00
	NOLAN	3	0	0	0	0.00	0	0	0.00
	PALO PINTO	3	0	0	0	0.00	0	0	0.00
	PECOS	3	0	0	0	0.00	0	0	0.00
	PRESIDIO	3	0	0	0	0.00	0	0	0.00
	RAINS	3	2	100	95	5.19	586	544	41.98
	REAGAN	3	18	872	826	48.49	5,784	5,294	490.17
	REAL	2	0	0	0	0.00	0	0	0.00
	RED RIVER	3	0	0	0	0.00	0	0	0.00
	REEVES	3	0	0	0	0.00	0	0	0.00
	REFUGIO	2	16	729	703	28.02	3,402	3,398	4.30
	ROBERTSON	2	0	0	0	0.00	0	0	0.00
	RUNNELS	3	0	0	0	0.00	0	0	0.00
	SAN SABA	3	0	0	0	0.00	0	0	0.00
	SCHLEICHER	3	0	0	0	0.00	0	0	0.00
	SCURRY	3	0	0	0	0.00	0	0	0.00
	SHACKELFORD	3	0	0	0	0.00	0	0	0.00
	SOMERVELL	3	0	0	0	0.00	0	0	0.00
	STARR	2	0	0	0	0.00	0	0	0.00
	STEPHENS	3	0	0	0	0.00	0	0	0.00
	STERLING	3	0	0	0	0.00	0	0	0.00
	STONEWALL	3	0	0	0	0.00	0	0	0.00
	SUTTON	3	0	0	0	0.00	0	0	0.00
	TAYLOR	3	0	0	0	0.00	0	0	0.00
	TERRELL	3	0	0	0	0.00	0	0	0.00
	THROCKMORTON	3	0	0	0	0.00	0	0	0.00
	TITUS	3	0	0	0	0.00	0	0	0.00
	TOM GREEN	3	400	19,253	18,276	1,045.01	118,964	109,528	9,436.19
	UPTON	3	0	0	0	0.00	0	0	0.00
	UVALDE	2	0	0	0	0.00	0	0	0.00
	VAL VERDE	2	8	370	355	15.69	1,820	1,726	93.56
	VAN ZANDT	3	80	3,988	3,794	207.43	23,433	21,754	1,679.22
	WARD	3	0	0	0	0.00	0	0	0.00
	WASHINGTON	2	2	90	87	3.34	434	433	0.71
	WEBB	2	765	35,410	34,033	1,473.81	151,935	151,787	147.78
	WHARTON	2	0	0	0	0.00	0	0	0.00
	WICHITA	3	50	2,583	2,439	154.40	18,644	16,999	1,644.77
	WILBARGER	3	0	0	0	0.00	0	0	0.00
	WILLACY	2	0	0	0	0.00	0	0	0.00
	WINKLER	3	0	0	0	0.00	0	0	0.00
	WISE	3	0	0	0	0.00	0	0	0.00
	YOUNG	3	2	96	91	5.56	696	639	57.05
	ZAPATA	2	0	0	0	0.00	0	0	0.00
	ZAVALA	2	0	0	0	0.00	0	0	0.00
	TOTAL		64,976			134,583			701,164

Table 14: 2014 Totalized Annual Electricity Savings by CM Zone from New Multi-family Residences

CM Zone	Total Electricity Savings by CM Zone (MWh) 2014-TRY 2008
Houston (H)	46,017
North (N)	43,010
West (W)	2,899
South (S)	28,964
Total	120,890

Table 15: 2014 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	2586.29	0.0000071	0.31	0.0000003	0.00	0.0005265	15.25	2601.85	1.30
	Chambers	0.0204500	941.04	0.0000026	0.11	0.0000001	0.00	0.0001916	5.55	946.71	0.47
	Fort Bend	0.0313463	1442.46	0.0000040	0.17	0.0000002	0.00	0.0002937	8.51	1451.14	0.73
	Galveston	0.0226620	1042.83	0.0000029	0.12	0.0000001	0.00	0.0002123	6.15	1049.11	0.52
	Harris	0.1486911	6842.30	0.0000189	0.81	0.0000009	0.00	0.0013930	40.35	6883.46	3.44
Dallas/Fort Worth Area	Collin	0.0012932	59.51	0.0079329	341.20	0.0003832	1.11	0.0000809	2.34	404.16	0.20
	Dallas	0.0024826	114.24	0.0152295	655.03	0.0007356	2.13	0.0001554	4.50	775.90	0.39
	Denton	0.0001267	5.83	0.0007770	33.42	0.0000375	0.11	0.0000079	0.23	39.59	0.02
	Tarrant	0.0004742	21.82	0.0029089	125.11	0.0001405	0.41	0.0000297	0.86	148.20	0.07
	Ellis	0.0029920	137.68	0.0183544	789.43	0.0008865	2.57	0.0001873	5.42	935.10	0.47
	Johnson	0.0007256	33.39	0.0044512	191.45	0.0002150	0.62	0.0000454	1.32	226.78	0.11
	Kaufman	0.0059718	274.81	0.0366343	1575.65	0.0017695	5.13	0.0003738	10.83	1866.42	0.93
	Parker	0.0000012	0.06	0.0000075	0.32	0.0000004	0.00	0.0000001	0.00	0.38	0.00
	Henderson	0.0006908	31.79	0.0042376	182.26	0.0002047	0.59	0.0000432	1.25	215.89	0.11
	Hood	0.0050771	233.63	0.0311454	1339.58	0.0015044	4.36	0.0003178	9.20	1586.77	0.79
	Hunt	0.0088463	407.08	0.0047066	202.43	0.0002273	0.66	0.0652823	1890.84	2501.01	1.25
San Antonio Area	Bexar	0.0138906	639.20	0.0009368	40.29	0.0000452	0.13	0.1109355	3213.14	3892.76	1.95
	Guadalupe	0.0032029	147.39	0.0002160	9.29	0.0000104	0.03	0.0255795	740.88	897.59	0.45
Austin Area	Bastrop	0.0033782	155.46	0.0002278	9.80	0.0000110	0.03	0.0269798	781.44	946.73	0.47
	Hays	0.0008331	38.34	0.0000562	2.42	0.0000027	0.01	0.0066537	192.72	233.48	0.12
	Travis	0.0051785	238.30	0.0003493	15.02	0.0000169	0.05	0.0413577	1197.89	1451.26	0.73
Corpus Christi Area	Nueces	0.0128578	591.67	0.0008672	37.30	0.0000419	0.12	0.1026870	2974.23	3603.32	1.80
	San Patricio	0.0015100	69.48	0.0001018	4.38	0.0000049	0.01	0.0120591	349.28	423.16	0.21
Victoria Area	Victoria	0.0021192	97.52	0.0001429	6.15	0.0000069	0.02	0.0169244	490.20	593.88	0.30
Other ERCOT counties	Andrews	0.0000037	0.17	0.0000230	0.99	0.0039003	11.31	0.0000002	0.01	12.47	0.01
	Bosque	0.0022204	102.18	0.0136212	585.85	0.0006579	1.91	0.0001390	4.03	693.96	0.35
	Brazos	0.0024089	110.85	0.0112305	483.03	0.0005425	1.57	0.0047829	138.53	733.98	0.37
	Calhoun	0.0009466	43.56	0.0000638	2.75	0.0000031	0.01	0.0075598	218.96	265.27	0.13
	Cameron	0.0063536	292.37	0.0004285	18.43	0.0000207	0.06	0.0507425	1469.71	1780.57	0.89
	Cherokee	0.0027392	126.05	0.0168033	722.72	0.0008116	2.35	0.0001714	4.97	856.08	0.43
	Ector	0.0019215	88.42	0.0006604	28.40	0.0911346	264.20	0.0146527	424.40	805.43	0.40
	Fannin	0.0000041	0.19	0.0000249	1.07	0.0000012	0.00	0.0000003	0.01	1.27	0.00
	Fayette	0.0051867	238.68	0.0103217	443.94	0.0004986	1.45	0.0283993	822.56	1506.62	0.75
	Freestone	0.0047643	219.24	0.0292268	1257.06	0.0014117	4.09	0.0002982	8.64	1489.03	0.74
	Hidalgo	0.0053716	247.18	0.0003623	15.58	0.0000175	0.05	0.0428994	1242.54	1505.35	0.75
	Howard	0.0002411	11.10	0.0007641	32.86	0.1283942	372.22	0.0009490	27.49	443.67	0.22
	Jack	0.0030783	141.65	0.0188839	812.20	0.0009121	2.64	0.0001927	5.58	962.08	0.48
	Lamar	0.0040001	184.07	0.0245388	1055.43	0.0011853	3.44	0.0002504	7.25	1250.19	0.63
	Llano	0.0040314	185.51	0.0002719	11.69	0.0000131	0.04	0.0321966	932.54	1129.79	0.56
	McLennan	0.0056576	260.35	0.0347066	1492.75	0.0016764	4.86	0.0003541	10.26	1768.21	0.88
	Milam	0.0012686	58.38	0.0000856	3.68	0.0000041	0.01	0.0101316	293.45	355.52	0.18
	Mitchell	0.0000311	1.43	0.0001910	8.21	0.0324260	94.00	0.0000019	0.06	103.71	0.05
	Nolan	0.0000293	1.35	0.0001795	7.72	0.0304745	88.35	0.0000018	0.05	97.47	0.05
	Palo Pinto	0.0036129	166.26	0.0221635	953.26	0.0010705	3.10	0.0002261	6.55	1129.17	0.56
	Pecos	0.0000020	0.09	0.0000121	0.52	0.0020520	5.95	0.0000001	0.00	6.56	0.00
	Robertson	0.0039506	181.79	0.0055755	239.80	0.0002693	0.78	0.0246170	713.01	1135.38	0.57
	Upton	0.0000025	0.12	0.0000156	0.67	0.0026494	7.68	0.0000002	0.00	8.47	0.00
	Ward	0.0001995	9.18	0.0012239	52.64	0.2078335	602.52	0.0000125	0.36	664.71	0.33
	Webb	0.0042017	193.35	0.0002834	12.19	0.0000137	0.04	0.0335565	971.93	1177.51	0.59
	Wharton	0.0021095	97.07	0.0001423	6.12	0.0000069	0.02	0.0168474	487.97	591.18	0.30
	Wichita	0.0000121	0.56	0.0000743	3.20	0.0126190	36.58	0.0000008	0.02	40.36	0.02
	Wilbarger	0.0179710	826.97	0.1102430	4741.60	0.0053249	15.44	0.0011247	32.58	5616.58	2.81
	Wise	0.0010202	46.95	0.0062583	269.17	0.0003023	0.88	0.0000638	1.85	318.84	0.16
	Young	0.0071054	326.97	0.0435880	1874.74	0.0021054	6.10	0.0004447	12.88	2220.69	1.11
	Total	**0.4414501**	**20314.14**	**0.4812863**	**20700.33**	**0.5345786**	**1549.77**	**0.6829349**	**19780.54**	**62344.78**	**31.17**

Energy Savings by PCA (MWh)		46,017		43,010		2,899		28,964	

4.3 2014 Results for New Residential Construction (Single-family and Multi-family)

Table 16 presents the individual and combined annual electricity savings and NOx emissions reductions resulted from the new single-family and multi-family Construction in 2014. In addition, Table 16 includes the combined natural gas savings from the new Construction for both single-family and multi-family and the corresponding NOx emissions reductions[29].

The total NOx reductions from electricity and natural gas savings from total new single-family and multi-family Construction in 2014 are 60.2 tons NOx/year, including 18.53 tons NOx/year (30.78 %) from single-family residential electricity savings, 31.17 tons NOx/year (51.78 %) from multi-family residential electricity savings, and 10.49 tons NOx/year (17.43 %) 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 16. 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.

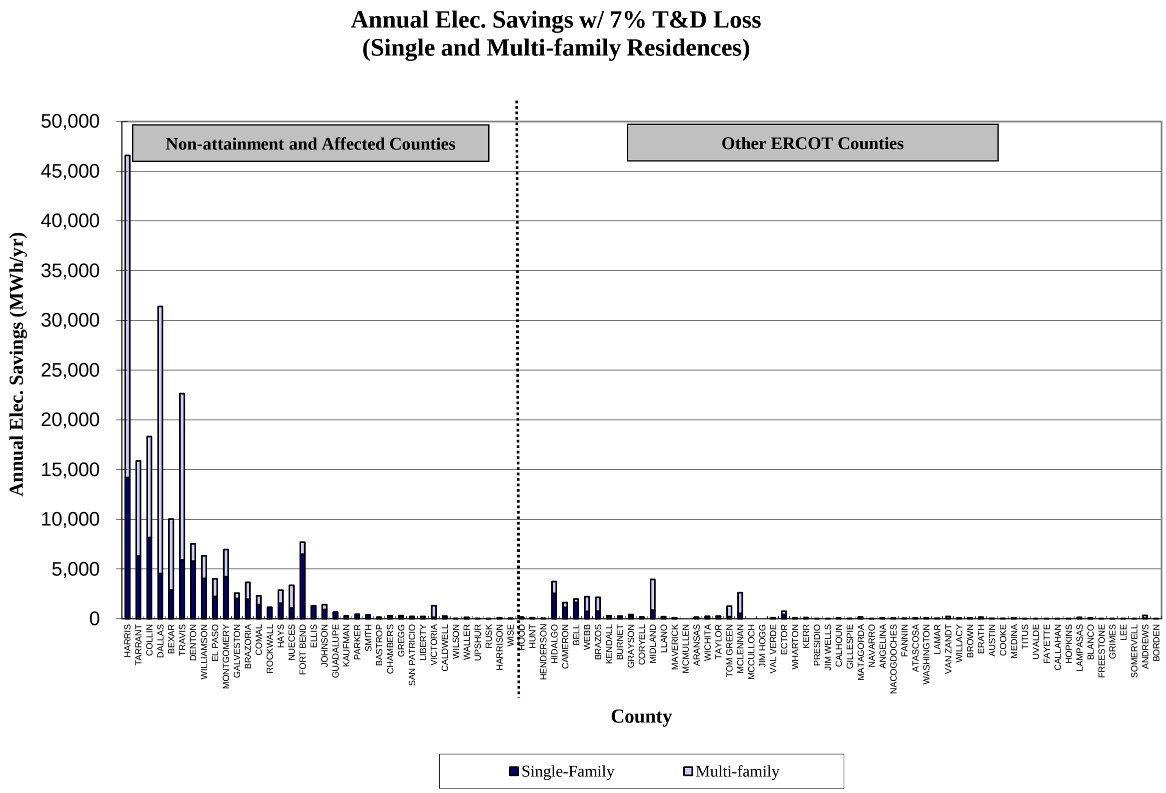
[29] 0.092 lb-NOx/MMBtu of emission rate was used for the calculation.

Table 16: 2014 Annual NOx Reductions from New Single-family and Multi-family Residences

	County	Electricity Savings and Resultant NOx Reductions (Single Family Houses)		Electricity Savings and Resultant NOx Reductions (Multifamily Houses)		Total Electricity Savings and Resultant NOx Reductions (Single and Multi-Family Houses)		Total Natural Gas Savings and Resultant NOx Reductions (Single and Multi-Family Houses)		Total Nox Reductions
		Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Annual Nox Reductions (Tons)
Non-attainment and Affected Counties	HARRIS	14,194.37	2.29	32,398.59	3.44	46,592.97	5.73	287,417.28	1.32	7.05
	TARRANT	6,295.60	0.04	9,576.79	0.07	15,872.39	0.12	177,937.55	0.82	0.94
	COLLIN	8,166.47	0.12	10,151.29	0.20	18,317.77	0.32	202,280.08	0.93	1.25
	DALLAS	4,553.12	0.22	26,846.02	0.39	31,399.14	0.61	287,776.81	1.32	1.94
	BEXAR	2,890.39	1.11	7,130.69	1.95	10,021.08	3.06	78,559.35	0.36	3.42
	TRAVIS	5,914.61	0.42	16,716.09	0.73	22,630.70	1.14	218,492.86	1.01	2.15
	DENTON	5,785.97	0.01	1,734.67	0.02	7,520.64	0.03	99,136.12	0.46	0.49
	WILLIAMSON	4,058.36		2,254.31		6,312.67	0.00	81,875.59	0.38	0.38
	EL PASO	2,245.15		1,760.06		4,005.21	0.00	76,551.77	0.35	0.35
	MONTGOMERY	4,220.86		2,731.60		6,952.46	0.00	87,952.16	0.40	0.40
	GALVESTON	2,018.54	0.35	553.25	0.52	2,571.79	0.87	42,899.41	0.20	1.07
	BRAZORIA	1,970.50	0.86	1,691.83	1.30	3,662.33	2.16	27,909.06	0.13	2.29
	COMAL	1,412.15		884.72		2,296.87	0.00	22,886.97	0.11	0.11
	ROCKWALL	1,151.83		0.00		1,151.83	0.00	18,132.63	0.08	0.08
	HAYS	1,566.15	0.07	1,310.66	0.12	2,876.81	0.18	36,691.45	0.17	0.35
	NUECES	1,068.28	1.03	2,292.59	1.80	3,360.87	2.83	15,830.23	0.07	2.91
	FORT BEND	6,483.32	0.48	1,208.53	0.73	7,691.85	1.21	133,971.39	0.62	1.82
	ELLIS	1,306.32	0.27	0.00	0.47	1,306.32	0.74	20,620.17	0.09	0.83
	JOHNSON	923.72	0.07	495.87	0.11	1,419.59	0.18	19,024.08	0.09	0.27
	GUADALUPE	676.48	0.26	0.00	0.45	676.48	0.71	9,428.03	0.04	0.75
	KAUFMAN	285.27	0.54	0.00	0.93	285.27	1.47	4,490.88	0.02	1.49
	PARKER	455.96	0.00	0.00	0.00	455.96	0.00	7,177.89	0.03	0.03
	SMITH	359.93		25.89		385.82	0.00	8,636.33	0.04	0.04
	BASTROP	154.28	0.27	0.00	0.47	154.28	0.74	5,009.56	0.02	0.77
	CHAMBERS	286.95	0.31	0.00	0.47	286.95	0.79	3,980.35	0.02	0.81
	GREGG	187.54		123.32		310.86	0.00	4,425.06	0.02	0.02
	SAN PATRICIO	199.77	0.12	13.49	0.21	213.26	0.33	2,918.69	0.01	0.35
	LIBERTY	230.22		0.00		230.22	0.00	4,833.36	0.02	0.02
	VICTORIA	133.16	0.17	1,176.70	0.30	1,309.86	0.47	2,806.63	0.01	0.48
	CALDWELL	276.89		0.00		276.89	0.00	3,770.11	0.02	0.02
	WILSON	30.03		0.00		30.03	0.00	418.48	0.00	0.00
	WALLER	3.83		128.72		132.55	0.00	106.43	0.00	0.00
	UPSHUR	12.93		20.73		33.67	0.00	677.15	0.00	0.00
	RUSK	2.37	0.00	0.00	0.00	2.37	0.00	66.25	0.00	0.00
	HARRISON	49.91		45.71		95.62	0.00	1,189.62	0.01	0.01
	WISE	63.26	0.09	0.00	0.16	63.26	0.25	995.89	0.00	0.26
Other ERCOT Counties	HOOD	139.45	0.46	10.66	0.79	150.12	1.25	2,296.79	0.01	1.26
	HUNT	82.28	0.72	8.03	1.25	90.31	1.97	1,381.39	0.01	1.97
	HENDERSON	66.72	0.06	0.00	0.11	66.72	0.17	1,601.08	0.01	0.18
	HIDALGO	2,556.97	0.43	1,174.13	0.75	3,731.10	1.18	27,165.41	0.12	1.31
	CAMERON	1,139.73	0.51	481.24	0.89	1,620.97	1.40	9,184.52	0.04	1.44
	BELL	1,646.10		344.60		1,990.70	0.00	35,989.29	0.17	0.17
	WEBB	734.80	0.34	1,473.81	0.59	2,208.61	0.93	8,722.04	0.04	0.97
	BRAZOS	764.38	0.21	1,389.21	0.37	2,153.59	0.58	10,761.41	0.05	0.63
	KENDALL	300.73		0.00		300.73	0.00	4,670.83	0.02	0.02
	BURNET	280.06		0.00		280.06	0.00	3,783.29	0.02	0.02
	GRAYSON	242.08		182.01		424.09	0.00	5,449.09	0.03	0.03
	CORYELL	101.55		77.11		178.66	0.00	2,759.64	0.01	0.01
	MIDLAND	871.95		3,074.13		3,946.08	0.00	51,745.62	0.24	0.24
	LLANO	208.54	0.32	0.00	0.56	208.54	0.89	3,351.96	0.02	0.90
	MAVERICK	53.92		50.84		104.76	0.00	628.53	0.00	0.00
	MCMULLEN	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	ARANSAS	154.04		0.00		154.04	0.00	1,555.70	0.01	0.01
	WICHITA	103.14	0.01	154.40	0.02	257.55	0.03	4,109.02	0.02	0.05
	TAYLOR	260.02		0.00		260.02	0.00	6,055.13	0.03	0.03
	TOM GREEN	214.63		1,045.01		1,259.64	0.00	13,922.49	0.06	0.06
	MCLENNAN	541.77	0.51	2,082.08	0.88	2,623.85	1.39	32,225.77	0.15	1.54
	MCCULLOCH	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	JIM HOGG	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	VAL VERDE	71.53		15.69		87.23	0.00	1,090.51	0.01	0.01
	ECTOR	408.88	0.24	354.71	0.40	763.58	0.64	13,136.42	0.06	0.70
	WHARTON	73.52	0.17	0.00	0.30	73.52	0.46	1,450.01	0.01	0.47
	KERR	67.11		62.07		129.18	0.00	1,624.11	0.01	0.01
	PRESIDIO	8.44		0.00		8.44	0.00	176.32	0.00	0.00
	JIM WELLS	22.01		0.00		22.01	0.00	321.40	0.00	0.00
	CALHOUN	62.66	0.08	12.26	0.13	74.92	0.21	831.29	0.00	0.21
	GILLESPIE	40.26		0.00		40.26	0.00	647.16	0.00	0.00
	MATAGORDA	181.36		0.00		181.36	0.00	3,576.69	0.02	0.02
	NAVARRO	20.56		0.00		20.56	0.00	459.80	0.00	0.00
	ANGELINA	60.73		15.08		75.81	0.00	1,697.47	0.01	0.01
	NACOGDOCHES	25.24		58.97		84.21	0.00	724.37	0.00	0.00
	FANNIN	11.93	0.00	53.53	0.00	65.46	0.00	658.14	0.00	0.00
	ATASCOSA	52.74		3.90		56.64	0.00	863.11	0.00	0.00
	WASHINGTON	63.57		3.34		66.91	0.00	1,316.65	0.01	0.01
	LAMAR	23.43	0.36	42.86	0.63	66.29	0.99	996.81	0.00	0.99
	VAN ZANDT	10.74		207.43		218.18	0.00	1,848.33	0.01	0.01
	WILLACY	87.28		0.00		87.28	0.00	928.91	0.00	0.00
	BROWN	64.13		14.46		78.59	0.00	1,412.16	0.01	0.01
	ERATH	39.28		119.60		158.88	0.00	2,141.47	0.01	0.01
	AUSTIN	19.21		5.02		24.22	0.00	264.14	0.00	0.00
	COOKE	29.80		0.00		29.80	0.00	439.32	0.00	0.00
	MEDINA	22.96		47.08		70.04	0.00	600.68	0.00	0.00
	TITUS	19.09	0.00	0.00	0.00	19.09	0.00	500.95	0.00	0.00
	UVALDE	11.48		0.00		11.48	0.00	160.01	0.00	0.00
	FAYETTE	4.60	0.43	0.00	0.75	4.60	1.19	95.13	0.00	1.19
	CALLAHAN	4.97		0.00		4.97	0.00	97.23	0.00	0.00
	HOPKINS	9.55		0.00		9.55	0.00	150.32	0.00	0.00
	LAMPASAS	138.57		0.00		138.57	0.00	0.00	0.00	0.00
	BLANCO	3.22		76.99		80.21	0.00	611.95	0.00	0.00
	FREESTONE	6.26	0.43	0.00	0.74	6.26	1.17	139.94	0.00	1.17
	GRIMES	11.49	0.00	0.00	0.00	11.49	0.00	237.82	0.00	0.00
	LEE	3.10		0.00		3.10	0.00	49.45	0.00	0.00
	SOMERVELL	21.45		0.00		21.45	0.00	338.65	0.00	0.00
	ANDREWS	50.40	0.00	287.14	0.01	337.54	0.01	4,111.62	0.02	0.03
	BORDEN	15.71		0.00		15.71	0.00	1,130.12	0.01	0.01

Table 16: 2014 Annual NOx Reductions from New Single-family and Multi-family Residences (Continued)

	County	Electricity Savings and Resultant NOx Reductions (Single Family Houses)		Electricity Savings and Resultant NOx Reductions (Multifamily Houses)		Total Electricity Savings and Resultant NOx Reductions (Single and Multi-Family Houses)		Total Natural Gas Savings and Resultant NOx Reductions (Single and Multi-Family Houses)		Total Nox Reductions
		Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Annual Nox Reductions (Tons)
Other ERCOT Counties	CHEROKEE	4.73	0.25	0.00	0.43	4.73	0.68	132.50	0.00	0.68
	DIMMIT	3.94		0.00		3.94	0.00	39.83	0.00	0.00
	FALLS	9.83		0.00		9.83	0.00	219.91	0.00	0.00
	COLORADO	8.00		0.00		8.00	0.00	109.62	0.00	0.00
	FRIO	10.23	0.00	0.00	0.00	10.23	0.00	162.55	0.00	0.00
	MILAM	7.25	0.10	0.00	0.18	7.25	0.28	122.68	0.00	0.28
	JACKSON	13.07		3.21		16.28	0.00	258.72	0.00	0.00
	ANDERSON	2.37		0.00		2.37	0.00	66.25	0.00	0.00
	HILL	8.94		0.00		8.94	0.00	199.92	0.00	0.00
	CULBERSON	0.74		0.00		0.74	0.00	21.17	0.00	0.00
	MASON	4.13		0.00		4.13	0.00	66.38	0.00	0.00
	PECOS	6.56	0.00	0.00	0.00	6.56	0.01	137.14	0.00	0.01
	RAINS	3.58		5.19		8.77	0.00	98.35	0.00	0.00
	LAVACA	8.62		0.00		8.62	0.00	178.84	0.00	0.00
	PALO PINTO	4.68	0.33	0.00	0.56	4.68	0.89	108.91	0.00	0.89
	KIMBLE	1.87		8.08		9.95	0.00	116.08	0.00	0.00
	MADISON	3.06		0.00		3.06	0.00	63.42	0.00	0.00
	ARCHER	9.67		0.00		9.67	0.00	216.56	0.00	0.00
	REFUGIO	4.90		28.02		32.92	0.00	100.96	0.00	0.00
	LIMESTONE	3.58	0.00	0.00	0.00	3.58	0.00	79.97	0.00	0.00
	CLAY	5.37		0.00		5.37	0.00	120.31	0.00	0.00
	BEE	9.31		0.00		9.31	0.00	123.29	0.00	0.00
	MARTIN	2.85		0.00		2.85	0.00	66.31	0.00	0.00
	GONZALES	23.84		16.09		39.94	0.00	443.75	0.00	0.00
	BURLESON	6.40		0.00		6.40	0.00	87.69	0.00	0.00
	KARNES	54.42		12.82		67.24	0.00	864.18	0.00	0.00
	KLEBERG	29.66		0.00		29.66	0.00	445.02	0.00	0.00
	BREWSTER	4.08		18.29		22.37	0.00	234.98	0.00	0.00
	WINKLER	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	FRANKLIN	1.19		0.00		1.19	0.00	18.79	0.00	0.00
	YOUNG	30.87	0.64	5.56	1.11	36.43	1.75	775.83	0.00	1.75
	HOUSTON	3.94		0.00		3.94	0.00	110.42	0.00	0.00
	SCURRY	6.50		0.00		6.50	0.00	518.11	0.00	0.00
	BOSQUE	2.67	0.20	0.00	0.35	2.67	0.55	53.02	0.00	0.55
	COMANCHE	2.67		0.00		2.67	0.00	53.02	0.00	0.00
	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	8.66		0.00		8.66	0.00	87.62	0.00	0.00
	NOLAN	0.00	0.03	0.00	0.05	0.00	0.08	0.00	0.00	0.08
	BROOKS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	ROBERTSON	39.06	0.33	0.00	0.57	39.06	0.89	808.59	0.00	0.90
	LIVE OAK	10.16		0.00		10.16	0.00	148.34	0.00	0.00
	HAMILTON	1.79		0.00		1.79	0.00	39.98	0.00	0.00
	JONES	0.94		0.00		0.94	0.00	21.78	0.00	0.00
	REAGAN	0.95		48.49		49.45	0.00	512.28	0.00	0.00
	WARD	18.07	0.20	0.00	0.33	18.07	0.54	419.97	0.00	0.54
	RED RIVER	6.94		0.00		6.94	0.00	182.16	0.00	0.00
	HASKELL	1.87		0.00		1.87	0.00	43.56	0.00	0.00
	HOWARD	43.44	0.14	11.26	0.22	54.70	0.36	965.99	0.00	0.36
	SAN SABA	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	JACK	4.68	0.28	0.00	0.48	4.68	0.76	108.91	0.00	0.76
	STEPHENS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	RUNNELS	3.75		0.00		3.75	0.00	78.36	0.00	0.00
	REEVES	2.85		0.00		2.85	0.00	66.31	0.00	0.00
	DE WITT	4.08		0.00		4.08	0.00	80.56	0.00	0.00
	CHILDRESS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	CROSBY	4.14		0.00		4.14	0.00	297.40	0.00	0.00
	DAWSON	11.64		0.00		11.64	0.00	817.72	0.00	0.00
	MITCHELL	4.68	0.03	0.00	0.05	4.68	0.08	108.91	0.00	0.08
	WILBARGER	2.22	1.62	0.00	2.81	2.22	4.43	52.99	0.00	4.43
	COLEMAN	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	UPTON	0.95	0.00	0.00	0.00	0.95	0.01	22.11	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	0.80		0.00		0.80	0.00	10.77	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	1.00		0.00		1.00	0.00	20.11	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	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	HALL	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	HUDSPETH	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	IRION	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	JEFF DAVIS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	KENEDY	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	KENT	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	KING	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	KINNEY	0.88		0.00		0.88	0.00	12.31	0.00	0.00
	KNOX	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	LA SALLE	8.47		22.79		31.26	0.00	98.59	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	13.12		0.00		13.12	0.00	209.03	0.00	0.00
	MOTLEY	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	REAL	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	SCHLEICHER	0.94		0.00		0.94	0.00	19.59	0.00	0.00
	SHACKELFORD	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	STARR	0.00		0.00		0.00	0.00	0.00	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	**92,395.71**	**18.53**	**134,379.34**	**31.17**	**226,775.05**	**49.70**	**2,281,365.12**	**10.49**	**60.20**



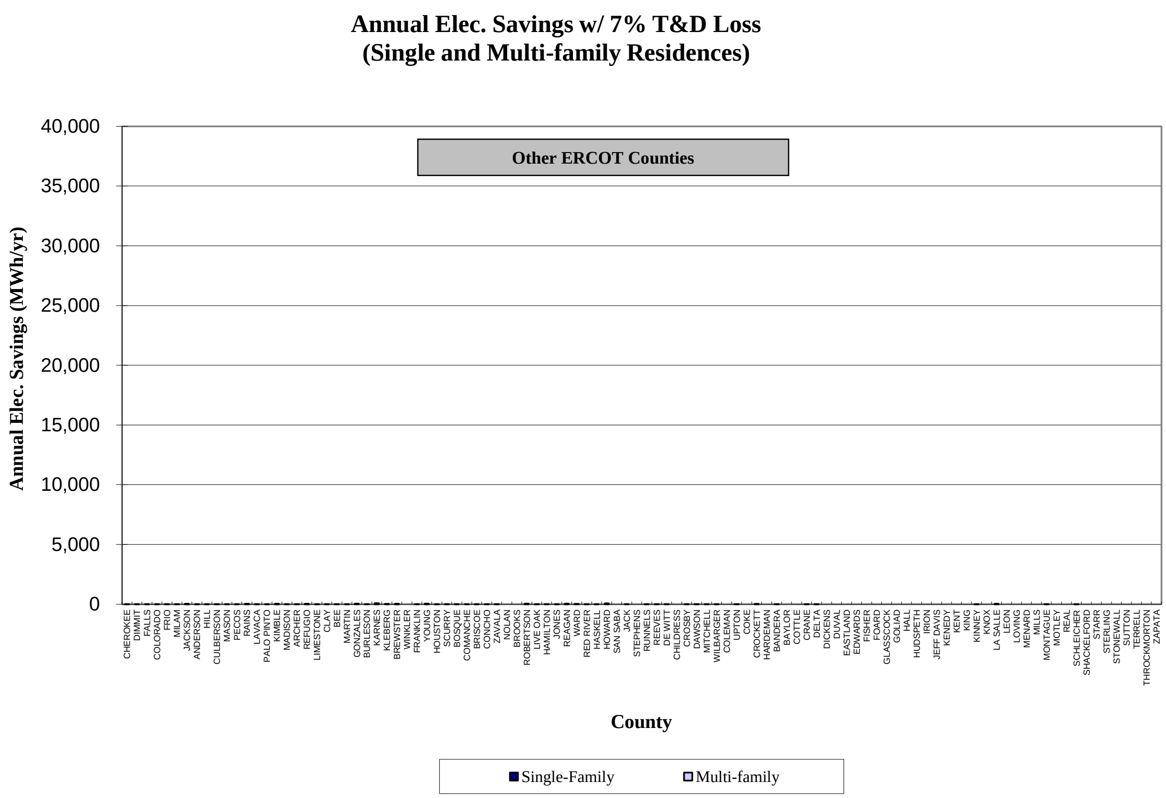


Figure 8: 2014 Annual Electricity Savings by County from New Single-family and Multi-family Residences

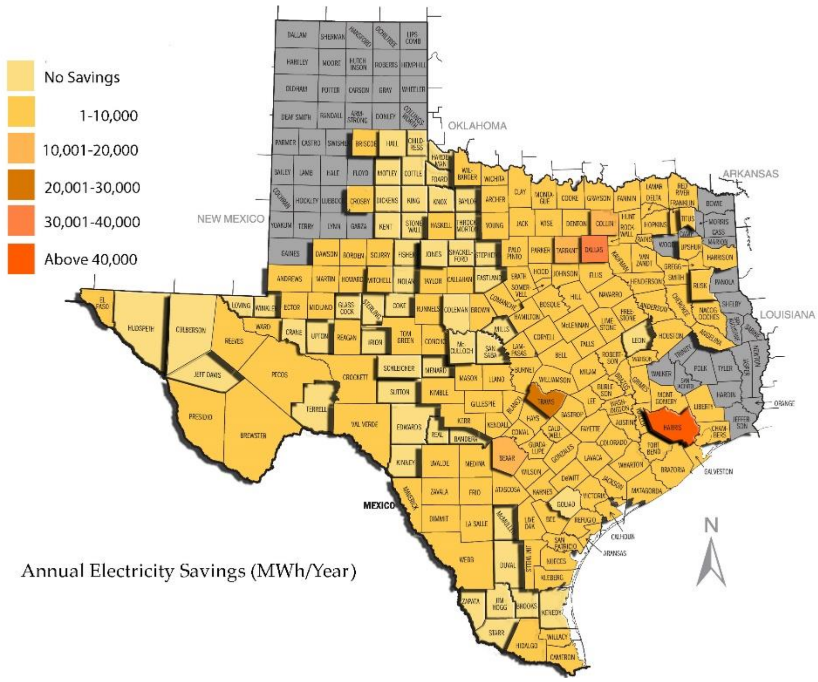
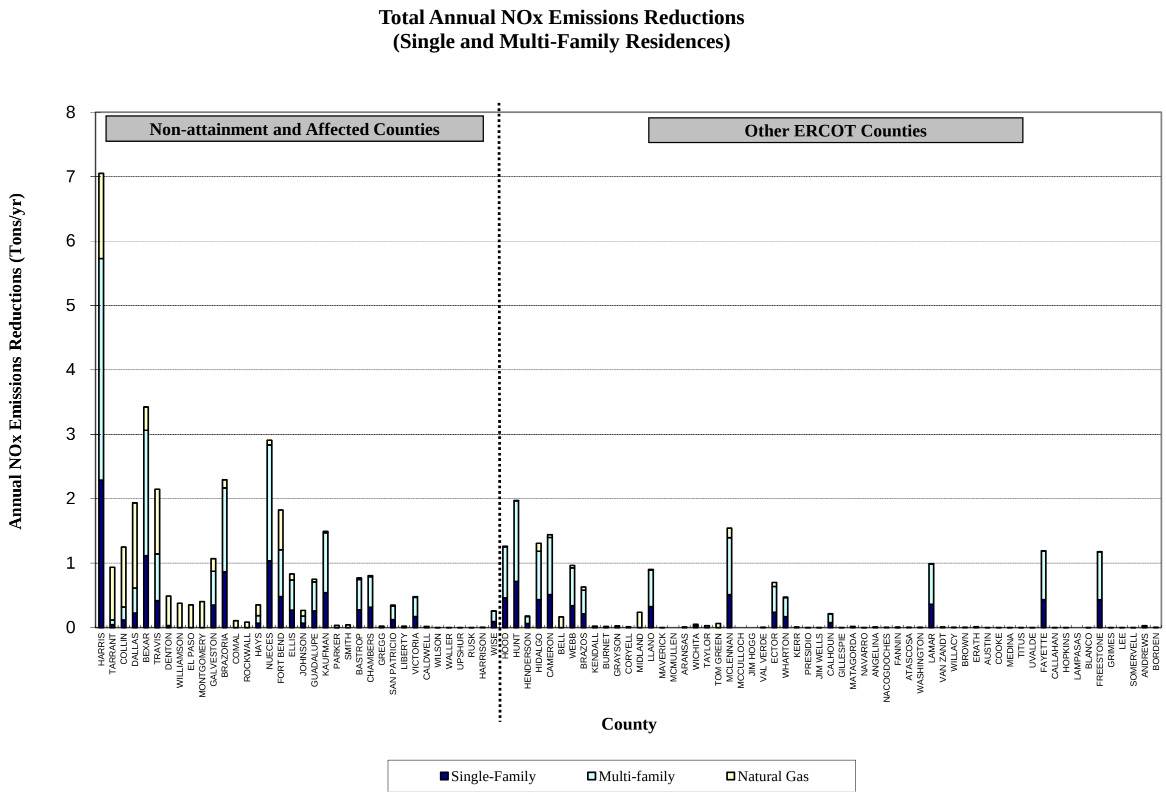


Figure 9: Map of 2014 Annual Electricity Savings by County from New Single-family and Multi-family Residences



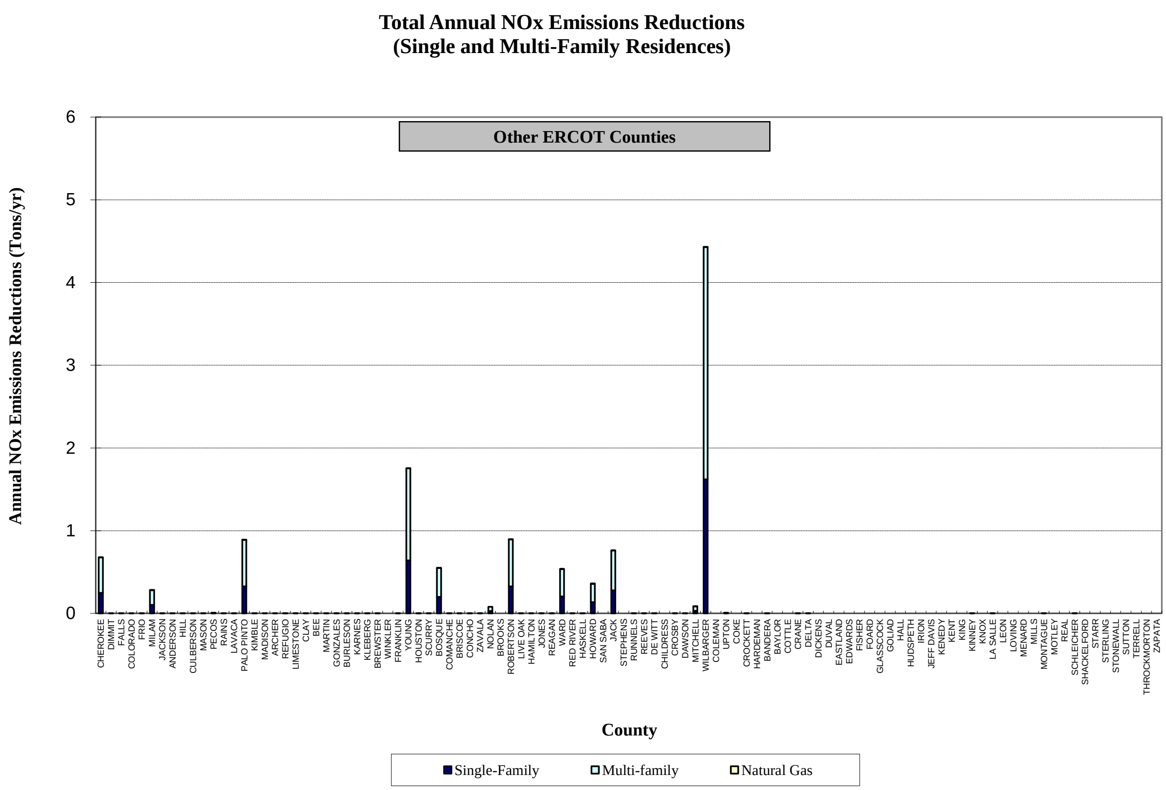


Figure 10: 2014 Annual NOx Reductions by County from New Single-family and Multi-family Residences

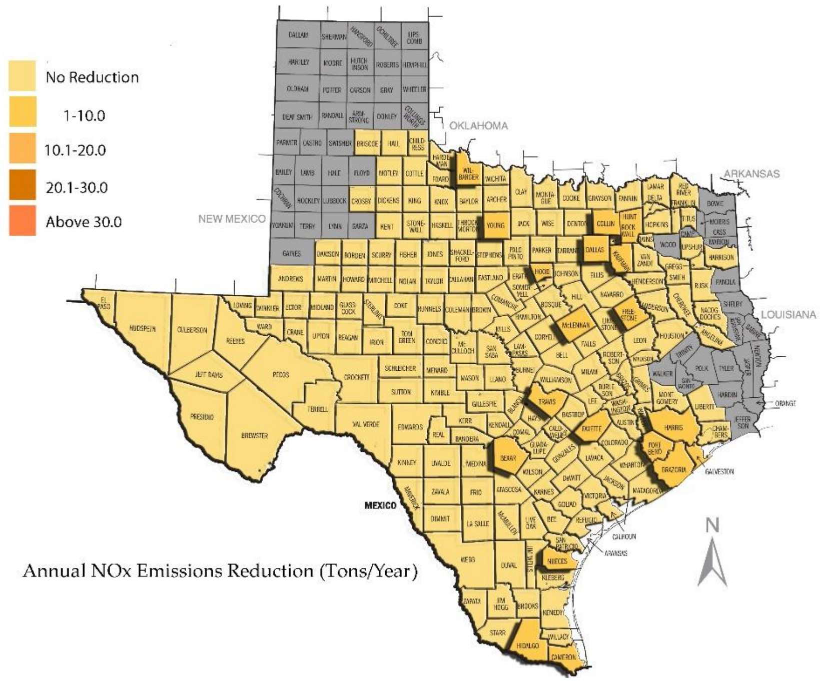


Figure 11: Map of 2014 Annual NOx Reductions by County from New Single-family and Multi-family Residences

4.4 2014 Results for Commercial Construction

This section reports the calculated energy savings and emissions reductions from new commercial Construction in 2014 that were built to meet ASHRAE Standard 90.1-2007.

To determine the energy savings and emissions reductions from new commercial Construction in all counties in the ERCOT region as well as the 36 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 Construction per county in Texas (Dodge 2015) was categorized by the building types in the report published by the US Department of Energy (DOE) (USDOE 2011). This allowed for the new Construction to be tracked by county and building type. The next block in Figure 12 and Table 17 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 18) 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 19 (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 Construction by the seven DOE building types is shown in Figure 13 for all building types and in Figure 14 for each building type.

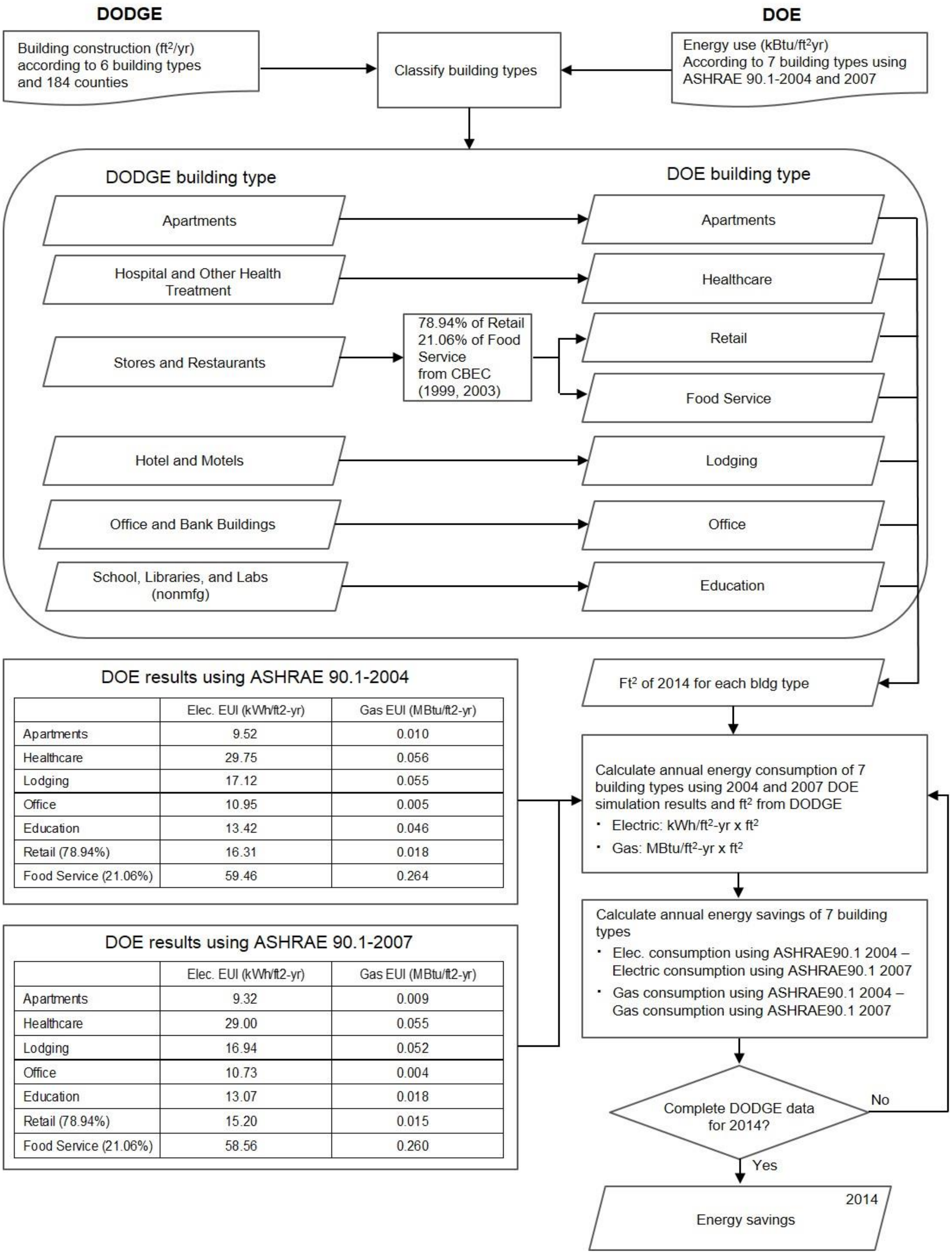
In the next step, the annual energy savings were calaulated. To accomplish this, this report used the resultant square footage and savings of the annual energy use intensity (EUI). The DOE report included the annual EUI values, which comply with the ASHRAE Standard 90.1-2004 and 2007, by seven building 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 20 to Table 22 show the annual energy use calculated for new commercial Construction, by building type, for ASHRAE Standard 90.1-2004 and ASHRAE Standard 90.1-2007. Table 23 shows the county-wide annual electricity and natural gas savings by building type[30].

[30] In this table (-) values are savings, (+) values are increased energy use.

In the next calculation step, CM Zones were assigned to each county as shown in Table 24. In the case where more than one provider was shown in a county, a percentage of electricity use was allocated. In Table 25, the total electricity savings by CM Zones are shown for 2014 for all estimated new commercial Construction. In addtition, Table 25 shows the calculated annual NOx emissions reductions from electricity savings, using the 2010 eGRID for Texas.

Table 26 shows the transformation of the annual county-wide electricity and natural gas savings, along with the associated 2014 NOx emissions reductions with 7% T&D losses[31]. Figure 15 shows the bar chart of the annual electricity savings for 2014. 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 Construction in 2014 are calculated to be 48.49 tons NOx/year which represents 11.26 tons NOx/year from electricity savings and 37.23 tons NOx/year from natural gas savings.

[31] 0.092 lb-NOx/MMBtu of emission rate was used for the calculation.



DOE results using ASHRAE 90.1-2004

	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

DOE results using ASHRAE 90.1-2007

	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 2014 Energy Savings from New Commercial Buildings

Table 17: Commercial Building Types in the US DOE Report and Dodge Database

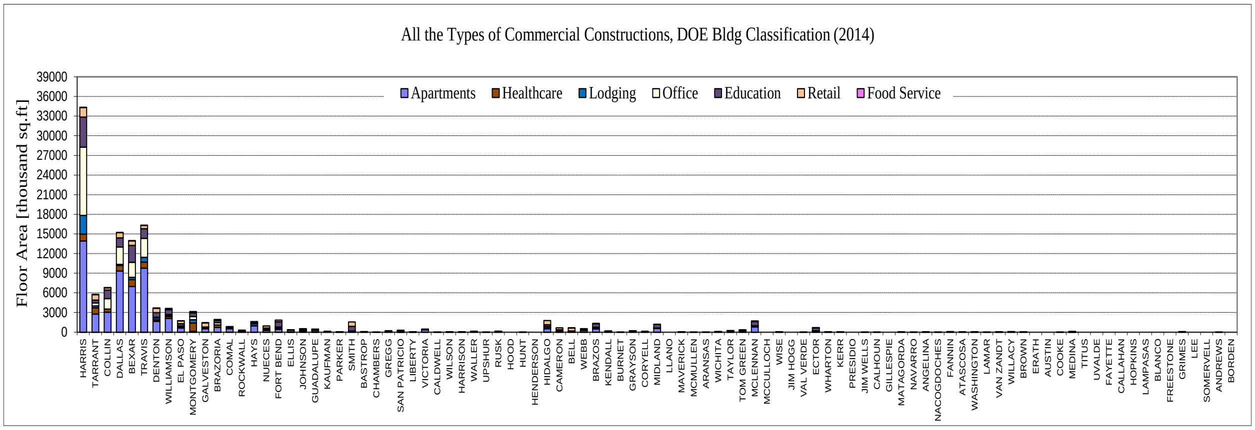
No	DOE Building Types	Dodge Building Types
1	Apartments	Apartments
2	Healthcare	Hospitals and Other Health Treatment
3	Lodging	Hotels and Motels
4	Office	Office and Bank Buildings
5	Education	Schools, Libraries, and Labs (nonmfg)
6	Retail	Stores and Restaurants
7	Food Service	Stores and Restaurants

Table 18: 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 19: 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



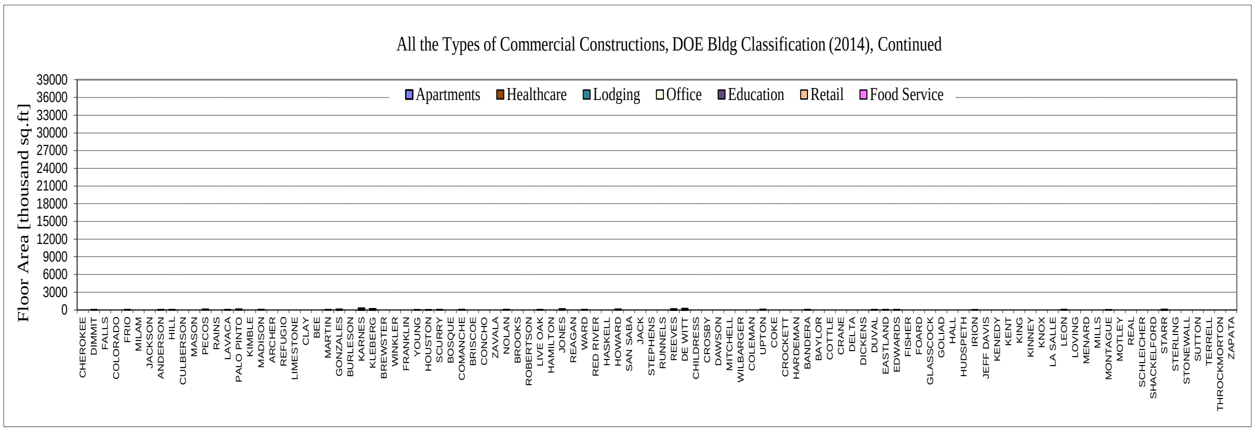
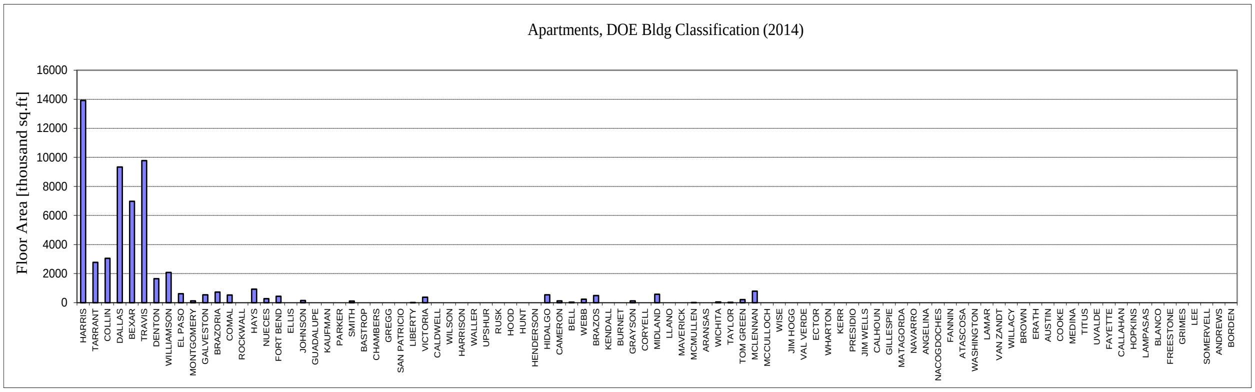
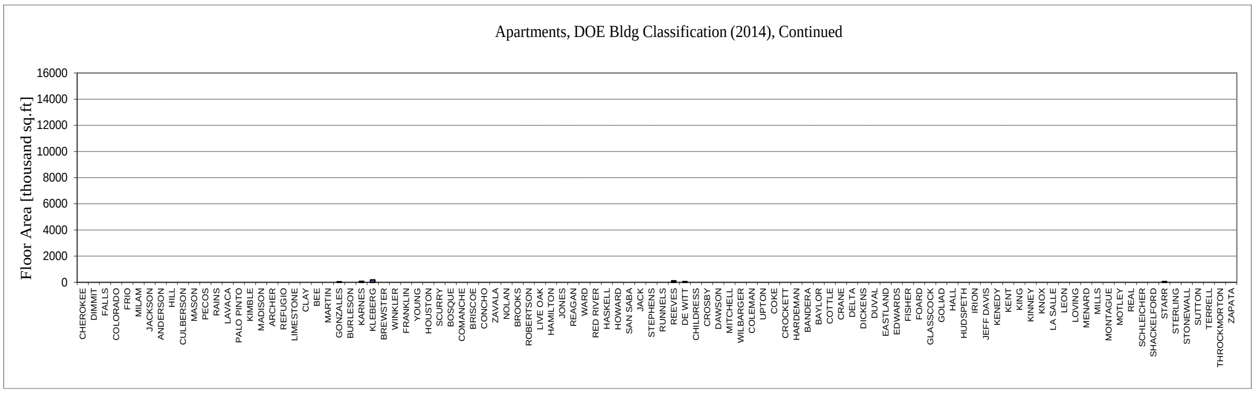
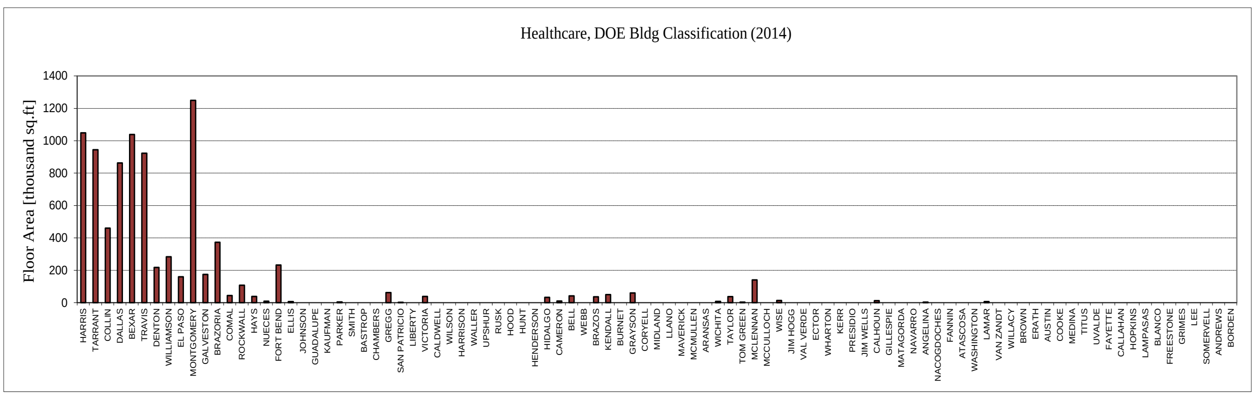


Figure 13: All the Types of 2014 New Commercial Building Construction (Dodge 2015)







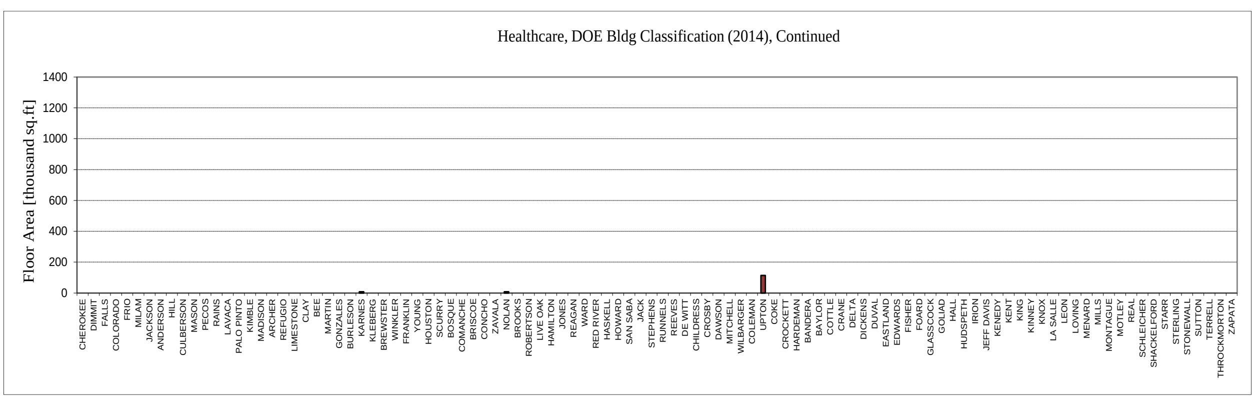
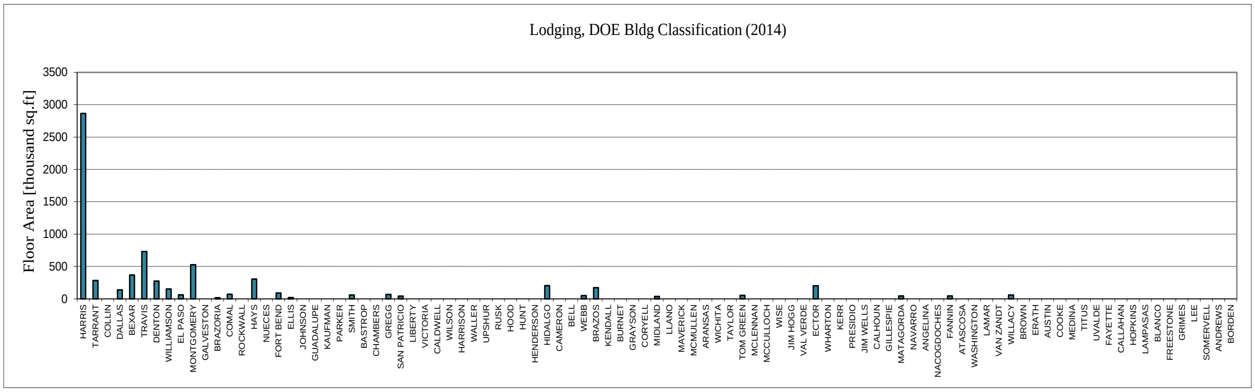
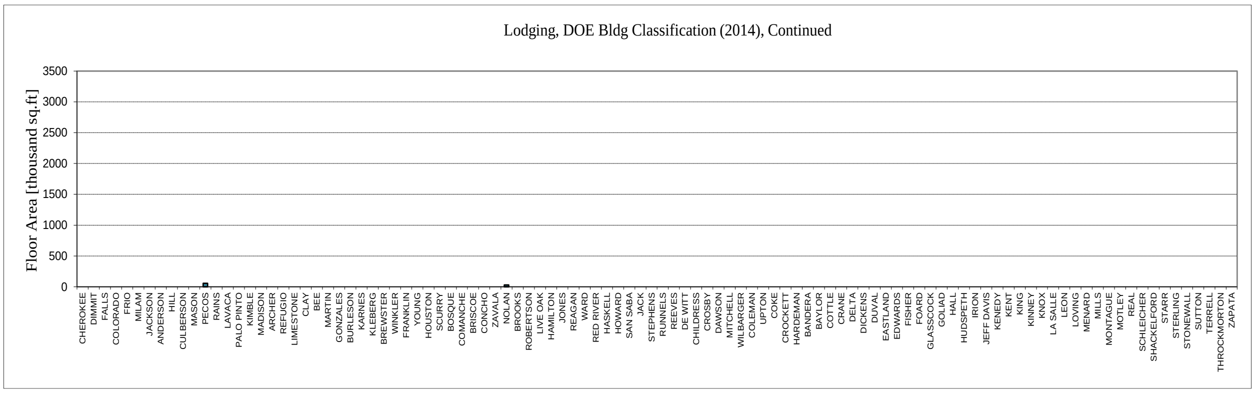
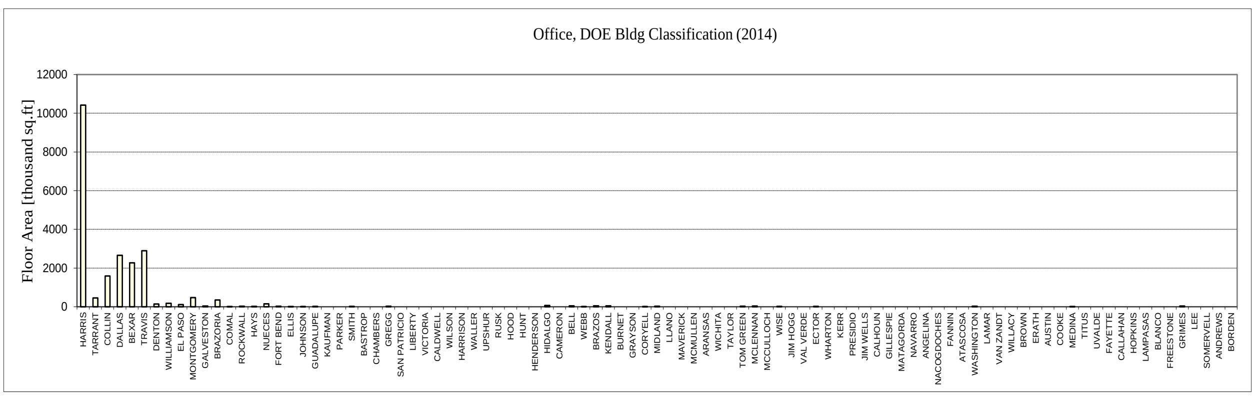


Figure 14: 2014 New Commercial Building Construction by Type (Dodge 2015)







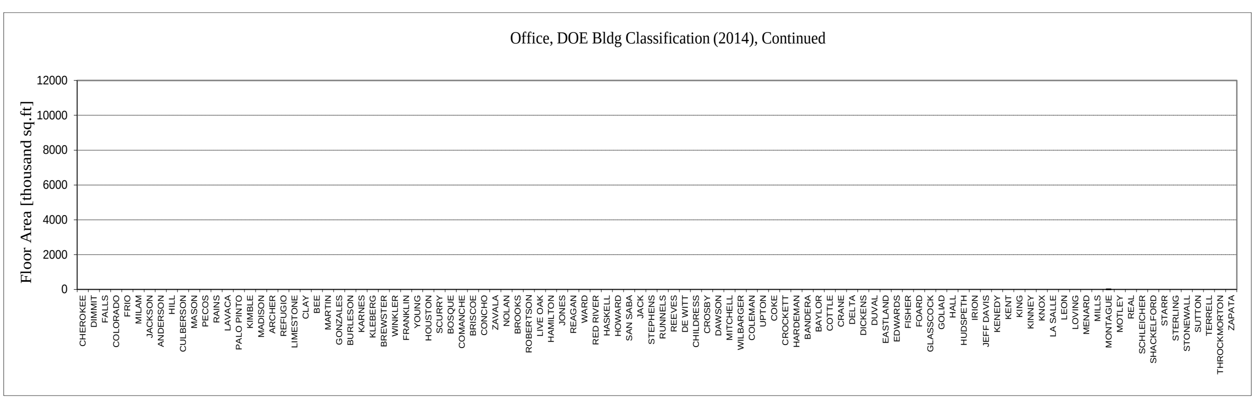
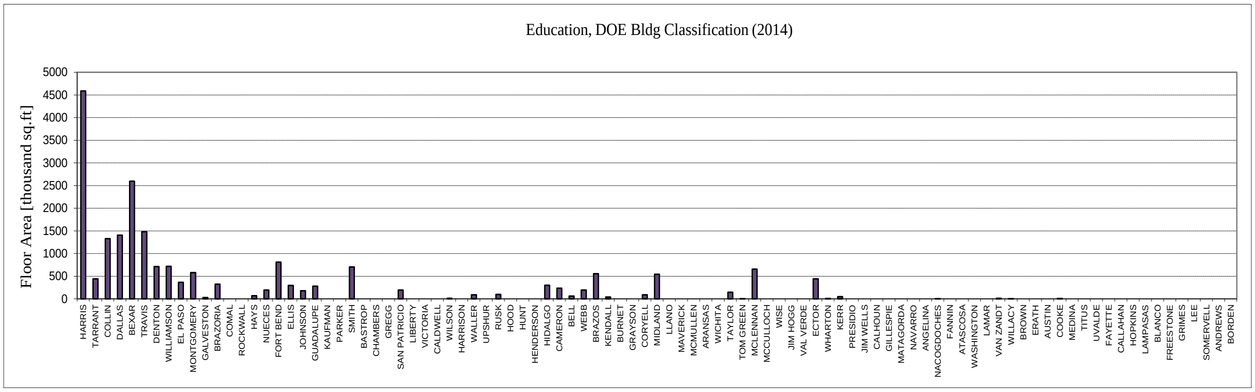
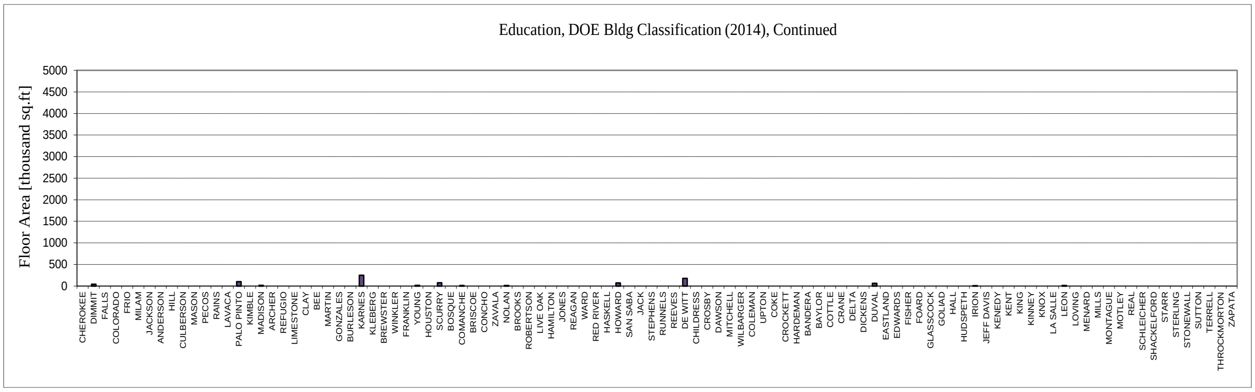
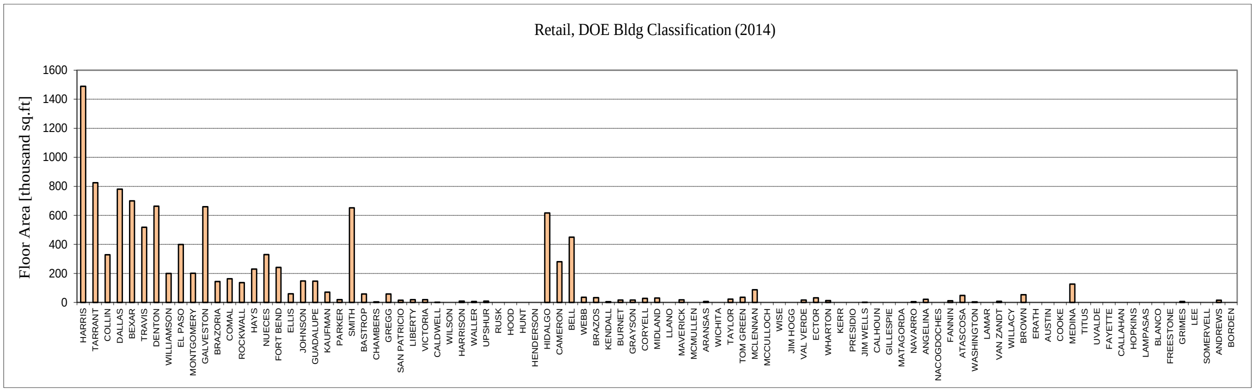


Figure 14: 2014 New Commercial Building Construction by Type (Dodge 2015) (Continued)







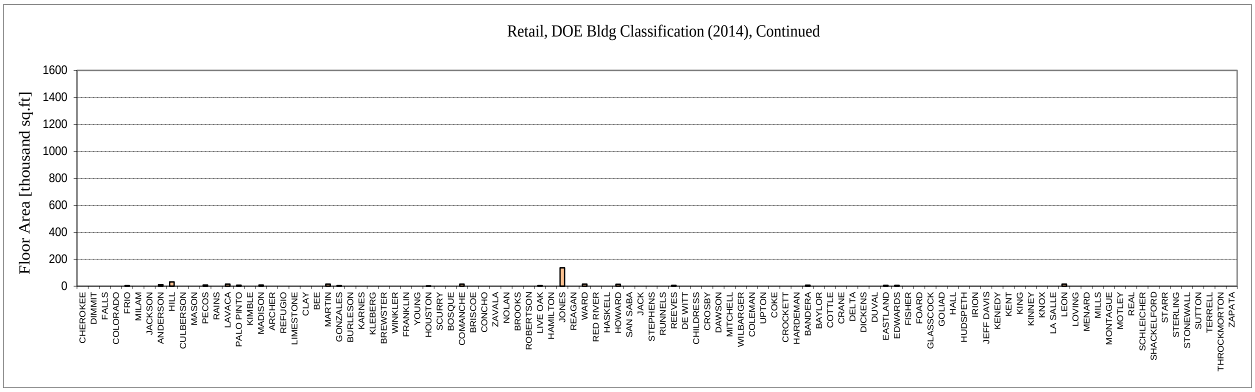
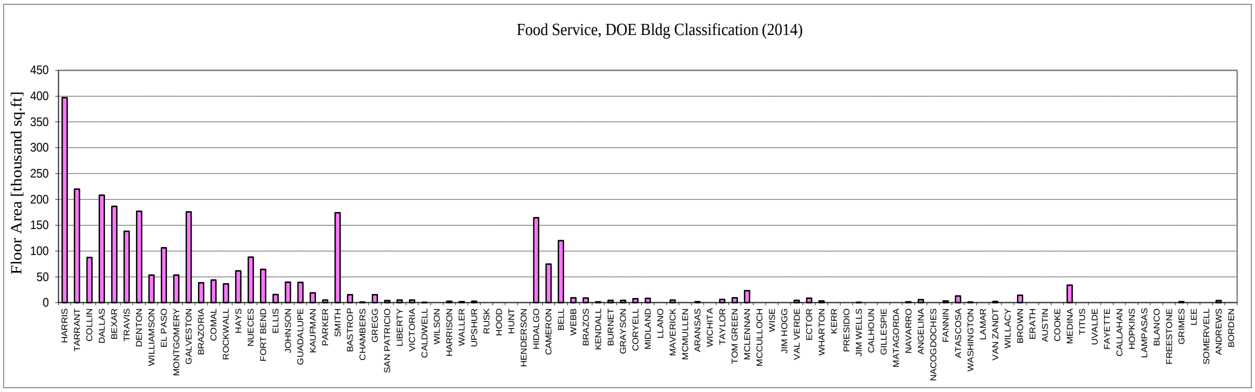


Figure 14: 2014 New Commercial Building Construction by Type (Dodge 2015) (Continued)



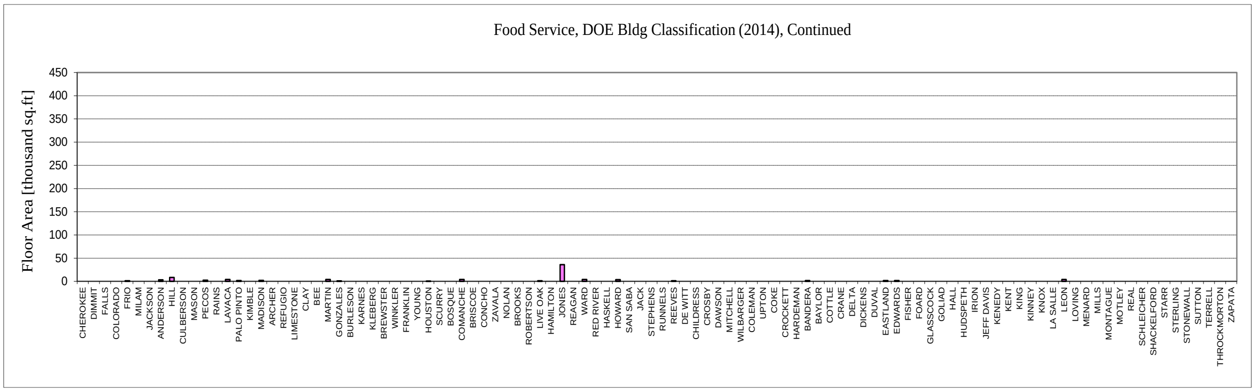


Figure 14: 2014 New Commercial Building Construction by Type (Dodge 2015) (Continued)

Table 20: 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	6915015	6766076	7333	6534	11116352	10837074	20983	20367	292673	289666	945	887
Chambers	0	0	0	0	0	0	0	0	0	0	0	0
Collin	29111643	28484623	30870	27508	13683495	13339722	25829	25070	0	0	0	0
Dallas	88920809	87005592	94291	84021	25683325	25038079	48480	47055	2358496	2334265	7613	7152
Denton	15742613	15403541	16693	14875	6484787	6321868	12241	11881	4708435	4660061	15199	14278
El Paso	5815852	5690587	6167	5495	4762451	4642803	8990	8725	1050883	1040086	3392	3187
Ellis	0	0	0	0	193354	188496	365	354	321769	318463	1039	976
Fort Bend	4182346	4092265	4435	3952	6919089	6745260	13060	12677	1528402	1512699	4934	4635
Galveston	5078631	4969245	5385	4799	5199728	5069094	9815	9527	0	0	0	0
Harris	132524457	129670084	140527	125222	31207292	30423267	58907	57176	49032080	48528325	158280	148683
Johnson	1457297	1425909	1545	1377	0	0	0	0	0	0	0	0
Kaufman	0	0	0	0	0	0	0	0	0	0	0	0
Liberty	113345	110904	120	107	0	0	0	0	0	0	0	0
Montgomery	1192507	1166822	1265	1127	37183410	36249245	70188	68125	8987275	8894940	29012	27253
Parker	0	0	0	0	151708	147897	286	278	0	0	0	0
Rockwall	0	0	0	0	3200748	3120335	6042	5864	0	0	0	0
Tarrant	26379926	25811743	27973	24926	28101734	27395730	53045	51486	4821397	4771862	15564	14620
Waller	0	0	0	0	0	0	0	0	0	0	0	0
Wise	0	0	0	0	407530	397292	769	747	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	0	0	0	0	0	0	0	0
Bexar	66396528	64966449	70406	62738	30889002	30112973	58306	56593	6284760	6220190	20288	19058
Caldwell	0	0	0	0	0	0	0	0	0	0	0	0
Comal	5039579	4931034	5344	4762	1308856	1275973	2471	2398	1198075	1185766	3868	3633
Gregg	0	0	0	0	1844297	1797963	3481	3379	1153575	1141723	3724	3498
Guadalupe	0	0	0	0	0	0	0	0	0	0	0	0
Harrison	0	0	0	0	0	0	0	0	0	0	0	0
Hays	8914274	8722274	9453	8423	1154173	1125177	2179	2115	5240723	5186880	16918	15892
Nueces	2607894	2551724	2765	2464	279619	272594	528	512	0	0	0	0
Rusk	0	0	0	0	0	0	0	0	0	0	0	0
San Patricio	0	0	0	0	89240	86998	168	164	703441	696214	2271	2133
Smith	1035347	1013048	1098	978	0	0	0	0	1026922	1016371	3315	3114
Travis	93122205	91116496	98746	87991	27450280	26760643	51815	50293	12518173	12389562	40410	37960
Upshur	0	0	0	0	0	0	0	0	0	0	0	0
Victoria	3570853	3493942	3786	3374	1142274	1113577	2156	2093	0	0	0	0
Williamson	19852571	19424977	21051	18759	8430223	8218429	15913	15445	2608381	2581582	8420	7910
Wilson	0	0	0	0	0	0	0	0	0	0	0	0

Table 20: 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	0	0	0	0	0	0	0	0
ANGELINA	0	0	0	0	113038	110198	213	207	0	0	0	0
ARANSAS	0	0	0	0	0	0	0	0	0	0	0	0
ARCHER	0	0	0	0	0	0	0	0	0	0	0	0
ATASCOSA	0	0	0	0	0	0	0	0	0	0	0	0
AUSTIN	0	0	0	0	0	0	0	0	0	0	0	0
BANDERA	0	0	0	0	0	0	0	0	0	0	0	0
BAYLOR	0	0	0	0	0	0	0	0	0	0	0	0
BEE	0	0	0	0	0	0	0	0	0	0	0	0
BELL	380993	372787	404	360	1249363	1217975	2358	2289	0	0	0	0
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	4611915	4512582	4890	4358	1100629	1072978	2078	2017	2935284	2905127	9475	8901
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	0	0	0	0	0	0	0	0
CALHOUN	0	0	0	0	380758	371192	719	698	0	0	0	0
CALLAHAN	0	0	0	0	0	0	0	0	0	0	0	0
CAMERON	1204889	1178938	1278	1139	297467	289994	562	545	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	0	0	0	0	0	0	0	0
COTTLE	0	0	0	0	0	0	0	0	0	0	0	0
CRANE	0	0	0	0	0	0	0	0	0	0	0	0
CROCKETT	0	0	0	0	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	457191	447344	485	432	0	0	0	0	0	0	0	0
DELTA	0	0	0	0	0	0	0	0	0	0	0	0
DICKENS	0	0	0	0	0	0	0	0	0	0	0	0
DIMMIT	0	0	0	0	0	0	0	0	0	0	0	0
DUVAL	0	0	0	0	0	0	0	0	0	0	0	0
EASTLAND	0	0	0	0	0	0	0	0	0	0	0	0
ECTOR	0	0	0	0	0	0	0	0	3421360	3386209	11044	10375
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	0	0	0	0	0	0	0	0
FRIO	0	0	0	0	0	0	0	0	0	0	0	0
GILLESPIE	0	0	0	0	0	0	0	0	0	0	0	0
GLASSCOCK	0	0	0	0	0	0	0	0	0	0	0	0
GOLIAD	0	0	0	0	0	0	0	0	0	0	0	0
GONZALES	409567	400746	434	387	0	0	0	0	0	0	0	0
GRAYSON	1111546	1087605	1179	1050	1784804	1739964	3369	3270	0	0	0	0
GRIMES	0	0	0	0	0	0	0	0	0	0	0	0
HALL	0	0	0	0	0	0	0	0	0	0	0	0
HAMILTON	0	0	0	0	0	0	0	0	0	0	0	0
HARDEMAN	0	0	0	0	0	0	0	0	0	0	0	0
HASKELL	0	0	0	0	0	0	0	0	0	0	0	0
HENDERSON	0	0	0	0	0	0	0	0	0	0	0	0
HIDALGO	5160544	5049394	5472	4876	978667	954080	1847	1793	3486399	3450579	11254	10572
HILL	0	0	0	0	0	0	0	0	0	0	0	0
HOOD	0	0	0	0	0	0	0	0	0	0	0	0
HOPKINS	0	0	0	0	0	0	0	0	0	0	0	0
HOUSTON	0	0	0	0	0	0	0	0	0	0	0	0
HOWARD	0	0	0	0	0	0	0	0	0	0	0	0
HUDSPETH	0	0	0	0	0	0	0	0	0	0	0	0
HUNT	0	0	0	0	1029237	1003379	1943	1886	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 20: 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	619113	605778	657	585	237974	231995	449	436	0	0	0	0
KENDALL	0	0	0	0	1487336	1449970	2808	2725	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	1714467	1677540	1818	1620	0	0	0	0	0	0	0	0
KNOX	0	0	0	0	0	0	0	0	0	0	0	0
LA SALLE	0	0	0	0	0	0	0	0	0	0	0	0
LAMAR	0	0	0	0	217151	211696	410	398	0	0	0	0
LAMPASAS	0	0	0	0	0	0	0	0	0	0	0	0
LAVACA	0	0	0	0	0	0	0	0	0	0	0	0
LEE	0	0	0	0	0	0	0	0	0	0	0	0
LEON	0	0	0	0	0	0	0	0	0	0	0	0
LIMESTONE	0	0	0	0	0	0	0	0	0	0	0	0
LIVE OAK	0	0	0	0	0	0	0	0	0	0	0	0
LLANO	0	0	0	0	0	0	0	0	0	0	0	0
LOVING	0	0	0	0	0	0	0	0	0	0	0	0
MADISON	0	0	0	0	0	0	0	0	0	0	0	0
MARTIN	0	0	0	0	0	0	0	0	0	0	0	0
MASON	0	0	0	0	0	0	0	0	0	0	0	0
MATAGORDA	0	0	0	0	0	0	0	0	754787	747033	2437	2289
MAVERICK	0	0	0	0	0	0	0	0	0	0	0	0
MCCULLOCH	0	0	0	0	0	0	0	0	0	0	0	0
MCLENNAN	7517936	7356011	7972	7104	4179415	4074415	7889	7657	0	0	0	0
MCMULLEN	57149	55918	61	54	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	5475816	5357875	5806	5174	0	0	0	0	599038	592883	1934	1817
MILAM	0	0	0	0	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	0	0	0	0	0	0	0	0
NOLAN	0	0	0	0	220126	214596	416	403	513461	508185	1658	1557
PALO PINTO	0	0	0	0	0	0	0	0	0	0	0	0
PECOS	0	0	0	0	0	0	0	0	975575	965552	3149	2958
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	1079161	1055918	1144	1020	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0
SHACKELFORD	0	0	0	0	0	0	0	0	0	0	0	0
SOMERVELL	0	0	0	0	0	0	0	0	0	0	0	0
STARR	476241	465983	505	450	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	257170	251631	273	243	1130376	1101977	2134	2071	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	2014498	1971109	2136	1904	113038	110198	213	207	884864	875773	2856	2683
UPTON	0	0	0	0	3361380	3276932	6345	6159	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	0	0	0	0	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	2286908	2237651	2425	2161	0	0	0	0	855768	846976	2763	2595
WHARTON	0	0	0	0	0	0	0	0	0	0	0	0
WICHITA	466716	456664	495	441	226075	220395	427	414	0	0	0	0
WILBARGER	0	0	0	0	0	0	0	0	0	0	0	0
WILLACY	0	0	0	0	0	0	0	0	1026922	1016371	3315	3114
WINKLER	0	0	0	0	0	0	0	0	0	0	0	0
YOUNG	0	0	0	0	0	0	0	0	0	0	0	0
ZAPATA	0	0	0	0	0	0	0	0	0	0	0	0
ZAVALA	0	0	0	0	0	0	0	0	0	0	0	0
Total	553275510	541358807	586687	522790	264989801	258332422	500195	485497	120059107	118825623	387562	364063

Table 21: 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	3827407	3748879	1573	1421	4367734	4253296	14903	5939
Chambers	0	0	0	0	0	0	0	0
Collin	17390338	17033533	7146	6458	17853482	17385705	60919	24274
Dallas	29149623	28551548	11978	10825	18895081	18400013	64473	25691
Denton	1503585	1472736	618	558	9599887	9348362	32756	13052
El Paso	1224332	1199212	503	455	4914036	4785284	16767	6681
Ellis	27378	26816	11	10	4006664	3901686	13671	5448
Fort Bend	282538	276741	116	105	10862960	10578341	37066	14770
Galveston	416142	407603	171	155	408049	397358	1392	555
Harris	114167348	111824931	46913	42396	61599278	59985323	210185	83753
Johnson	128128	125499	53	48	2416079	2352776	8244	3285
Kaufman	0	0	0	0	0	0	0	0
Liberty	0	0	0	0	0	0	0	0
Montgomery	5207245	5100406	2140	1934	7803935	7599465	26628	10611
Parker	0	0	0	0	0	0	0	0
Rockwall	300060	293904	123	111	0	0	0	0
Tarrant	4991509	4889096	2051	1854	5961004	5804820	20340	8105
Waller	0	0	0	0	1208040	1176388	4122	1643
Wise	192739	188785	79	72	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	0	0	0	0	0	0	0	0
Bexar	24896218	24385412	10230	9245	34854625	33941403	118929	47390
Caldwell	0	0	0	0	0	0	0	0
Comal	88704	86884	36	33	0	0	0	0
Gregg	306631	300339	126	114	0	0	0	0
Guadalupe	234353	229545	96	87	3773110	3674251	12874	5130
Harrison	0	0	0	0	0	0	0	0
Hays	169742	166259	70	63	942271	917583	3215	1281
Nueces	1626237	1592871	668	604	2606681	2538384	8894	3544
Rusk	0	0	0	0	1342266	1307098	4580	1825
San Patricio	0	0	0	0	2610708	2542305	8908	3550
Smith	183978	180204	76	68	9468345	9220266	32307	12874
Travis	31653043	31003605	13007	11754	19880304	19359423	67834	27030
Upshur	0	0	0	0	0	0	0	0
Victoria	0	0	0	0	0	0	0	0
Williamson	1921917	1882484	790	714	9657605	9404567	32953	13131
Wilson	0	0	0	0	201340	196065	687	274

Table 21: 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	0	0	0	0
ANGELINA	0	0	0	0	0	0	0	0
ARANSAS	0	0	0	0	0	0	0	0
ARCHER	0	0	0	0	0	0	0	0
ATASCOSA	0	0	0	0	0	0	0	0
AUSTIN	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	459946	450509	189	171	853681	831314	2913	1161
BLANCO	0	0	0	0	0	0	0	0
BORDEN	0	0	0	0	0	0	0	0
BOSQUE	0	0	0	0	0	0	0	0
BRAZOS	526748	515940	216	196	7438839	7243935	25382	10114
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	3146272	3063837	10736	4278
CHEROKEE	0	0	0	0	0	0	0	0
CHILDRESS	0	0	0	0	0	0	0	0
CLAY	0	0	0	0	0	0	0	0
COKE	0	0	0	0	0	0	0	0
COLEMAN	0	0	0	0	0	0	0	0
COLORADO	0	0	0	0	0	0	0	0
COMANCHE	0	0	0	0	131542	128096	449	179
CONCHO	0	0	0	0	0	0	0	0
COOKE	0	0	0	0	134227	130710	458	183
CORYELL	54755	53632	23	20	1220120	1188152	4163	1659
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	0	0	0	0	2389234	2326634	8152	3249
DELTA	0	0	0	0	0	0	0	0
DICKENS	0	0	0	0	0	0	0	0
DIMMIT	0	0	0	0	536906	522839	1832	730
DUVAL	0	0	0	0	859050	836542	2931	1168
EASTLAND	0	0	0	0	0	0	0	0
ECTOR	237639	232763	98	88	5958319	5802206	20331	8101
EDWARDS	0	0	0	0	0	0	0	0
ERATH	0	0	0	0	0	0	0	0
FALLS	0	0	0	0	0	0	0	0
FANNIN	0	0	0	0	0	0	0	0
FAYETTE	0	0	0	0	0	0	0	0
FISHER	0	0	0	0	0	0	0	0
FOARD	0	0	0	0	0	0	0	0
FRANKLIN	0	0	0	0	0	0	0	0
FREESTONE	0	0	0	0	0	0	0	0
FRIO	0	0	0	0	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	0	0	0	0	0	0	0	0
GRAYSON	0	0	0	0	0	0	0	0
GRIMES	438044	429056	180	163	0	0	0	0
HALL	0	0	0	0	0	0	0	0
HAMILTON	0	0	0	0	0	0	0	0
HARDEMAN	0	0	0	0	0	0	0	0
HASKELL	0	0	0	0	0	0	0	0
HENDERSON	0	0	0	0	0	0	0	0
HIDALGO	756721	741195	311	281	4042906	3936978	13795	5497
HILL	0	0	0	0	0	0	0	0
HOOD	0	0	0	0	1677833	1633872	5725	2281
HOPKINS	0	0	0	0	0	0	0	0
HOUSTON	0	0	0	0	0	0	0	0
HOWARD	0	0	0	0	939586	914968	3206	1278
HUDSPETH	0	0	0	0	0	0	0	0
HUNT	0	0	0	0	0	0	0	0
IRION	0	0	0	0	110066	107182	376	150
JACK	0	0	0	0	0	0	0	0
JACKSON	0	0	0	0	0	0	0	0
JEFF DAVIS	0	0	0	0	0	0	0	0
JIM HOGG	0	0	0	0	0	0	0	0

Table 21: Energy Use of ASHRAE Standard 90.1-2004 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	0	0	0	0	0	0	0	0
JONES	0	0	0	0	0	0	0	0
KARNES	0	0	0	0	3339558	3252059	11395	4541
KENDALL	493894	483761	203	183	550329	535910	1878	748
KENEDY	0	0	0	0	0	0	0	0
KENT	0	0	0	0	0	0	0	0
KERR	0	0	0	0	671133	653549	2290	913
KIMBLE	0	0	0	0	0	0	0	0
KING	0	0	0	0	0	0	0	0
KINNEY	0	0	0	0	0	0	0	0
KLEBERG	0	0	0	0	0	0	0	0
KNOX	0	0	0	0	0	0	0	0
LA SALLE	0	0	0	0	0	0	0	0
LAMAR	0	0	0	0	0	0	0	0
LAMPASAS	0	0	0	0	0	0	0	0
LAVACA	0	0	0	0	0	0	0	0
LEE	0	0	0	0	0	0	0	0
LEON	0	0	0	0	124831	121560	426	170
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	190602	185608	650	259
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	0	0	0	0	0	0	0	0
MCCULLOCH	0	0	0	0	0	0	0	0
MCLENNAN	394239	386151	162	146	8799897	8569332	30026	11965
MCMULLEN	0	0	0	0	0	0	0	0
MEDINA	5476	5363	2	2	0	0	0	0
MENARD	0	0	0	0	0	0	0	0
MIDLAND	294584	288540	121	109	7284478	7093619	24856	9904
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	38329	37542	16	14	0	0	0	0
MOTLEY	0	0	0	0	0	0	0	0
NACOGDOCHES	0	0	0	0	29530	28756	101	40
NAVARRO	0	0	0	0	0	0	0	0
NOLAN	0	0	0	0	134227	130710	458	183
PALO PINTO	0	0	0	0	1324817	1290105	4520	1801
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	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	0	0	0	0	1020122	993394	3481	1387
SHACKELFORD	0	0	0	0	0	0	0	0
SOMERVELL	0	0	0	0	0	0	0	0
STARR	0	0	0	0	0	0	0	0
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	0	0	0	0	1959709	1908362	6687	2665
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	248590	243489	102	92	21476	20914	73	29
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	0	0	0	0	193286	188222	660	263
WARD	0	0	0	0	0	0	0	0
WASHINGTON	328533	321792	135	122	0	0	0	0
WEBB	117177	114773	48	44	2606681	2538384	8894	3544
WHARTON	0	0	0	0	107381	104568	366	146
WICHITA	0	0	0	0	0	0	0	0
WILBARGER	0	0	0	0	0	0	0	0
WILLACY	0	0	0	0	10738	10457	37	15
WINKLER	0	0	0	0	0	0	0	0
YOUNG	0	0	0	0	185233	180379	632	252
ZAPATA	0	0	0	0	0	0	0	0
ZAVALA	0	0	0	0	0	0	0	0
Total	244283869	239271800	100381	90714	293226093	285543313	1000528	398682

Table 22: 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	2356061	2195180	2535	2181	2291736	2256722	10178	10011
Chambers	64373	59978	69	60	62616	61659	278	274
Collin	5354567	4988936	5762	4958	5208378	5128802	23132	22751
Dallas	12733029	11863568	13702	11789	12385395	12196165	55008	54102
Denton	10825006	10085832	11648	10022	10529464	10368590	46765	45995
El Paso	6505561	6061336	7000	6023	6327948	6231266	28105	27642
Ellis	966886	900863	1040	895	940489	926119	4177	4108
Fort Bend	3937068	3668230	4237	3645	3829579	3771069	17008	16728
Galveston	10759345	10024655	11578	9961	10465596	10305698	46481	45716
Harris	24271291	22613952	26118	22471	23608642	23247938	104854	103127
Johnson	2424297	2258756	2609	2245	2358109	2322081	10473	10301
Kaufman	1169018	1089193	1258	1082	1137102	1119729	5050	4967
Liberty	319291	297489	344	296	310574	305829	1379	1357
Montgomery	3270161	3046862	3519	3028	3180880	3132281	14127	13895
Parker	307704	286693	331	285	299303	294730	1329	1307
Rockwall	2229889	2077624	2400	2065	2169010	2135870	9633	9475
Tarrant	13450147	12531719	14473	12453	13082934	12883047	58106	57149
Waller	108147	100762	116	100	105194	103587	467	460
Wise	0	0	0	0	0	0	0	0
Affected Counties	**Retail**				**Food Service**			
	Electricity (kWh/yr), DOE		**Gas (mBtu/yr), DOE**		**Electricity (kWh/yr), DOE**		**Gas (mBtu/yr), DOE**	
	2004 (Annual)	**2007 (Annual)**	**2004 (Annual)**	**2007 (Annual)**	**2004 (Annual)**	**2007 (Annual)**	**2004 (Annual)**	**2007 (Annual)**
Bastrop	948862	884070	1021	878	922956	908855	4099	4032
Bexar	11403078	10624431	12270	10557	11091754	10922289	49262	48451
Caldwell	15450	14395	17	14	15028	14798	67	66
Comal	2667628	2485472	2871	2470	2594797	2555152	11524	11335
Gregg	948862	884070	1021	878	922956	908855	4099	4032
Guadalupe	2399835	2235965	2582	2222	2334315	2298650	10367	10197
Harrison	154496	143946	166	143	150278	147982	667	656
Hays	3756823	3500292	4043	3478	3654255	3598424	16230	15962
Nueces	5380316	5012927	5790	4981	5233424	5153466	23243	22861
Rusk	0	0	0	0	0	0	0	0
San Patricio	254918	237511	274	236	247958	244170	1101	1083
Smith	10633174	9907099	11442	9845	10342869	10184846	45936	45179
Travis	8448346	7871460	9091	7822	8217691	8092137	36497	35896
Upshur	149346	139148	161	138	145269	143049	645	635
Victoria	311567	290292	335	288	303060	298430	1346	1324
Williamson	3253424	3031268	3501	3012	3164600	3116250	14055	13824
Wilson	0	0	0	0	0	0	0	0

Table 22: 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	193120	179933	208	179	187847	184977	834	821
ANDREWS	245906	229114	265	228	239192	235538	1062	1045
ANGELINA	355340	331076	382	329	345639	340358	1535	1510
ARANSAS	117159	109159	126	108	113961	112220	506	498
ARCHER	0	0	0	0	0	0	0	0
ATASCOSA	798228	743722	859	739	776435	764573	3448	3392
AUSTIN	0	0	0	0	0	0	0	0
BANDERA	117159	109159	126	108	113961	112220	506	498
BAYLOR	0	0	0	0	0	0	0	0
BEE	0	0	0	0	0	0	0	0
BELL	7338551	6837446	7897	6794	7138195	7029135	31703	31181
BLANCO	0	0	0	0	0	0	0	0
BORDEN	0	0	0	0	0	0	0	0
BOSQUE	0	0	0	0	0	0	0	0
BRAZOS	540735	503812	582	501	525972	517936	2336	2298
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	872901	813296	939	808	849070	836097	3771	3709
BURLESON	0	0	0	0	0	0	0	0
BURNET	272943	254305	294	253	265491	261434	1179	1160
CALHOUN	0	0	0	0	0	0	0	0
CALLAHAN	0	0	0	0	0	0	0	0
CAMERON	4575651	4263207	4924	4236	4450727	4382727	19767	19442
CHEROKEE	0	0	0	0	0	0	0	0
CHILDRESS	0	0	0	0	0	0	0	0
CLAY	0	0	0	0	0	0	0	0
COKE	0	0	0	0	0	0	0	0
COLEMAN	0	0	0	0	0	0	0	0
COLORADO	0	0	0	0	0	0	0	0
COMANCHE	245906	229114	265	228	239192	235538	1062	1045
CONCHO	0	0	0	0	0	0	0	0
COOKE	0	0	0	0	0	0	0	0
CORYELL	457050	425841	492	423	444572	437779	1974	1942
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	0	0	0	0	0	0	0	0
DELTA	0	0	0	0	0	0	0	0
DICKENS	0	0	0	0	0	0	0	0
DIMMIT	0	0	0	0	0	0	0	0
DUVAL	0	0	0	0	0	0	0	0
EASTLAND	96560	89966	104	89	93924	92489	417	410
ECTOR	526573	490617	567	488	512197	504371	2275	2237
EDWARDS	106860	99563	115	99	103942	102354	462	454
ERATH	0	0	0	0	0	0	0	0
FALLS	0	0	0	0	0	0	0	0
FANNIN	193120	179933	208	179	187847	184977	834	821
FAYETTE	0	0	0	0	0	0	0	0
FISHER	0	0	0	0	0	0	0	0
FOARD	0	0	0	0	0	0	0	0
FRANKLIN	0	0	0	0	0	0	0	0
FREESTONE	0	0	0	0	0	0	0	0
FRIO	83685	77971	90	77	81400	80157	362	356
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	64373	59978	69	60	62616	61659	278	274
GRAYSON	266505	248307	287	247	259229	255269	1151	1132
GRIMES	115872	107960	125	107	112708	110986	501	492
HALL	0	0	0	0	0	0	0	0
HAMILTON	0	0	0	0	0	0	0	0
HARDEMAN	0	0	0	0	0	0	0	0
HASKELL	0	0	0	0	0	0	0	0
HENDERSON	293542	273498	316	272	285528	281165	1268	1247
HIDALGO	10057677	9370899	10823	9312	9783085	9633614	43450	42734
HILL	514986	479821	554	477	500926	493273	2225	2188
HOOD	1931198	1799328	2078	1788	1878472	1849772	8343	8206
HOPKINS	0	0	0	0	0	0	0	0
HOUSTON	19312	17993	21	18	18785	18498	83	82
HOWARD	234319	218318	252	217	227921	224439	1012	996
HUDSPETH	0	0	0	0	0	0	0	0
HUNT	272943	254305	294	253	265491	261434	1179	1160
IRION	0	0	0	0	0	0	0	0
JACK	0	0	0	0	0	0	0	0
JACKSON	0	0	0	0	0	0	0	0
JEFF DAVIS	0	0	0	0	0	0	0	0
JIM HOGG	0	0	0	0	0	0	0	0

Table 22: 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	29612	27590	32	27	28803	28363	128	126
JONES	2214440	2063229	2383	2050	2153982	2121072	9567	9409
KARNES	0	0	0	0	0	0	0	0
KENDALL	90123	83969	97	83	87662	86323	389	383
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	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	244618	227915	263	226	237940	234304	1057	1039
LEE	0	0	0	0	0	0	0	0
LEON	245906	229114	265	228	239192	235538	1062	1045
LIMESTONE	0	0	0	0	0	0	0	0
LIVE OAK	77248	71973	83	72	75139	73991	334	328
LLANO	0	0	0	0	0	0	0	0
LOVING	0	0	0	0	0	0	0	0
MADISON	132609	123554	143	123	128988	127018	573	563
MARTIN	245906	229114	265	228	239192	235538	1062	1045
MASON	0	0	0	0	0	0	0	0
MATAGORDA	0	0	0	0	0	0	0	0
MAVERICK	302554	281895	326	280	294294	289798	1307	1286
MCCULLOCH	0	0	0	0	0	0	0	0
MCLENNAN	1417499	1320707	1525	1312	1378799	1357733	6124	6023
MCMULLEN	0	0	0	0	0	0	0	0
MEDINA	2059944	1919283	2217	1907	2003704	1973090	8899	8753
MENARD	0	0	0	0	0	0	0	0
MIDLAND	500824	466626	539	464	487151	479708	2164	2128
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	93985	87567	101	87	91419	90022	406	399
NOLAN	0	0	0	0	0	0	0	0
PALO PINTO	117159	109159	126	108	113961	112220	506	498
PECOS	150633	140348	162	139	146521	144282	651	640
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	86260	80370	93	80	83905	82623	373	367
REFUGIO	0	0	0	0	0	0	0	0
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	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	0	0	0	0
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	387527	361065	417	359	376947	371188	1674	1647
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	576784	537399	621	534	561037	552465	2492	2451
UPTON	0	0	0	0	0	0	0	0
UVALDE	0	0	0	0	0	0	0	0
VAL VERDE	279380	260303	301	259	271752	267600	1207	1187
VAN ZANDT	136471	127153	147	126	132745	130717	590	580
WARD	245906	229114	265	228	239192	235538	1062	1045
WASHINGTON	64373	59978	69	60	62616	61659	278	274
WEBB	583222	543397	628	540	567299	558631	2520	2478
WHARTON	213719	199126	230	198	207884	204708	923	908
WICHITA	0	0	0	0	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	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	193182843	179991562	207877	178858	187908609	185037654	834564	820818

Table 23: Annual Electricity and Natural Gas Savings from New Commercial Construction

Counties	Apartments		Healthcare		Lodging		Office		Education		Retail		Food Service		Total		Total*1.07 (T&D loss) for eGrid	
	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	MWh/yr	Therm/yr
Non-attainment Counties																		
(square feet in thousands)																		
Brazoria	-148939	-799	-279278	-617	-3007	-57	-78528	-151	-114438	-8965	-160881	-354	-35014	-168	-820086	-11110	877	118880
Chambers	0	0	0	0	0	0	0	0	0	0	-4396	-10	-957	-5	-5352	-14	6	152
Collin	-627020	-3362	-343773	-759	0	0	-356804	-688	-467777	-36644	-365631	-804	-79576	-381	-2240581	-42639	2397	456235
Dallas	-1915217	-10269	-645246	-1425	-24231	-462	-598074	-1153	-495068	-38782	-869461	-1913	-189230	-906	-4736528	-54910	5068	587536
Denton	-339072	-1818	-162918	-360	-48374	-922	-30850	-59	-251525	-19704	-739174	-1626	-160874	-770	-1732787	-25259	1854	270272
El Paso	-125264	-672	-119648	-264	-10797	-206	-25120	-48	-128752	-10086	-444225	-977	-96681	-463	-950488	-12716	1017	136063
Ellis	0	0	-4858	-11	-3306	-63	-562	-1	-104978	-8224	-66023	-145	-14369	-69	-194095	-8513	208	91084
Fort Bend	-90081	-483	-173829	-384	-15703	-299	-5797	-11	-284619	-22296	-268838	-591	-58510	-280	-897378	-24345	960	260491
Galveston	-109386	-587	-130634	-288	0	0	-8538	-16	-10691	-838	-734690	-1616	-159898	-766	-1153837	-4111	1235	43985
Harris	-2854373	-15305	-784026	-1731	-503754	-9597	-2342417	-4518	-1613955	-126432	-1657339	-3646	-360704	-1727	-10116567	-162956	10825	1743631
Johnson	-31388	-168	0	0	0	0	-2629	-5	-63303	-4959	-165540	-364	-36028	-173	-298889	-5669	320	60659
Kaufman	0	0	0	0	0	0	0	0	0	0	-79825	-176	-17373	-83	-97198	-259	104	2769
Liberty	-2441	-13	0	0	0	0	0	0	0	0	-21802	-48	-4745	-23	-28989	-84	31	896
Montgomery	-25685	-138	-934164	-2063	-92335	-1759	-106839	-206	-204470	-16018	-223299	-491	-48599	-233	-1635392	-20907	1750	223703
Parker	0	0	-3811	-8	0	0	0	0	0	0	-21011	-46	-4573	-22	-29396	-77	31	819
Rockwall	0	0	-80413	-178	0	0	-6156	-12	0	0	-152266	-335	-33139	-159	-271974	-683	291	7309
Tarrant	-568183	-3047	-706004	-1559	-49535	-944	-102413	-198	-156184	-12235	-918429	-2020	-199887	-957	-2700634	-20959	2890	224262
Waller	0	0	0	0	0	0	0	0	-31652	-2480	-7385	-16	-1607	-8	-40644	-2503	43	26787
Wise	0	0	-10238	-23	0	0	-3955	-8	0	0	0	0	0	0	-14193	-30	15	323
Affected Counties																		
(square feet in thousands)																		
Bastrop	0	0	0	0	0	0	0	0	0	0	-64792	-143	-14101	-68	-78893	-210	84	2248
Bexar	-1430079	-7668	-776029	-1713	-64569	-1230	-510806	-985	-913222	-71539	-778647	-1713	-169465	-811	-4642817	-85660	4968	916563
Caldwell	0	0	0	0	0	0	0	0	0	0	-1055	-2	-230	-1	-1285	-3	1	37
Comal	-108545	-582	-32883	-73	-12309	-235	-1820	-4	0	0	-182156	-401	-39645	-190	-377357	-1483	404	15870
Gregg	0	0	-46335	-102	-11852	-226	-6291	-12	0	0	-64792	-143	-14101	-68	-143371	-550	153	5888
Guadalupe	0	0	0	0	0	0	-4808	-9	-98859	-7744	-163870	-361	-35665	-171	-303202	-8285	324	88648
Harrison	0	0	0	0	0	0	0	0	0	0	-10550	-23	-2296	-11	-12846	-34	14	366
Hays	-192000	-1029	-28996	-64	-53843	-1026	-3483	-7	-24688	-1934	-256531	-564	-55831	-267	-615372	-4892	658	52341
Nueces	-56170	-301	-7025	-16	0	0	-33366	-64	-68297	-5350	-367389	-808	-79959	-383	-612206	-6922	655	74069
Rusk	0	0	0	0	0	0	0	0	-35169	-2755	0	0	0	0	-35169	-2755	38	29479
San Patricio	0	0	-2242	-5	-7227	-138	0	0	-68403	-5358	-17407	-38	-3788	-18	-99067	-5558	106	59466
Smith	-22300	-120	0	0	-10551	-201	-3775	-7	-248079	-19434	-726075	-1597	-158023	-757	-1168802	-22116	1251	236636
Travis	-2005709	-10754	-689638	-1523	-128611	-2450	-649438	-1253	-520881	-40804	-576886	-1269	-125554	-601	-4696717	-58654	5025	627602
Upshur	0	0	0	0	0	0	0	0	0	0	-10198	-22	-2219	-11	-12417	-33	13	354
Victoria	-76911	-412	-28698	-63	0	0	0	0	0	0	-21275	-47	-4630	-22	-131513	-545	141	5829
Williamson	-427594	-2293	-211794	-468	-26798	-511	-39433	-76	-253038	-19822	-222157	-489	-48350	-232	-1229163	-23889	1315	255616
Wilson	0	0	0	0	0	0	0	0	-5275	-413	0	0	0	0	-5275	-413	6	4422

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

Table 23: Annual Electricity and Natural Gas Savings from New Commercial Construction (Continued)

Counties	Apartments		Healthcare		Lodging		Office		Education		Retail		Food Service		Total		Total*1.07 (T&D loss) for eGrid	
	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	MWh/yr	Therm/yr
Other ERCOT Counties																		
(square feet in thousands)																		
ANDERSON	0	0	0	0	0	0	0	0	0	0	-13187	-29	-2870	-14	-16057	-43	17	457
ANDREWS	0	0	0	0	0	0	0	0	0	0	-16791	-37	-3654	-17	-20446	-54	22	582
ANGELINA	0	0	-2840	-6	0	0	0	0	0	0	-24264	-53	-5281	-25	-32385	-85	35	909
ARANSAS	0	0	0	0	0	0	0	0	0	0	-8000	-18	-1741	-8	-9741	-26	10	278
ARCHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ATASCOSA	0	0	0	0	0	0	0	0	0	0	-54506	-120	-11863	-57	-66369	-177	71	1891
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	-8000	-18	-1741	-8	-9741	-26	10	278
BAYLOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BELL	-8206	-44	-31388	-69	0	0	-9437	-18	-22367	-1752	-501105	-1102	-109061	-522	-681564	-3508	729	37538
BLANCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BORDEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BOSQUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BRAZOS	-99334	-533	-27651	-61	-30157	-575	-10807	-21	-194904	-15268	-36924	-81	-8036	-38	-407813	-16577	436	177373
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	-59605	-131	-12972	-62	-72578	-193	78	2068
BURLESON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BURNET	0	0	0	0	0	0	0	0	0	0	-18638	-41	-4056	-19	-22694	-60	24	647
CALHOUN	0	0	-9566	-21	0	0	0	0	0	0	0	0	0	0	-9566	-21	10	226
CALLAHAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMERON	-25951	-139	-7473	-17	0	0	0	0	-82435	-6458	-312443	-687	-68000	-326	-496303	-7626	531	81602
CHEROKEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHILDRESS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLAY	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	0	0	0	0	0	0	0	0
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	-3447	-270	-16791	-37	-3654	-17	-23892	-324	26	3471
CONCHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COOKE	0	0	0	0	0	0	0	0	-3517	-276	0	0	0	0	-3517	-276	4	2948
CORYELL	0	0	0	0	0	0	-1123	-2	-31968	-2504	-31209	-69	-6792	-33	-71093	-2608	76	27902
COTTLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CRANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CROCKETT	0	0	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	-9847	-53	0	0	0	0	0	0	-62600	-4904	0	0	0	0	-72447	-4957	78	53037
DELTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DICKENS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIMMIT	0	0	0	0	0	0	0	0	-14067	-1102	0	0	0	0	-14067	-1102	15	11791
DUVAL	0	0	0	0	0	0	0	0	-22508	-1763	0	0	0	0	-22508	-1763	24	18866
EASTLAND	0	0	0	0	0	0	0	0	0	0	-6593	-15	-1435	-7	-8028	-21	9	229
ECTOR	0	0	0	0	-35151	-670	-4876	-9	-156113	-12229	-35956	-79	-7826	-37	-239922	-13025	257	139368
EDWARDS	0	0	0	0	0	0	0	0	0	0	-7297	-16	-1588	-8	-8885	-24	10	253
ERATH	0	0	0	0	0	0	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	0	0	0	0	0	0
FANNIN	0	0	0	0	-7913	-151	0	0	0	0	-13187	-29	-2870	-14	-23970	-194	26	2070
FAYETTE	0	0	0	0	0	0	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	0	0	0	0	0	0
FOARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRANKLIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FREESTONE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRIO	0	0	0	0	0	0	0	0	0	0	-5714	-13	-1244	-6	-6958	-19	7	198
GILLESPIE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	-8821	-47	0	0	0	0	0	0	0	0	-4396	-10	-957	-5	-14174	-62	15	659
GRAYSON	-23941	-128	-44840	-99	0	0	0	0	0	0	-18198	-40	-3961	-19	-90940	-286	97	3064
GRIMES	0	0	0	0	0	0	-8988	-17	0	0	-7912	-17	-1722	-8	-18622	-43	20	460
HALL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAMILTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HARDEMAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HASKELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HENDERSON	0	0	0	0	0	0	0	0	0	0	-20044	-44	-4362	-21	-24407	-65	26	695
HIDALGO	-111150	-596	-24587	-54	-35819	-682	-15526	-30	-105928	-8298	-686778	-1511	-149470	-716	-1129258	-11887	1208	127193
HILL	0	0	0	0	0	0	0	0	0	0	-35165	-77	-7653	-37	-42819	-114	46	1220
HOOD	0	0	0	0	0	0	0	0	-43961	-3444	-131870	-290	-28700	-137	-204531	-3871	219	41423
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	-1319	-3	-287	-1	-1606	-4	2	46
HOWARD	0	0	0	0	0	0	0	0	-24618	-1929	-16000	-35	-3482	-17	-44100	-1980	47	21190
HUDSPETH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HUNT	0	0	-25858	-57	0	0	0	0	0	0	-18638	-41	-4056	-19	-48552	-118	52	1257
IRION	0	0	0	0	0	0	0	0	-2884	-226	0	0	0	0	-2884	-226	3	2417
JACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JACKSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JEFF DAVIS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JIM HOGG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JIM WELLS	0	0	0	0	0	0	0	0	0	0	-2022	-4	-440	-2	-2462	-7	3	70
JONES	0	0	0	0	0	0	0	0	0	0	-151211	-333	-32910	-158	-184120	-490	197	5245
KARNES	-13335	-72	-5979	-13	0	0	0	0	-87499	-6854	0	0	0	0	-106813	-6939	114	74249

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

Table 23: Annual Electricity and Natural Gas Savings from New Commercial Construction (Continued)

Counties	Apartments		Healthcare		Lodging		Office		Education		Retail		Food Service		Total		Total*1.07 (T&D loss) for eGrid	
	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	kWh/yr	MBtu/yr	MWh/yr	Therm/yr
Other ERCOT Counties																		
(square feet in thousands)																		
KENDALL	0	0	-37367	-83	0	0	-10133	-20	-14419	-1130	-6154	-14	-1339	-6	-69412	-1252	74	13392
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	-17584	-1378	0	0	0	0	-17584	-1378	19	14739
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	-36927	-198	0	0	0	0	0	0	0	0	0	0	0	0	-36927	-198	40	2119
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	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAMAR	0	0	-5456	-12	0	0	0	0	0	0	0	0	0	0	-5456	-12	6	129
LAMPASAS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAVACA	0	0	0	0	0	0	0	0	0	0	-16703	-37	-3635	-17	-20339	-54	22	579
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	-3271	-256	-16791	-37	-3654	-17	-23717	-311	25	3324
LIMESTONE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIVE OAK	0	0	0	0	0	0	0	0	0	0	-5275	-12	-1148	-5	-6423	-17	7	183
LLANO	0	0	0	0	0	0	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	0	0	0	0	0	0
MADISON	0	0	0	0	0	0	0	0	-4994	-391	-9055	-20	-1971	-9	-16020	-421	17	4500
MARTIN	0	0	0	0	0	0	0	0	0	0	-16791	-37	-3654	-17	-20446	-54	22	582
MASON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MATAGORDA	0	0	0	0	-7755	-148	0	0	0	0	0	0	0	0	-7755	-148	8	1581
MAVERICK	0	0	0	0	0	0	0	0	0	0	-20660	-45	-4496	-22	-25156	-67	27	717
MCCULLOCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MCLENNAN	-161925	-868	-105000	-232	0	0	-8089	-16	-230565	-18062	-96792	-213	-21066	-101	-623437	-19491	667	208556
MCMULLEN	-1231	-7	0	0	0	0	0	0	0	0	0	0	0	0	-1231	-7	1	71
MEDINA	0	0	0	0	0	0	-112	0	0	0	-140661	-309	-30614	-147	-171387	-456	183	4882
MENARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MIDLAND	-117941	-632	0	0	-6154	-117	-6044	-12	-190860	-14951	-34198	-75	-7443	-36	-362640	-15824	388	169312
MILAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MILLS	0	0	0	0	0	0	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	0	0	0	0	0	0
MONTAGUE	0	0	0	0	0	0	-786	-2	0	0	0	0	0	0	-786	-2	1	16
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	-774	-61	0	0	0	0	-774	-61	1	649
NAVARRO	0	0	0	0	0	0	0	0	0	0	-6418	-14	-1397	-7	-7814	-21	8	223
NOLAN	0	0	-5530	-12	-5275	-101	0	0	-3517	-276	0	0	0	0	-14322	-388	15	4154
PALO PINTO	0	0	0	0	0	0	0	0	-34711	-2719	-8000	-18	-1741	-8	-44453	-2745	48	29373
PECOS	0	0	0	0	-10023	-191	0	0	0	0	-10286	-23	-2239	-11	-22547	-224	24	2400
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	0	0	0	0	0	0	0	0
RED RIVER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REEVES	-23243	-125	0	0	0	0	0	0	0	0	-5890	-13	-1282	-6	-30416	-144	33	1538
REFUGIO	0	0	0	0	0	0	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	0	0	0	0	0	0
RUNNELS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAN SABA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCHLEICHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCURRY	0	0	0	0	0	0	0	0	-26728	-2094	0	0	0	0	-26728	-2094	29	22404
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	-10257	-55	0	0	0	0	0	0	0	0	0	0	0	0	-10257	-55	11	589
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	0	0	0	0	0	0	0	0
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	-5539	-30	-28399	-63	0	0	0	0	-51346	-4022	-26462	-58	-5759	-28	-117505	-4200	126	44945
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	-43389	-233	-2840	-6	-9091	-173	-5100	-10	-563	-44	-39385	-87	-8572	-41	-108940	-594	117	6353
UPTON	0	0	-84448	-186	0	0	0	0	0	0	0	0	0	0	-84448	-186	90	1995
UVALDE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VAL VERDE	0	0	0	0	0	0	0	0	0	0	-19077	-42	-4152	-20	-23229	-62	25	662
VAN ZANDT	0	0	0	0	0	0	0	0	-5064	-397	-9319	-21	-2028	-10	-16411	-427	18	4568
WARD	0	0	0	0	0	0	0	0	0	0	-16791	-37	-3654	-17	-20446	-54	22	582
WASHINGTON	0	0	0	0	0	0	-6741	-13	0	0	-4396	-10	-957	-5	-12093	-27	13	292
WEBB	-49256	-264	0	0	-8792	-168	-2404	-5	-68297	-5350	-39825	-88	-8667	-41	-177242	-5916	190	63297
WHARTON	0	0	0	0	0	0	0	0	-2813	-220	-14594	-32	-3176	-15	-20583	-268	22	2865
WICHITA	-10052	-54	-5680	-13	0	0	0	0	0	0	0	0	0	0	-15732	-66	17	711
WILBARGER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WILLACY	0	0	0	0	-10551	-201	0	0	-281	-22	0	0	0	0	-10832	-223	12	2387
WINKLER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
YOUNG	0	0	0	0	0	0	0	0	-4853	-380	0	0	0	0	-4853	-380	5	4068
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	0	0	0	0	0	0	0	0
Total	-11916703	-63897	-6657379	-14699	-1233484	-23499	-5012069	-9666	-7682780	-601846	-13191281	-29020	-2870955	-13746	-48564651	-756373	51964	8093191

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

Table 24: 2014 Totalized Annual Electricity Savings by CM Zone from New Commercial Construction

CM Zone	Total Electricity Savings by CM Zone (MWh) 2014-TRY 2008
Houston (H)	17,236
North (N)	11,794
West (W)	1,075
South (S)	12,694
Total	42,800

Table 25: 2014 Annual NOx Reductions from New Commercial Construction 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	968.69	0.0000071	0.08	0.0000003	0.00	0.0005265	6.68	975.46	0.49
	Chambers	0.0204500	352.47	0.0000026	0.03	0.0000001	0.00	0.0001916	2.43	354.93	0.18
	Fort Bend	0.0313463	540.27	0.0000040	0.05	0.0000002	0.00	0.0002937	3.73	544.05	0.27
	Galveston	0.0226620	390.59	0.0000029	0.03	0.0000001	0.00	0.0002123	2.70	393.32	0.20
	Harris	0.1486911	2562.77	0.0000189	0.22	0.0000009	0.00	0.0013930	17.68	2580.68	1.29
Dallas/ Fort Worth Area	Collin	0.0012932	22.29	0.0079329	93.56	0.0003832	0.41	0.0000809	1.03	117.29	0.06
	Dallas	0.0024826	42.79	0.0152295	179.62	0.0007356	0.79	0.0001554	1.97	225.18	0.11
	Denton	0.0001267	2.18	0.0007770	9.16	0.0000375	0.04	0.0000079	0.10	11.49	0.01
	Tarrant	0.0004742	8.17	0.0029089	34.31	0.0001405	0.15	0.0000297	0.38	43.01	0.02
	Ellis	0.0029920	51.57	0.0183544	216.48	0.0008865	0.95	0.0001873	2.38	271.38	0.14
	Johnson	0.0007256	12.51	0.0044512	52.50	0.0002150	0.23	0.0000454	0.58	65.81	0.03
	Kaufman	0.0059718	102.93	0.0366343	432.08	0.0017695	1.90	0.0003738	4.74	541.66	0.27
	Parker	0.0000012	0.02	0.0000075	0.09	0.0000004	0.00	0.0000001	0.00	0.11	0.00
	Henderson	0.0006908	11.91	0.0042376	49.98	0.0002047	0.22	0.0000432	0.55	62.65	0.03
	Hood	0.0050771	87.51	0.0311454	367.34	0.0015044	1.62	0.0003178	4.03	460.50	0.23
	Hunt	0.0088463	152.47	0.0047066	55.51	0.0002273	0.24	0.0652823	828.72	1036.95	0.52
San Antonio Area	Bexar	0.0138906	239.41	0.0009368	11.05	0.0000452	0.05	0.1109355	1408.26	1658.77	0.83
	Guadalupe	0.0032029	55.20	0.0002160	2.55	0.0000104	0.01	0.0255795	324.72	382.48	0.19
Austin Area	Bastrop	0.0033782	58.23	0.0002278	2.69	0.0000110	0.01	0.0269798	342.49	403.42	0.20
	Hays	0.0008331	14.36	0.0000562	0.66	0.0000027	0.00	0.0066537	84.46	99.49	0.05
	Travis	0.0051785	89.25	0.0003493	4.12	0.0000169	0.02	0.0413577	525.01	618.40	0.31
Corpus Christi Area	Nueces	0.0128578	221.61	0.0008672	10.23	0.0000419	0.05	0.1026870	1303.55	1535.43	0.77
	San Patricio	0.0015100	26.02	0.0001018	1.20	0.0000049	0.01	0.0120591	153.08	180.31	0.09
Victoria Area	Victoria	0.0021192	36.52	0.0001429	1.69	0.0000069	0.01	0.0169244	214.84	253.06	0.13
Other ERCOT counties	Andrews	0.0000037	0.06	0.0000230	0.27	0.0039003	4.19	0.0000002	0.00	4.53	0.00
	Bosque	0.0022204	38.27	0.0136212	160.65	0.0006579	0.71	0.0001390	1.76	201.40	0.10
	Brazos	0.0024089	41.52	0.0112305	132.46	0.0005425	0.58	0.0047829	60.72	235.28	0.12
	Calhoun	0.0009466	16.31	0.0000638	0.75	0.0000031	0.00	0.0075598	95.97	113.04	0.06
	Cameron	0.0063536	109.51	0.0004285	5.05	0.0000207	0.02	0.0507425	644.14	758.73	0.38
	Cherokee	0.0027392	47.21	0.0168033	198.19	0.0008116	0.87	0.0001714	2.18	248.45	0.12
	Ector	0.0019215	33.12	0.0006604	7.79	0.0911346	98.00	0.0146527	186.01	324.92	0.16
	Fannin	0.0000041	0.07	0.0000249	0.29	0.0000012	0.00	0.0000003	0.00	0.37	0.00
	Fayette	0.0051867	89.40	0.0103217	121.74	0.0004986	0.54	0.0283993	360.51	572.18	0.29
	Freestone	0.0047643	82.12	0.0292268	344.71	0.0014117	1.52	0.0002982	3.79	432.13	0.22
	Hidalgo	0.0053716	92.58	0.0003623	4.27	0.0000175	0.02	0.0428994	544.58	641.45	0.32
	Howard	0.0002411	4.16	0.0007641	9.01	0.1283942	138.07	0.0009490	12.05	163.29	0.08
	Jack	0.0030783	53.06	0.0188839	222.72	0.0009121	0.98	0.0001927	2.45	279.21	0.14
	Lamar	0.0040001	68.94	0.0245388	289.42	0.0011853	1.27	0.0002504	3.18	362.82	0.18
	Llano	0.0040314	69.48	0.0002719	3.21	0.0000131	0.01	0.0321966	408.72	481.42	0.24
	McLennan	0.0056576	97.51	0.0347066	409.35	0.0016764	1.80	0.0003541	4.49	513.16	0.26
	Milam	0.0012686	21.87	0.0000856	1.01	0.0000041	0.00	0.0101316	128.61	151.49	0.08
	Mitchell	0.0000311	0.54	0.0001910	2.25	0.0324260	34.87	0.0000019	0.02	37.68	0.02
	Nolan	0.0000293	0.50	0.0001795	2.12	0.0304745	32.77	0.0000018	0.02	35.42	0.02
	Palo Pinto	0.0036129	62.27	0.0221635	261.41	0.0010705	1.15	0.0002261	2.87	327.70	0.16
	Pecos	0.0000020	0.03	0.0000121	0.14	0.0020520	2.21	0.0000001	0.00	2.38	0.00
	Robertson	0.0039506	68.09	0.0055755	65.76	0.0002693	0.29	0.0246170	312.50	446.64	0.22
	Upton	0.0000025	0.04	0.0000156	0.18	0.0026494	2.85	0.0000002	0.00	3.08	0.00
	Ward	0.0001995	3.44	0.0012239	14.44	0.2078335	223.50	0.0000125	0.16	241.53	0.12
	Webb	0.0042017	72.42	0.0002834	3.34	0.0000137	0.01	0.0335565	425.98	501.76	0.25
	Wharton	0.0021095	36.36	0.0001423	1.68	0.0000069	0.01	0.0168474	213.87	251.91	0.13
	Wichita	0.0000121	0.21	0.0000743	0.88	0.0126190	13.57	0.0000008	0.01	14.67	0.01
	Wilbarger	0.0179710	309.74	0.1102430	1300.25	0.0053249	5.73	0.0011247	14.28	1630.00	0.81
	Wise	0.0010202	17.58	0.0062583	73.81	0.0003023	0.33	0.0000638	0.81	92.53	0.05
	Young	0.0071054	122.47	0.0435880	514.10	0.0021054	2.26	0.0004447	5.65	644.47	0.32
	Total	**0.4414501**	**7608.63**	**0.4812863**	**5676.50**	**0.5345786**	**574.87**	**0.6829349**	**8669.43**	**22529.44**	**11.26**

Energy Savings by PCA (MWh)		17,236		11,794		1,075		12,694	

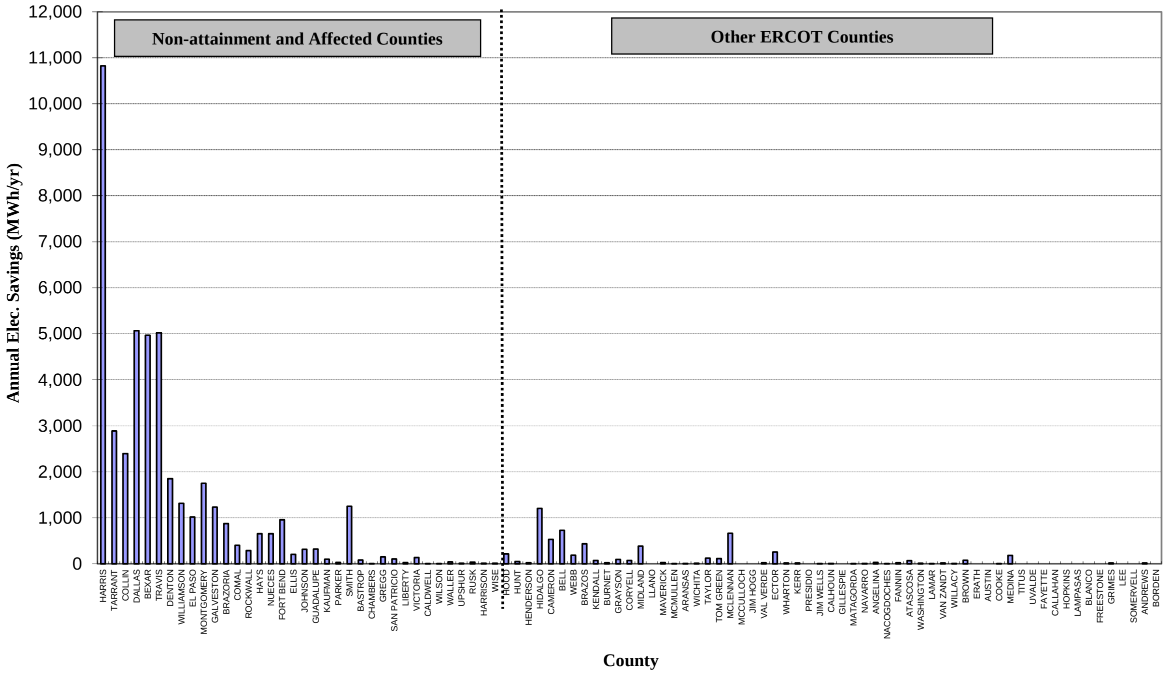
Table 26: 2014 Annual Electricity and Natural Gas Savings and NOx Reductions from New Commercial Construction

	County	Electricity Savings and Resultant NOx Reductions (Commercial)		Total Natural Gas Savings and Resultant NOx Reductions (Commercial)		Total Nox Reductions
		Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Annual Nox Reductions (Tons)
Non-attainment and Affected Counties	HARRIS	10,824.73	1.29	1,743,631.19	8.02	9.31
	TARRANT	2,889.68	0.02	224,261.51	1.03	1.05
	COLLIN	2,397.42	0.06	456,235.18	2.10	2.16
	DALLAS	5,068.08	0.11	587,535.72	2.70	2.82
	BEXAR	4,967.81	0.83	916,562.68	4.22	5.05
	TRAVIS	5,025.49	0.31	627,601.69	2.89	3.20
	DENTON	1,854.08	0.01	270,271.51	1.24	1.25
	WILLIAMSON	1,315.20		255,616.42	1.18	1.18
	EL PASO	1,017.02		136,063.26	0.63	0.63
	MONTGOMERY	1,749.87		223,703.41	1.03	1.03
	GALVESTON	1,234.61	0.20	43,985.44	0.20	0.40
	BRAZORIA	877.49	0.49	118,880.06	0.55	1.03
	COMAL	403.77		15,869.91	0.07	0.07
	ROCKWALL	291.01		7,308.72	0.03	0.03
	HAYS	658.45	0.05	52,340.95	0.24	0.29
	NUECES	655.06	0.77	74,068.86	0.34	1.11
	FORT BEND	960.19	0.27	260,490.67	1.20	1.47
	ELLIS	207.68	0.14	91,083.84	0.42	0.55
	JOHNSON	319.81	0.03	60,658.85	0.28	0.31
	GUADALUPE	324.43	0.19	88,647.84	0.41	0.60
	KAUFMAN	104.00	0.27	2,769.08	0.01	0.28
	PARKER	31.45	0.00	818.91	0.00	0.00
	SMITH	1,250.62		236,636.39	1.09	1.09
	BASTROP	84.42	0.20	2,247.59	0.01	0.21
	CHAMBERS	5.73	0.18	152.48	0.00	0.18
	GREGG	153.41		5,887.98	0.03	0.03
	SAN PATRICIO	106.00	0.09	59,465.71	0.27	0.36
	LIBERTY	31.02		896.38	0.00	0.00
	VICTORIA	140.72	0.13	5,828.54	0.03	0.15
	CALDWELL	1.37		36.60	0.00	0.00
	WILSON	5.64		4,421.78	0.02	0.02
	WALLER	43.49		26,786.82	0.12	0.12
	UPSHUR	13.29		353.76	0.00	0.00
	RUSK	37.63	0.00	29,478.50	0.14	0.14
	HARRISON	13.74		365.96	0.00	0.00
	WISE	15.19	0.05	323.48	0.00	0.05
Other ERCOT Counties	HOOD	218.85	0.23	41,422.60	0.19	0.42
	HUNT	51.95	0.52	1,257.39	0.01	0.52
	HENDERSON	26.12	0.03	695.32	0.00	0.03
	HIDALGO	1,208.31	0.32	127,192.96	0.59	0.91
	CAMERON	531.04	0.38	81,601.51	0.38	0.75
	BELL	729.27		37,538.38	0.17	0.17
	WEBB	189.65	0.25	63,296.58	0.29	0.54
	BRAZOS	436.36	0.12	177,373.41	0.82	0.93
	KENDALL	74.27		13,391.52	0.06	0.06
	BURNET	24.28		646.53	0.00	0.00
	GRAYSON	97.31		3,064.14	0.01	0.01
	CORYELL	76.07		27,901.77	0.13	0.13
	MIDLAND	388.02		169,312.01	0.78	0.78
	LLANO	0.00	0.24	0.00	0.00	0.24
	MAVERICK	26.92		716.67	0.00	0.00
	MCMULLEN	1.32		70.62	0.00	0.00
	ARANSAS	10.42		277.52	0.00	0.00
	WICHITA	16.83	0.01	710.91	0.00	0.01
	TAYLOR	125.73		44,945.23	0.21	0.21
	TOM GREEN	116.57		6,352.78	0.03	0.03
	MCLENNAN	667.08	0.26	208,556.22	0.96	1.22
	MCCULLOCH	0.00		0.00	0.00	0.00
	JIM HOGG	0.00		0.00	0.00	0.00
	VAL VERDE	24.86		661.77	0.00	0.00
	ECTOR	256.72	0.16	139,368.40	0.64	0.80
	WHARTON	22.02	0.13	2,864.52	0.01	0.14
	KERR	18.82		14,739.25	0.07	0.07
	PRESIDIO	0.00		0.00	0.00	0.00
	JIM WELLS	2.63		70.14	0.00	0.00
	CALHOUN	10.24	0.06	225.98	0.00	0.06
	GILLESPIE	0.00		0.00	0.00	0.00
	MATAGORDA	8.30		1,580.76	0.01	0.01
	NAVARRO	8.36		222.62	0.00	0.00
	ANGELINA	34.65		908.79	0.00	0.00
	NACOGDOCHES	0.83		648.53	0.00	0.00
	FANNIN	25.65	0.00	2,070.47	0.01	0.01
	ATASCOSA	71.01		1,890.78	0.01	0.01
	WASHINGTON	12.94		291.58	0.00	0.00
	LAMAR	5.84	0.18	128.88	0.00	0.18
	VAN ZANDT	17.56		4,568.17	0.02	0.02
	WILLACY	11.59		2,386.53	0.01	0.01
	BROWN	77.66		2,067.66	0.01	0.01
	ERATH	0.00		0.00	0.00	0.00
	AUSTIN	0.00		0.00	0.00	0.00
	COOKE	3.76		2,947.85	0.01	0.01
	MEDINA	183.38		4,881.76	0.02	0.02
	TITUS	0.00	0.00	0.00	0.00	0.00
	UVALDE	0.00		0.00	0.00	0.00
	FAYETTE	0.00	0.29	0.00	0.00	0.29
	CALLAHAN	0.00		0.00	0.00	0.00
	HOPKINS	0.00		0.00	0.00	0.00
	LAMPASAS	0.00		0.00	0.00	0.00
	BLANCO	0.00		0.00	0.00	0.00
	FREESTONE	0.00	0.22	0.00	0.00	0.22
	GRIMES	19.93	0.00	459.94	0.00	0.00
	LEE	0.00		0.00	0.00	0.00
	SOMERVELL	0.00		0.00	0.00	0.00
	ANDREWS	21.88	0.00	582.48	0.00	0.00
	BORDEN	0.00		0.00	0.00	0.00

Table 26: 2014 Annual Electricity and Natural Gas Savings and NOx Reductions from New Commercial Construction (Continued)

	County	Electricity Savings and Resultant NOx Reductions (Commercial)		Total Natural Gas Savings and Resultant NOx Reductions (Commercial)		Total Nox Reductions
		Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Annual Nox Reductions (Tons)
Other ERCOT Counties	CHEROKEE	0.00	0.12	0.00	0.00	0.12
	DIMMIT	15.05		11,791.40	0.05	0.05
	FALLS	0.00		0.00	0.00	0.00
	COLORADO	0.00		0.00	0.00	0.00
	FRIO	7.45	0.00	198.23	0.00	0.00
	MILAM	0.00	0.08	0.00	0.00	0.08
	JACKSON	0.00		0.00	0.00	0.00
	ANDERSON	17.18		457.45	0.00	0.00
	HILL	45.82		1,219.86	0.01	0.01
	CULBERSON	0.00		0.00	0.00	0.00
	MASON	0.00		0.00	0.00	0.00
	PECOS	24.13	0.00	2,399.97	0.01	0.01
	RAINS	0.00		0.00	0.00	0.00
	LAVACA	21.76		579.43	0.00	0.00
	PALO PINTO	47.56	0.16	29,372.80	0.14	0.30
	KIMBLE	0.00		0.00	0.00	0.00
	MADISON	17.14		4,500.06	0.02	0.02
	ARCHER	0.00		0.00	0.00	0.00
	REFUGIO	0.00		0.00	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	0.00		0.00	0.00	0.00
	MARTIN	21.88		582.48	0.00	0.00
	GONZALES	15.17		658.59	0.00	0.00
	BURLESON	0.00		0.00	0.00	0.00
	KARNES	114.29		74,248.80	0.34	0.34
	KLEBERG	39.51		2,118.60	0.01	0.01
	BREWSTER	0.00		0.00	0.00	0.00
	WINKLER	0.00		0.00	0.00	0.00
	FRANKLIN	0.00		0.00	0.00	0.00
	YOUNG	5.19	0.32	4,068.03	0.02	0.34
	HOUSTON	1.72		45.74	0.00	0.00
	SCURRY	28.60		22,403.66	0.10	0.10
	BOSQUE	0.00	0.10	0.00	0.00	0.10
	COMANCHE	25.56		3,471.38	0.02	0.02
	BRISCOE	0.00		0.00	0.00	0.00
	CONCHO	0.00		0.00	0.00	0.00
	ZAVALA	0.00		0.00	0.00	0.00
	NOLAN	15.32	0.02	4,153.85	0.02	0.04
	BROOKS	0.00		0.00	0.00	0.00
	ROBERTSON	0.00	0.22	0.00	0.00	0.22
	LIVE OAK	6.87		182.98	0.00	0.00
	HAMILTON	0.00		0.00	0.00	0.00
	JONES	197.01		5,245.40	0.02	0.02
	REAGAN	0.00		0.00	0.00	0.00
	WARD	21.88	0.12	582.48	0.00	0.12
	RED RIVER	0.00		0.00	0.00	0.00
	HASKELL	0.00		0.00	0.00	0.00
	HOWARD	47.19	0.08	21,189.99	0.10	0.18
	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	32.54		1,537.87	0.01	0.01
	DE WITT	77.52		53,036.69	0.24	0.24
	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	90.36	0.00	1,995.02	0.01	0.01
	COKE	0.00	0.00	0.00	0.00	0.00
	CROCKETT	0.00		0.00	0.00	0.00
	HARDEMAN	0.00		0.00	0.00	0.00
	BANDERA	10.42		277.52	0.00	0.00
	BAYLOR	0.00		0.00	0.00	0.00
	COTTLE	0.00		0.00	0.00	0.00
	CRANE	0.00		0.00	0.00	0.00
	DELTA	0.00		0.00	0.00	0.00
	DICKENS	0.00		0.00	0.00	0.00
	DUVAL	24.08		18,866.24	0.09	0.09
	EASTLAND	8.59		228.72	0.00	0.00
	EDWARDS	9.51		253.12	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	3.09		2,417.24	0.01	0.01
	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	0.00		0.00	0.00	0.00
	LEON	25.38		3,323.98	0.02	0.02
	LOVING	0.00		0.00	0.00	0.00
	MENARD	0.00		0.00	0.00	0.00
	MILLS	0.00		0.00	0.00	0.00
	MONTAGUE	0.84		16.23	0.00	0.00
	MOTLEY	0.00		0.00	0.00	0.00
	REAL	0.00		0.00	0.00	0.00
	SCHLEICHER	0.00		0.00	0.00	0.00
	SHACKELFORD	0.00		0.00	0.00	0.00
	STARR	10.98		588.50	0.00	0.00
	STERLING	0.00		0.00	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	**51,964.18**	**11.26**	**8,093,190.89**	**37.23**	**48.49**

Annual Elec. Savings w/ 7% T&D Loss
(Commercial Buildings)



Annual Elec. Savings w/ 7% T&D Loss
(Commercial Buildings)

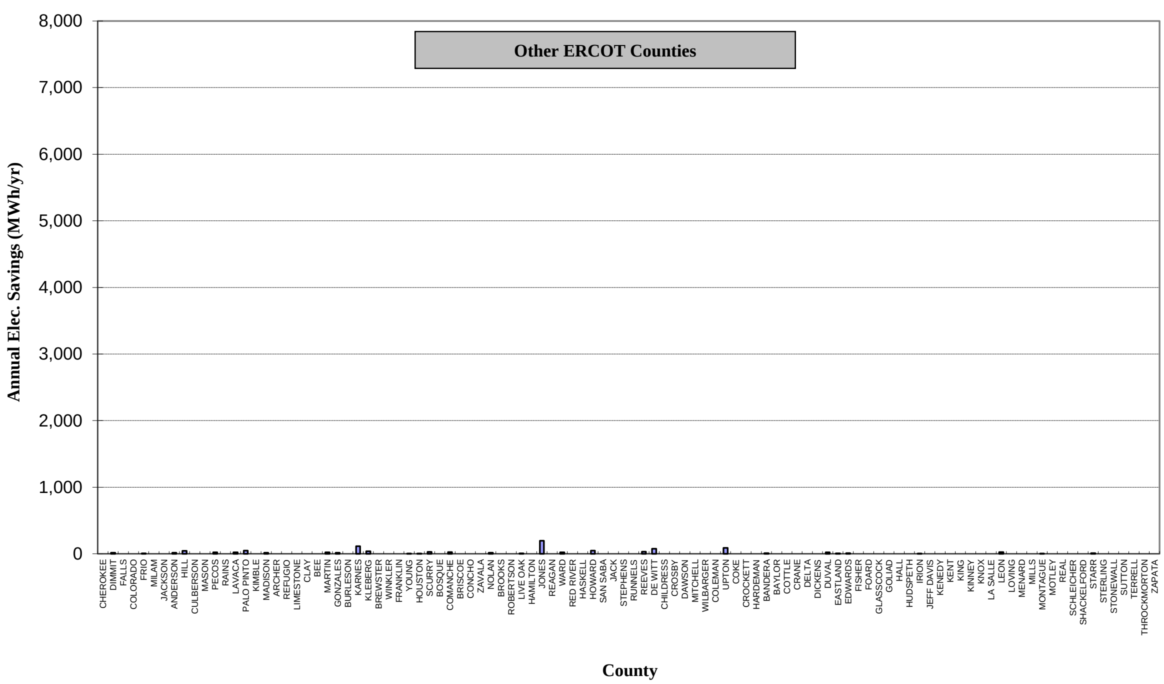
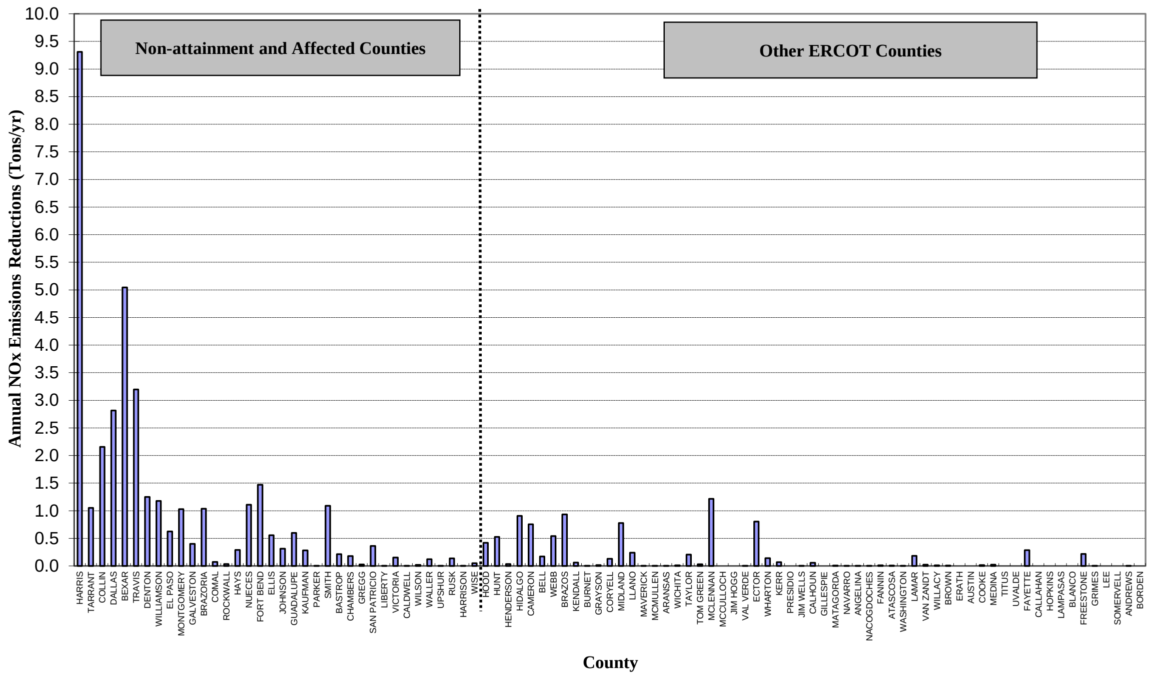


Figure 15: 2014 Annual Electricity Savings by County from New Commercial Construction

Annual NOx Emissions Reductions (Commercial Buildings)



Annual NOx Emissions Reductions (Commercial Buildings)

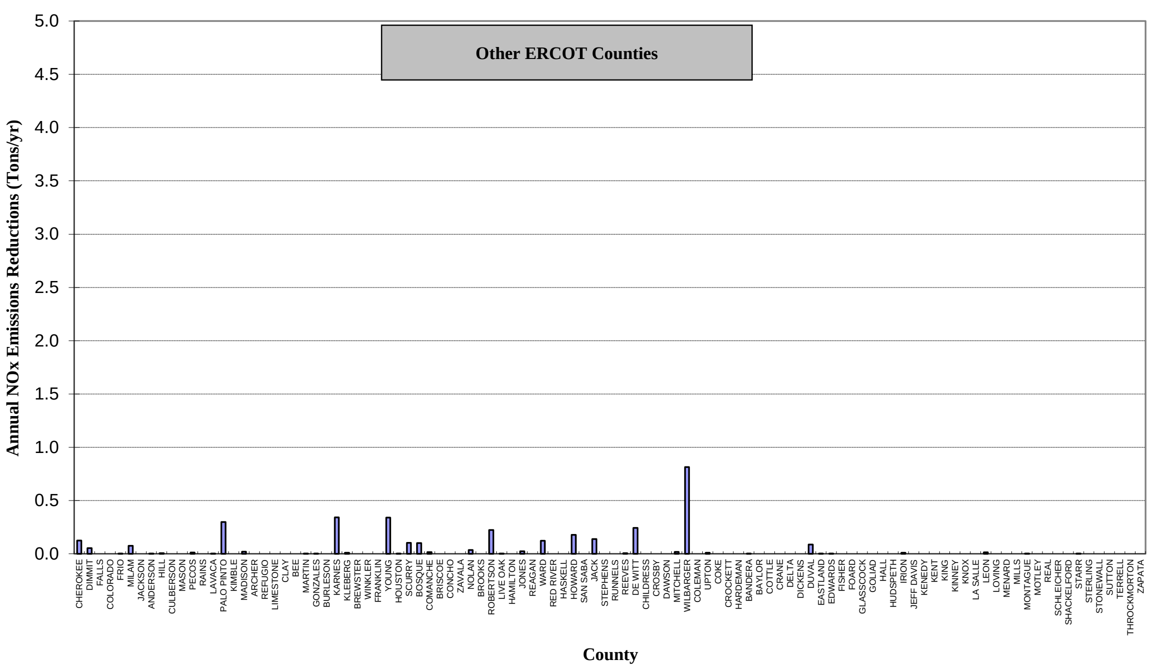


Figure 16: 2014 Annual NOx Reductions by County from New Commercial Construction

4.5 2014 Results for New Residential (Single-family and Multi-family) and Commercial Construction

Figure 17 shows the bar chart and Figure 18 shows the spatial distribution of the 2014 annual electricity savings, and Figure 19 shows the bar chart and Figure 20 shows the spatial distribution of the 2014 annual NOx reductions for new residential and commercial Construction, respectively. As shown in Table 27, the total annual electricity savings in 2014 resulted in 278,739.23 MWh/yr which includes 92,395.71 MWh/yr (i.e., 33.15 %) for single-family buildings, 134,379.34 MWh/yr (i.e., 48.21 %) for multi-family buildings, and 51,964.18 MWh/yr (i.e., 18.64 %) for new commercial buildings. In addition, the total annual natural gas savings from new residential and commercial Construction in 2014 resulted in 1,037,765.47 MMBtu[32] (10,377,654.70 therms).

The total NOx reductions[33] from electricity and natural gas savings from new residential (single-family and multi-family) and commercial Construction in 2014 resulted in 108.71 tons NOx/year which represents 60.97 tons NOx/year from electricity savings and 47.74 tons NOx/year from natural gas savings.

[32] 1 Therm = 0.10 MMBtu, source from www.eia.gov/tools/faqs/faq.cfm?id=45&t=8
[33] 0.092 lb-NOx/MMBtu of emission rate was used for the calculation.

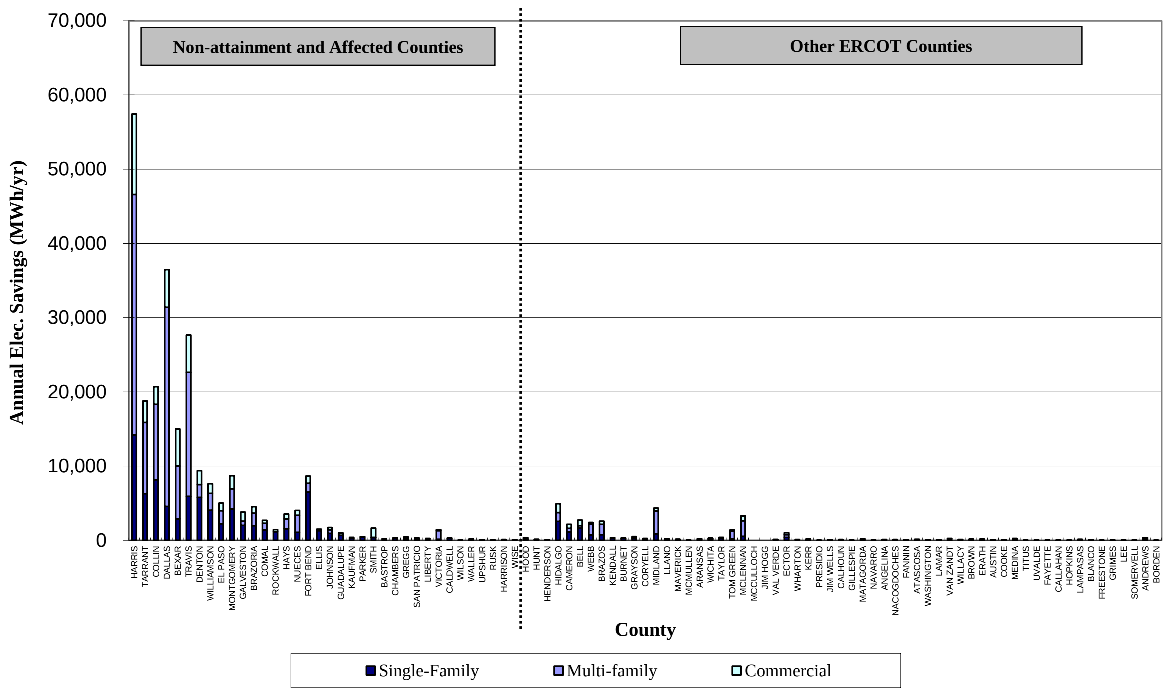
Table 27: 2014 Annual NOx Reductions from New Residential and Commercial Construction

	County	Electricity Savings and Resultant NOx Reductions (Single Family Houses)		Electricity Savings and Resultant NOx Reductions (Multifamily Houses)		Electricity Savings and Resultant NOx Reductions (Commercial Buildings)		Total Electricity Savings and Resultant NOx Reductions (SF, MF and Commecial Buildings)		Total Natural Gas Savings and Resultant NOx Reductions (Single and Multi-Family Houses)		Total Natural Gas Savings and Resultant NOx Reductions (SF, MF and Commecial Buildings)		Total Nox Reductions
		Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Annual Nox Reductions (Tons)
Non-attainment and Affected Counties	HARRIS	14,194.37	2.29	32,398.59	3.44	10,824.73	1.29	57,417.69	7.02	287,417.28	1.32	2,031,048.47	9.34	16.36
	TARRANT	6,295.60	0.04	9,576.79	0.07	2,889.68	0.02	18,762.07	0.14	177,937.55	0.82	402,199.06	1.85	1.99
	COLLIN	8,166.47	0.12	10,151.29	0.20	2,397.42	0.06	20,715.19	0.38	202,280.08	0.93	658,515.26	3.03	3.41
	DALLAS	4,553.12	0.22	26,846.02	0.39	5,068.08	0.11	36,467.22	0.72	287,776.81	1.32	875,312.53	4.03	4.75
	BEXAR	2,890.39	1.11	7,130.69	1.95	4,967.81	0.83	14,988.89	3.89	78,559.35	0.36	995,122.03	4.58	8.47
	TRAVIS	5,914.61	0.42	16,716.09	0.73	5,025.49	0.31	27,656.19	1.45	218,492.86	1.01	846,094.55	3.89	5.34
	DENTON	5,785.97	0.01	1,734.67	0.02	1,854.08	0.01	9,374.72	0.04	99,136.12	0.46	369,407.62	1.70	1.74
	WILLIAMSON	4,058.36		2,254.31		1,315.20	0.00	7,627.88	0.00	81,875.59	0.38	337,492.01	1.55	1.55
	EL PASO	2,245.15		1,760.06		1,017.02	0.00	5,022.23	0.00	76,551.77	0.35	212,615.03	0.98	0.98
	MONTGOMERY	4,220.86		2,731.60		1,749.87	0.00	8,702.33	0.00	87,952.16	0.40	311,655.56	1.43	1.43
	GALVESTON	2,018.54	0.35	553.25	0.52	1,234.61	0.20	3,806.39	1.07	42,899.41	0.20	86,884.85	0.40	1.47
	BRAZORIA	1,970.50	0.86	1,691.83	1.30	877.49	0.49	4,539.82	2.65	27,909.06	0.13	146,789.12	0.68	3.33
	COMAL	1,412.15		884.72		403.77	0.00	2,700.64	0.00	22,886.97	0.11	38,756.87	0.18	0.18
	ROCKWALL	1,151.83		0.00		291.01	0.00	1,442.84	0.00	18,132.63	0.08	25,441.34	0.12	0.12
	HAYS	1,566.15	0.07	1,310.66	0.12	658.45	0.05	3,535.26	0.23	36,691.45	0.17	89,032.40	0.41	0.64
	NUECES	1,068.28	1.03	2,292.59	1.80	655.06	0.77	4,015.93	3.60	15,830.23	0.07	89,899.09	0.41	4.01
	FORT BEND	6,483.32	0.48	1,208.53	0.73	960.19	0.27	8,652.05	1.48	133,971.39	0.62	394,462.07	1.81	3.29
	ELLIS	1,306.32	0.27	0.00	0.47	207.68	0.14	1,514.00	0.87	20,620.17	0.09	111,704.01	0.51	1.39
	JOHNSON	923.72	0.07	495.87	0.11	319.81	0.03	1,739.40	0.21	19,024.08	0.09	79,682.93	0.37	0.58
	GUADALUPE	676.48	0.26	0.00	0.45	324.43	0.19	1,000.90	0.90	9,428.03	0.04	98,075.86	0.45	1.35
	KAUFMAN	285.27	0.54	0.00	0.93	104.00	0.27	389.27	1.74	4,490.88	0.02	7,259.96	0.03	1.78
	PARKER	455.96	0.00	0.00	0.00	31.45	0.00	487.41	0.00	7,177.89	0.03	7,996.80	0.04	0.04
	SMITH	359.93		25.89		1,250.62	0.00	1,636.44	0.00	8,636.33	0.04	245,272.72	1.13	1.13
	BASTROP	154.28	0.27	0.00	0.47	84.42	0.20	238.69	0.95	5,009.56	0.02	7,257.16	0.03	0.98
	CHAMBERS	286.95	0.31	0.00	0.47	5.73	0.18	292.68	0.97	3,980.35	0.02	4,132.83	0.02	0.98
	GREGG	187.54		123.32		153.41	0.00	464.27	0.00	4,425.06	0.02	10,313.04	0.05	0.05
	SAN PATRICIO	199.77	0.12	13.49	0.21	106.00	0.09	319.26	0.42	2,918.69	0.01	62,384.40	0.29	0.71
	LIBERTY	230.22		0.00		31.02	0.00	261.24	0.00	4,833.36	0.02	5,729.74	0.03	0.03
	VICTORIA	133.16	0.17	1,176.70	0.30	140.72	0.13	1,450.58	0.59	2,806.63	0.01	8,635.17	0.04	0.63
	CALDWELL	276.89		0.00		1.37	0.00	278.26	0.00	3,770.11	0.02	3,806.71	0.02	0.02
	WILSON	30.03		0.00		5.64	0.00	35.67	0.00	418.48	0.00	4,840.25	0.02	0.02
	WALLER	3.83		128.72		43.49	0.00	176.04	0.00	106.43	0.00	26,893.26	0.12	0.12
	UPSHUR	12.93		20.73		13.29	0.00	46.95	0.00	677.15	0.00	1,030.90	0.00	0.00
	RUSK	2.37	0.00	0.00	0.00	37.63	0.00	40.00	0.00	66.25	0.00	29,544.75	0.14	0.14
	HARRISON	49.91		45.71		13.74	0.00	109.36	0.00	1,189.62	0.01	1,555.57	0.01	0.01
	WISE	63.26	0.09	0.00	0.16	15.19	0.05	78.45	0.30	995.89	0.00	1,319.36	0.01	0.30
Other ERCOT Counties	HOOD	139.45	0.46	10.66	0.79	218.85	0.23	368.96	1.48	2,296.79	0.01	43,719.39	0.20	1.68
	HUNT	82.28	0.72	8.03	1.25	51.95	0.52	142.26	2.49	1,381.39	0.01	2,638.78	0.01	2.50
	HENDERSON	66.72	0.06	0.00	0.11	26.12	0.03	92.84	0.20	1,601.08	0.01	2,296.40	0.01	0.21
	HIDALGO	2,556.97	0.43	1,174.13	0.75	1,208.31	0.32	4,939.41	1.50	27,165.41	0.12	154,358.37	0.71	2.21
	CAMERON	1,139.73	0.51	481.24	0.89	531.04	0.38	2,152.01	1.78	9,184.52	0.04	90,786.03	0.42	2.20
	BELL	1,646.10		344.60		729.27	0.00	2,719.98	0.00	35,989.29	0.17	73,527.67	0.34	0.34
	WEBB	734.80	0.34	1,473.81	0.59	189.65	0.25	2,398.26	1.18	8,722.04	0.04	72,018.61	0.33	1.51
	BRAZOS	764.38	0.21	1,389.21	0.37	436.36	0.12	2,589.95	0.70	10,761.41	0.05	188,134.82	0.87	1.56
	KENDALL	300.73		0.00		74.27	0.00	375.00	0.00	4,670.83	0.02	18,062.36	0.08	0.08
	BURNET	280.06		0.00		24.28	0.00	304.34	0.00	3,783.29	0.02	4,429.82	0.02	0.02
	GRAYSON	242.08		182.01		97.31	0.00	521.40	0.00	5,449.09	0.03	8,513.22	0.04	0.04
	CORYELL	101.55		77.11		76.07	0.00	254.73	0.00	2,759.64	0.01	30,661.40	0.14	0.14
	MIDLAND	871.95		3,074.13		388.02	0.00	4,334.11	0.00	51,745.62	0.24	221,057.63	1.02	1.02
	LLANO	208.54	0.32	0.00	0.56	0.00	0.24	208.54	1.13	3,351.96	0.02	3,351.96	0.02	1.14
	MAVERICK	53.92		50.84		26.92	0.00	131.67	0.00	628.53	0.00	1,345.20	0.01	0.01
	MCMULLEN	0.00		0.00		1.32	0.00	1.32	0.00	0.00	0.00	70.62	0.00	0.00
	ARANSAS	154.04		0.00		10.42	0.00	164.47	0.00	1,555.70	0.01	1,833.22	0.01	0.01
	WICHITA	103.14	0.01	154.40	0.02	16.83	0.01	274.38	0.04	4,109.02	0.02	4,819.93	0.02	0.06
	TAYLOR	260.02		0.00		125.73	0.00	385.75	0.00	6,055.13	0.03	51,000.37	0.23	0.23
	TOM GREEN	214.63		1,045.01		116.57	0.00	1,376.21	0.00	13,922.49	0.06	20,275.27	0.09	0.09
	MCLENNAN	541.77	0.51	2,082.08	0.88	667.08	0.26	3,290.93	1.65	32,225.77	0.15	240,781.99	1.11	2.76
	MCCULLOCH	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	JIM HOGG	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VAL VERDE	71.53		15.69		24.86	0.00	112.08	0.00	1,090.51	0.01	1,752.29	0.01	0.01
	ECTOR	408.88	0.24	354.71	0.40	256.72	0.16	1,020.30	0.80	13,136.42	0.06	152,504.82	0.70	1.50
	WHARTON	73.52	0.17	0.00	0.30	22.02	0.13	95.55	0.59	1,450.01	0.01	4,314.53	0.02	0.61
	KERR	67.11		62.07		18.82	0.00	147.99	0.00	1,624.11	0.01	16,363.36	0.08	0.08
	PRESIDIO	8.44		0.00		0.00	0.00	8.44	0.00	176.32	0.00	176.32	0.00	0.00
	JIM WELLS	22.01		0.00		2.63	0.00	24.64	0.00	321.40	0.00	391.54	0.00	0.00
	CALHOUN	62.66	0.08	12.26	0.13	10.24	0.06	85.15	0.27	831.29	0.00	1,057.27	0.00	0.27
	GILLESPIE	40.26		0.00		0.00	0.00	40.26	0.00	647.16	0.00	647.16	0.00	0.00
	MATAGORDA	181.36		0.00		8.30	0.00	189.65	0.00	3,576.69	0.02	5,157.45	0.02	0.02
	NAVARRO	20.56		0.00		8.36	0.00	28.92	0.00	459.80	0.00	682.43	0.00	0.00
	ANGELINA	60.73		15.08		34.65	0.00	110.47	0.00	1,697.47	0.01	2,606.26	0.01	0.01
	NACOGDOCHES	25.24		58.97		0.83	0.00	85.04	0.00	724.37	0.00	1,372.90	0.01	0.01
	FANNIN	11.93	0.00	53.53	0.00	25.65	0.00	91.11	0.00	658.14	0.00	2,728.61	0.01	0.01
	ATASCOSA	52.74		3.90		71.01	0.00	127.66	0.00	863.11	0.00	2,753.90	0.01	0.01
	WASHINGTON	63.57		3.34		12.94	0.00	79.85	0.00	1,316.65	0.01	1,608.24	0.01	0.01
	LAMAR	23.43	0.36	42.86	0.63	5.84	0.18	72.13	1.17	996.81	0.00	1,125.69	0.01	1.17
	VAN ZANDT	10.74		207.43		17.56	0.00	235.74	0.00	1,848.33	0.01	6,416.50	0.03	0.03
	WILLACY	87.28		0.00		11.59	0.00	98.87	0.00	928.91	0.00	3,315.43	0.02	0.02
	BROWN	64.13		14.46		77.66	0.00	156.25	0.00	1,412.16	0.01	3,479.82	0.02	0.02
	ERATH	39.28		119.60		0.00	0.00	158.88	0.00	2,141.47	0.01	2,141.47	0.01	0.01
	AUSTIN	19.21		5.02		0.00	0.00	24.22	0.00	264.14	0.00	264.14	0.00	0.00
	COOKE	29.80		0.00		3.76	0.00	33.56	0.00	439.32	0.00	3,387.17	0.02	0.02
	MEDINA	22.96		47.08		183.38	0.00	253.43	0.00	600.68	0.00	5,482.44	0.03	0.03
	TITUS	19.09	0.00	0.00	0.00	0.00	0.00	19.09	0.00	500.95	0.00	500.95	0.00	0.00
	UVALDE	11.48		0.00		0.00	0.00	11.48	0.00	160.01	0.00	160.01	0.00	0.00
	FAYETTE	4.60	0.43	0.00	0.75	0.00	0.29	4.60	1.47	95.13	0.00	95.13	0.00	1.47
	CALLAHAN	4.97		0.00		0.00	0.00	4.97	0.00	97.23	0.00	97.23	0.00	0.00
	HOPKINS	9.55		0.00		0.00	0.00	9.55	0.00	150.32	0.00	150.32	0.00	0.00
	LAMPASAS	138.57		0.00		0.00	0.00	138.57	0.00	0.00	0.00	3,098.69	0.01	0.01
	BLANCO	3.22		76.99		0.00	0.00	80.21	0.00	611.95	0.00	611.95	0.00	0.00
	FREESTONE	6.26	0.43	0.00	0.74	0.00	0.22	6.26	1.39	139.94	0.00	139.94	0.00	1.39
	GRIMES	11.49	0.00	0.00	0.00	19.93	0.00	31.41	0.00	237.82	0.00	697.76	0.00	0.00
	LEE	3.10		0.00		0.00	0.00	3.10	0.00	49.45	0.00	49.45	0.00	0.00
	SOMERVELL	21.45		0.00		0.00	0.00	21.45	0.00	338.65	0.00	338.65	0.00	0.00
	ANDREWS	50.40	0.00	287.14	0.01	21.88	0.00	359.42	0.01	4,111.62	0.02	4,694.10	0.02	0.03
	BORDEN	15.71		0.00		0.00	0.00	15.71	0.00	1,130.12	0.01	1,130.12	0.01	0.01

Table 27: 2014 Annual NOx Reductions from New Residential and Commercial Construction (Continued)

	County	Electricity Savings and Resultant NOx Reductions (Single Family Houses)		Electricity Savings and Resultant NOx Reductions (Multifamily Houses)		Electricity Savings and Resultant NOx Reductions (Commercial Buildings)		Total Electricity Savings and Resultant NOx Reductions (SF, MF and Commecial Buildings)		Total Natural Gas Savings and Resultant NOx Reductions (Single and Multi-Family Houses)		Total Natural Gas Savings and Resultant NOx Reductions (SF, MF and Commecial Buildings)		Total Nox Reductions
		Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Annual Nox Reductions (Tons)
	CHEROKEE	4.73	0.25	0.00	0.43	0.00	0.12	4.73	0.80	132.50	0.00	132.50	0.00	0.80
	DIMMIT	3.94		0.00		15.05	0.00	18.99	0.00	39.83	0.00	11,831.23	0.05	0.05
	FALLS	9.83		0.00		0.00	0.00	9.83	0.00	219.91	0.00	219.91	0.00	0.00
	COLORADO	8.00		0.00		0.00	0.00	8.00	0.00	109.62	0.00	109.62	0.00	0.00
	FRIO	10.23	0.00	0.00	0.00	7.45	0.00	17.68	0.00	162.55	0.00	360.78	0.00	0.00
	MILAM	7.25	0.10	0.00	0.18	0.00	0.08	7.25	0.36	122.68	0.00	122.68	0.00	0.36
	JACKSON	13.07		3.21		0.00	0.00	16.28	0.00	258.72	0.00	258.72	0.00	0.00
	ANDERSON	2.37		0.00		17.18	0.00	19.55	0.00	66.25	0.00	523.70	0.00	0.00
	HILL	8.94		0.00		45.82	0.00	54.76	0.00	199.92	0.00	1,419.78	0.01	0.01
	CULBERSON	0.74		0.00		0.00	0.00	0.74	0.00	21.17	0.00	21.17	0.00	0.00
	MASON	4.13		0.00		0.00	0.00	4.13	0.00	66.38	0.00	66.38	0.00	0.00
	PECOS	6.56	0.00	0.00	0.00	24.13	0.00	30.69	0.01	137.14	0.00	2,537.11	0.01	0.02
	RAINS	3.58		5.19		0.00	0.00	8.77	0.00	98.35	0.00	98.35	0.00	0.00
	LAVACA	8.62		0.00		21.76	0.00	30.38	0.00	178.84	0.00	758.28	0.00	0.00
	PALO PINTO	4.68	0.33	0.00	0.56	47.56	0.16	52.24	1.05	108.91	0.00	29,481.70	0.14	1.19
	KIMBLE	1.87		8.08		0.00	0.00	9.95	0.00	116.08	0.00	116.08	0.00	0.00
	MADISON	3.06		0.00		17.14	0.00	20.20	0.00	63.42	0.00	4,563.48	0.02	0.02
	ARCHER	9.67		0.00		0.00	0.00	9.67	0.00	216.56	0.00	216.56	0.00	0.00
	REFUGIO	4.90		28.02		0.00	0.00	32.92	0.00	100.96	0.00	100.96	0.00	0.00
	LIMESTONE	3.58	0.00	0.00	0.00	0.00	0.00	3.58	0.00	79.97	0.00	79.97	0.00	0.00
	CLAY	5.37		0.00		0.00	0.00	5.37	0.00	120.31	0.00	120.31	0.00	0.00
	BEE	9.31		0.00		0.00	0.00	9.31	0.00	123.29	0.00	123.29	0.00	0.00
	MARTIN	2.85		0.00		21.88	0.00	24.73	0.00	66.31	0.00	648.79	0.00	0.00
	GONZALES	23.84		16.09		15.17	0.00	55.10	0.00	443.75	0.00	1,102.35	0.01	0.01
	BURLESON	6.40		0.00		0.00	0.00	6.40	0.00	87.69	0.00	87.69	0.00	0.00
	KARNES	54.42		12.82		114.29	0.00	181.53	0.00	864.18	0.00	75,112.97	0.35	0.35
	KLEBERG	29.66		0.00		39.51	0.00	69.17	0.00	445.02	0.00	2,563.62	0.01	0.01
	BREWSTER	4.08		18.29		0.00	0.00	22.37	0.00	234.98	0.00	234.98	0.00	0.00
	WINKLER	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	FRANKLIN	1.19		0.00		0.00	0.00	1.19	0.00	18.79	0.00	18.79	0.00	0.00
	YOUNG	30.87	0.64	5.56	1.11	5.19	0.32	41.62	2.07	775.83	0.00	4,843.86	0.02	2.10
	HOUSTON	3.94		0.00		1.72	0.00	5.66	0.00	110.42	0.00	156.16	0.00	0.00
	SCURRY	6.50		0.00		28.60	0.00	35.09	0.00	518.11	0.00	22,921.77	0.11	0.11
	BOSQUE	2.67	0.20	0.00	0.35	0.00	0.10	2.67	0.65	53.02	0.00	53.02	0.00	0.65
	COMANCHE	2.67		0.00		25.56	0.00	28.24	0.00	53.02	0.00	3,524.40	0.02	0.02
	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		0.00	0.00	1.02	0.00	17.46	0.00	17.46	0.00	0.00
	ZAVALA	8.66		0.00		0.00	0.00	8.66	0.00	87.62	0.00	87.62	0.00	0.00
	NOLAN	0.00	0.03	0.00	0.05	15.32	0.02	15.32	0.10	0.00	0.00	4,153.85	0.02	0.12
	BROOKS	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	ROBERTSON	39.06	0.33	0.00	0.57	0.00	0.22	39.06	1.12	808.59	0.00	808.59	0.00	1.12
	LIVE OAK	10.16		0.00		6.87	0.00	17.03	0.00	148.34	0.00	331.32	0.00	0.00
	HAMILTON	1.79		0.00		0.00	0.00	1.79	0.00	39.98	0.00	39.98	0.00	0.00
	JONES	0.94		0.00		197.01	0.00	197.94	0.00	21.78	0.00	5,267.18	0.02	0.02
	REAGAN	0.95		48.49		0.00	0.00	49.45	0.00	512.28	0.00	512.28	0.00	0.00
	WARD	18.07	0.20	0.00	0.33	21.88	0.12	39.94	0.66	419.97	0.00	1,002.45	0.00	0.66
	RED RIVER	6.94		0.00		0.00	0.00	6.94	0.00	182.16	0.00	182.16	0.00	0.00
	HASKELL	1.87		0.00		0.00	0.00	1.87	0.00	43.56	0.00	43.56	0.00	0.00
	HOWARD	43.44	0.14	11.26	0.22	47.19	0.08	101.88	0.44	965.99	0.00	22,155.98	0.10	0.54
	SAN SABA	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other ERCOT Counties	JACK	4.68	0.28	0.00	0.48	0.00	0.14	4.68	0.90	108.91	0.00	108.91	0.00	0.90
	STEPHENS	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RUNNELS	3.75		0.00		0.00	0.00	3.75	0.00	78.36	0.00	78.36	0.00	0.00
	REEVES	2.85		0.00		32.54	0.00	35.40	0.00	66.31	0.00	1,604.18	0.01	0.01
	DE WITT	4.08		0.00		77.52	0.00	81.60	0.00	80.56	0.00	53,117.25	0.24	0.24
	CHILDRESS	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CROSBY	4.14		0.00		0.00	0.00	4.14	0.00	297.40	0.00	297.40	0.00	0.00
	DAWSON	11.64		0.00		0.00	0.00	11.64	0.00	817.72	0.00	817.72	0.00	0.00
	MITCHELL	4.68	0.03	0.00	0.05	0.00	0.02	4.68	0.10	108.91	0.00	108.91	0.00	0.10
	WILBARGER	2.22	1.62	0.00	2.81	0.00	0.81	2.22	5.24	52.99	0.00	52.99	0.00	5.24
	COLEMAN	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	UPTON	0.95	0.00	0.00	0.00	90.36	0.00	91.31	0.01	22.11	0.00	2,017.13	0.01	0.02
	COKE	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
	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	0.80		0.00		10.42	0.00	11.22	0.00	10.77	0.00	288.29	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	1.00		0.00		0.00	0.00	1.00	0.00	20.11	0.00	20.11	0.00	0.00
	DELTA	2.30		0.00		0.00	0.00	2.30	0.00	33.76	0.00	33.76	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		24.08	0.00	24.08	0.00	0.00	0.00	18,866.24	0.09	0.09
	EASTLAND	0.00		0.00		8.59	0.00	8.59	0.00	0.00	0.00	228.72	0.00	0.00
	EDWARDS	0.00		0.00		9.51	0.00	9.51	0.00	0.00	0.00	253.12	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	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	HALL	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	HUDSPETH	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	IRION	0.00		0.00		3.09	0.00	3.09	0.00	0.00	0.00	2,417.24	0.01	0.01
	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	0.88		0.00		0.00	0.00	0.88	0.00	12.31	0.00	12.31	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	8.47		22.79		0.00	0.00	31.26	0.00	98.59	0.00	98.59	0.00	0.00
	LEON	0.00		0.00		25.38	0.00	25.38	0.00	0.00	0.00	3,323.98	0.02	0.02
	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		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MONTAGUE	13.12		0.00		0.84	0.00	13.96	0.00	209.03	0.00	225.26	0.00	0.00
	MOTLEY	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	REAL	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SCHLEICHER	0.94		0.00		0.00	0.00	0.94	0.00	19.59	0.00	19.59	0.00	0.00
	SHACKELFORD	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	STARR	0.00		0.00		10.98	0.00	10.98	0.00	0.00	0.00	588.50	0.00	0.00
	STERLING	0.00		0.00		0.00	0.00	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	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	**92,395.71**	**18.53**	**134,379.34**	**31.17**	**51,964.18**	**11.26**	**278,739.23**	**60.97**	**2,281,365.12**	**10.49**	**10,377,654.70**	**47.74**	**108.71**

Annual Elec. Savings w/ 7% T&D Loss
(Single-Family, Multi-Family and Commercial Buildings)



Annual Elec. Savings w/ 7% T&D Loss
(Single-Family, Multi-Family and Commercial Buildings)

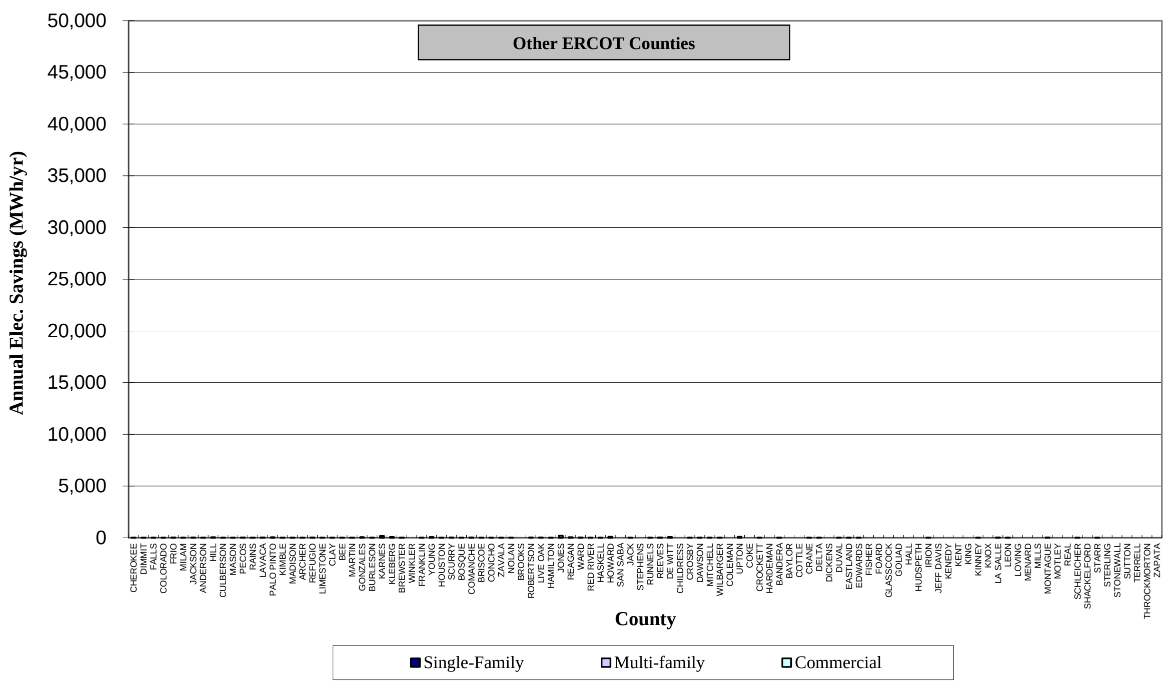


Figure 17: 2014 Annual Electricity Savings by County from New Residential and Commercial Construction

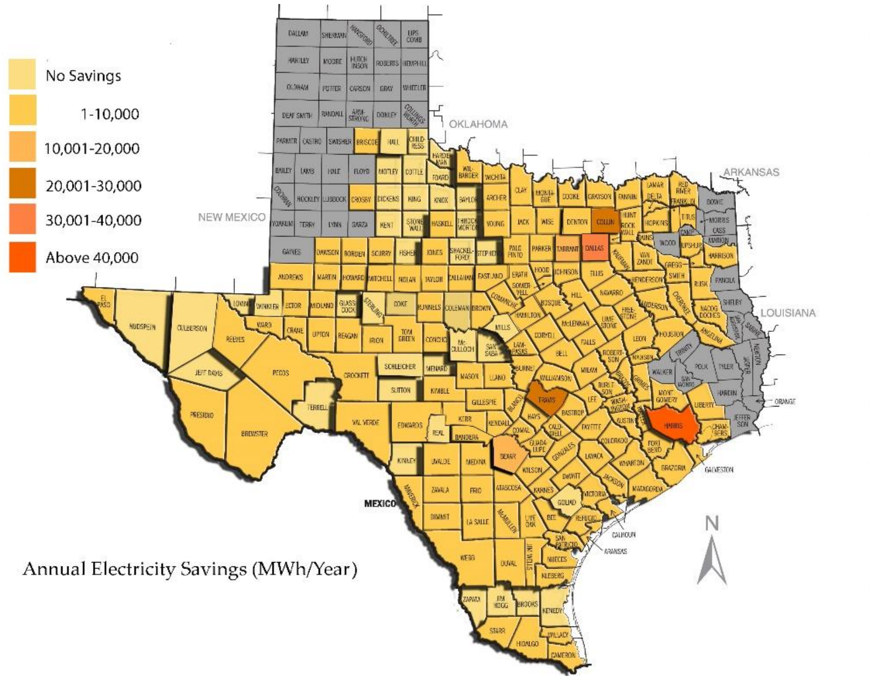
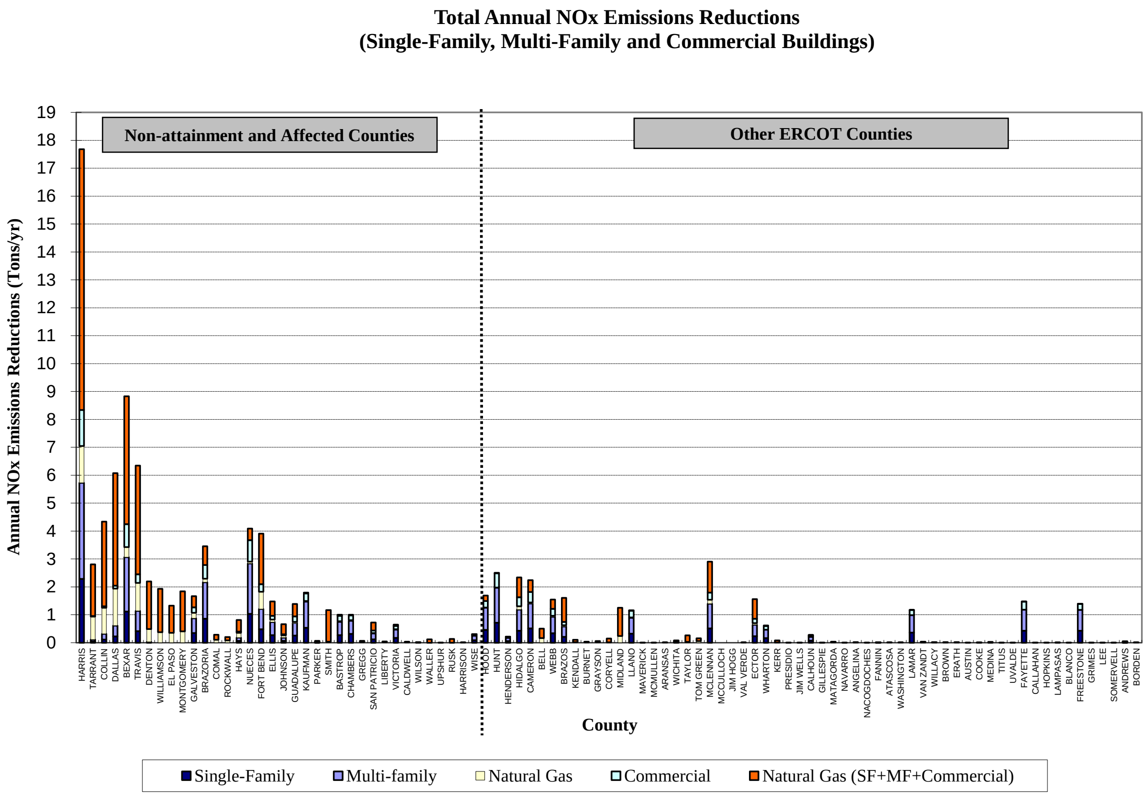


Figure 18: Map of 2014 Annual Electricity Savings by County from New Residential and Commercial Construction



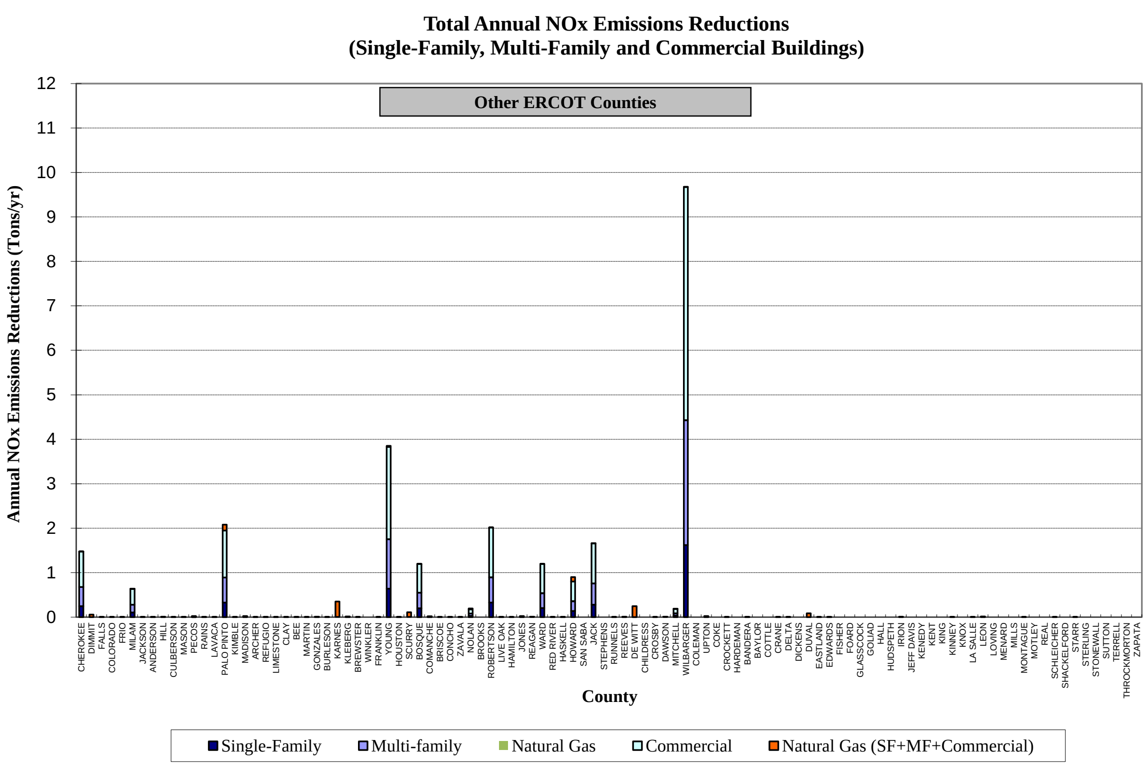


Figure 19: 2014 Annual NOx Reductions by County from New Residential and Commercial Construction

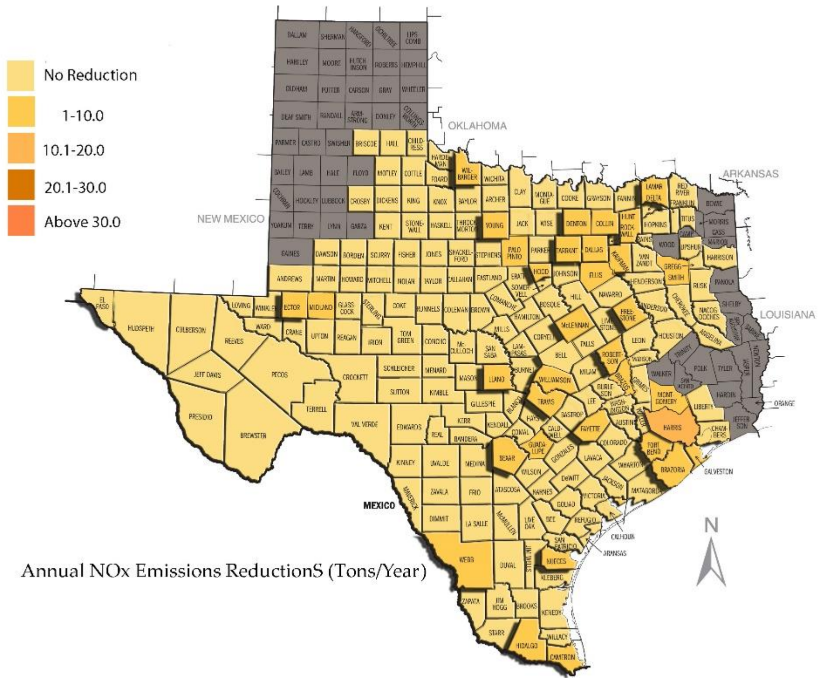


Figure 20: Map of 2014 Annual NOx Reductions by County from New Residential and Commercial Construction

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

5.1 Background

In January 2005, the Laboratory was asked by the Texas Commission on Environmental Quality (TCEQ) to develop a method by which the NOx emissions reductions from the energy-efficiency programs from multiple Texas State Agencies working under Senate Bill 5 and Senate Bill 7 could be reported in a uniform format to allow the TCEQ to consider the combined savings for Texas' State Implementation Plan (SIP) planning purposes. This required that the analysis should include the integrated savings estimation from all projects projected through 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 2014 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)
- 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 - 2014).

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 2015).

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 2014.

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 2014 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 2014 were included. For projections to 2020, the annual growth factor was estimated using the last six years installed wind power capacity.

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

5.2 Description of the Analysis Method

Annual and Ozone Season Day (OSD) NOx emissions reductions were calculated for 2014 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 28 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[34]. 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 24 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 (4.8%) is a linear projection based on the installed wind power capacity for 2009 through 2014 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[35]. 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 2015). The OSD consumption is the average daily consumption for the period between July 15 and September 15.

The SECO electricity savings were submitted as annual savings by project[36]. 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.

[34] 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.

[35] 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.

[36] 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.

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 28. 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 2014 included the savings from code-compliant new housing in all 36 non-attainment and affected counties as reported in the Laboratory's annual report submitted by the Laboratory to the Texas Commission of Environmental Quality (TCEQ). From 2009 to 2014, based on year 2008, the annual electricity savings were calculated for new residential construction in all the counties in ERCOT region, which includes the 36 non-attainment and affected counties. These savings were then tabulated by county and program. Using the calculated values through 2014, 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 2014 through 2020[37]. 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[38].

For the 2014 annual NOx emissions calculations, the US EPA's 2010 eGRID were used. An example of the eGRID spreadsheet is given in the Table 29. 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 2014 for commercial buildings were obtained from the annual reports for 2004 through 2014 submitted by the Laboratory to TCEQ[39]. From 2009 to 2014, based on year 2008, the annual electricity savings were also calculated for new commercial construction by county. Using the calculated savings through 2014, savings were then projected to 2020 by incorporating the different adjustment factors mentioned above[40]. In the projected annual electricity savings, it was assumed that the same 2014 amount of electricity savings would be achieved for each year through 2020. Similarly to the single family calculations, the projected energy saving numbers through 2020, by county, were allocated into the appropriate CM zones.

PUC-Senate Bill 7. For the PUC Senate Bill 7 program savings, the annual electricity savings for 2001 through 2014 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 2014 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

[37] This would include the appropriate discount and degradation factors for each year.
[38] Haberl et al., 2010, pp. 265.
[39] 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 (2015).
[40] This also includes the appropriate discount and degradation factors for each year.

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 47 counties through 2014 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[41]. 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 2014 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 2014, 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[42]. 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 this analysis, it was assumed that an equal number of existing houses had their air conditioners replaced, as reported for 2006, by the air conditioner manufacturers. This replacement rate continued until all the existing air conditioner stock was replaced with SEER 13 air conditioners.

In the 2014 report to the TCEQ, the annual and OSD electricity savings for all the counties in ERCOT region as well as the 36 non-attainment and affected counties were calculated. Using the numbers for 2008, the savings after 2008 until 2020 were projected by incorporating the appropriate adjustment factors[43]. 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.

[41] In the 2014 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 2013.

[42] 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.

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

5.4 Results

The total integrated annual and OSD electricity savings for all the different programs in the integrated format were calculated for 2009 through 2020 as shown in Table 30, using the adjustment factors shown in Table 28. Annual and OSD NOx emissions reductions from the electricity savings (presented in Table 30) for all the programs in the integrated format were shown in Table 31.

In 2014, the total integrated annual savings from all programs are 23,684,427 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction are 927,408 MWh/year (3.9% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program are 2,675,295 MWh/year (11.3%),
- Savings from SECO's Senate Bill 5 program are 936,047 MWh/year (4.0%),
- Electricity savings from green power purchases (wind) are 18,857,560 MWh/year (79.6%), and
- Savings from residential air conditioner retrofits[44] are 288,118 MWh/year (1.2%).

In 2014, the total integrated OSD savings from all programs are 57,751 MWh/day, which would be a 2,406 MW average hourly load reduction during the OSD period. The integrated OSD electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction are 3,007 MWh/day (5.2%),
- Savings from the PUC's Senate Bill 7 programs are 7,330 MWh/day (12.7%),
- Savings from SECO's Senate Bill 5 program are 2,565 MWh/day (4.4%),
- Electricity savings from green power purchases (wind) are 42,806 MWh/day (74.1%), and
- Savings from residential air conditioner retrofits are 2,043 MWh/day (3.5%).

By 2020, the total integrated annual savings from all programs will be 34,278,170 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction will be 2,294,744 MWh/year (6.7% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program will be 4,728,263 MWh/year (13.8%),
- Savings from SECO's Senate Bill 5 program will be 2,098,664 MWh/year (6.1%),
- Electricity savings from green power purchases (wind) will be 24,944,707 MWh/year (72.8%), and
- Savings from residential air conditioner retrofits will be 211,793 MWh/year (0.6%).

By 2020, the total integrated OSD savings from all programs will be 83,530 MWh/day, which would be a 3,480 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 6,700 MWh/day (8.0%),
- Savings from the PUC's Senate Bill 7 programs will be 12,954 MWh/day (15.5%),
- Savings from SECO's Senate Bill 5 program will be 5,750 MWh/day (6.9%),
- Electricity savings from green power purchases (wind) will be 56,624 MWh/day (67.8%), and
- Savings from residential air conditioner retrofits will be 1,502 MWh/day (1.8%).

In 2014 (Table 31), the total integrated annual NOx emissions reductions from all programs are 6,494 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 233 tons-NOx/year (3.6% of the total NOx savings),
- NOx emissions reductions from the PUC's Senate Bill 7 programs are 669 tons-NOx/year (10.3%),
- NOx emissions reductions from SECO's Senate Bill 5 program are 241 tons-NOx/year (3.7%),
- NOx emissions reductions from green power purchases (wind) are 5,283 tons-NOx/year (81.4%), and
- NOx emissions reductions from residential air conditioner retrofits are 68 tons-NOx/year (1.0%).

[44] 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 2014, the total integrated OSD NOx emissions reductions from all programs are 15.70 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 0.76 tons-NOx/day (4.8%),
- NOx emissions reductions from the PUC's Senate Bill 7 programs are 1.83 tons-NOx/day (11.7%),
- NOx emissions reductions from SECO's Senate Bill 5 program are 0.66 tons-NOx/day (4.2%),
- NOx emissions reductions from green power purchases (wind) are 11.97 tons-NOx/day (76.3%), and
- NOx emissions reductions from residential air conditioner retrofits are 0.47 tons-NOx/day (3.0%).

By 2020, the total integrated annual NOx emissions reductions from all programs will be 9,332 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 578 tons-NOx/year (6.2% of the total NOx savings),
- NOx emissions reductions from the PUC's Senate Bill 7 programs will be 1,183 tons-NOx/year (12.7%),
- NOx emissions reductions from SECO's Senate Bill 5 program will be 533 tons-NOx/year (5.7%),
- NOx emissions reductions from green power purchases (wind) will be 6,989 tons-NOx/year (74.9%), and
- NOx emissions reductions from residential air conditioner retrofits will be 50 tons-NOx/year (0.5%).

By 2020, the total integrated OSD NOx emissions reductions from all programs will be 22.58 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 1.69 tons-NOx/day (7.5%),
- NOx emissions reductions from the PUC's Senate Bill 7 programs will be 3.24 tons-NOx/day (14.4%),
- NOx emissions reductions from SECO's Senate Bill 5 program will be 1.46 tons-NOx/day (6.5%),
- NOx emissions reductions from green power purchases (wind) will be 15.84 tons-NOx/day (70.2%), and
- NOx emissions reductions from residential air conditioner retrofits will be 0.35 tons-NOx/day (1.5%).

Table 28: Final Adjustment Factors used for the Calculation of the Annual and OSD NOx Savings for the Different Programs

	ESL-Single Family[16]	ESL[16]-Multifamily	ESL[16]-Commercial	PUC (SB7)[15]	SECO[15]	Wind-ERCOT[8]	SEER13 Single Family	SEER13 Multi Family
Annual Degradation Factor [11]	2.0%	2.0%	2.0%	5.0%	5.0%	0.0%	5.0%	5.0%
T&D Loss [9]	7.0%	7.0%	7.0%	7.0%	7.0%	0.0%	7.0%	7.0%
Initial Discount Factor [12]	20.0%	20.0%	20.0%	10.0%	60.0%	10.0%	20.0%	20.0%
Growth Factor	3.3%	1.5%	3.3%	0.0%	0.0%	4.8%	N.A.	N.A.
Weather Normalized	Yes	Yes	Yes	No	No	No	Yes	Yes

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

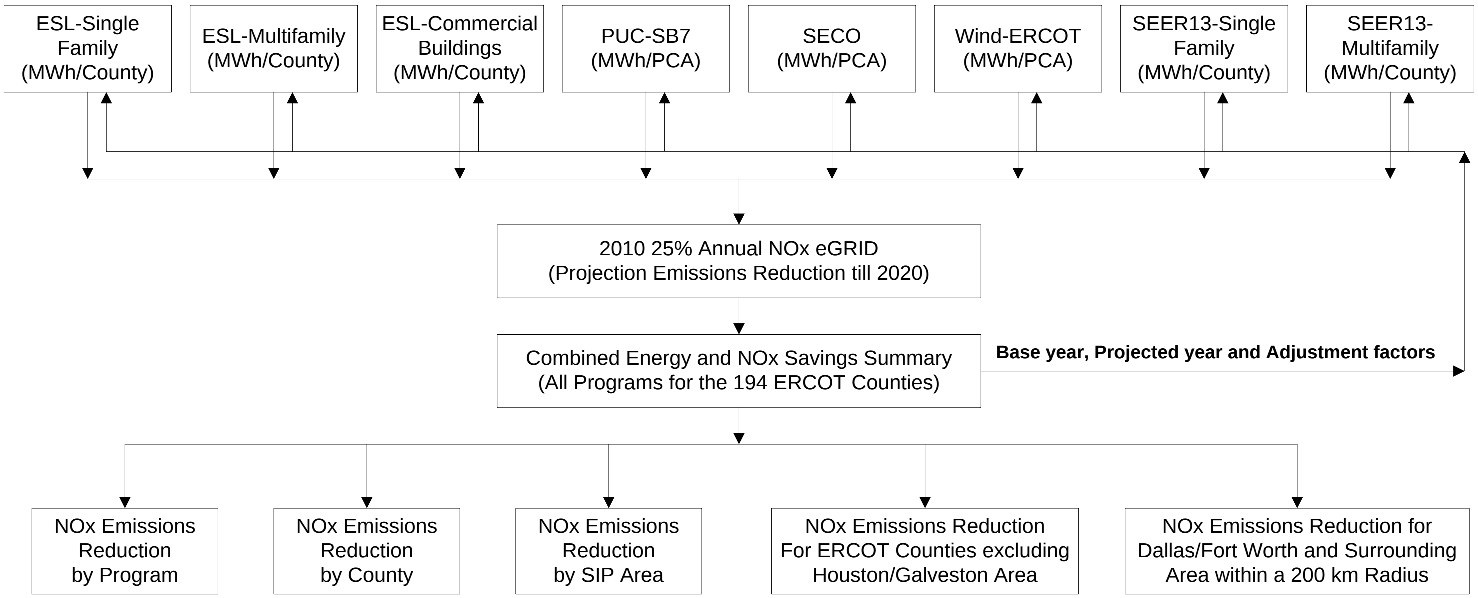


Figure 21: Process Flow Diagram of the NOx Emissions Reduction Calculations

Table 29: 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	5863.1467	0.0000071	0.6535	0.0000003	0.0016	0.0005265	40.1622	5903.96	2.95
	Chambers	0.0204500	2133.3552	0.0000026	0.2378	0.0000001	0.0006	0.0001916	14.6133	2148.21	1.07
	Fort Bend	0.0313463	3270.0646	0.0000040	0.3645	0.0000002	0.0009	0.0002937	22.3997	3292.83	1.65
	Galveston	0.0226620	2364.1080	0.0000029	0.2635	0.0000001	0.0006	0.0002123	16.1940	2380.57	1.19
	Harris	0.1486911	15511.5349	0.0000189	1.7289	0.0000009	0.0042	0.0013930	106.2530	15619.52	7.81
	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	134.9040	0.0079329	727.0449	0.0003832	1.7539	0.0000809	6.1733	869.88	0.43
	Dallas	0.0024826	258.9870	0.0152295	1395.7719	0.0007356	3.3672	0.0001554	11.8515	1669.98	0.83
	Denton	0.0001267	13.2136	0.0007770	71.2128	0.0000375	0.1718	0.0000079	0.6047	85.20	0.04
	Tarrant	0.0004742	49.4670	0.0029089	266.5950	0.0001405	0.6431	0.0000297	2.2637	318.97	0.16
	Ellis	0.0029920	312.1262	0.0183544	1682.1577	0.0008865	4.0581	0.0001873	14.2832	2012.63	1.01
	Johnson	0.0007256	75.6949	0.0044512	407.9462	0.0002150	0.9841	0.0000454	3.4639	488.09	0.24
	Kaufman	0.0059718	622.9863	0.0366343	3357.4922	0.0017695	8.0997	0.0003738	28.5084	4017.09	2.01
	Parker	0.0000012	0.1283	0.0000075	0.6913	0.0000004	0.0017	0.0000001	0.0059	0.83	0.00
	Rockwall	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Wise	0.0010202	106.4258	0.0062583	573.5658	0.0003023	1.3837	0.0000638	4.8701	686.25	0.34
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	1449.0751	0.0009368	85.8580	0.0000452	0.2071	0.1109355	8461.6472	9996.79	5.00
	Comal	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Guadalupe	0.0032029	334.1271	0.0002160	19.7971	0.0000104	0.0478	0.0255795	1951.0826	2305.05	1.15
	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	352.4181	0.0002278	20.8809	0.0000110	0.0504	0.0269798	2057.8902	2431.24	1.22
	Caldwell	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Hays	0.0008331	86.9124	0.0000562	5.1496	0.0000027	0.0124	0.0066537	507.5115	599.59	0.30
	Travis	0.0051785	540.2275	0.0003493	32.0086	0.0000169	0.0772	0.0413577	3154.5738	3726.89	1.86
	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	1341.3301	0.0008672	79.4741	0.0000419	0.1917	0.1026870	7832.4872	9253.48	4.63
	San Patricio	0.0015100	157.5191	0.0001018	9.3330	0.0000049	0.0225	0.0120591	919.8084	1086.68	0.54
Victoria Area	Victoria	0.0021192	221.0714	0.0001429	13.0985	0.0000069	0.0316	0.0169244	1290.9120	1525.11	0.76
Other ERCOT counties	Andrews	0.0000037	0.3906	0.0000230	2.1051	0.0039003	17.8531	0.0000002	0.0179	20.37	0.01
	Angelina	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Bosque	0.0022204	231.6358	0.0136212	1248.3667	0.0006579	3.0116	0.0001390	10.5999	1493.61	0.75
	Brazos	0.0024089	251.2953	0.0112305	1029.2655	0.0005425	2.4830	0.0047829	364.8180	1647.86	0.82
	Calhoun	0.0009466	98.7480	0.0000638	5.8508	0.0000031	0.0141	0.0075598	576.6235	681.24	0.34
	Cameron	0.0063536	662.8140	0.0004285	39.2719	0.0000207	0.0947	0.0507425	3870.3988	4572.58	2.29
	Cherokee	0.0027392	285.7501	0.0168033	1540.0077	0.0008116	3.7151	0.0001714	13.0762	1842.55	0.92
	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	200.4528	0.0006604	60.5209	0.0911346	417.1584	0.0146527	1117.6386	1795.77	0.90
	Fannin	0.0000041	0.4230	0.0000249	2.2798	0.0000012	0.0055	0.0000003	0.0194	2.73	0.00
	Fayette	0.0051867	541.0795	0.0103217	945.9712	0.0004986	2.2821	0.0283993	2166.1670	3655.50	1.83
	Freestone	0.0047643	497.0183	0.0292268	2678.6063	0.0014117	6.4619	0.0002982	22.7440	3204.83	1.60
	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
	Henderson	0.0006908	72.0621	0.0042376	388.3682	0.0002047	0.9369	0.0000432	3.2976	464.66	0.23
	Hidalgo	0.0053716	560.3655	0.0003623	33.2018	0.0000175	0.0801	0.0428994	3272.1668	3865.81	1.93
	Hood	0.0050771	529.6452	0.0311454	2854.4443	0.0015044	6.8861	0.0003178	24.2370	3415.21	1.71
	Howard	0.0002411	25.1535	0.0007641	70.0263	0.1283942	587.7096	0.0009490	72.3846	755.27	0.38
	Hunt	0.0088463	922.8543	0.0047066	431.3585	0.0002273	1.0406	0.0652823	4979.4299	6334.68	3.17
	Jack	0.0030783	321.1312	0.0188839	1730.6891	0.0009121	4.1751	0.0001927	14.6952	2070.69	1.04
	Jones	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Lamar	0.0040001	417.2969	0.0245388	2248.9595	0.0011853	5.4254	0.0002504	19.0959	2690.78	1.35
	Limestone	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Llano	0.0040314	420.5627	0.0002719	24.9184	0.0000131	0.0601	0.0321966	2455.8099	2901.35	1.45
	McLennan	0.0056576	590.2061	0.0347066	3180.8280	0.0016764	7.6735	0.0003541	27.0083	3805.72	1.90
	Milam	0.0012686	132.3417	0.0000856	7.8413	0.0000041	0.0189	0.0101316	772.7884	912.99	0.46
	Mitchell	0.0000311	3.2474	0.0001910	17.5012	0.0324260	148.4261	0.0000019	0.1486	169.32	0.08
	Nolan	0.0000293	3.0519	0.0001795	16.4479	0.0304745	139.4934	0.0000018	0.1397	159.13	0.08
	Palo Pinto	0.0036129	376.9036	0.0221635	2031.2661	0.0010705	4.9003	0.0002261	17.2474	2430.32	1.22
	Pecos	0.0000020	0.2055	0.0000121	1.1075	0.0020520	9.3929	0.0000001	0.0094	10.72	0.01
	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	412.1259	0.0055755	510.9865	0.0002693	1.2327	0.0246170	1877.6671	2802.01	1.40
	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	0.2653	0.0000156	1.4300	0.0026494	12.1275	0.0000002	0.0121	13.83	0.01
	Ward	0.0001995	20.8139	0.0012239	112.1737	0.2078335	951.3341	0.0000125	0.9525	1085.27	0.54
	Webb	0.0042017	438.3262	0.0002834	25.9709	0.0000137	0.0627	0.0335565	2559.5374	3023.90	1.51
	Wharton	0.0021095	220.0655	0.0001423	13.0389	0.0000069	0.0315	0.0168474	1285.0380	1518.17	0.76
	Wichita	0.0000121	1.2638	0.0000743	6.8108	0.0126190	57.7620	0.0000008	0.0578	65.89	0.03
	Wilbarger	0.0179710	1874.7449	0.1102430	10103.6592	0.0053249	24.3742	0.0011247	85.7899	12088.57	6.04
	Young	0.0071054	741.2391	0.0435880	3994.7982	0.0021054	9.6371	0.0004447	33.9197	4779.59	2.39
	Total	**0.4414501**	**46052.3029**	**0.4812863**	**44109.3980**	**0.5345786**	**2446.9721**	**0.6829349**	**52091.0965**	144699.77	**72.35**
Energy Savings (MWh)		104,321		91,649		4,577		76,275			

Table 30: 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	293,313	366,737	441,309	517,093	594,153	672,557	752,372
ESL-Multifamily (MWh)	0	50,218	94,867	167,566	262,939	357,717	463,922	569,704	675,096	780,131	884,845	989,268	1,093,435
ESL-Commercial (MWh)	0	0	25,750	54,550	87,230	126,228	170,173	214,773	260,065	306,088	352,880	400,483	448,937
PUC (SB7) (MWh)	0	538,841	976,984	1,437,883	1,831,318	2,267,414	2,675,295	3,062,781	3,430,894	3,780,601	4,112,822	4,428,433	4,728,263
SECO (MWh)	0	71,910	154,786	347,175	508,375	705,060	936,047	1,155,485	1,363,951	1,561,993	1,750,134	1,928,867	2,098,664
Wind-ERCOT (MWh)	0	3,273,150	8,135,429	10,995,427	13,049,580	15,723,534	18,857,560	19,757,605	20,700,609	21,688,621	22,723,790	23,808,366	24,944,707
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	23,684,427	25,400,797	27,131,950	28,881,552	30,653,297	32,450,913	34,278,170

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	1,002	1,199	1,400	1,604	1,811	2,022	2,237
ESL-Multifamily (MWh)	0	233	460	744	999	1,253	1,539	1,823	2,107	2,390	2,671	2,953	3,233
ESL-Commercial (MWh)	0	0	71	149	239	346	466	588	713	839	967	1,097	1,230
PUC (SB7) (MWh)	0	1,476	2,677	3,939	5,017	6,212	7,330	8,391	9,400	10,358	11,268	12,133	12,954
SECO (MWh)	0	197	424	951	1,393	1,932	2,565	3,166	3,737	4,279	4,795	5,285	5,750
Wind-ERCOT (MWh)	0	14,246	23,054	27,654	33,273	32,560	42,806	44,849	46,990	49,233	51,582	54,044	56,624
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	57,751	61,958	66,190	70,453	74,759	79,115	83,530

Table 31: Annual and OSD NOx Emissions Reduction Values for the Different Programs (Base Year 2008)

PROGRAM	ANNUAL (in tons NOx)												
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family	0	5	14	23	38	54	72	91	109	128	147	166	186
ESL-Multifamily	0	13	24	43	67	91	118	145	172	199	225	252	278
ESL-Commercial	0	0	6	14	22	32	43	54	66	77	89	101	114
PUC (SB7)	0	135	246	362	460	567	669	766	858	946	1,029	1,108	1,183
SECO	0	19	43	92	133	183	241	296	348	398	445	490	533
Wind-ERCOT	0	895	2,262	3,053	3,648	4,399	5,283	5,535	5,800	6,076	6,366	6,670	6,989
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	6,494	6,951	7,413	7,882	8,357	8,840	9,332

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	0.25	0.30	0.35	0.40	0.45	0.50	0.55
ESL-Multifamily	0	0.06	0.12	0.19	0.26	0.32	0.39	0.46	0.54	0.61	0.68	0.75	0.82
ESL-Commercial	0	0.00	0.02	0.04	0.06	0.09	0.12	0.15	0.18	0.21	0.24	0.28	0.31
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	0.66	0.81	0.95	1.09	1.22	1.34	1.46
Wind-ERCOT	0	3.93	6.40	7.62	9.28	9.06	11.97	12.55	13.15	13.77	14.43	15.12	15.84
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	15.70	16.81	17.94	19.08	20.23	21.39	22.58

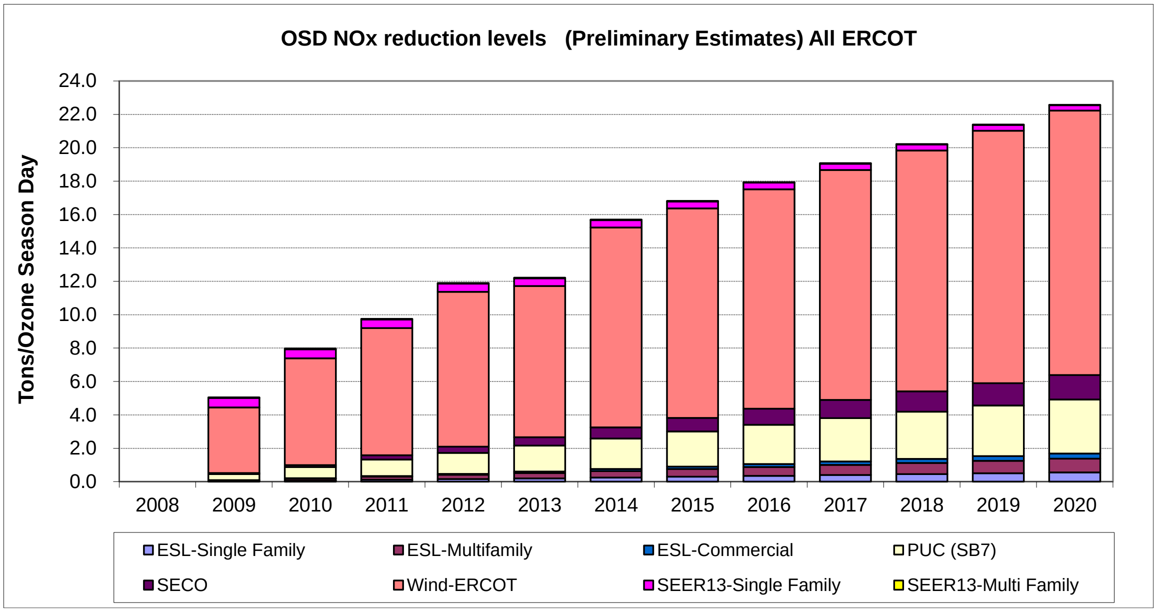


Figure 22: Integrated OSD NOx Emissions Reduction Projections through 2020 (Base Year 2008)

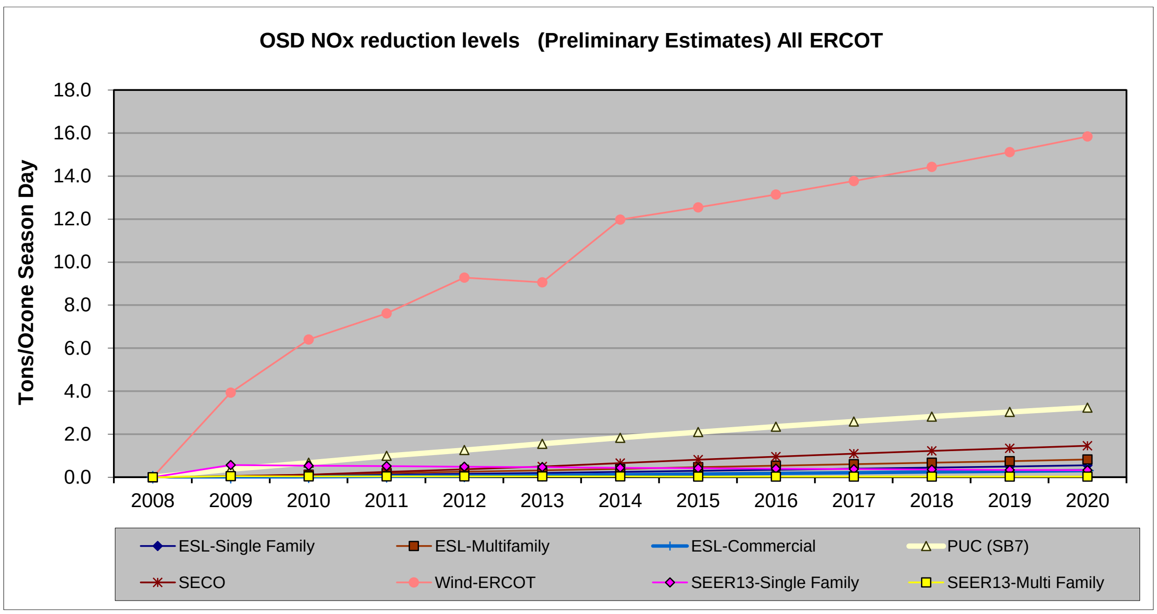


Figure 23: Integrated OSD Individual Programs NOx Emissions Reduction Projections through 2020 (Base Year 2008)

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*[45] and *TCV*[46]. 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. In 2014, the reports continued and numbers where gathered.

Figure 24 shows the Projects and Certificates issued each month from January 2014 to December 2014. 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 2014, some users entered a basic floor plan and re-cycled it to generate more certificates.

Figure 25 shows the cumulative Users and Certificates for 2014. 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.

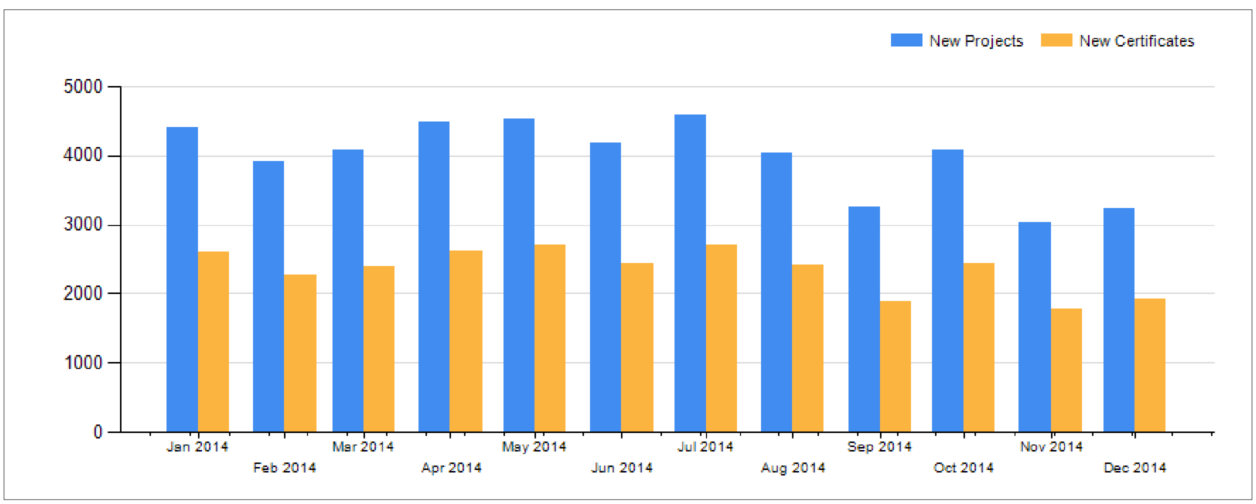


Figure 24: *IC3* 2014 Certificates and Projects

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

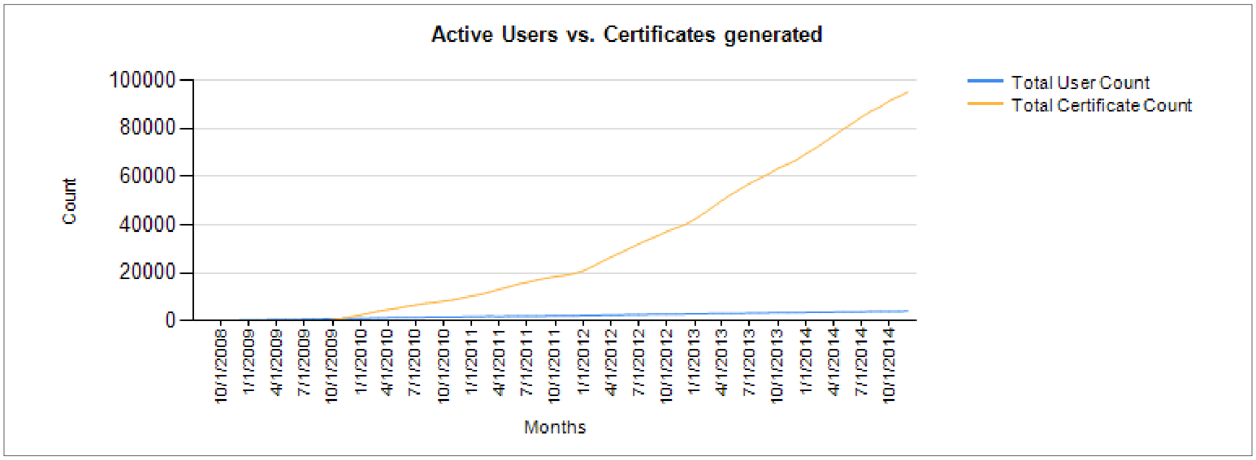


Figure 25: *IC3* 2014 Active Users and Certificates

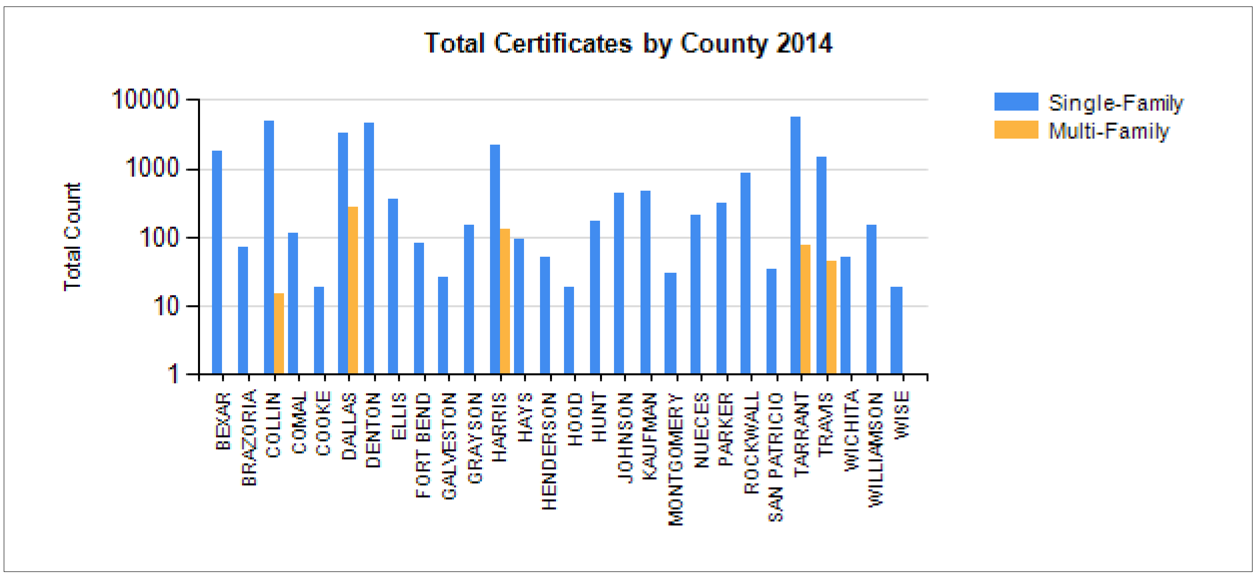


Figure 26: *IC3* 2014 Certificates – Counties with at least 10 Certificates

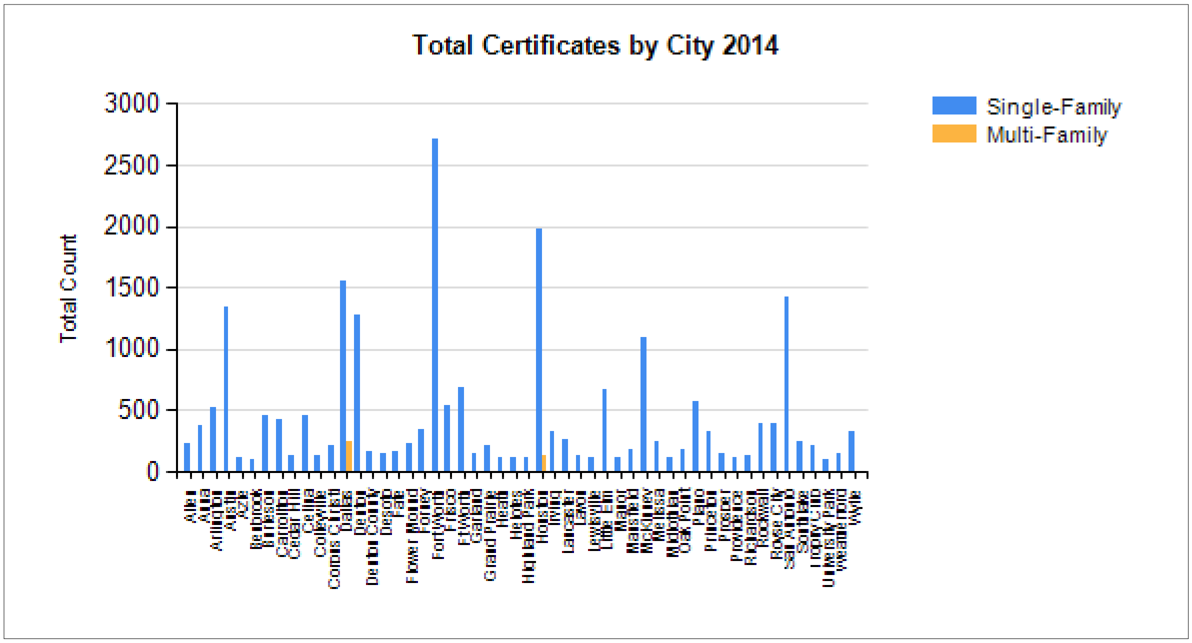


Figure 27: *IC3* 2014 Certificates – Cities with at least 200 Certificates

6.1.2 Texas Building Registry 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[47] (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.

[47] 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.

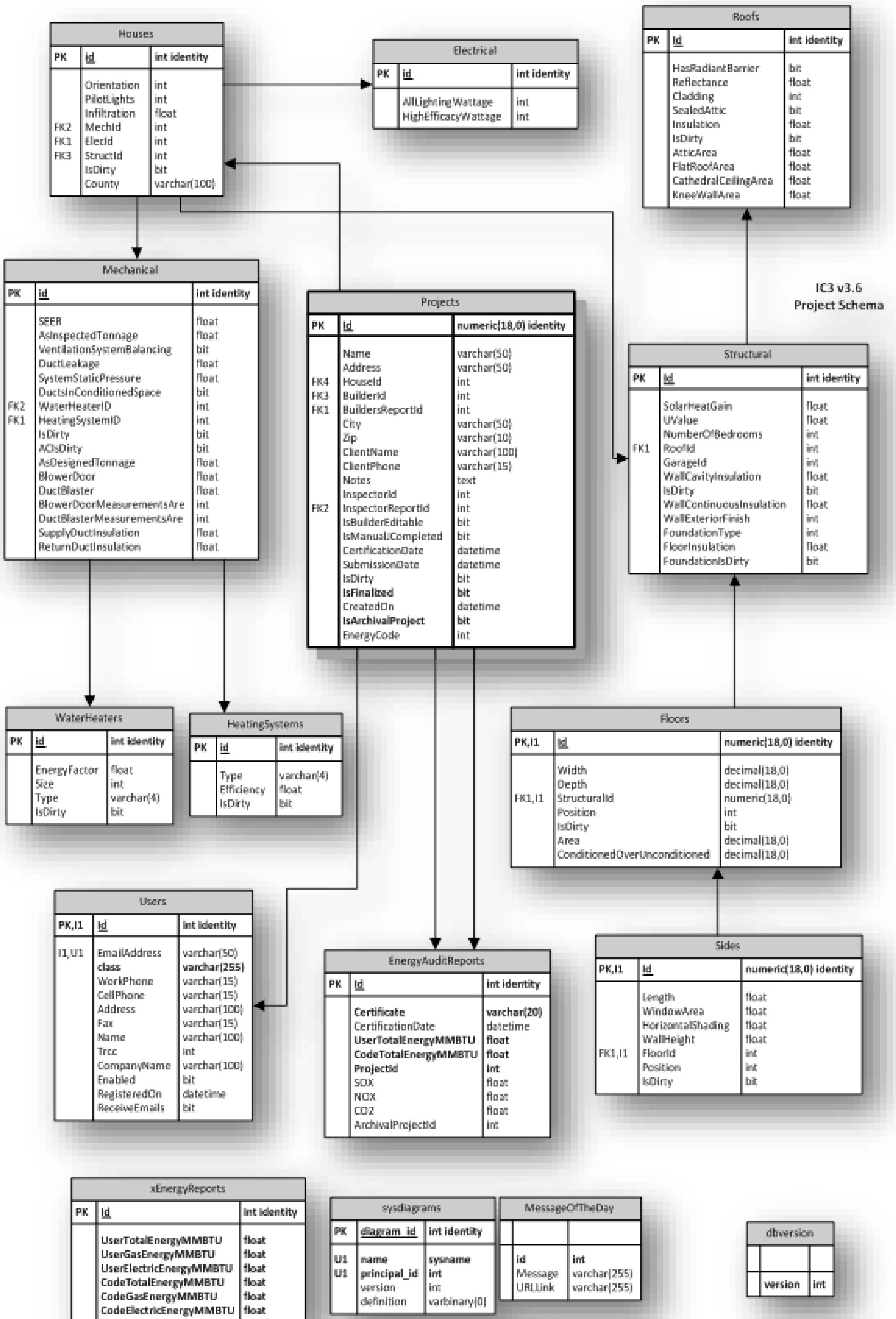


Figure 28: Database Schema

6.1.3 Usage Reports

Figure 29 shows a steady growth from the start of record keeping (July 2009) until the end of 2014. During this year, ESL conducted several workshops and was able to detect a correlation between workshops and IC3 usage.

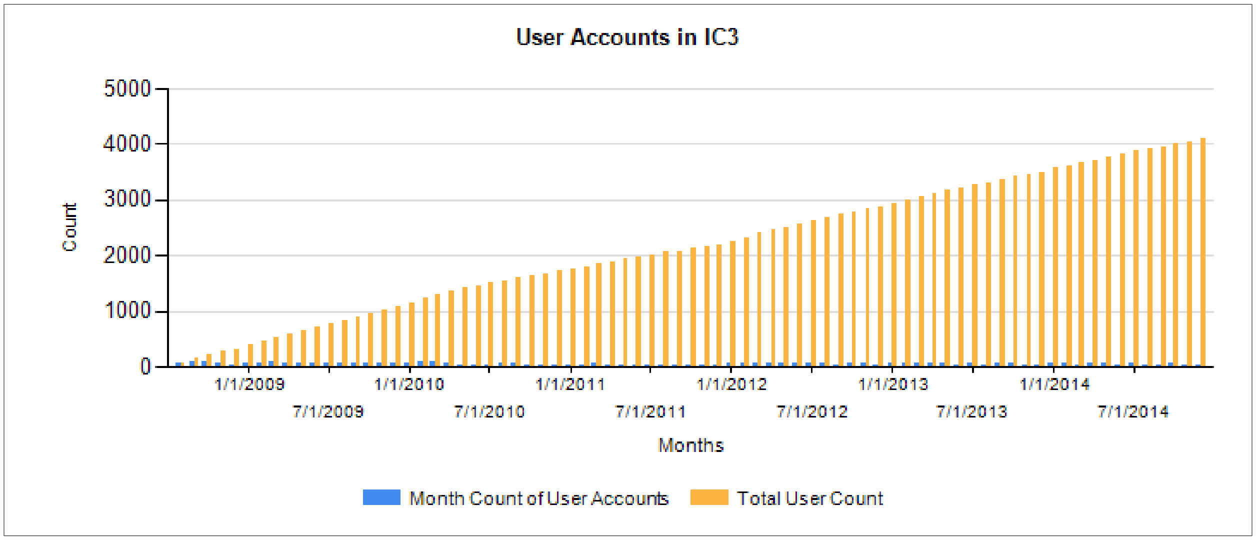


Figure 29: IC3 Usage Growth in 2014

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.

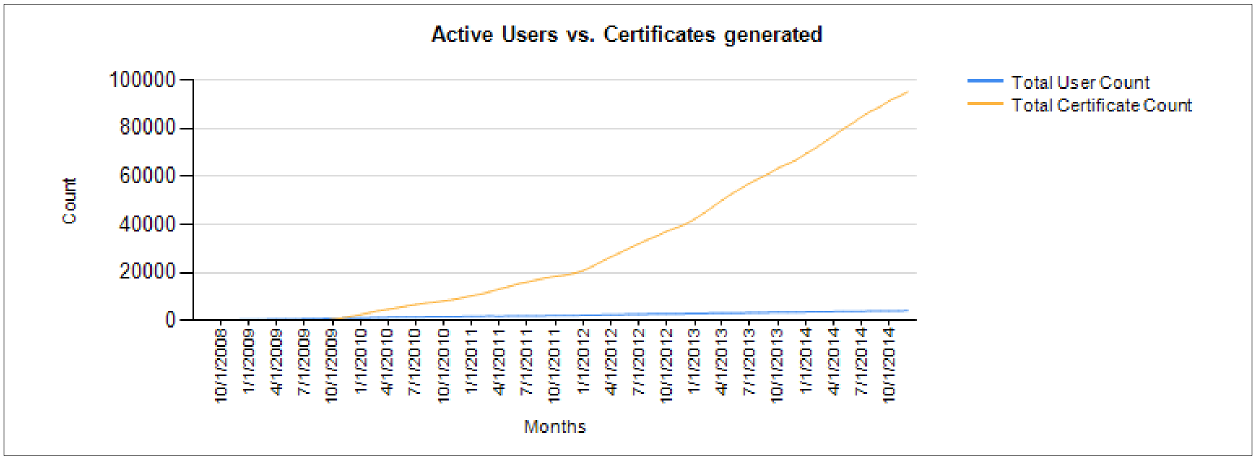


Figure 30: Users and Certificates 2014

Figure 31 through Figure 35 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 2014. In the figures, the colors change to show the lowest counts in the dark green all the way to the highest counts in red.

Counties Generating Single-Family HomesIC3 Certificates in 2014													
													Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
ANDERSON	0	0	0	0	0	0	0	1	0	1	0	0	2
BANDERA	1	0	0	0	0	0	0	2	0	0	0	0	3
BEXAR	182	148	153	166	156	165	145	117	102	247	74	88	1743
BRAZORIA	0	0	0	0	0	0	0	10	24	27	5	3	69
BRAZOS	0	0	0	0	0	1	0	0	0	0	0	0	1
COLLIN	483	539	501	460	452	387	334	343	290	338	339	261	4727
COMAL	0	8	8	4	0	5	5	28	11	9	15	18	111
COOKE	2	2	5	3	0	1	3	0	0	3	0	0	19
DALLAS	420	282	261	342	318	264	346	276	191	243	177	188	3308
DENTON	355	343	337	338	494	375	498	446	232	381	246	402	4447
ELLIS	39	7	19	50	24	17	41	21	17	27	38	58	358
FORT BEND	4	7	11	4	5	9	9	11	3	12	5	2	82
GALVESTON	2	2	1	2	1	0	1	0	2	1	8	6	26
GRAY	0	0	0	0	2	1	0	0	0	0	0	0	3
GRAYSON	30	6	14	16	16	10	10	15	15	5	7	3	147
GUADALUPE	0	0	0	0	0	0	0	0	0	1	0	0	1
HARRIS	213	143	206	195	192	220	201	201	109	121	178	159	2138
HAYS	0	5	1	19	26	0	6	11	9	8	0	5	90
HENDERSON	5	8	6	2	5	5	4	2	3	5	3	1	49
HOOD	2	0	0	0	3	3	0	4	3	0	2	1	18
HOUSTON	0	0	0	0	0	0	0	0	0	1	2	0	3
HUNT	8	6	28	31	9	34	39	6	6	3	1	3	174
JACK	0	0	0	0	0	0	1	0	0	0	0	0	1
JEFFERSON	0	0	0	3	0	0	0	0	0	0	0	0	3
JOHNSON	35	42	46	37	32	46	31	28	30	24	19	64	434
KAUFMAN	47	25	33	40	74	44	47	34	37	26	30	24	461
KENDALL	0	0	0	0	0	0	0	0	0	0	0	6	6
LIBERTY	0	0	0	0	0	2	3	0	0	0	0	0	5
MATAGORDA	0	0	0	0	0	0	0	1	1	0	0	0	2
MCLENNAN	0	0	0	0	0	0	0	0	0	2	0	0	2

Figure 31: Counties Generating Single-Family HomesIC3 Certificates in 2014

MEDINA	0	0	0	0	0	1	0	0	0	3	0	3	7
MONTGOMERY	1	0	0	0	0	1	0	4	11	0	8	4	29
MOORE	0	0	0	0	1	0	0	0	0	0	0	0	1
NUECES	19	18	16	18	10	21	27	16	20	15	15	17	212
PALO PINTO	2	1	2	0	0	0	0	1	0	2	2	0	10
PARKER	33	23	22	23	17	28	25	21	35	28	37	28	320
RANDALL	0	0	0	0	1	0	0	0	2	0	0	0	3
ROCKWALL	109	68	92	103	90	70	59	49	44	66	35	48	833
SAN PATRICIO	1	0	7	2	0	0	2	4	2	5	5	5	33
SMITH	0	0	2	0	2	0	0	0	2	0	0	0	6
TARRANT	328	390	481	501	500	507	618	467	463	532	363	393	5543
TAYLOR	1	0	2	1	0	1	1	0	0	0	0	0	6
TOM GREEN	0	0	0	0	0	1	0	0	0	0	0	0	1
TRAVIS	71	120	87	185	176	135	149	138	105	151	58	63	1438
VAL VERDE	0	0	2	0	0	0	0	2	1	0	0	5	10
VAN ZANDT	0	1	0	0	0	0	0	0	0	0	0	0	1
WASHINGTON	0	0	0	0	0	0	0	0	1	0	0	0	1
WICHITA	17	5	0	1	7	2	1	0	5	8	1	4	51
WILLIAMSON	1	5	5	20	26	16	11	7	12	18	14	12	147
WILSON	0	0	0	0	0	0	0	0	0	0	4	0	4
WISE	1	4	1	3	1	0	3	0	1	2	2	1	19

Figure 31: (Continued)

Counties Generating Multi-Family Homes IC3 Certificates in 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
COLLIN	0	10	0	0	0	2	0	0	0	0	3	0	15
DALLAS	115	14	0	12	10	0	7	65	12	0	33	6	274
ELLIS	0	0	0	0	1	0	0	0	0	0	0	0	1
HARRIS	2	3	16	0	12	29	2	0	1	66	1	0	132
PARKER	0	0	0	0	0	0	0	0	0	0	1	0	1
TARRANT	4	3	5	0	1	17	12	7	11	18	0	0	78
TRAVIS	4	3	2	3	10	1	6	1	0	9	4	2	45

Figure 32: Counties Generating Multi-Family Homes IC3 Certificates in 2014

Cities Generating Single-Family Homes IC3 Certificates in 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
	0	0	0	0	0	0	0	1	0	1	0	0	2
Houston	0	0	1	0	1	0	0	1	0	1	0	0	4
San Antonio	1	0	0	1	0	0	2	0	0	0	0	0	4
75230	0	0	0	1	0	0	0	0	0	0	0	0	1
a	3	0	0	0	0	0	0	0	0	0	0	0	3
Abilene	0	0	2	1	0	1	0	0	0	0	0	0	4
Abilene	1	0	0	0	0	0	1	0	0	0	0	0	2
Addison	4	2	1	0	0	0	0	0	0	0	0	0	7
adf	0	0	0	0	0	0	0	0	1	0	0	0	1
Aledo	3	15	5	8	5	3	2	1	0	2	18	6	68
Allen	22	16	23	25	33	26	24	16	8	8	7	16	224
Alvarado	3	6	4	7	10	1	2	5	0	0	0	0	38
Alvin	0	0	0	0	0	0	0	9	24	27	5	3	68
Anetta	0	0	0	0	0	0	0	0	0	2	0	0	2
Anna	93	73	35	51	11	17	13	12	22	25	16	4	372
Annetta	0	0	0	0	0	0	0	0	0	0	2	0	2
Argyle	5	2	0	6	2	3	0	3	4	3	4	5	37
Arlington	33	33	35	43	53	76	66	62	38	32	31	24	526
Athens	0	0	0	0	0	0	0	0	1	0	0	0	1
Aubrey	1	7	0	10	22	7	3	1	0	1	5	1	58
Aurora	1	1	0	0	0	0	1	0	0	0	0	0	3
Aurora	0	0	0	0	1	0	0	0	0	0	0	0	1
Ausitn	0	0	0	0	0	0	0	2	0	0	0	0	2
Austin	27	106	0	178	186	140	133	117	103	154	65	50	1259
Austin	0	0	82	0	0	0	0	0	0	0	0	0	82
Austin Tx	0	0	0	0	0	0	0	0	0	0	0	2	2
Austin Tx.	0	0	0	0	0	0	0	0	0	0	0	1	1
Autin	1	4	0	0	0	0	0	0	0	0	0	0	5
Azle	6	9	11	2	7	10	14	6	8	0	2	30	105
Azle	0	0	0	0	0	0	0	0	0	1	0	0	1

Figure 33: Cities Generating Single-Family Homes IC3 Certificates in 2014

Azle/Reno	0	0	0	3	0	0	0	0	0	0	0	0	3
Balch Springs	0	0	0	0	1	0	1	0	0	0	0	0	2
Bartonville	2	0	1	2	0	0	0	1	0	1	0	0	7
Bay City	0	0	0	0	0	0	0	1	1	0	0	0	2
Baytown	0	0	2	0	0	0	0	0	0	0	0	0	2
Beaumont	0	0	0	3	0	0	0	0	0	0	0	0	3
Bedford	0	0	2	4	7	1	2	0	0	0	0	0	16
Bedford	0	0	0	0	0	0	0	0	0	3	0	0	3
Bee Cave	0	0	0	13	0	0	0	0	0	0	0	0	13
BELLAIR	0	0	0	0	0	0	1	0	0	0	0	0	1
Bellaire	2	0	0	1	1	0	0	0	0	0	0	3	7
Belverde	0	2	1	1	0	0	0	1	2	0	0	1	8
Benbrook	7	3	8	4	3	6	7	10	9	15	12	18	102
Benbrooks	1	0	3	0	0	0	0	1	0	0	0	0	5
Bilverde	0	0	0	0	0	0	0	0	0	0	0	1	1
Blue Ridge	0	0	0	0	0	0	0	0	0	0	1	0	1
Boeme	0	0	0	0	0	0	0	0	0	2	0	2	4
Boerne	9	1	2	4	1	9	5	0	1	4	0	0	36
Boerne	0	0	0	0	0	0	0	0	0	0	0	6	6
Brenham	0	0	0	0	0	0	0	0	1	0	0	0	1
Brookside Village	0	0	0	0	0	0	0	1	0	0	0	0	1
Bryan	0	0	0	0	0	1	0	0	0	0	0	0	1
Buda	0	0	0	1	0	0	0	0	0	0	0	0	1
Bulverde	0	6	0	1	0	4	6	15	1	0	0	0	33
Bulverde	0	0	2	0	0	0	0	0	0	3	4	8	17
Bunker Hill Village	0	0	0	0	4	3	0	0	0	0	0	0	7
Burelson	0	1	0	0	0	0	0	0	0	0	0	0	1
Burleson	41	41	53	37	28	47	40	31	36	0	0	64	418
Burleson	0	0	0	0	0	0	0	0	0	25	19	0	44
Burlesonb	0	0	0	1	0	0	0	0	0	0	0	0	1
Caddo Mills	1	0	0	0	0	0	0	0	0	0	0	0	1
Canyon	0	0	0	0	1	0	0	0	2	0	0	0	3

Figure 33: Continued

Carollton	0	0	1	0	0	0	0	0	0	0	0	0	1
Carrollton	0	0	63	15	79	36	18	49	19	22	13	32	346
Carrollton	41	32	0	0	0	0	0	0	0	0	0	0	73
Carrolton	1	4	2	4	3	6	2	1	3	2	3	1	32
Castroville	0	0	0	0	4	4	6	1	0	0	0	0	15
Castroville	0	0	0	0	0	0	0	0	0	4	1	3	8
Cedar Hiil	0	0	0	0	0	0	0	0	0	0	1	0	1
Cedar Hill	6	2	15	13	13	10	12	8	0	6	12	17	114
Cedar hill	0	0	0	0	0	0	0	0	7	0	0	0	7
Cedar Hill, TX	0	0	0	0	1	0	0	0	0	0	0	0	1
Celina	51	62	145	31	16	8	22	37	21	40	18	7	458
Chandler	0	4	0	0	0	0	0	1	2	5	0	0	12
Chapel Hill	0	1	1	0	2	0	0	0	0	0	0	0	4
Chesmar Homes	0	0	0	0	0	0	0	0	0	1	0	0	1
Cibolo	10	2	0	0	0	0	4	0	0	2	0	0	18
clarence	0	0	0	0	0	1	0	0	0	0	0	0	1
Clear Lake Shores	0	0	0	2	1	0	0	0	0	0	0	1	4
Cleburne	1	0	1	0	1	1	0	0	1	0	4	2	11
Colleyville	10	9	15	9	7	15	10	14	8	4	10	10	121
Combine	0	3	0	0	0	0	0	1	0	0	0	0	4
Conroe	0	2	0	0	0	1	0	6	12	0	8	4	33
Conroe	0	0	0	0	0	0	0	0	0	2	0	0	2
Converse	0	0	0	0	0	0	1	0	1	0	0	0	2
Copeville	0	0	0	13	1	0	2	4	7	4	0	0	31
Coppell	8	8	12	3	2	4	13	9	8	5	0	4	76
Copper Canyon	0	0	0	0	7	2	1	0	0	0	1	3	14
Corinth	0	1	3	3	1	3	1	10	1	4	5	2	34
Cornith	0	0	2	0	0	0	0	0	0	0	0	0	2
Corpus Christi	19	18	16	18	10	21	27	16	20	15	15	17	212
County	0	2	0	0	0	0	0	0	0	0	0	0	2
Crandall	3	4	3	2	5	1	3	2	3	8	4	4	42
Crandell	0	0	2	0	0	0	0	0	0	0	0	0	2

Figure 33: Continued

Cresson	0	1	0	0	0	0	0	2	0	0	0	0	3
Cresson	0	0	1	0	0	0	0	0	0	0	0	0	1
Cro	0	0	0	1	0	0	0	0	0	0	0	0	1
Crosby	0	0	0	0	0	0	1	0	0	0	0	0	1
Cross Roads	16	2	7	20	4	1	2	3	5	1	0	1	62
Crossroads	2	2	7	0	0	1	0	20	16	2	1	1	52
Crowely	0	0	2	1	0	0	0	0	2	2	0	0	7
Crowley	15	23	10	11	0	12	0	0	1	0	0	0	72
Cumby	0	0	0	0	0	0	0	1	0	0	0	0	1
Dallas	174	169	154	176	147	126	146	117	98	87	71	80	1545
Dalworthington Gardens	0	0	0	0	0	0	0	0	3	0	0	0	3
Dayton	0	0	0	0	0	0	3	0	0	0	0	0	3
Dayton`	0	0	0	0	0	0	0	0	0	1	0	0	1
Decatur	0	0	0	1	0	0	0	0	0	0	0	0	1
Del Rio	0	0	2	0	0	0	0	2	1	0	0	5	10
Denon	0	0	0	0	2	3	0	0	0	0	0	0	5
Denton	82	55	42	59	129	104	188	167	46	202	53	143	1270
Denton County	0	52	26	37	3	12	9	7	0	5	2	5	158
Denton Master	0	0	0	0	0	0	0	0	0	0	0	4	4
DeSoto	17	10	13	12	5	8	19	3	14	17	9	11	138
Dish	0	0	0	0	0	0	0	0	1	0	0	0	1
Double Oak	2	0	0	0	0	0	0	0	0	0	1	0	3
Driftwood	0	0	1	3	0	0	0	0	0	0	0	0	4
Dumas	0	0	0	0	1	0	0	0	0	0	0	0	1
Duncanville	3	2	1	0	0	1	1	0	0	0	0	0	8
Ennis	2	0	0	0	0	0	0	3	0	3	0	0	8
Ennis	0	0	1	0	0	0	0	0	0	0	0	0	1
Euless	1	4	3	2	6	3	19	5	8	6	2	4	63
Fair Oak Ranch	0	0	0	0	0	0	0	0	1	0	0	0	1
Fair Oaks	0	0	0	2	0	0	0	0	0	0	0	0	2
Fair Oaks	0	0	0	0	1	0	0	0	1	0	0	4	6
Fair Oaks Ranch	0	0	0	0	7	4	0	3	2	0	2	0	18

Figure 33: Continued

Fair Oaks Ranch	0	0	3	2	0	0	2	0	0	0	0	3	10
Fairs Oaks Ranch	0	0	0	0	0	1	0	0	0	0	0	0	1
Fairview	1	0	0	5	1	3	0	0	2	1	0	1	14
Farmers Branch	0	1	0	3	3	2	5	0	0	4	4	3	25
Farmersville	0	1	1	0	0	5	0	0	3	1	0	0	11
Fate	50	16	27	25	16	4	4	4	6	5	0	0	157
Fate	0	0	0	0	0	0	0	0	0	0	4	3	7
Floresville	0	0	0	0	0	0	0	0	0	0	4	0	4
Flower Mound	23	0	5	26	49	12	9	10	21	18	6	37	216
Flower Mound	0	18	0	0	0	0	0	0	0	0	0	0	18
Flowermound	0	0	1	0	0	0	0	1	0	1	0	0	3
Flowermound TX	0	6	0	0	0	0	0	0	0	0	0	0	6
Forest Hill	0	0	0	0	0	0	0	4	0	0	1	0	5
Forney	39	14	26	33	62	43	39	22	28	2	16	9	333
Fort Worth	0	0	1	0	0	0	0	0	0	0	0	0	1
Fort Worth	181	188	272	285	257	211	281	211	238	241	187	168	2720
Fort Worth, TX	0	0	0	0	0	0	0	1	0	0	0	0	1
Fort Worth, Tx.	2	0	0	0	0	0	0	0	0	0	2	0	4
FORTH WORTH	0	1	0	0	0	2	0	4	0	0	0	0	7
Fortworth	1	0	5	0	1	11	0	0	0	52	2	0	72
Fprt Worth	0	0	0	0	0	0	0	1	0	0	0	0	1
Freeport	0	0	0	0	0	0	1	0	0	0	0	0	1
Frisco	39	54	41	30	32	30	62	48	47	55	57	39	534
Frot Worth	0	0	0	0	0	0	0	0	1	0	0	0	1
Frt Worth	0	0	0	0	0	0	1	0	0	0	0	0	1
Ft Worth	0	25	0	52	47	37	86	88	66	85	61	64	611
Ft Worth	27	0	45	0	0	0	0	0	0	0	0	0	72
FT WORTH, TX	0	0	0	0	0	0	0	0	2	1	0	0	3
Ft. Worth	3	7	6	4	0	0	4	1	0	2	2	0	29
ft.worth	0	0	0	0	0	0	4	0	0	0	0	0	4
Fulshear	0	0	0	0	0	0	0	2	0	0	0	0	2

Figure 33: Continued

Gainesville	0	2	3	3	0	1	3	0	0	3	0	0	15
Gaineville	0	0	2	0	0	0	0	0	0	0	0	0	2
Galveston	2	2	1	0	0	0	2	0	0	0	0	1	8
Garden Ridge	0	0	0	0	0	0	0	0	0	0	2	0	2
Garland	19	10	0	22	7	4	8	2	11	33	13	9	138
Garpevine	0	0	0	0	0	0	0	0	0	1	0	0	1
Georgetown	1	0	0	0	0	0	0	0	0	0	0	0	1
Glenn Heights	1	0	0	3	0	0	2	5	1	0	0	1	13
Godley	0	0	0	3	0	0	0	0	0	0	0	0	3
Gordon	2	1	2	0	0	0	0	1	0	2	2	0	10
Gordonville	0	0	2	0	0	0	0	3	0	0	2	0	7
Gran Prairie	0	0	0	0	0	0	0	0	0	1	0	0	1
Granbury	2	0	0	0	3	3	0	2	3	0	2	1	16
Grand Pairie	0	0	0	0	1	0	0	0	0	0	0	0	1
Grand Prairae	0	0	1	0	0	0	0	0	0	0	0	0	1
Grand Praire	0	0	0	0	0	0	0	0	1	0	0	0	1
Grand Prairie	15	12	14	10	31	22	28	17	12	21	13	16	211
Grand Prarie	0	0	0	0	2	0	1	0	0	0	0	0	3
Grandview	0	0	0	0	0	3	0	0	0	0	0	0	3
Grapevine	1	2	1	7	12	19	28	3	2	6	0	4	85
Greenville	6	2	9	9	6	8	9	1	3	0	1	1	55
Gun Barrel City	1	4	0	1	5	3	3	1	0	0	3	1	22
Gunter	0	0	0	4	1	0	0	0	0	1	0	0	6
Hackberry	19	9	1	4	20	1	0	3	2	4	0	7	70
Haltom City	3	0	0	3	0	0	0	0	1	2	0	0	9
Haslet	1	0	1	3	7	2	3	9	5	1	1	2	35
Heartland	5	0	1	0	3	0	5	9	4	4	0	3	34
Heath	12	5	5	11	13	5	8	19	10	6	8	14	116
Hedwig Village	0	0	1	0	0	0	0	0	0	0	0	0	1
Helotes	11	2	4	14	2	18	14	0	6	24	2	8	105
Helotes	0	0	0	0	0	0	0	8	0	0	0	0	8
Hickory Creek	0	0	3	7	4	7	2	1	4	5	5	18	56
Highland Park	0	3	6	8	9	17	17	3	5	15	0	7	90

Figure 33: Continued

Highland Park	11	0	0	0	0	0	0	0	0	0	3	0	14
Highland Village	0	1	2	0	0	3	4	1	2	0	5	0	18
Houson	0	0	0	0	0	0	0	0	0	2	0	0	2
Houston	184	129	180	184	179	201	204	186	101	107	172	151	1978
Hudson Oaks	7	2	1	3	0	7	10	3	0	11	4	4	52
HUFFMAN	0	0	0	1	0	3	1	2	0	0	0	0	7
Humble	0	1	7	1	0	0	0	3	0	0	0	0	12
Humble T.X.	0	0	0	0	0	0	0	0	0	0	3	0	3
Hurst	3	0	0	0	0	1	0	1	3	0	0	0	8
Hutchins	0	0	0	1	0	0	0	0	0	0	0	0	1
Irving	45	14	14	39	0	0	40	32	0	34	19	21	258
Irving	0	0	0	0	32	31	0	0	11	0	0	0	74
Irving.	0	0	0	0	1	0	0	0	0	0	0	0	1
Itving	0	3	0	0	0	0	0	0	0	0	0	0	3
Jacksboro	0	0	0	0	0	0	1	0	0	0	0	0	1
Jamaica Beach	0	0	0	0	0	0	0	0	0	0	0	1	1
Josaphine	2	0	0	0	0	0	0	0	0	0	0	0	2
Josephine	1	3	1	1	0	0	0	0	0	0	64	1	71
Joshua	0	0	0	0	0	1	0	0	1	0	0	1	3
Justin	1	2	0	4	0	0	0	5	4	3	4	2	25
Katy	9	7	1	7	9	9	7	11	4	6	4	1	75
Kaufman	0	5	1	0	0	0	0	0	0	1	0	0	7
Keene	0	2	0	0	0	2	2	0	0	0	0	0	6
Keller	5	1	4	11	3	5	3	2	11	3	7	5	60
Kennedale	0	1	1	0	8	1	3	0	3	1	0	0	18
Kingwood	10	1	6	2	2	2	0	0	1	0	0	0	24
Krugerville	0	0	0	0	0	0	8	0	0	0	0	1	9
Krum	3	9	13	2	11	2	9	1	0	0	0	0	50
Kum	0	0	0	0	0	0	5	0	0	0	0	0	5
Kyle	0	5	0	12	24	0	6	11	9	8	0	5	80
La Porte	0	0	1	0	0	0	0	0	0	0	0	0	1
Lake Dallas	1	0	3	0	1	0	0	0	0	0	0	0	5

Figure 33: Continued

Lake Worth	0	1	5	0	4	0	0	0	0	0	0	1	11
Lakeside	2	0	0	0	0	0	0	0	0	0	0	0	2
Lakewood Village	0	2	0	0	0	0	0	1	0	4	1	0	8
Lancaster	51	13	2	26	33	5	48	40	7	5	23	2	255
Lantana	4	4	3	3	1	2	0	0	0	0	0	0	17
Laporte	0	0	0	0	0	0	0	0	0	0	0	2	2
Las Colinas	0	0	0	0	0	5	0	0	0	0	0	0	5
Lavon	19	15	13	30	13	14	8	1	9	6	1	7	136
League City	0	0	0	0	0	0	0	0	1	1	8	3	13
Leander	0	0	1	0	2	0	0	0	0	0	7	2	12
Lewisville	13	15	12	2	1	13	14	6	3	6	0	21	106
Liberty	0	0	0	0	0	2	0	0	0	0	0	0	2
Liberty Hill	0	0	0	0	0	0	0	0	0	1	0	0	1
Little Elm	0	60	55	0	63	52	69	42	0	33	64	80	518
Little Elm	49	0	0	52	0	0	0	0	42	0	0	0	143
Lucas	5	5	4	4	3	19	15	7	2	3	5	5	77
Lytle	0	0	2	0	0	0	0	0	0	0	0	0	2
Magnolia	1	0	0	0	0	0	0	0	0	0	0	0	1
Malakoff	4	0	6	1	0	2	1	0	0	0	0	0	14
Mannor	0	0	0	0	0	0	0	0	0	3	0	0	3
Manor	12	14	0	14	10	6	0	12	12	8	0	18	106
Mansfield	14	27	14	18	24	21	11	10	10	10	7	18	184
Mansfield, TX	0	0	0	0	0	0	0	0	0	1	0	0	1
Master Denton	0	0	0	0	0	0	0	0	0	0	0	6	6
Mc Kinney	4	32	0	0	0	0	0	10	0	1	0	4	51
McClendon Chisholom	0	0	0	0	0	0	0	0	0	0	0	1	1
McClendon Chislom	0	0	0	2	0	0	0	0	0	0	0	0	2
McKinney	99	144	129	92	76	89	53	51	100	70	88	99	1090
McKinney, Texas	0	0	0	0	2	0	0	0	0	0	0	0	2
McKinny	0	0	0	0	0	0	0	0	1	0	0	0	1

Figure 33: Continued

Mclendon Chishlom	0	0	0	0	0	0	0	0	1	0	0	0	1
McLendon Chisholm	0	1	6	1	13	1	5	7	0	3	2	5	44
Mclendon-Chisholm	2	0	0	0	0	0	3	0	0	0	0	0	5
McLendon-Chishom	0	0	0	0	0	3	0	0	0	0	0	0	3
McLendon-Chisolm	0	0	0	0	0	10	0	0	0	0	0	0	10
Melissa	14	16	10	35	30	23	41	34	14	10	4	6	237
Mellisa	1	0	0	0	0	0	0	0	0	0	0	0	1
Mesquite	2	0	8	0	1	4	0	0	0	4	0	3	22
Mico	0	0	0	0	0	1	0	0	0	0	0	0	1
Midlothian	22	4	12	22	5	4	17	4	8	4	2	13	117
Millsap	0	0	0	0	0	0	0	0	0	0	1	0	1
Missouri City	1	0	0	0	0	0	0	0	0	0	0	2	3
Murphy	5	6	1	17	6	5	7	0	3	4	0	0	54
N. Richland Hills	1	0	0	0	0	0	0	0	0	0	0	0	1
Needville	2	0	0	0	0	0	0	0	0	0	3	0	5
New Braunfels	3	4	6	3	0	2	2	13	7	6	6	6	58
New Braunsfels	1	0	0	0	0	0	0	0	0	0	0	0	1
New Fairview	2	0	0	0	0	0	0	0	0	1	0	0	3
North Lake	0	0	0	0	0	1	0	1	0	0	0	1	3
North Richland Hills	6	12	3	7	9	5	13	3	11	9	3	1	82
Northlake	6	4	5	6	0	3	1	3	1	0	3	4	36
Oak Leaf	0	0	0	0	0	0	0	0	0	0	0	3	3
Oak Point	23	14	25	11	6	18	31	5	16	14	9	8	180
Ovilla	2	0	0	2	0	0	0	4	0	6	2	1	17
Pampa	0	0	0	0	2	1	0	0	0	0	0	0	3
Pantego	0	5	0	0	1	0	0	0	1	0	0	0	7
Parker	3	4	0	1	1	0	2	1	0	0	0	1	13
Pflugerville	1	0	0	0	0	0	0	0	0	0	0	0	1
Pilot Point	0	0	0	0	0	0	0	0	0	0	13	0	13
Pilot Point	0	0	0	0	0	0	0	0	0	0	0	1	1

Figure 33: Continued

Pipe Creeek	0	0	0	0	0	0	0	2	0	0	0	0	2
Plano	58	59	39	62	30	68	51	48	35	63	24	34	571
Poetry	0	0	0	0	0	0	0	0	0	1	1	0	2
Ponder	0	0	0	6	0	0	0	0	0	0	0	0	6
Porsper	0	0	0	1	0	1	0	0	0	0	0	0	2
Portland	1	0	7	2	0	0	2	4	2	5	5	5	33
Post Oak Bend	0	0	0	0	0	0	0	0	0	3	7	0	10
Post Oak Bend City	0	0	0	0	0	0	0	0	0	0	0	5	5
Princeton	18	16	3	12	126	59	27	46	3	2	8	10	330
Prosper	23	11	22	14	10	12	25	15	1	6	0	4	143
Providence	11	10	12	10	7	16	13	11	7	7	5	7	116
Quinlan	0	2	0	0	0	0	0	0	1	1	0	1	5
Red Oak	1	1	5	8	15	12	8	4	6	13	2	11	86
Reno	0	0	0	0	0	0	0	1	0	1	0	0	2
Rhome	0	1	0	2	0	0	2	0	1	0	0	0	6
Richardson	10	10	12	14	13	11	6	28	3	7	3	7	124
Richmond	0	0	0	2	0	0	0	0	0	0	0	0	2
River Oaks	0	0	1	0	0	0	0	0	0	0	0	0	1
River Oaks	0	0	0	0	0	0	0	0	2	0	0	0	2
Roanoke	6	1	0	3	2	5	9	9	1	15	1	0	52
Rockwall	36	39	0	63	33	35	27	16	16	47	9	16	337
Rockwall	0	0	46	0	0	0	0	0	0	0	0	0	46
Roesenberg	0	0	0	0	0	0	0	0	0	0	1	0	1
ROSENBERG	0	0	1	0	0	0	0	0	0	0	0	0	1
Round Rock	0	0	3	0	0	0	0	0	0	0	0	0	3
Rowlett	0	6	2	2	1	4	2	1	0	1	1	3	23
Royce City	0	0	0	0	0	0	1	0	0	0	0	0	1
Royse city	24	0	54	28	79	40	73	26	0	9	0	17	350
Royse City	0	10	0	0	0	0	0	0	17	0	13	0	40
Runaway Bay	0	0	1	1	0	0	0	0	0	1	2	1	6
Sache	0	0	0	0	0	0	0	0	0	0	0	1	1
Sachse	3	3	1	2	1	4	2	9	3	9	5	3	45

Figure 33: Continued

Saginaw	1	7	13	6	8	11	4	7	0	5	0	10	72
San Antonio	2	3	4	0	2	0	2	2	0	1	1	0	17
San Antoni	0	0	0	0	0	0	0	0	0	0	0	1	1
San Antonio	140	0	0	139	134	0	103	93	87	204	67	67	1034
San Antonio	0	133	131	0	0	127	0	0	0	0	0	0	391
San Antonio,	1	0	0	0	1	0	0	0	0	0	0	0	2
Sanger	7	4	3	4	0	14	11	5	1	0	7	4	60
Savanna	0	0	0	0	0	0	0	0	2	0	0	0	2
Savannah	0	1	0	0	32	9	7	3	4	4	4	4	68
Schertz	3	2	7	0	1	2	3	0	4	0	4	5	31
Schertz	0	0	0	4	0	0	0	9	0	4	0	0	17
Seabrook	7	0	1	0	0	0	0	0	0	0	0	0	8
Seagoville	29	6	0	2	30	0	0	0	0	2	1	3	73
Seguin	2	0	0	0	3	0	0	0	0	0	0	0	5
Selma	0	1	0	0	1	0	0	0	0	5	0	0	7
Seogoville	0	1	0	0	0	0	0	0	0	0	0	0	1
Shady Shores	4	0	0	0	0	0	0	2	2	0	0	0	8
Shamrock Gardens, DeSoto	0	0	0	0	0	0	0	0	0	1	0	0	1
Sherman	16	3	10	10	13	5	5	11	8	4	5	2	92
South Lake	0	0	0	0	0	0	0	0	0	10	1	0	11
South Lake	0	4	0	0	0	0	0	0	0	0	0	0	4
Southlake	15	8	14	19	12	31	52	17	12	24	15	20	239
Spicewood	0	1	1	1	0	5	0	2	0	0	0	0	10
Spring	0	0	0	0	0	0	0	0	1	0	0	0	1
Spring Branch	0	0	0	0	1	0	0	0	0	0	0	0	1
Spring Valley	0	0	3	0	0	0	0	0	0	0	0	1	4
Springtown	0	0	0	0	0	4	0	0	0	0	0	0	4
St Paul	1	0	0	0	0	0	0	0	0	0	0	0	1
STAFFORD,TX	0	0	0	0	0	0	0	2	0	0	0	0	2
Sugar Land	0	5	10	2	5	9	9	9	3	12	1	0	65
Sugarland	1	2	0	0	0	0	0	0	0	0	0	0	3
Sunnyvaile	0	0	0	0	1	0	0	0	0	0	0	0	1

Figure 33: Continued

Sunnyvale	1	3	2	0	1	0	4	2	0	0	2	0	15
Sunnyvale	0	0	0	0	0	0	0	0	0	0	0	2	2
Sunnyvalle	0	0	0	0	1	0	0	0	0	0	0	0	1
Talty	0	0	0	0	0	0	0	0	0	2	1	0	3
Taylor	0	0	0	0	0	0	0	2	0	0	0	0	2
Terrell	0	1	0	5	3	0	0	0	2	5	1	3	20
Texas City	0	0	0	0	0	0	0	0	1	0	0	0	1
The Colony	0	0	5	1	1	6	1	1	9	0	0	1	25
Tioga	0	3	0	0	0	1	0	0	0	0	0	0	4
Tomball	0	0	0	0	0	0	0	0	2	1	1	1	5
Town of Hickory Creek	0	0	0	0	0	0	0	4	0	0	0	0	4
Trophy Club	17	22	18	24	14	19	17	48	7	6	11	6	209
Tyler	0	0	2	0	2	0	0	0	2	0	0	0	6
Univeristy Park	0	0	0	0	0	0	0	0	0	1	0	0	1
Univeristy Park	0	0	0	0	0	0	0	0	0	0	1	0	1
University Park	22	5	4	9	3	10	7	6	12	7	16	2	103
Universtiy Park	0	0	0	1	0	0	0	0	0	0	0	0	1
Unveristy Park	0	0	0	0	0	0	0	0	0	0	0	1	1
Unversity Park	0	0	0	0	0	0	0	0	0	0	1	0	1
Van Alstyne	14	1	3	2	2	3	5	1	7	0	0	1	39
Van Alystyne	0	0	0	0	0	1	0	0	0	0	0	0	1
Venus	1	8	4	1	3	6	1	0	2	0	0	0	26
Wakefield	0	0	0	0	0	0	0	0	0	1	0	0	1
Watauga	3	0	0	0	4	0	0	0	0	0	0	0	7
Waxachie	1	0	0	0	0	0	0	0	0	0	0	0	1
Waxahachie	10	2	2	13	2	1	13	1	1	0	22	20	87
Weaherford	0	0	0	0	0	4	2	0	0	0	0	0	6
Weatherfor	0	0	0	0	0	0	0	0	0	0	0	1	1
Weatherford	18	2	6	8	12	7	7	9	33	13	8	17	140
West	0	0	0	0	0	0	0	0	0	2	0	0	2
West Lake Hills	4	0	0	0	0	0	0	0	0	0	0	0	4
West University	0	0	0	0	0	1	0	0	0	0	0	0	1

Figure 33: Continued

West University Place	1	3	4	0	0	1	0	0	0	1	0	0	10
Westlake	0	1	2	4	0	7	2	2	3	4	1	0	26
Westlake	1	0	0	0	3	0	0	0	0	0	0	0	4
Wheatherford	0	0	0	0	0	0	0	0	0	0	3	0	3
White Settlement	0	0	0	0	0	0	2	0	0	0	0	0	2
Wichita Falls	17	3	0	1	7	2	1	0	5	6	1	4	47
Wichita Falls TX	0	1	0	0	0	0	0	0	0	0	0	0	1
Wichita Falls Tx.	0	0	0	0	0	0	0	0	0	2	0	0	2
Wichta Falls	0	1	0	0	0	0	0	0	0	0	0	0	1
Willow Park	4	3	0	1	0	0	0	4	2	0	0	0	14
Wills Point	0	1	0	0	0	0	0	0	0	0	0	0	1
Wilmer	0	0	0	0	2	6	0	3	7	0	1	0	19
Woodway	0	0	0	0	0	0	0	0	0	0	1	0	1
Wylie	24	23	20	40	14	17	6	15	15	51	65	27	317

Figure 33: Continued

Cities Generating Multi-Family Homes IC3 Certificates in 2014													
													Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0	1	0	0	0	0	0	0	0	0	0	0	1
Addison	0	0	0	0	0	0	0	0	0	0	0	2	2
Arlington	0	0	0	0	0	5	3	0	0	0	0	0	8
Austin	4	2	2	3	1	1	6	1	0	9	4	2	35
Benbrook	0	0	0	0	0	2	0	0	0	0	0	0	2
Cedar Hill	2	5	0	0	0	0	0	0	0	0	0	0	7
Dallas	101	3	0	6	10	0	4	65	12	0	33	4	238
fgf	0	0	0	0	9	0	0	0	0	0	0	0	9
Fort Worth	1	3	5	0	1	10	9	7	11	18	0	0	65
Frisco	0	0	0	0	0	0	0	0	0	0	4	0	4
Highland Park	12	6	0	0	0	0	0	0	0	0	0	0	18
Houston	2	3	16	0	12	29	2	0	1	66	1	0	132
Midlothian	0	0	0	0	1	0	0	0	0	0	0	0	1
Princeton	0	10	0	0	0	2	0	0	0	0	0	0	12
Southlake	3	0	0	0	0	0	0	0	0	0	0	0	3
University Park	0	0	0	6	0	0	3	0	0	0	0	0	9

Figure 34: Cities Generating Multi-Family Homes IC3 Certificates in 2014

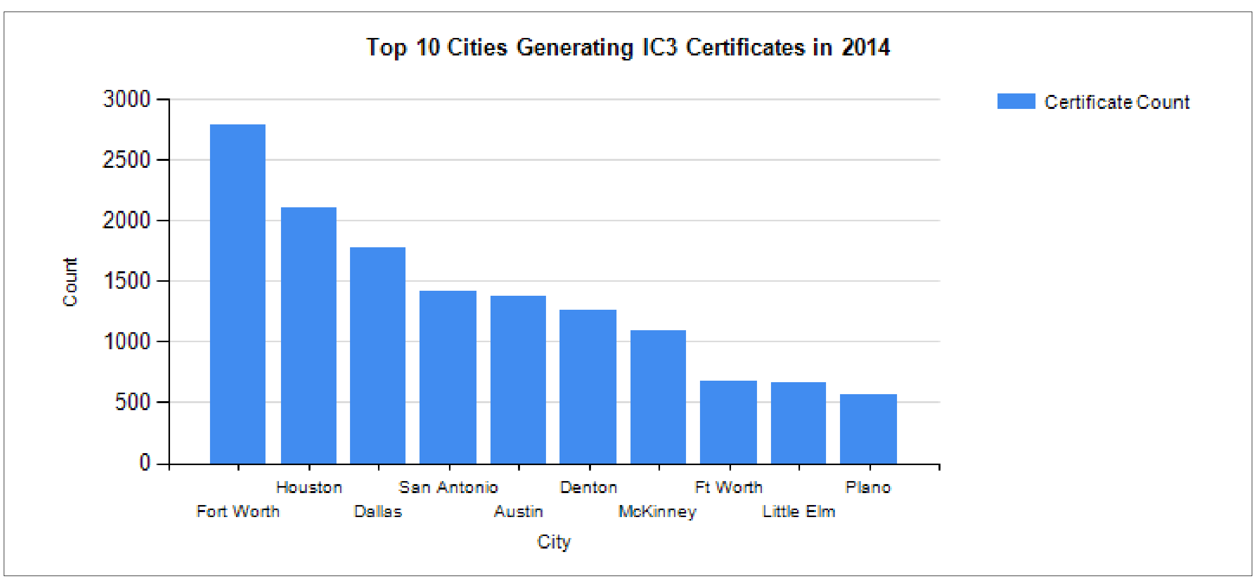


Figure 35: Top 10 Cities Generating Certificates in 2014

6.1.4 Parameter Reports

A unique and valuable use of the Registry is to look at building trends across the state. This report shows the yearly average wall cavity insulation distribution in Texas for 2014. In Figure 36 we see ranges, for Single-Familyhomes, of 13 to 16.55 with an average of 13.99. Last year's average was 13.95. The total count of Single-Family Homesis 18654, which is 985 more than last year. In Figure 37 we see ranges, for Multi-Family Homes , of 13.51 to 18.53 with an average of 17.07. Last years average was 15.10. The total count Multi-Family Homes is 313, which is 87 more than last year

Yearly Average Wall Cavity Insulation Distribution for 2014

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

	Total Count	Average Wall Cavity Insulation	Standard Deviation
Single Family	18654	13.99	2.17
Multi Family	313	17.07	3.33

Single Family

County	Avg Wall Cavity	House Count
Williamson	16.55	91
Harris	16.52	1164
Travis	15.06	845
San patricio	15.00	27
Nueces	15.00	193
Wichita	14.82	38
Bexar	14.41	1264
Dallas	14.30	2196
Comal	13.95	80
Collin	13.93	3500
Henderson	13.79	34
Galveston	13.75	16
Denton	13.51	2909
Cooke	13.46	13
Tarrant	13.46	4106
Johnson	13.40	310
Wise	13.35	17
Rockwall	13.35	606
Brazoria	13.29	21
Fort bend	13.22	59
Ellis	13.20	282
Kaufman	13.13	364
Parker	13.11	220
Hunt	13.07	114
Hays	13.02	53
Montgomery	13.00	16
Grayson	13.00	116

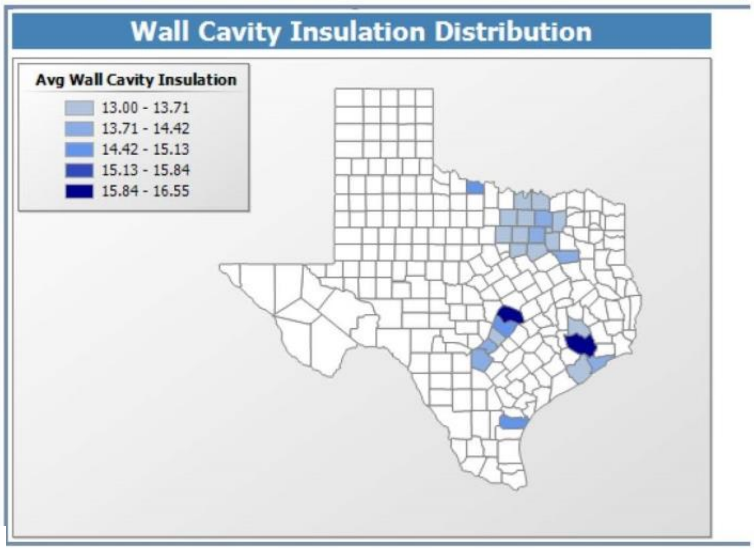


Figure 36: Yearly Average Wall Cavity Insulation Distribution by County for Single-Family Homes in 2014

Multi Family

County	Avg Wall Cavity	Unit Count
Dallas	18.53	167
Travis	17.20	75
Tarrant	13.51	71

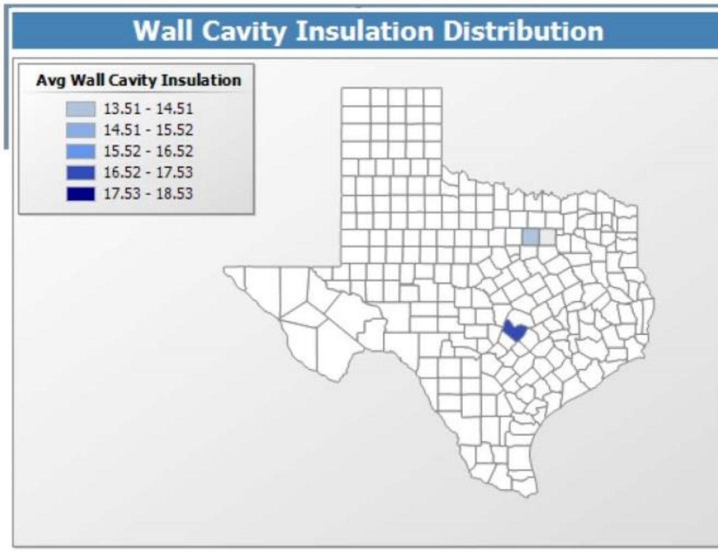


Figure 37: Yearly Average Wall Cavity Insulation Distribution by County for Multi-Family Homes in 2014

This report shows both natural gas and electric water heater efficiencies across Texas in 2014. In Figure 38 the ranges, for Single-Familyhomes, for natural gas are 0.58 to 0.92 with an average of 0.90. The ranges for electric are 0.82 to 0.93 with an average of 0.70. Last year's average for natural gas was 0.90 and electric was 0.68. In Figure 39, the ranges, for Multi-Family, for natural gas are 0.59 to 0.88 with an avergae of 0.75. The ranges for electric are 0.85 to 0.91 with an average of 0.86. Last year's average for natural gas was 0.74 and electric was 0.86.

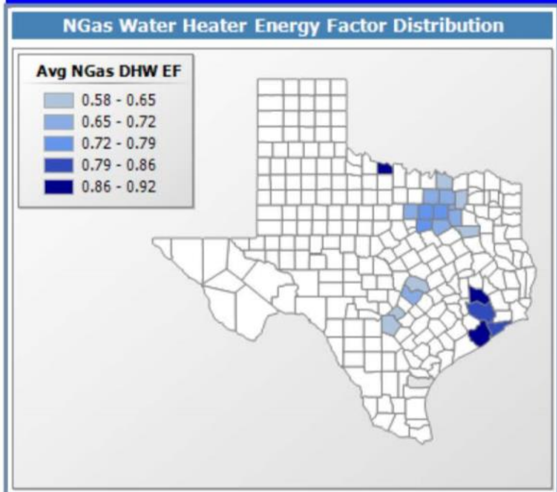
Yearly Average Water Heater Energy Factor Distribution for 2014

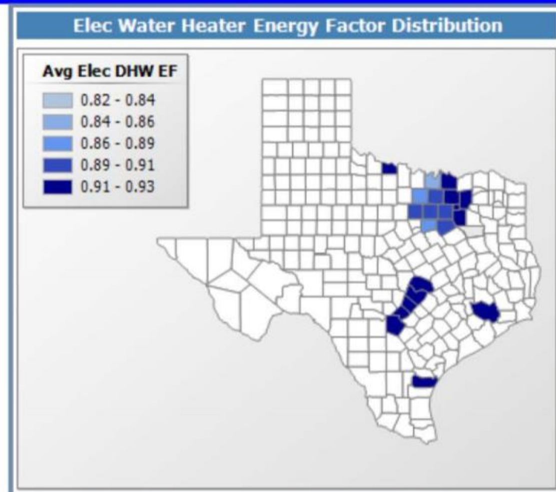
Overall Data Statistics derived from a subset of Counties having house count > 10

	Total Count	Average NGas EF	Standard Deviation
Single Family	7035	0.90	0.05
Multi Family	251	0.75	0.16

	Total Count	Average Elec EF	Standard Deviation
Single Family	11628	0.70	0.13
Multi Family	62	0.86	0.11

Single Family



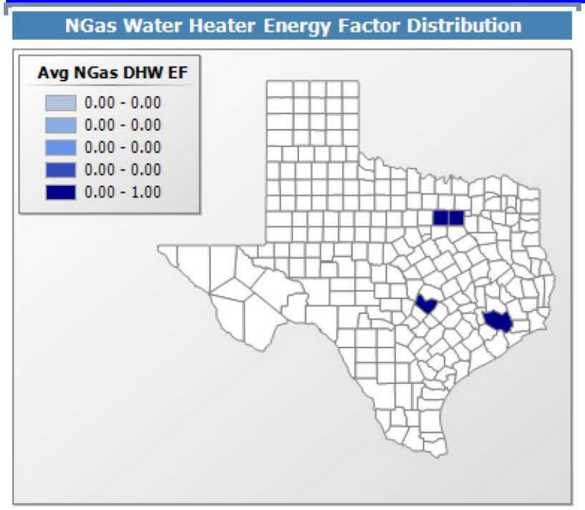


County	Avg NGas WH EF	House Count
Brazoria	0.92	21
Wichita	0.89	27
Montgomery	0.87	16
Galveston	0.83	15
Fort bend	0.82	59
Harris	0.81	1086
Dallas	0.75	1496
Johnson	0.75	57
Tarrant	0.72	1875
Ellis	0.69	64
Travis	0.68	586
Denton	0.67	1715
Rockwall	0.67	507
Collin	0.66	2452
Kaufman	0.65	185
Parker	0.65	49
Comal	0.64	41
Bexar	0.64	1085
Grayson	0.63	63
Hunt	0.61	11
Williamson	0.60	56
Henderson	0.58	11
Nueces	0.58	138

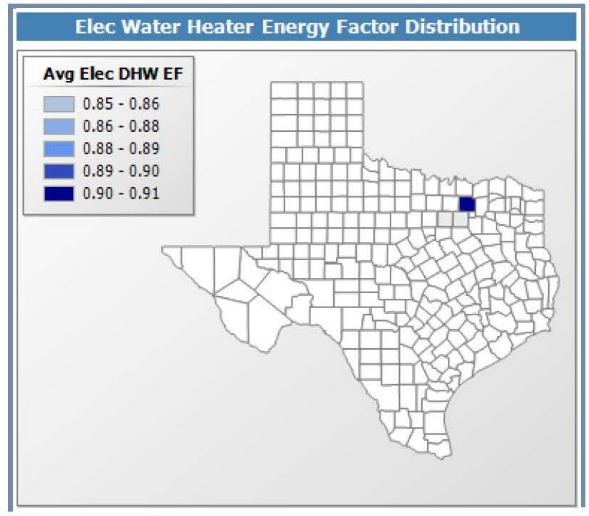
County	Avg Elec WH EF	House Count
Williamson	0.93	35
San patricio	0.93	27
Nueces	0.93	55
Wichita	0.93	11
Harris	0.93	78
Hays	0.93	49
Travis	0.93	258
Comal	0.92	39
Hunt	0.92	103
Kaufman	0.91	179
Bexar	0.91	179
Collin	0.91	1048
Grayson	0.91	53
Rockwall	0.91	99
Denton	0.91	1194
Parker	0.91	171
Ellis	0.90	218
Tarrant	0.90	2231
Dallas	0.89	700
Wise	0.88	15
Johnson	0.86	253
Cooke	0.86	12
Henderson	0.82	23

Figure 38: Yealry Average Water Heater Energy Factor Distribution for Single-Family Homes in 2014

Multi Family



County	Avg NGas WH EF	Unit Count
Harris	0.88	12
Dallas	0.80	134
Travis	0.69	75
Tarrant	0.59	30



County	Avg Elec WH EF	Unit Count
Dallas	0.91	33
Collin	0.91	13
Tarrant	0.85	41

Figure 39: Yealry Average Water Heater Energy Factor Distribution for Multi-Family Homes in 2014

This report shows the average window to wall ratio across Texas in 2014.
The formula used is: 100 * <total window area sq. ft.> / <total wall area sq. ft.>
In Figure 40 we see ranges, for Single-Familyhomes, from 8.14 to 14.83 with an average of 11.89. Last year's average was 11.89. In. Figure 41 we see ranges, for Multi-Family Homes , from 12.72 to 30.46 with an average of 21.76. Last year's average was 18.06.

Average Window to Wall Area Ratio across Counties for 2014

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

	Average	Standard Deviation
Single Family	11.89	3.55
Multi Family	21.76	15.29

Single Family

County	Avg Window To Wall Area	House Count
Henderson	14.83	34
Bexar	13.93	1264
Galveston	13.34	16
Comal	13.23	80
Wise	13.09	17
Ellis	12.83	282
Fort bend	12.81	59
Dallas	12.76	2196
Rockwall	12.59	606
Denton	12.03	2909
Grayson	11.99	116
Williamson	11.86	91
Collin	11.62	3500
Tarrant	11.53	4106
San patricio	11.40	27
Johnson	11.37	310
Travis	11.20	845
Parker	11.16	220
Nueces	10.84	193
Kaufman	10.84	364
Harris	10.79	1164
Hays	10.69	53
Montgomery	9.97	16
Hunt	9.55	114
Cooke	9.35	13
Wichita	8.20	38
Brazoria	8.14	21

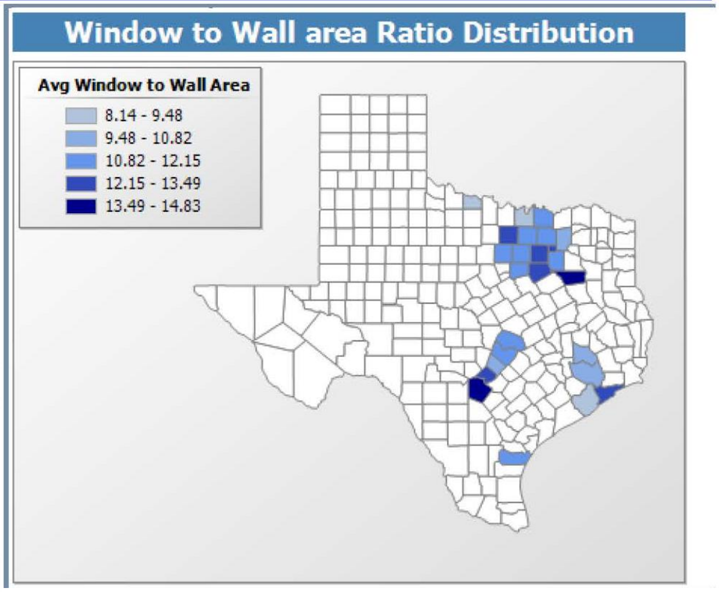


Figure 40: Average Window to Wall Ratio across Counties for Single-Family Homes in 2014

Multi Family

County	Avg Window To Wall Area	Unit Count
Dallas	30.46	31
Travis	24.00	21
Tarrant	12.72	35

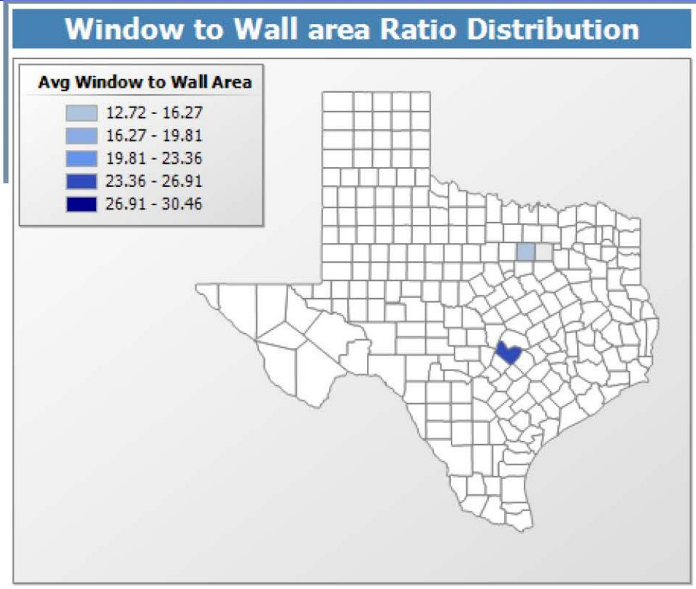


Figure 41: Average Window to Wall Ratio across Counties for Multi-Family Homes in 2014

This report shows the average A/C SEER across Texas in 2014. The efficiency (and sizing) of air conditioning is a vital component of energy efficiency in Texas. In Figure 42 we see ranges, for Single-Familyhomes, from 13.34 to 15.95 with and average of 14.70. Last year's average was 14.68. In Figure 43 we see ranges, for Multi-Family Homes , from 13.80 to 15.53 with an average of 14.42. Last year's average was 14.55.

Average A/C SEER across Counties for 2014

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

	Average	Standard Deviation
Single Family	14.70	1.14
Multi Family	14.42	1.22

Single Family

County	Avg SEER Value	House Count
Brazoria	15.95	21
Fort bend	15.80	59
Montgomery	15.63	16
Bexar	15.40	1264
Wichita	15.38	38
Harris	15.34	1164
Galveston	15.25	16
Williamson	15.20	91
Henderson	15.18	34
San patricio	15.06	27
Nueces	15.02	193
Travis	14.95	845
Johnson	14.86	310
Denton	14.73	2909
Dallas	14.71	2196
Comal	14.70	80
Collin	14.63	3500
Cooke	14.46	13
Tarrant	14.44	4106
Ellis	14.38	282
Grayson	14.34	116
Parker	14.29	220
Rockwall	14.26	606
Hunt	14.24	114
Wise	14.13	17
Kaufman	14.09	364
Hays	13.34	53

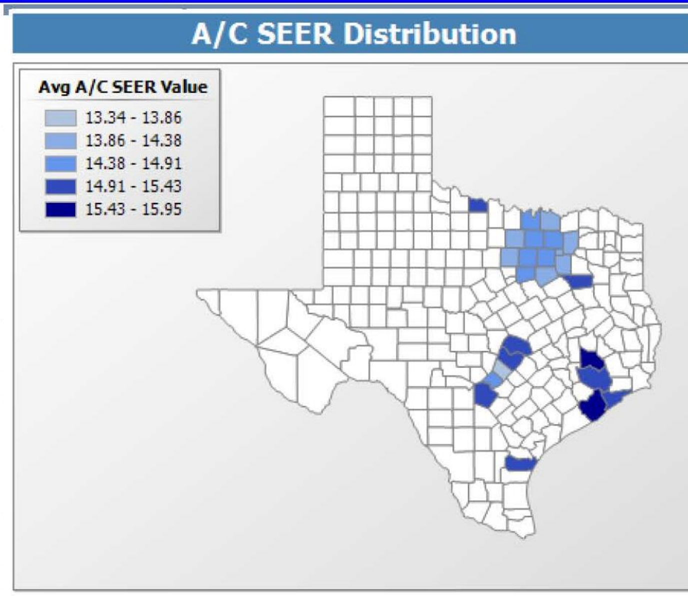


Figure 42: Average A/C SEER across Counties for Single-Family Homes in 2014

Multi Family

County	Avg SEER Value	Unit Count
Travis	15.53	75
Dallas	14.19	167
Tarrant	13.80	71

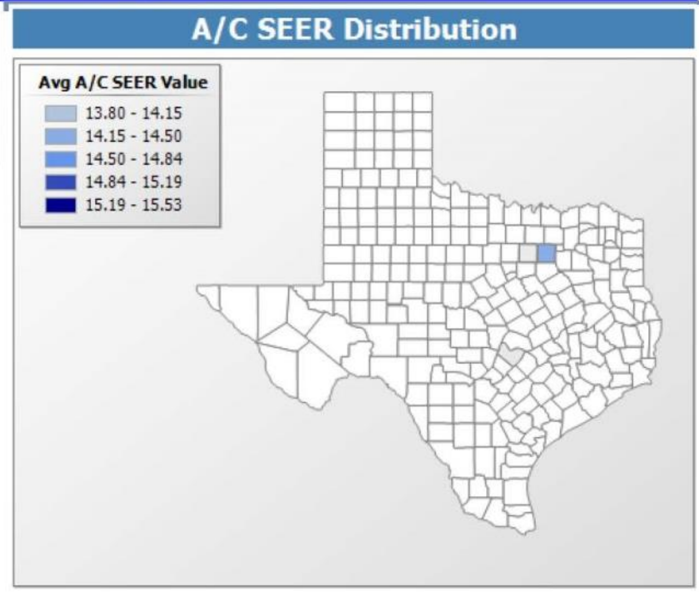


Figure 43 Average A/C SEER across Counties for Multi-Family Homes in 2014.

This report shows the average ceiling insulation across Texas in 2014. In Figure 44 we see ranges, for Single-Family Homes, from 30.00 to 38.63 with and average of 34.26. Last year’s average was 34.18. In Figure 45 we see ranges, for Multi-Family Homes , from 33.50 to 38.71 with an average of 35.30. Last year’s average was 35.02.

Average Ceiling Insulation across Counties for 2014

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

	Average	Standard Deviation
Single Family	34.26	5.06
Multi Family	35.30	5.80

Single Family

County	Avg Ceiling Insulation	House Count
Wichita	38.63	38
Cooke	37.69	13
Rockwall	36.99	606
Travis	36.76	845
Williamson	36.68	91
Fort bend	36.36	59
Johnson	36.23	310
Ellis	36.12	282
Parker	35.45	220
Collin	35.44	3500
Henderson	35.30	34
Bexar	35.19	1264
Grayson	35.16	116
Denton	34.90	2909
Kaufman	34.75	364
Comal	34.63	80
Hunt	34.23	114
Dallas	33.85	2196
Wise	33.29	17
Tarrant	32.26	4106
Harris	31.86	1164
Hays	30.21	53
Brazoria	30.00	21
Galveston	30.00	16
Montgomery	30.00	16
Nueces	30.00	193
San patricio	30.00	27

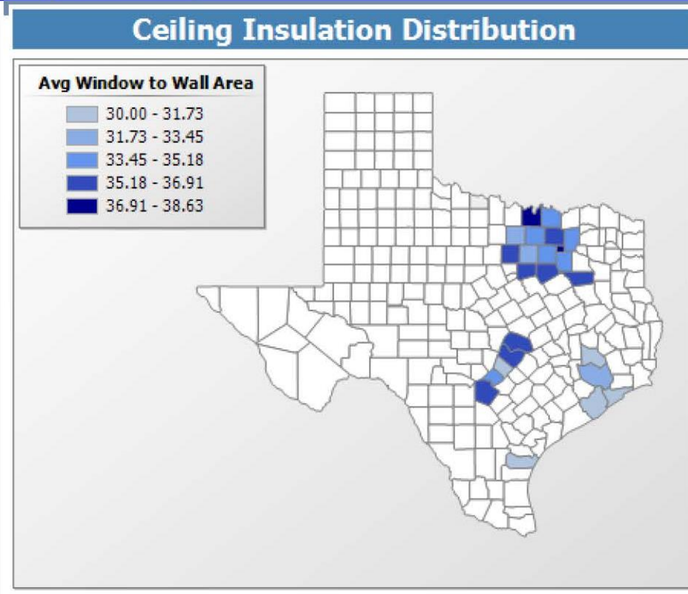


Figure 44: Average Ceiling Insulation across Counties for Single-Family Homes in 2014

Multi Family

County	Avg Ceiling Insulation	House Count
Travis	38.71	75
Tarrant	37.28	71
Dallas	33.50	167

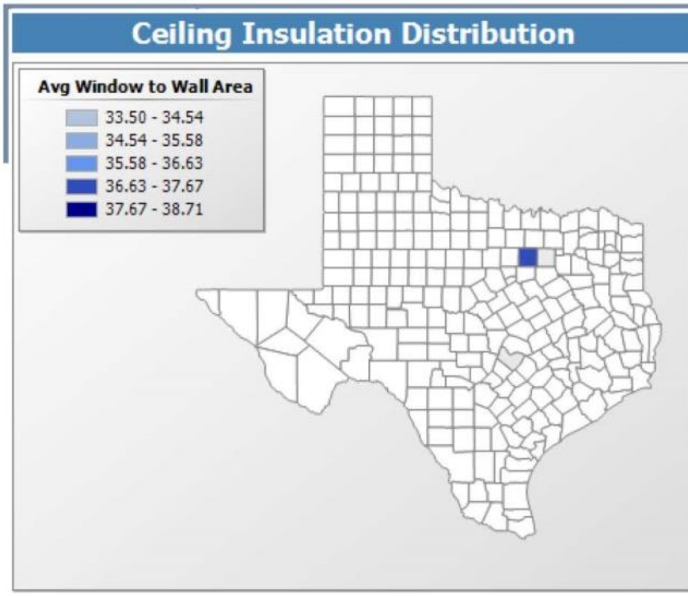


Figure 45: Average Ceiling Insulation across Counties for Multi-Family Homes in 2014

This report shows the average heating efficiency across Texas in 2014. Here we examine space heating efficiency in 2014 using both natural gas and heap pump heating. In Figure 46 we see ranges, for Single-Family Homes, for natural gas are from 0.80 to 0.88 with an average of 0.81. The ranges for heat pump are 8.00 to 9.60 with an average of 8.34. Last year's average for natural gas was 0.81 and heat pump was 8.39. In Figure 47 we see ranges, for Multi-Family Homes , for natural gas from 0.80 to 0.87 with an average od 0.83. The ranges for heat pump are 7.95 to 9.75 woth an average of 9.05. Last year's average for electric was 0.81 and heat pump was 8.47.

Average Heating Efficiency across Counties for 2014

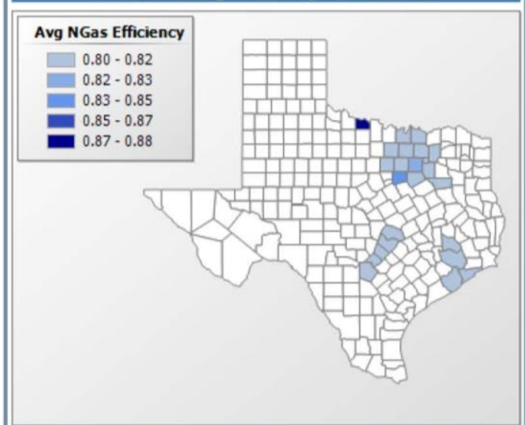
Overall Data Statistics derived from a subset of Counties having house count > 10

	Total Count	Average NGas Efficiency	Standard Deviation
Single Family	11322	0.81	0.04
Multi Family	204	0.83	0.05

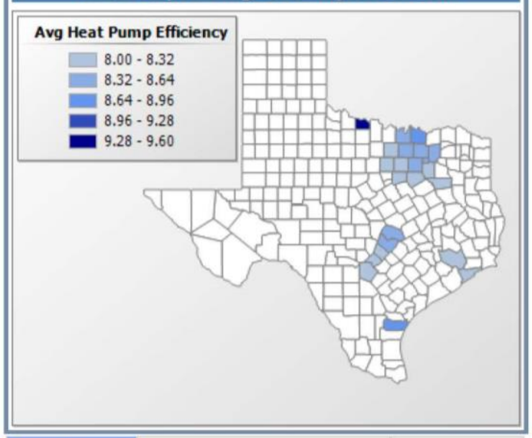
	Total Count	Average Heat Pump Efficiency	Standard Deviation
Single Family	7313	8.34	0.49
Multi Family	109	9.05	1.23

Single Family

NGas Heating Efficiency Distribution



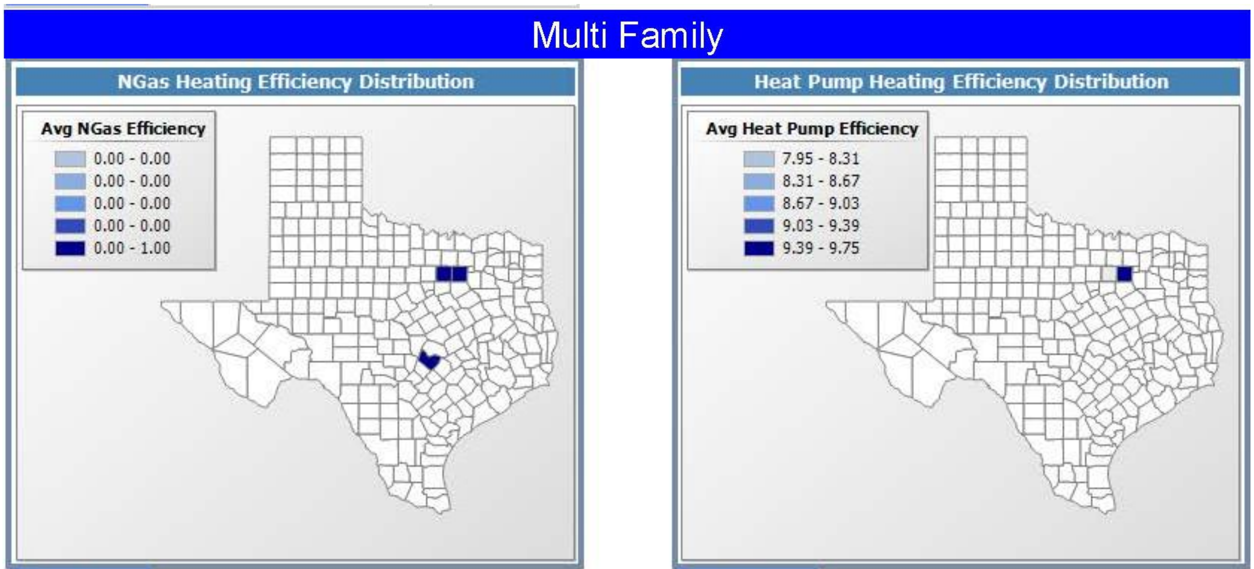
Heat Pump Heating Efficiency Distribution



County	Avg NGas Heating Efficiency	House Count
Wichita	0.88	26
Johnson	0.84	54
Dallas	0.82	1421
Tarrant	0.82	1876
Harris	0.81	1089
Galveston	0.81	15
Parker	0.81	62
Denton	0.81	1691
Travis	0.81	558
Collin	0.80	2440
Ellis	0.80	59
Bexar	0.80	1052
Rockwall	0.80	510
Grayson	0.80	75
Kaufman	0.80	179
Comal	0.80	38
Brazoria	0.80	21
Montgomery	0.80	16
Cooke	0.80	2
Hays	0.80	4
Hunt	0.80	13
Wise	0.80	2
Henderson	0.80	11
Williamson	0.80	50
Fort bend	0.80	58

County	Avg Heat Pump Heating Efficiency	House Count
Wichita	9.60	12
Grayson	8.71	41
Nueces	8.70	193
San patricio	8.70	27
Cooke	8.56	11
Denton	8.46	1217
Dallas	8.45	771
Rockwall	8.42	94
Collin	8.40	1060
Hunt	8.38	101
Travis	8.34	287
Williamson	8.32	41
Bexar	8.30	210
Kaufman	8.24	185
Tarrant	8.23	2227
Parker	8.23	158
Wise	8.20	15
Harris	8.18	71
Johnson	8.14	256
Henderson	8.10	23
Ellis	8.06	220
Comal	8.06	42
Hays	8.02	49
Fort bend	8.00	1
Galveston	8.00	1

Figure 46: Average Heating Efficiency across Counties for Single-Family Homes in 2014



County	Avg NGas Heating Efficiency	Unit Count
Dallas	0.87	100
Travis	0.80	75
Tarrant	0.80	29

County	Avg Heat Pump Heating Efficiency	Unit Count
Dallas	9.75	67
Tarrant	7.95	42

Figure 47: Average Heating Efficiency across Counties for Multi-Family Homes in 2014

This report shows the average SHGC across Texas in 2014. In Figure 48 we see ranges, for Single-Familyhomes, from 0.22 to 0.30 with an average of 0.26. Last year’s average was 0.27. In Figure 49 we see ranges, for Multi-Family Homes , from 0.23 to 0.29 ewith an average of 0.25. Last year’s average was 0.25.

Average SHGC across Counties for 2014

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

	Average	Standard Deviation
Single Family	0.26	0.04
Multi Family	0.25	0.04

Single Family

County	Avg SHGC Value	House Count
Wise	0.30	17
Cooke	0.29	13
Wichita	0.28	38
Brazoria	0.28	21
Johnson	0.27	310
Tarrant	0.27	4106
Parker	0.27	220
Harris	0.27	1164
Montgomery	0.27	16
Dallas	0.26	2196
Rockwall	0.26	606
Hays	0.26	53
Galveston	0.26	16
Ellis	0.26	282
Grayson	0.25	116
Travis	0.25	845
Denton	0.25	2909
Kaufman	0.24	364
Hunt	0.24	114
Collin	0.24	3500
Comal	0.24	80
Henderson	0.23	34
Bexar	0.23	1264
Williamson	0.23	91
San patricio	0.23	27
Nueces	0.23	193
Fort bend	0.22	59

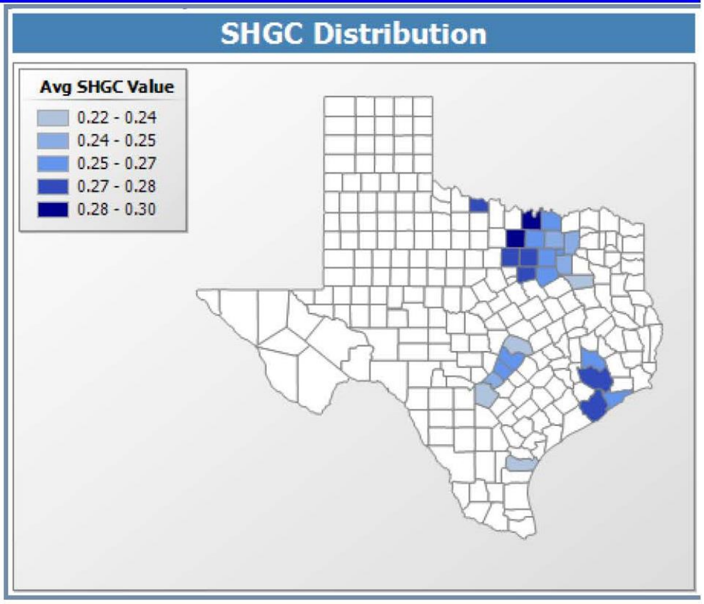


Figure 48: Average SHGC across Counties for Single-Family Homes in 2014

Multi Family

County	Avg SHGC Value	Unit Count
Tarrant	0.29	71
Dallas	0.25	167
Travis	0.23	75

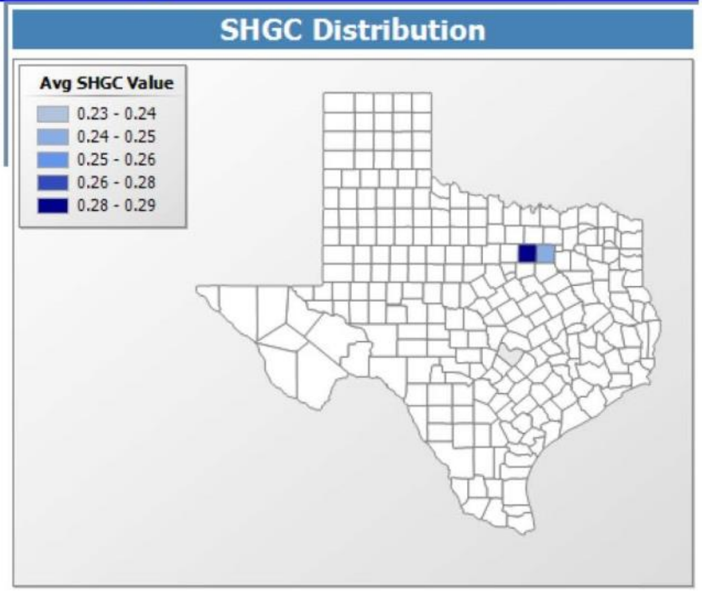


Figure 49: Average SHGC across Counties for Multi-Family Homes in 2014

Another way to evaluate high performing houses is how much air conditioning they have per sq. ft. of house. In Figure 50 we see ranges, for Single-Familyhomes, of 421 to 818 sq. ft. per ton with an average of 571 sq. ft. per ton. Last year's average was 565 sq. ft. per ton. In Figure 51 we see ranges, for Multi-Family Homes , of 725 to 1463 sq. ft. per ton with an average of 1096 sq. ft. per ton. Last year's average was 978 sq. ft. per ton. Thus, Texas is becoming more efficient.

Average HVAC across Counties for 2014

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

	Average	Standard Deviation
Single Family	571.67	144.20
Multi Family	1096.38	622.18

Single Family

County	Avg Sqft Tonnage Value	House Count
Hays	818.16	53
San patricio	726.20	27
Nueces	717.89	193
Williamson	709.02	91
Comal	663.94	80
Travis	643.18	845
Galveston	612.56	16
Ellis	604.42	282
Montgomery	600.89	16
Wise	593.24	17
Rockwall	590.34	606
Dallas	586.34	2196
Johnson	573.81	310
Harris	572.05	1164
Wichita	571.79	38
Bexar	569.11	1264
Henderson	567.59	34
Denton	565.42	2909
Collin	564.27	3500
Kaufman	552.56	364
Tarrant	548.69	4106
Grayson	537.17	116
Parker	529.48	220
Cooke	527.04	13
Hunt	500.62	114
Brazoria	499.47	21
Fort bend	421.52	59

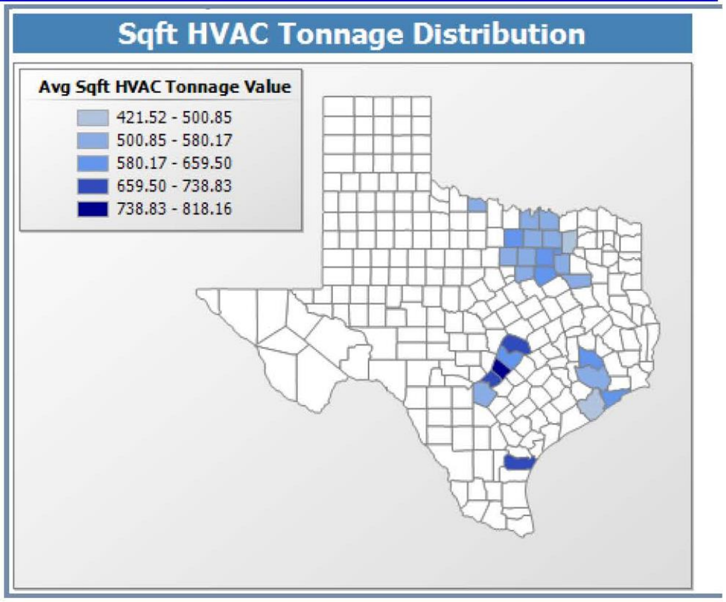


Figure 50: Average HVAC Tonnage to Sq Ft across Counties for Single-Family Homes in 2014

Multi Family

County	Avg Sqft Tonnage Value	Unit Count
Dallas	1462.78	31
Travis	1174.74	21
Tarrant	724.82	35

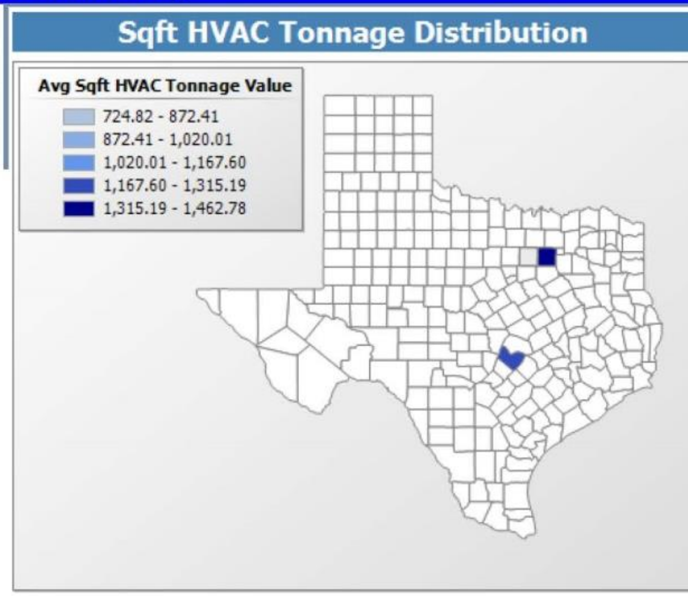


Figure 51: Average HVAC Tonnage to Sq Ft across Counties for Multi-Family Homes in 2014

This report shows the average U Factor acorss Texas is 2014. The U Factor applies to the heat transfer of a window caused by temperature, no direct solar radiation. In Figure 52 we see ranges, for Single-Familyhomes, from 0.28 to 0.50 with an average of 0.35. Last year's average was 0.36. In Figure 53 we see ranges, for Multi-Family Homes , from 0.30 to 0.37 with an average of 0.33. Last year's average was 0.36.

Average U Factor across Counties for 2014

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

	Average	Standard Deviation
Single Family	0.35	0.06
Multi Family	0.33	0.07

Single Family

County	Avg U Factor	House Count
Hays	0.50	53
Cooke	0.48	13
Wise	0.46	17
Comal	0.42	80
Kaufman	0.38	364
Ellis	0.37	282
Tarrant	0.37	4106
Bexar	0.36	1264
Rockwall	0.36	606
Wichita	0.35	38
Denton	0.35	2909
Parker	0.35	220
Johnson	0.35	310
Collin	0.34	3500
Grayson	0.34	116
Travis	0.34	845
Dallas	0.34	2196
Hunt	0.33	114
Williamson	0.33	91
Harris	0.33	1164
Henderson	0.32	34
Nueces	0.32	193
San patricio	0.32	27
Fort bend	0.30	59
Galveston	0.30	16
Montgomery	0.28	16
Brazoria	0.28	21

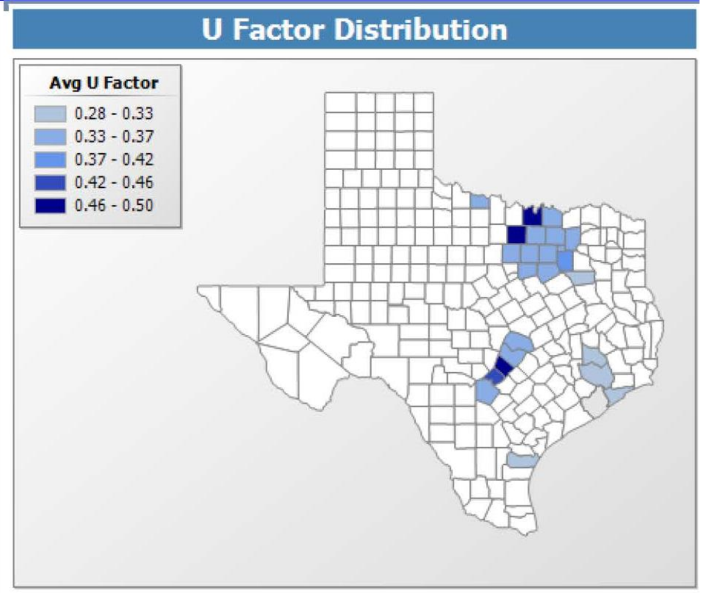


Figure 52: Average U Factor across Counties for Single-Family Homes in 2014

Multi Family

County	Avg U Factor	Unit Count
Travis	0.37	75
Tarrant	0.36	71
Dallas	0.30	167

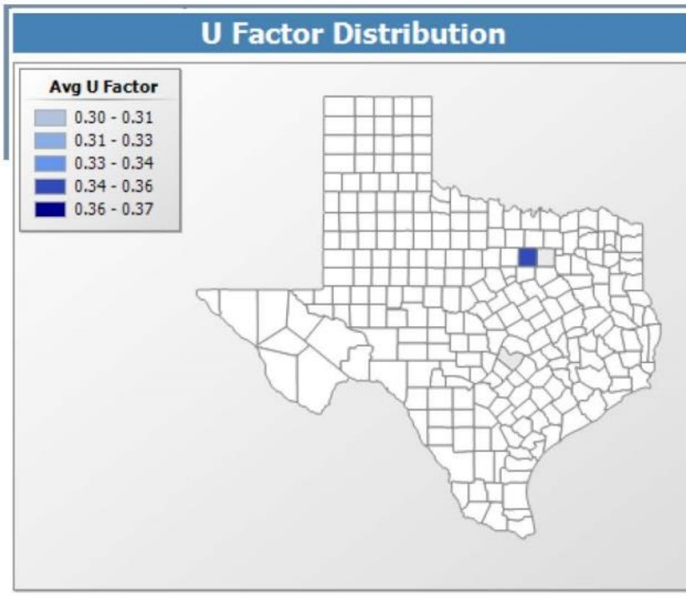


Figure 53: Average U Factor across Counties for Multi-Family Homes in 2014

6.2 IC3 Enhancements

IC3 is continuously being enhanced since 2009 released Version 3.5.2 to 2013 released Version 3.13.x. Numerous enhancements have been made and are detailed out in section 6.2.1.

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 3.5.2 (November 2009)

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

In Version 3.6.1 (December 2009)

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

In Version 3.6.2 (April 2010)

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

In Version 3.7.x (June 2010)

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

In Version 3.8.x (September 2010)

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

In Version 3.9.x (October 2010)

- Added slab insulation
- Updated the manual

In Version 3.10 (September 2011)

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

- Tweaked min/max values on duct insulation, water heaters.

In Version 3.11 (December 2011)

- Added support for IECC 2009 Austin Amendments

In version 3.12.x (January 2012)

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

In version 3.13.x (August 2013)

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

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 32 presents the summarized description of the changes in Single-Family Input file since the 2012 annual simulation.

Table 32: 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

<u>Added sensible and latent components for equipment heat gain</u>
In order to incorporate the HERS Index calculations in IC3, it became necessary to elaborate the input for lighting, equipment and occupants[48]. 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.

<u>Added special construction for knee wall</u>
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.

<u>Corrected plywood layers for floor</u>
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.

<u>Corrected construction for floor over ambient</u>
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.

<u>Added heat-pump water heater module</u>
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).

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

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

The heat rate values of 7,700 Btu/hr are adopted from EnergyGauge regardless of the size of the tank[49].
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)[50].

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.

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

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

Since the fall of 2001, the Laboratory has maintained a TERP webpage, where information is provided to builders, code officials, the design community and homeowners about TERP. In 2010, the Laboratory redesigned its website to make navigation easier. On the navigation bar is a tab that links to the TERP homepage (Figure 54). 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
      - 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 2002-2015
- 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

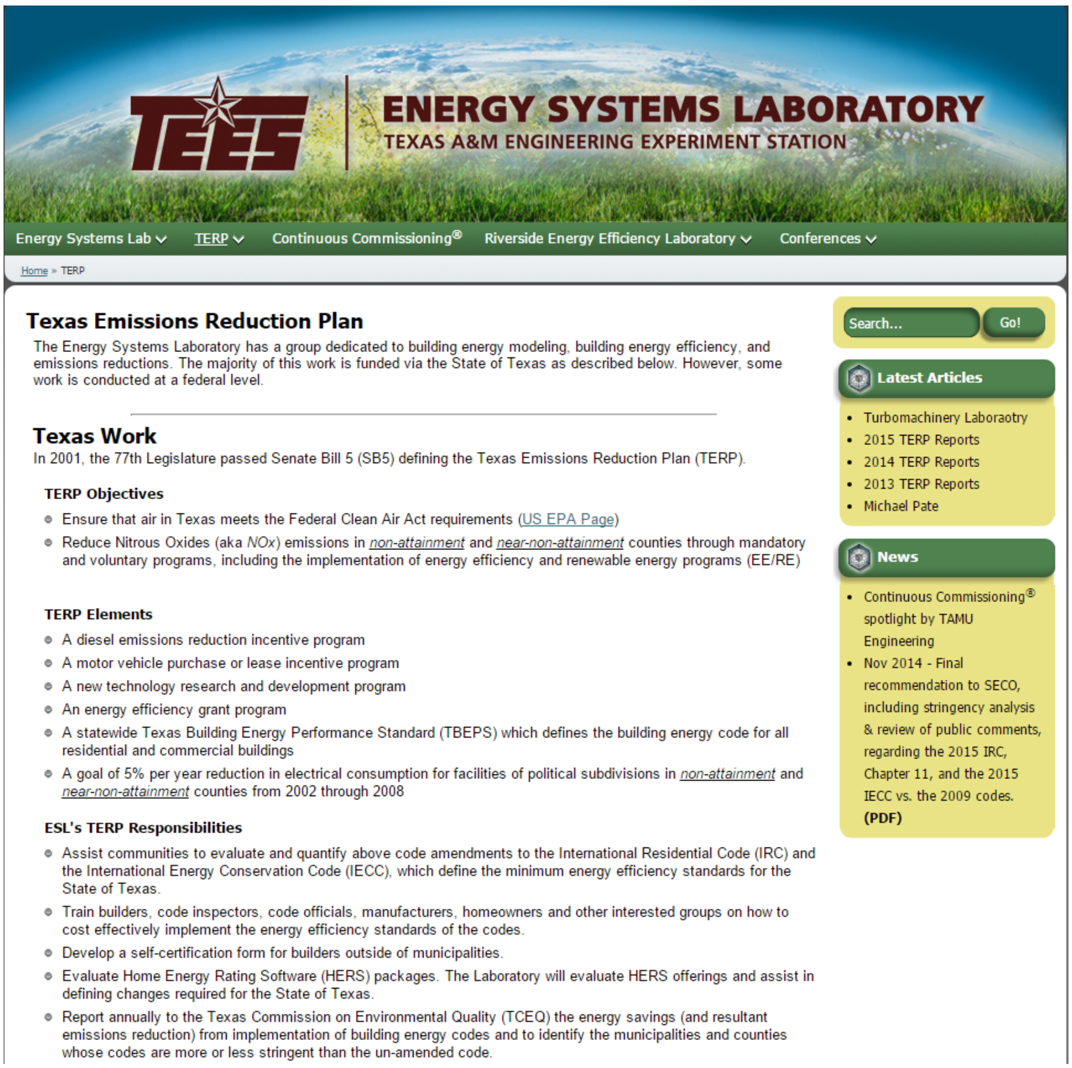
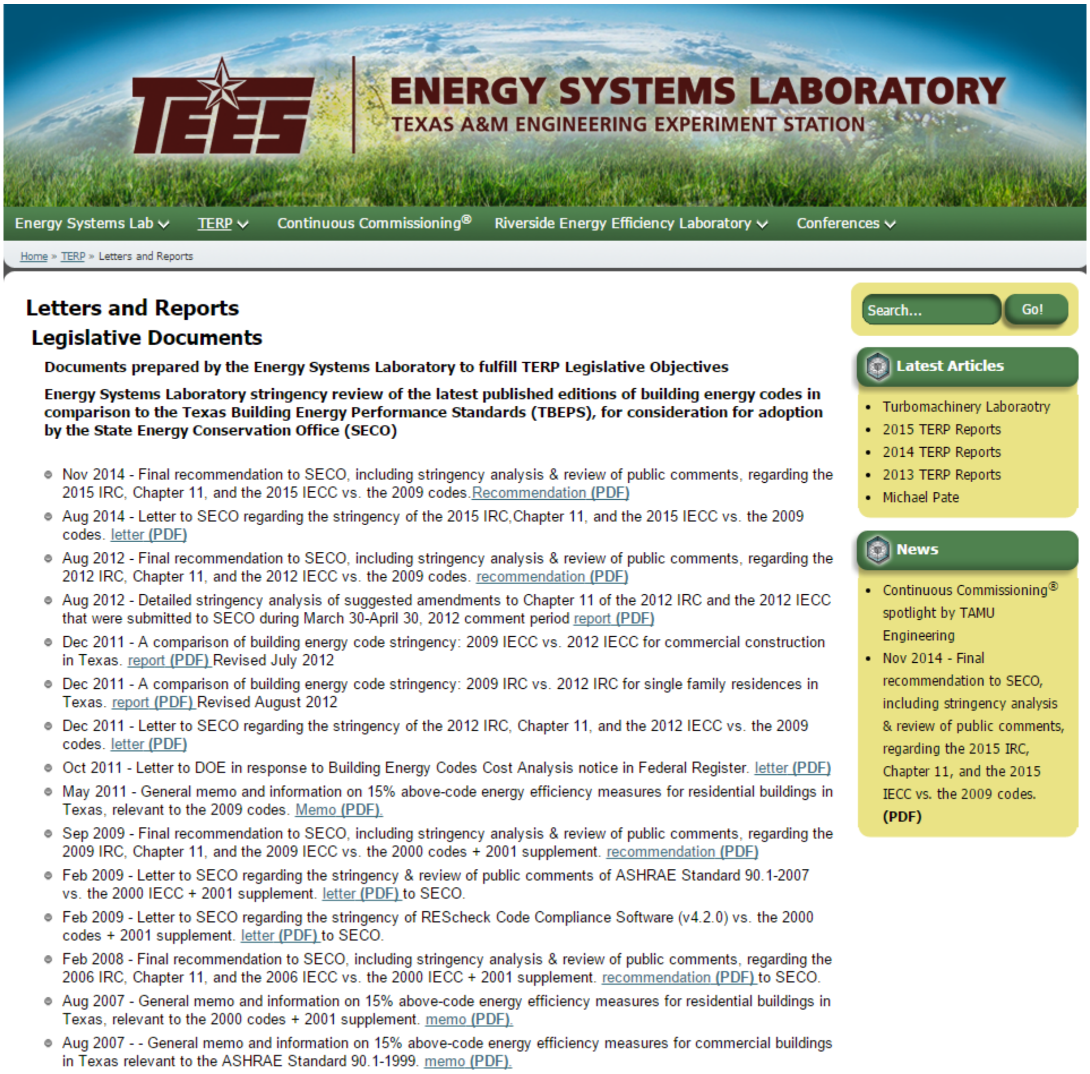


Figure 54. TERP Home Page



ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

Energy Systems Lab | TERP | Continuous Commissioning® | Riverside Energy Efficiency Laboratory | Conferences

Home » TERP » Letters and Reports

Letters and Reports

Legislative Documents

Documents prepared by the Energy Systems Laboratory to fulfill TERP Legislative Objectives

Energy Systems Laboratory stringency review of the latest published editions of building energy codes in comparison to the Texas Building Energy Performance Standards (TBEPS), for consideration for adoption by the State Energy Conservation Office (SECO)

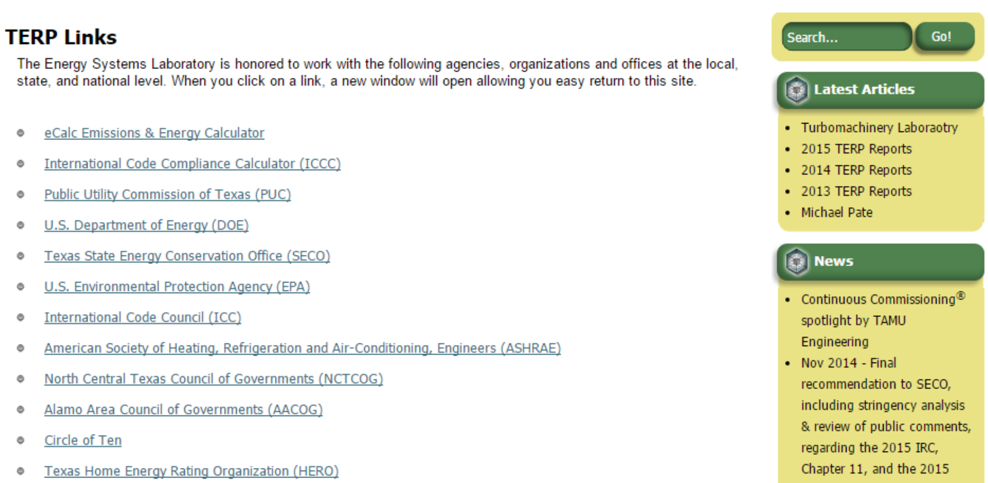
- Nov 2014 - Final recommendation to SECO, including stringency analysis & review of public comments, regarding the 2015 IRC, Chapter 11, and the 2015 IECC vs. the 2009 codes. Recommendation (PDF)
- Aug 2014 - Letter to SECO regarding the stringency of the 2015 IRC,Chapter 11, and the 2015 IECC vs. the 2009 codes. letter (PDF)
- Aug 2012 - Final recommendation to SECO, including stringency analysis & review of public comments, regarding the 2012 IRC, Chapter 11, and the 2012 IECC vs. the 2009 codes. recommendation (PDF)
- Aug 2012 - Detailed stringency analysis of suggested amendments to Chapter 11 of the 2012 IRC and the 2012 IECC that were submitted to SECO during March 30-April 30, 2012 comment period report (PDF)
- Dec 2011 - A comparison of building energy code stringency: 2009 IECC vs. 2012 IECC for commercial construction in Texas. report (PDF) Revised July 2012
- Dec 2011 - A comparison of building energy code stringency: 2009 IRC vs. 2012 IRC for single family residences in Texas. report (PDF) Revised August 2012
- Dec 2011 - Letter to SECO regarding the stringency of the 2012 IRC, Chapter 11, and the 2012 IECC vs. the 2009 codes. letter (PDF)
- Oct 2011 - Letter to DOE in response to Building Energy Codes Cost Analysis notice in Federal Register. letter (PDF)
- May 2011 - General memo and information on 15% above-code energy efficiency measures for residential buildings in Texas, relevant to the 2009 codes. Memo (PDF)
- Sep 2009 - Final recommendation to SECO, including stringency analysis & review of public comments, regarding the 2009 IRC, Chapter 11, and the 2009 IECC vs. the 2000 codes + 2001 supplement. recommendation (PDF)
- Feb 2009 - Letter to SECO regarding the stringency & review of public comments of ASHRAE Standard 90.1-2007 vs. the 2000 IECC + 2001 supplement. letter (PDF) to SECO.
- Feb 2009 - Letter to SECO regarding the stringency of REScheck Code Compliance Software (v4.2.0) vs. the 2000 codes + 2001 supplement. letter (PDF) to SECO.
- Feb 2008 - Final recommendation to SECO, including stringency analysis & review of public comments, regarding the 2006 IRC, Chapter 11, and the 2006 IECC vs. the 2000 IECC + 2001 supplement. recommendation (PDF) to SECO.
- Aug 2007 - General memo and information on 15% above-code energy efficiency measures for residential buildings in Texas, relevant to the 2000 codes + 2001 supplement. memo (PDF).
- Aug 2007 - - General memo and information on 15% above-code energy efficiency measures for commercial buildings in Texas relevant to the ASHRAE Standard 90.1-1999. memo (PDF).

Search... Go!

Latest Articles
- Turbomachinery Laboraotry
- 2015 TERP Reports
- 2014 TERP Reports
- 2013 TERP Reports
- Michael Pate

News
- Continuous Commissioning® spotlight by TAMU Engineering
- Nov 2014 - Final recommendation to SECO, including stringency analysis & review of public comments, regarding the 2015 IRC, Chapter 11, and the 2015 IECC vs. the 2009 codes. **(PDF)**

Figure 55: TERP –Letters and Reports



TERP Links

The Energy Systems Laboratory is honored to work with the following agencies, organizations and offices at the local, state, and national level. When you click on a link, a new window will open allowing you easy return to this site.

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

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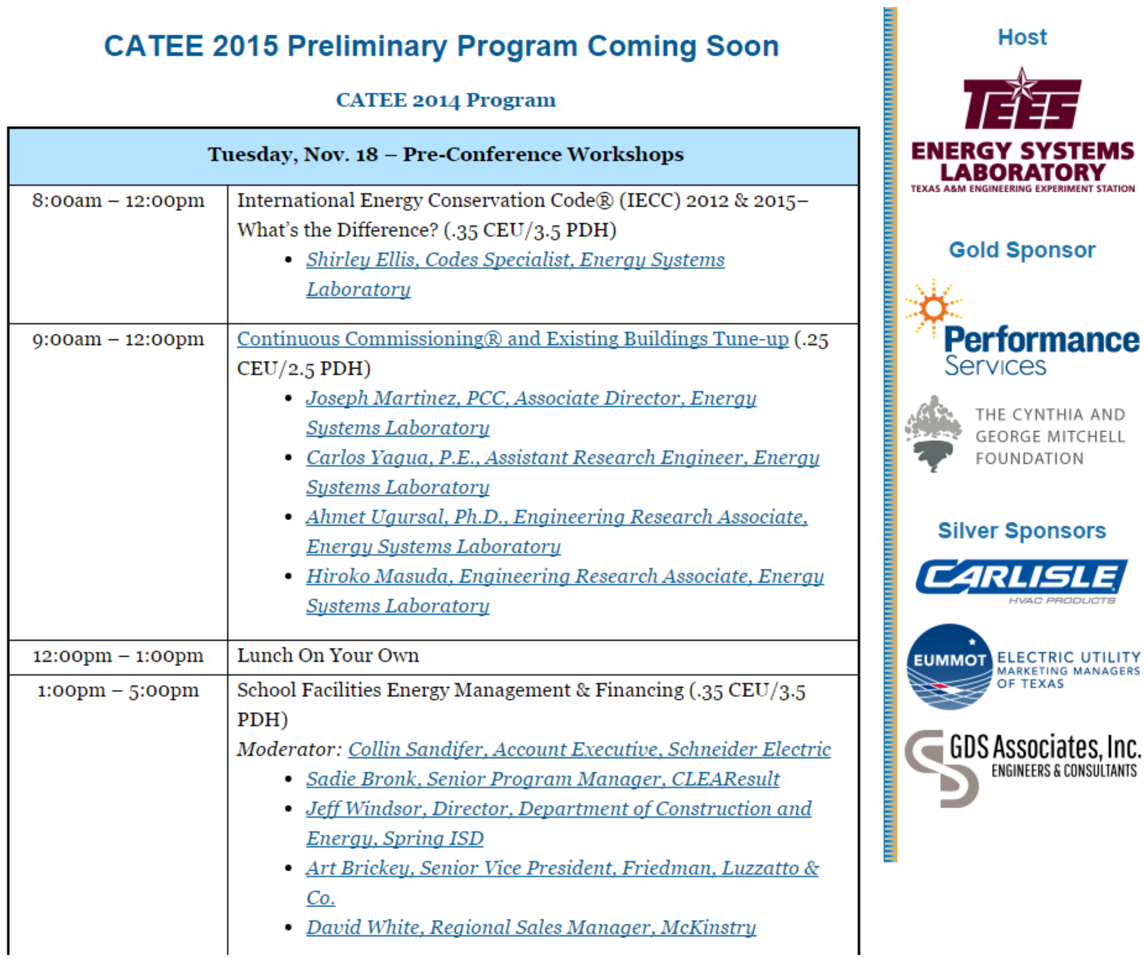
- Michael Pate

News
- Continuous Commissioning® spotlight by TAMU Engineering
- Nov 2014 - Final recommendation to SECO, including stringency analysis & review of public comments, regarding the 2015 IRC, Chapter 11, and the 2015

Figure 56: 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 2015 Preliminary Program Coming Soon

CATEE 2014 Program

Tuesday, Nov. 18 – Pre-Conference Workshops	
8:00am – 12:00pm	International Energy Conservation Code® (IECC) 2012 & 2015– What's the Difference? (.35 CEU/3.5 PDH) • *Shirley Ellis, Codes Specialist, Energy Systems Laboratory*
9:00am – 12:00pm	Continuous Commissioning® and Existing Buildings Tune-up (.25 CEU/2.5 PDH) • *Joseph Martinez, PCC, Associate Director, Energy Systems Laboratory* • *Carlos Yagua, P.E., Assistant Research Engineer, Energy Systems Laboratory* • *Ahmet Ugursal, Ph.D., Engineering Research Associate, Energy Systems Laboratory* • *Hiroko Masuda, Engineering Research Associate, Energy Systems Laboratory*
12:00pm – 1:00pm	Lunch On Your Own
1:00pm – 5:00pm	School Facilities Energy Management & Financing (.35 CEU/3.5 PDH) *Moderator: Collin Sandifer, Account Executive, Schneider Electric* • *Sadie Bronk, Senior Program Manager, CLEAResult* • *Jeff Windsor, Director, Department of Construction and Energy, Spring ISD* • *Art Brickey, Senior Vice President, Friedman, Luzzatto & Co.* • *David White, Regional Sales Manager, McKinstry*

Figure 57: 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, 2011, 2012, 2013, and 2014 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 2014, the Laboratory provided 2012 code trainings at the 14th Annual Building Professional Institute in Arlington, TX. The total number of workshops held by the Energy Systems Laboratory was two with 27 participants.

Table 33: List of all short courses/workshops conducted in 2014

Short Courses/Workshops				
Course Title	**Description**	**Date**	**Location**	**Attendance**
2012 IECC Residential	Full Day training	5/19/2014	Arlington, TX (14th Annual Building Professional Institute)	15
2012 IECC Commercial	Full Day training	5/20/2014	Arlington, TX (14th Annual Building Professional Institute)	12

6.4.3 ASHRAE Standard 90.1 Standards Committee Activities

The following sections are the minutes and transactions of SSPC 90.1 at the ASHRAE Winter Conference in New York, New York, January 18-20, 2014 and the ASHRAE Summer Conference in Seattle, Washington, June 26-30, 2014.

6.4.3.1 *SSPC 90.1 at the ASHRAE Winter Conference in New York, New York, January 18-20, 2014*

The following paragraphs track the changes and discussion in the ASHRAE 90.1 Standard at the ASHRAE winter conference in New York, New York in 2014.

ASHRAE SSPC 90.1 MEETING AGENDA
Annual Meeting, ASHRAE, New York, NY
January 18-20, 2014
Agenda 01/08/14

Full Committee meetings are in the Hilton New York/Midtown Hotel – in the Murray East/West 2nd Floor

Notes:

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

Full Committee Saturday, June 28, 2014 ....8:00 am to 12 NOON

- Introductions
    - Sign-in and Quorum Determination (Steve Ferguson)
    - Introductions of members and guests (Drake Erbe)
    - ASHRAE Code of Ethics (briefly referred to by Drake Erbe)

ASHRAE Code Of Ethics
(Approved by ASHRAE Board of Directors January 30, 2013)
1.140.001.1 As members of ASHRAE or participants in ASHRAE committees, we pledge to act with honesty, fairness, courtesy, competence, integrity and respect for others in our conduct.
A. Efforts of the Society, its members, and its bodies shall be directed at all times to enhancing the public health, safety and welfare.
B. Members and organized bodies of the Society shall be good stewards of the world's resources including energy, natural, human and financial resources.
C. Our products and services shall be offered only in areas where our competence and expertise can satisfy the public need.
D. We shall act with care and competence in all activities, using and developing up-to-date knowledge and skills.
E. We shall avoid real or perceived conflicts of interest whenever possible, and disclose them to affected parties when they do exist.
F. The confidentiality of business affairs, proprietary information, intellectual property, procedures, and restricted Society discussions and materials shall be respected.
G. Each member is expected and encouraged to be committed to the code of ethics of his or her own professional or trade association in their nation and area of work.
H. Activities crossing national and cultural boundaries shall respect the ethical codes of the seat of the principal activity.

- Review Agenda (Erbe announced that there are very few changes from poste agenda. There will be an updated report on 90.1 progress indicators by PNNL)
- Announcements (Erbe)
    - Bias and Conflict Forms - Update with any changes - Send to ASHRAE HQ
    - Availability of Errata for Standard and User's Manual on public website (Ferguson) (Look on web site for this.)

- Results of Standards Committee Actions (Ferguson)

  Update on Addenda: (Some addenda ready for publication. Look on ASHREA website.)

- Liaison Reports

Liaison	Report
2. ASHRAE - Ferguson	Item was stolen in lobby. Watch your stuff.
SPLS (Modera)	No one present to report
IESNA (Harrold)	No one present to report
1. CIS (VanGeem)	No one present to report
INTERNATIONAL (Hoegling)	No one present to report
3. TC 1.4 Control Applications (Young)	No report
4. TC 4.5 Fenestration (Hogan)	Brief report
5. TC 5.2 Duct Design (Craig Wray)	Substantive report
6. TC 5.4 Industrial Process Air Cleaning 7. TC 5.7 Evap Clg, 5.8, Ind. Vent Systems. 9.2 Ind. Air Conditioning (???)	Looking for liaisons for these TC's.
TC 5.5 Air-to-air Energy Recovery (Dobbs)	No one present to report
TC 6.1 Hydronic Systems (Towsley)	No one present to report
8. TC 6.5 Radiant Heat & Cool (Watson)	Brief report
9. TC 6.9 Thermal Storage (Paul McCracken)	Brief report
TC 8.6 Cooling Towers (Lindahl)	No one present to report
10. TC 7.6 Energy Utilization (Emerson)	See seminar 32 on air flow for data centers. Also seminar 17 on IT equipment power.
TC 9.9 Mission Critical Facilities (Pavlak)	No one present to report

- Approval of Minutes –
  - April 2014, Webinar
- PowerPoint Presentation (available from presenter) on 90.1 use in BC and the City of Vancouver and Canadian Code-Mr. Greg McCall. In 2014, now using 90.1-2010. Incorporated NECB 2011 (National Energy Code for Buildings, developed by NRC Canada.) Similar structure as Standard 90.1; uses most of the same definitions for building types and conditions. Climate zone for Vancouver is different (4 vs. 5) between 90.1-2010 and NECB 2011. Code has envelope allowances for modelers, around 5%, but 1% for Vancouver. Energy modeling for 90.1-2010 is energy-cost based, but for NECB 2011 is energy-based. Target is 20% energy consumption below the 90.1-2007 version. Vancouver.ca/building-energy-requirements. Compliance forms appear to be different than 90.1 forms. ECB forms look to be about the same.
- PNNL-90.1 End Use Data- Reid Hart. (Progress Indicator Results (90.1-2013.) Email: Reid.Hart@PNNL.gov.
- Climate Zone Working Group Report – Merle McBride (Report on Selection Criteria for rep. weather files. Evaluated CDD and HDD baselines & representative HVAC design criteria and dev. of Tables for 90.1-2013 weather files.) No Climate zone 0 in the U.S. 0A = Singapore Changi AP; 0B = Jeddah, SA; 1A = Honolulu Int'l AP; 1B = New Delhi, IN; 2 = Tucson, AZ; 3 = Atlanta, GA; 4A = Cincinnati, OH; 4B = Albuquerque, NM; 4C = Seattle, WA; 5A = Buffalo, NY; 5B = Denver AP, CO; 5C = Bariloche AP, Argentina; 6A = Bismarck, ND; 6B = Boseman-Yellowstone AP, MT; 7 = Fort McMurray, Alberta, CA; 8 = Yellowknife AP, Northwest Territories, and most of Alaska.
- Subcommittee Reports and Actions – (Energy Savings proposals first.)

  - Mechanical (Recommended acceptance of an internally generated proposal that DVR (dynamic ventilation reset) and ERV to be required for DDC systems. Committee vote to approve passed 34-0-1).
    - Motor text cleanup language
    - Update heat rejection equip min efficiency Table – internally generated proposal
    - VRF part load efficiency – internally generated proposal
    - Hauer – CMP response and possible internally generated proposal
    - Bassam Sabeeh – pipe insulation – official interpretation response
  - Lighting
  - ECB
    - References to the opaque assemblies for the building envelope portion of the main table in Appendix G (Discussion focused on Table G3.1, Part b, re envelope opaque assemblies.)
    - updated section G3.1.1 related to the selection procedure for the baseline HVAC system
  - Envelope
    - Proposal on Envelope Verification
  - Format & Compliance
- Public time to address SSPC (30 minutes). Persons wishing to address the Project Committee should contact the Chair (Drake Erbe – drakeerbe@airxchange.com) by 12 NOON June 25.

End of Full Committee Meeting…………………………………………………………………………...........12 NOON

Full Committee Sunday, January 29, 2014 …………………………..………………………9 am to 12 NOON

- Introductions
  - Sign-in and Quorum Determination (ASHRAE Staff)
  - Introductions of members and guests (Erbe)
- Announcements (Erbe)
  - Bias and Conflict Forms
- International Energy Standards – (Hoegling) Presented the European activities in the ISO Standard for reporting building energy performance ratings. ISO/TC 163 & 205. Committee questioned about how the standards are enforced.
- Subcommittee Reports –Votes:
  - No. 2 Envelope
    - metal building walls (Jones CMP 901-13-12-003-001): Motion explained about envelope verification. Proposed a change to require verification of the continuous air barrier. Proposed to be in accordance with ASTM E779-2010 or E1827-2011 by an independent third party. Addendum L for publication and public review, Roll call vote passed by 20-6-9. Will issue a continuation ballot.
  - Lighting
    - First building type simplified approach proposal
      - Interior and exterior Exemption rework (remove, revise)

        - Emergency lighting control language
  - No. 1 ECB
    - Addendum BM (Jason Glazer moved to approve addendum bm for publication and 3rd public review,) Modifies Appendix G – Performance Rating Method. All the proposed changes were explained by Mike Rosenberg of PNNL. Look at section 4.2.1.1 (alternative compliance path) and all of section 4.2 on PCI calculation. For details, download addendum bm. Some updates are shown in Table G3.5.1 on performance ratings of HVAC equipment. Summary: Addendum bm offers a 3rd path for compliance with 90.1. Look at Table 4.2.1.1 on Building Performance Factors (BPF). Roll call vote: passed by 28-3-3.
    - Added motion on clarifying values in Appendix A, Opaque Assemblies tables. Roll call vote passed by 33-0-1.
  - Mechanical
    - Static pressure table revision (elimination of ducted return)
    - Ventilation Optimization internally generated proposal
    - ERV internally generated proposal
    - Humidification language – internally generated proposal
    - Weather data for mechanical systems
    - Response to CMP for item 2 above
  - Format & Compliance

- Continuous Maintenance Proposals Status updates – Garrigus
- Interpretations - Status updates – Garrigus

End of Full Committee Meeting 12 NOON

Full Committee Monday, January 30, 2014 .... 8:00 AM to 12 NOON

- Introductions
  - Sign-in and Quorum Determination (Ferguson)
  - Introduction of members and guests (Erbe)
- Announcements (Erbe)
  - Bias and Conflict Forms
- Future Meetings
  - Fall Interm Meeting 2014 – Atlanta – October XX-XX, 2014 at ASHRAE HQ
    - Meeting times
    - SSPC Full committee Friday 8 am- 12 NOON, Saturday 8 am- 12 NOON
      - ECB: Thursday 3-7 pm, Friday 1-9 pm
      - ENVELOPE: Thursday 8 am-9 pm, Friday 1-9 pm
      - FORMAT & COMPLIANCE: Thursday 3-7 pm, Friday 1-9 pm
      - LIGHTING: Thursday 8 am-9 pm, Friday 1-9 pm
      - MECHANICAL: Thursday 8 am-9 pm, Friday 1-9 pm
  - Winter 2015 – Chicago

- PNNL 90.1-2010-Cost Effectiveness Analysis-Hart (Presentation by Reid Hart on cost effectiveness of 90.1-2010 vs. 90.1-2007.) 16 prototypes in 17 climate zones (great summary.) Houston is included. Full report is PNNL 22972, downloadable form web site.
- DOE RFI-Williams (see http://www.energycodes.gov/regulations)
- Subcommittee Votes
  - Envelope

        - Addendum AB – All metal building test reports and documentation related to addendum AB can be found in this folder on the committee only FTP site. (Steve Skalko presented and then moved that the SPCC approve for publication and public review of addendum ab on metal buildings, Table A2.3 Assembly U-factors for roofs, with knowledge of unresolved commenter/objector. Motion was passed contentiously by roll call vote 27-2-4.)
        - Jones CMP 901-13-12-003-002 Metal Roofs
    - Lighting (Eric Richman reported no new proposals.)
    - ECB (Jason Glazer presented one proposal related to procedures to be followed in section G3.1.1, HVAC baseline system types.)
    - Format & Compliance
    - Mechanical
        - Response to comments on Addendum I – elimination of computer room economizer table
        - Damper leakage
        - Possible ISC for Addendum du
        - Compressor staging
- AES WG-Burton
- Brief overview of subcommittee plans
- Membership Approval Results
- Other Business
- Adjournment ....12 NOON
- **MEETING ROOM SCHEDULE**
    - All meetings are in the Hilton Hotel

- **SSPC 90.1 ENERGY EFF. DESIGN OF NEW BLDG.**
    - Saturday 8:00a-12p Murray East/West 2nd Floor
    - Sunday 9:00a-12p Murray East/West 2nd Floor
    - Monday 8:00a-12p Murray East/West 2nd Floor
- **FORMAT & COMPLIANCE SUBCOMMITTEE**
    - Friday 5:00-10:00p Holland 4th Floor
    - Saturday 1:00-5:00p Midtown 4th Floor
    - Sunday 4:00-7:00p Concourse D Concourse Level
- **MECHANICAL SUBCOMMITTEE**
    - Friday 9:00a-10p Murray Hill East 2nd Floor
    - Saturday 1:00-7:00p Murray Hill East 2nd Floor
    - Sunday 1:00-8:00p Gibson 2nd Floor
- **LIGHTING SUBCOMMITTEE**
    - Friday 9:00a-10p Harlem 4th Floor
    - Saturday 1:00-7:00p Madison 2nd Floor
    - Sunday 1:00-8:00p Concourse C Concourse Level
- **ECB SUBCOMMITTEE**
    - Friday 5:00-10:00p East Suite 4th Floor
    - Saturday 1:00-5:00p Holland 2nd Floor
    - Sunday 1:00-4:00p Concourse D Concourse Level
- **ENVELOPE SUBCOMMITTEE**

  - Friday 9:30a-7:30p Gibson 2nd Floor
  - Saturday 1:00-7:30p Bryant 2nd Floor
  - Sunday 1:00-7:30p Concourse G Concourse Level

- **USERS MANUAL REVIEW GROUP**
  - Saturday 5:00p-6:00p Holland 2nd Floor

The following are presentations made at the 90.1 meeting from Seattle, Washington.

6.4.3.2 SSPC 90.1 at the ASHRAE Summer Conference in Seattle, Washington, June 26-30, 2014

The following paragraphs track the changes and discussion in the ASHRAE 90.1 Standard at the ASHRAE summer conference in Seattle, Washington in 2014.

ASHRAE SSPC 90.1 MEETING AGENDA
Annual Meeting, ASHRAE, Seattle, WA
June 26-30, 2014
Agenda 06/14/14, subject to change

Full Committee meetings are in the Sheraton– in the Grand Ballroom A 2nd Floor

Notes:

- Full Committee meetings will start promptly at times noted.
- Subcommittee meeting rooms are at end of agenda
- All sessions are open to the public.
- The agenda order shown may not be followed
- Material for Project Committee members is posted on the Committee Only FTP site (\2014 meetings\2014_01_NYC_SSPC)

Full Committee Saturday, January 18, 2014 ....8:00 am to 12 NOON

- Introductions
  - Sign-in and Quorum Determination (Ferguson)
  - Introductions of members and guests (Erbe)
  - ASHRAE Code of Ethics

ASHRAE Code Of Ethics
(Approved by ASHRAE Board of Directors January 30, 2013)
1.140.001.1 As members of ASHRAE or participants in ASHRAE committees, we pledge to act with honesty, fairness, courtesy, competence, integrity and respect for others in our conduct.
A. Efforts of the Society, its members, and its bodies shall be directed at all times to enhancing the public health, safety and welfare.
B. Members and organized bodies of the Society shall be good stewards of the world's resources including energy, natural, human and financial resources.
C. Our products and services shall be offered only in areas where our competence and expertise can satisfy the public need.
D. We shall act with care and competence in all activities, using and developing up-to-date knowledge and skills.
E. We shall avoid real or perceived conflicts of interest whenever possible, and disclose them to affected parties when they do exist.
F. The confidentiality of business affairs, proprietary information, intellectual property, procedures, and restricted Society discussions and materials shall be respected.
G. Each member is expected and encouraged to be committed to the code of ethics of his or her own professional or trade association in their nation and area of work.
H. Activities crossing national and cultural boundaries shall respect the ethical codes of the seat of the principal activity.

- Review Agenda
  - Progress indicators report on Sunday
  - Advanced energy systems, energy targets and scalar report on Monday.
- Announcements (Drake Erbe)
  - Bias and Conflict Forms - Update with any changes - Send to ASHRAE HQ
  - Availability of Errata for Standard and User's Manual on public website (Ferguson)
  - Speaker (Bob xxx?) on CEC energy efficiency advancements and status. Adopted the ASHRAE Standard 180 for maintenance of buildings.
- Results of Standards Committee Actions (Ferguson)

  - Update on Addenda
- Liaison Reports

Liaison	Report
ASHRAE - Ferguson	
SPLS (Modera)	
IESNA (Harrold)	
CIS (VanGeem)	
INTERNATIONAL (Hoegling)	
TC 1.4 Control Applications (Young)	
TC 4.5 Fenestration (Hogan)	
TC 5.4 Industrial Process Air Cleaning TC 5.7 Evap Clg, 5.8, Ind. Vent Systems. 9.2 Ind. Air Conditioning (???)	
TC 5.5 Air-to-air Energy Recovery (Dobbs)	
TC 6.1 Hydronic Systems (Towsley)	
TC 6.5 Radiant Heat & Cool (Watson)	
TC 6.9 Thermal Storage (McCracken)	
TC 8.6 Cooling Towers (Lindahl)	
TC 7.6 Energy Utilization (Emerson)	
TC 9.9 Mission Critical Facilities (Pavlak)	

- Approval of Minutes –
  - October 2013 Atlanta – minutes available on secure 90.1 ftp site, please review prior to meeting. VOTE. Approved.
  - December 2013 Web Meetings – minutes available on secure 90.1 ftp site, please review prior to meeting. VOTE. Approved.
    - 12/19/13
    - 12/17/13
- Advanced Energy Standard Working Group (Drake Erbe),

  Presentation by Merle McBride on the "SSPC 90.1-2016 Determination and Application of Dual Scalar Ratios". Made a motion to approve the new values used to derive the SRs assuming after tax considerations:

  New graphs based on LCC as a function of first costs and annual value of fuel savings.

  For envelope, Scalar Ratio (SR) = (Delta First Cost) / (annual savings in energy cost + maintenance cost).

  Different SR values result for heating and cooling systems. SR also depends on the component's economic life.

  Discount rate = 9.34%, loan int rate =7%, fed tax = 0%, state tax = 0%, fuel escalation based on Table 6 and Figure 12. Years 1-30, use the NIST value plus the rate of inflation at 2.38%. SR values are tabulated as a function of economic life.

  Some serious objections were raised as to how the discount rate was derived, with a request to delay the vote in order to allow for added investigations of the factors used.

  The motion passed on voice vote.
- Subcommittee Reports and Actions – (PC votes and SC items for consideration.)

- Mechanical:

  Motions:
  - Motion 5: Hotel guest room controls w/ ventilation shutoff and vacancy setback. Section 6.4.3.3.5.1. Roll call vote: passed 34-0-1.
  - Motion 6: Addendum xx to 90.1-2013, Editorial change to Fan Power requirement in section 6.5.3.1-2. Roll call vote passed 34-0-1.
- Envelope
- Lighting

  Motions:
  - Lighting controls in section 9.4.1.5 – lighting controls during construction. Motion failed 7-21-8, based on security and fife safety issues.
  - Second motion passed.
- ECB: Discuss addendum bm later.
- Format & Compliance

- User's Manual – Lane,

  Meeting later today at 5 p.m. Contractor will be there to report on second draft.
- Public time to address SSPC (30 minutes). Persons wishing to address the Project Committee should contact the Chair (Drake Erbe – drakeerbe@airxchange.com) by 12 NOON January 14th.

End of Full Committee Meeting……………………………………………………………………….........12 NOON

Full Committee Sunday, January 19, 2014 ………………………...………………………9 am to 12 NOON

- Introductions
  - Sign-in and Quorum Determination (ASHRAE Staff)
  - Introductions of members and guests (Drake Erbe)
- Announcements (Erbe)
  - Bias and Conflict Forms
- Subcommittee Reports – Votes:
  - Envelope
    - Interpretation requests and responses: Request submitted as to whether greenhouse on roof would be covered by Standard 90.1. ESC considers the greenhouse as a commercial process and thus must comply with Standard per Section 2.3c and is ventilated. This is similar to a ventilated attic, so the envelope requirement must meet the conditions for that type space.
    - Proposed addendum H to Fan Power in section C3.5.8 HVAC Systems. Motion 10 to approve. Roll call vote passed 24-0-7.
  - Lighting, Eric Richman reported on some ongoing work in changes to lighting controls. No proposals at this time
  - ECB. Jason Glazer had no action items.
  - Mechanical. Ned Heminger (spelling corrected on 1/20/2014) had no action items today, but

talked briefly about computer room requirements, which will be put forth later.

  - Format & Compliance: Busy agenda on interpretations on the work plan, proposed a new way of reporting.

- Continuous Maintenance Proposals Status updates – Subcommittee chairs
- Interpretations - Status updates – Lane/Subcommittee Chairs
  Official: No substantive information presented.
  Unofficial: No substantive information presented.
- 90.1-2013 Progress Indicator (Bing Liu) Presented the PNNL report on the 90.1-2013 Energy Cost Savings. 90.1-2004 still the baseline. There are 110 addenda published in 90.1-2013, 58 have energy impact. The PI analysis work captured 33 addenda, 25 not captured. She gave reasons why not used in the analyses. Target savings = 50% in regulated energy and 40% in whole building energy use. Current result is at 37.7% for regulated loads. (The full PDF file of Bing's PowerPoint presentation is attached.)
  The 90.1 AES WG in working on modifying the prototype assumptions. Also, there are simulation improvements -- updated to Energy Plus v8.0 (from 6.0) and updated weather database to TMY3 (from TM2).

Work plan Discussion – Energy Targets (Erbe)
This working group developing a path toward setting Energy Targets for buildings by approximately 2016. Some freewheeling discussion ensued from the SSPC members. Consensus seems to be to put forth a detailed work plan. Some felt that this is important, while others were skeptical about setting energy targets or goals.

End of Full Committee Meeting 12 NOON

Full Committee Monday, January 20, 2014 .... 8:00 AM to 12 NOON

- Introductions
  - Sign-in and Quorum Determination (Ferguson)
  - Introduction of members and guests (Erbe)
- Announcements (Erbe)
  - Bias and Conflict Forms
  - Meeting began with a PPT presentation on upcoming FEMP Training (Federal Energy Management Program), Begins in March on the Fundamentals of Life-Cycle Costing for Energy Conservation. Location not certain. FEMP is an approved CEU provider.
  - Martha VanGeem reported on a Sunday evening (7-10 p.m.) meeting on IECC and CIS matters. Not sure what CIS is.
  - Steve Comstock reported on approx. 55 proposals that were considered by the board that were either approved or declined. No details on the contents of and proposals.
  - Drake Erbe reported on the membership of the WG on the Advanced Energy Standards (AES). The 10 members were thanked for their efforts, as some were rolling off the committee.
- Future Meetings
  - Spring 2014 – Atlanta – April 16-18, 2014 at ASHRAE HQ. Questioned whether this meeting was needed. Decided instead that the SSPC could meet a day (Thursday) at the Seattle meeting. However, the chair announced that the SSPC would still need to have a web meeting prior to the Seattle meeting. A date for this was discussed and tentatively set on a Wednesday afternoon from 1 to 4 p.m. EST.
    - Meeting times: (these would have been meeting times in Atlanta if interim mtg would take place)
      - ECB: <u>Thursday</u> 3-7 pm, <u>Friday 1</u>-9 pm
      - ENVELOPE: <u>Thursday</u> 8 am-9 pm, <u>Friday</u> <u>1</u>-9 pm
      - FORMAT & COMPLIANCE: <u>Thursday</u> 3-7 pm, <u>Friday</u> <u>1</u>-9 pm
      - LIGHTING: <u>Thursday</u> 8 am-9 pm, <u>Friday</u> <u>1</u>-9 pm

        - MECHANICAL: Thursday 8 am-9 pm, Friday 1-9 pm

    - Summer 2014 – Seattle
- International Energy Standards – (Hoegling)
- Subcommittee Votes
    - Lighting: No action items to vote on.
    - ECB

      Jason Glazer discussed an interpretation request about defining U-factors for below grade conditions as they relate to baseline building in the ECB. Comments that Appendix G does not apply well to buildings with large amounts of the façade below grade. Clarification is that "using 90.1-2007, the requester would need to apply the definitions of above-grade and below grade walls to the proposed design and select the appropriate baseline U-values from Table 5.1.1-5.1.8." Committee approved this response by hand vote 32-0-0.

    - Format & Compliance: No action requests to vote on. Subcommittee Chair made a brief statement on current work.
    - Mechanical
        - MSC 03, Motion 11 passed 32-0-0
        - MSC 04, Motion 5 to reconsider a change to Addendum D in 90,1-2013. Roll call vote passed 30-0-3.
        - Another proposed change to Section 6.4.3.3.5 (automatic controls of HVAC systems in Hotel/Motel guest rooms). Hand vote to modify, passed 29-0-2.
        - MSC 05, proposed addendum AQ to include computer rooms in Section 6.5.1, Economizers. Removed separate table for computer rooms, so now the table would apply to all building types, rather than have special conditions for computer rooms. Roll call vote passed 31-0-2. So, "one size fits all" results.
    - Envelope

      Break in the agenda at 9:00 a.m.:

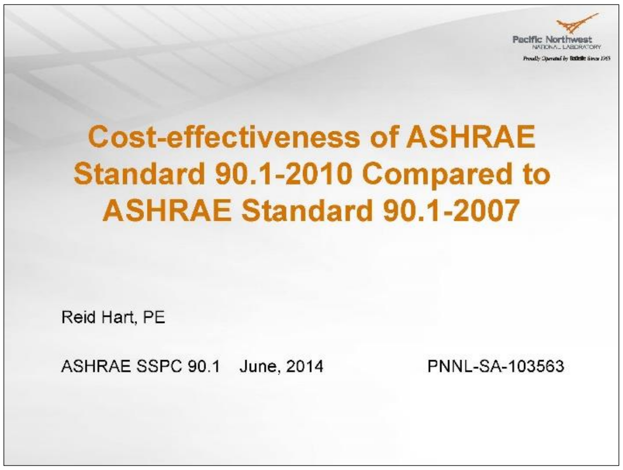
      Invited speaker made a 20-minute presentation on the international energy code process in Europe (code name prEN15603.) Working toward EU energy codes to be an ISO Standard by 2016. Talked about energy calculation methods, measured energy ratings, contributions from renewable energy. This standard would not be a prescriptive standard but rather would specify calculation procedures for different building types. Goal is to develop an Energy Performance (EP) target with units of kWh/sq.m. Standard is alleged to be taking steps toward NZEB. Includes an effort toward requiring energy labeling of building products. A technical report outlining the standard is TR15615. Speaker explained the various technical committees that are conducting numerous work tasks to develop the standard. Expect to have all the work tasks completed by the end of 2015. The SSPC chair emphasized the importance of the 90.1 SSPC keeping in touch with the EU efforts, mainly because they are progressive and the North America could be left behind.

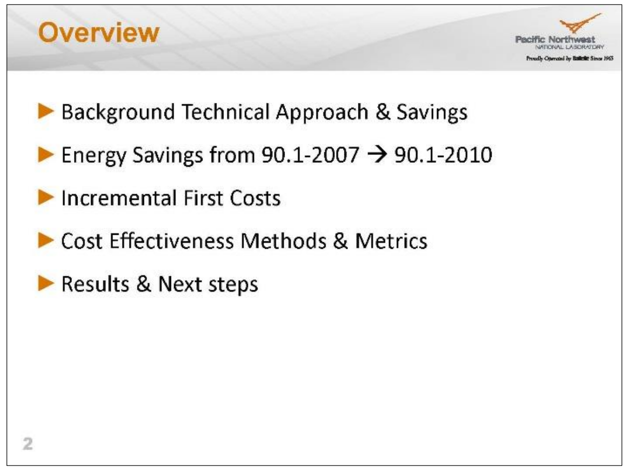
Committee had additional comments on this for another 10 minutes.

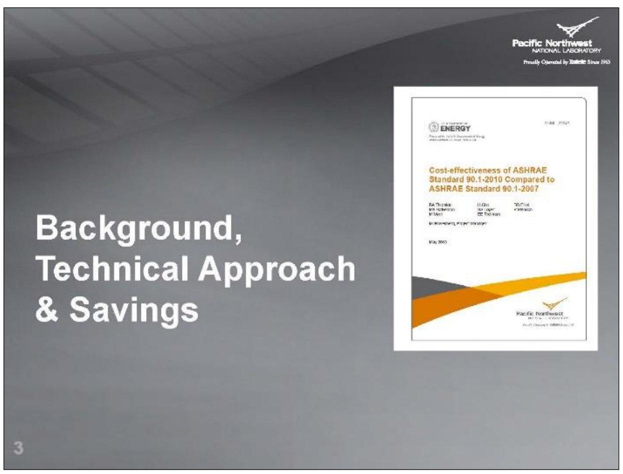
- Work Plan for 9.1-2016 – FINAL VOTE
  Very important discussion on the 90.1-2016 work plan after the break:
  Proposed that the energy savings goal be based on WHOLE BUILDING energy vs. regulated loads with a target of 40%. One member proposed a more realistic savings goal of 35% rather than 40%. After numerous other members of the SSPC presented extensive discussions, Committee voted to settle on the statement of 35-40% in the published information.
  Following the vote on the savings issue, the committee briefly discussed the scalar ratios that were presented on Saturday by Merle McBride, and then voted to approve the entire work plan (including the new scalar ratios). Vote was for approval 31-0-1.
- Brief overview of subcommittee plans
- Other Business
  Recognition of Steve Skalko's contributions to the committee and to ASHRAE. Steve was awarded a large Goodbye greeting card plus a Sushi tray engraved with the ASHRAE logo.
- Adjournment ....12 NOON
- **MEETING ROOM SCHEDULE**
  - All meetings are in the Sheraton Hotel

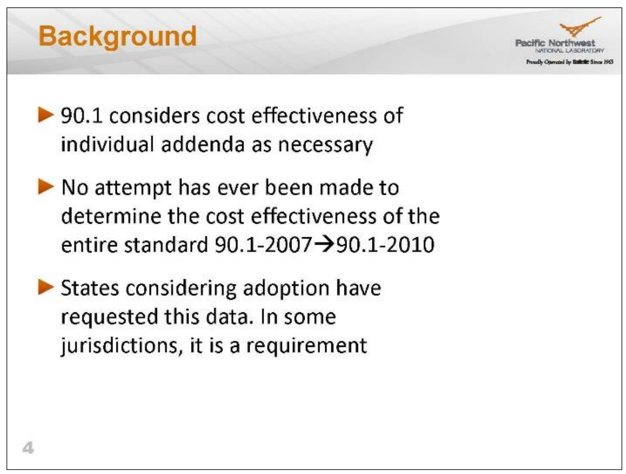
- **SSPC 90.1 ENERGY EFF. DESIGN OF NEW BLDG.**
  - Saturday 8:00a-12p Grand Ballroom A 2nd Floor
  - Sunday 9:00a-12p Grand Ballroom A 2nd Floor
  - Monday 8:00a-12p Grand Ballroom A 2nd Floor
- **FORMAT & COMPLIANCE SUBCOMMITTEE**
  - Friday **6**:00-10:00p Ballard 3rd Floor
  - Saturday 1:00-5:00p DashPoint (4-Pike St. Tower)
  - Sunday 4:00-7:00p Eagle Boardroom 1st Floor
- **MECHANICAL SUBCOMMITTEE**
  - Thursday 2:00-8:00p Ravenna A/B 3rd Floor
  - Friday 9:00a-10p Willow A 2nd Floor
  - Saturday 1:00-7:00p Grand Ballroom A 2nd Floor
  - Sunday 1:00-8:00p Aspen 2nd Floor
- **LIGHTING SUBCOMMITTEE**
  - Friday 9:00a-10p Leschi 3rd Floor
  - Saturday 1:00-7:00p Juniper 2nd Floor
  - Sunday 1:00-7:00p Ballard 3rd Floor
- **ECB SUBCOMMITTEE**
  - Friday 5:00-10:00p Greenwood 3rd Floor
  - Saturday 1:00-5:00p Everett 3rd Floor
  - Sunday 1:00-4:00p Eagle Boardroom 1st Floor
- **ENVELOPE SUBCOMMITTEE**
  - Friday 9:00a-10:00p Cedar 2nd Floor
  - Saturday 1:00-7:00p Ravenna A/B 3rd Floor
  - Sunday 1:00-8:00p Cedar 2nd Floor

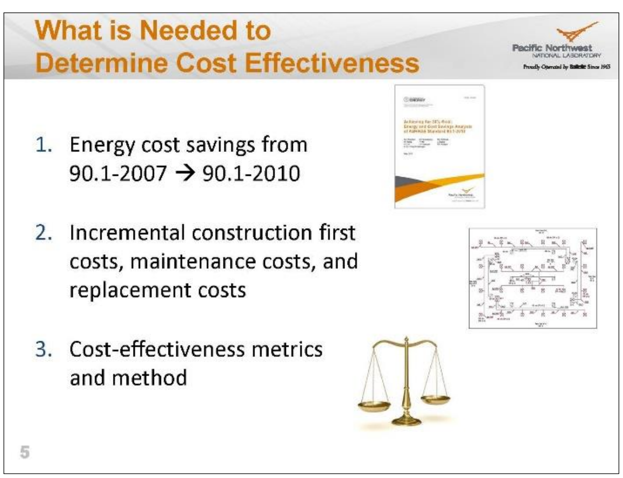
6.4.3.3 Cost-effectiveness of ASHRAE Standard 90.1-2010 Compared to ASHRAE Standard 90.1-2007 These slides are from the SSPC 90.1 at the ASHRAE Summer Conference in Seattle, Washington meeting.

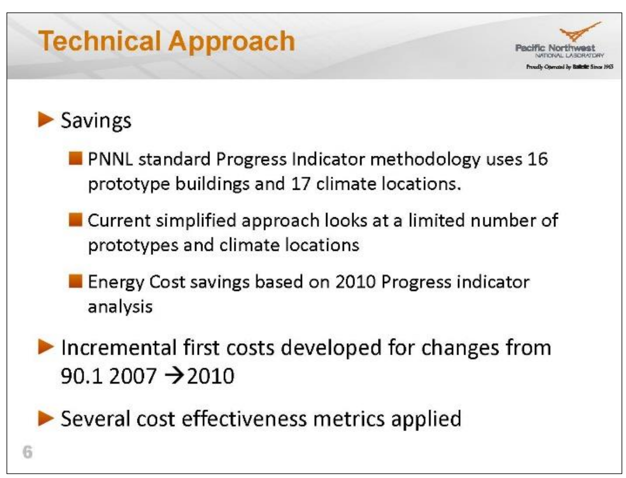






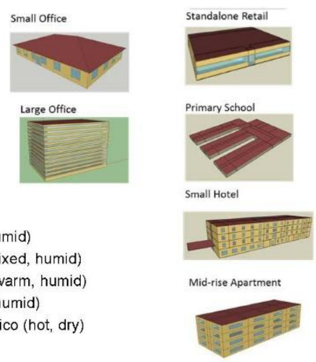






Savings from the Progress Indicator

- 6 of 16 Prototypes
  - Small Office
  - Large Office
  - Standalone Retail
  - Primary School
  - Small Hotel
  - Mid-rise Apartment
- 5 of 15 Climate locations
  - 2A Houston, Texas (hot, humid)
  - 4A Baltimore, Maryland (mixed, humid)
  - 3A Memphis, Tennessee (warm, humid)
  - 5A Chicago, Illinois (cool, humid)
  - 3B Albuquerque, New Mexico (hot, dry)



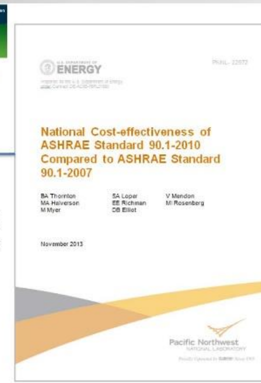
7

90.1 Cost-Effectiveness Analysis

Can access from BECP web site: Development; Economic Analysis

or search for "PNNL 22972"

Be sure to get November 2013 version



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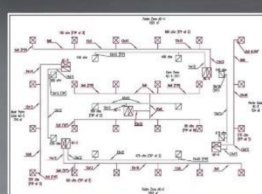
Incremental First Costs



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Development of Incremental Costs

Define items that need costs

1. Increased costs based on addenda

   41 with energy savings
   - 38 total addenda captured in selected models
   - 3 addenda with savings don't apply to the six prototypes
2. Decreased costs in some cases:
   - Heating and cooling equipment capacity reduction
   - Reduction in ductwork, piping, fittings, fans, pumps, motors
   - Lighting cost reductions based on fewer lamps or ballasts in some cases.
   - Reduced lighting replacement costs due to longer lamp lives

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Incremental Costs Data Source

- Costs developed by:
  - Cost Estimating consultant
  - Architecture and Engineering consultant
  - Including RS Means equipment costs if available, for comparison
  - Online catalogues
  - Other sources
- New construction, maintenance, and replacement
  - Material, labor, overhead and profit; may also include construction equipment, and commissioning
  - Labor is generally from RS Means 2012 to maintain consistency with cost estimates from multiple sources
  - When material costs are available from more than one source, an average cost is used
- Costs reviewed by 90.1 subcommittees

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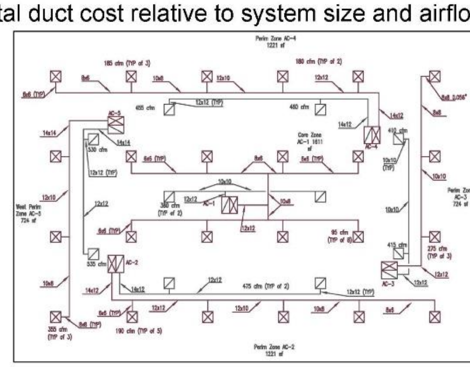
Example: Small Office Duct Layout

Total duct cost relative to system size and airflow



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Conservative Cost Factors

Cost Items	Value	Description
New construction labor cost adjustment	52.6%	Labor costs: base wages with fringe benefits. 19%: 16% for payroll, taxes and insurance including worker's comp, FICA, unemployment compensation and contractor's liability; plus 3% for small tools. 25%: 15% for home office overhead; plus 10% for profit. 2.56% contingency as allowance to cover wage increases.
New construction material cost adjustment	15.0% to 26.5%	10% waste allowance in most cases for building envelope materials. 0% for other materials such as HVAC equipment. 10% profit on materials. 5% average value for sales taxes.
Replacement - additional labor allowance	65.0%	Added labor hours for replacement to cover demolition, protection, logistics, clean-up and lost productivity relative to new construction.
Replacement labor cost adjustment	62.3%	Used for replacement labor costs. Sub-contractor overhead is 23% instead of 15% to support small repair and replacement jobs.
Replacement material cost adjustment	26.5% to 38.0%	Used for replacement material costs for purchase of smaller lots and replacement parts. 10% is added and then is adjusted for profit and sales taxes.
Project cost adjustment	28.8%	Sub-contractor general conditions add 12% General contractor markup of 10% 5% contingency

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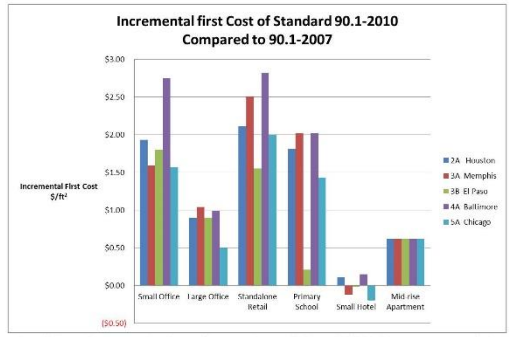
Development of Incremental Costs



Small hotel cost reductions due to downsizing of HVAC systems and ductwork.

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Incremental Cost Increase

Prototype	Building First Cost $/ft²	Incremental Cost for 90.1-2010 vs. 2007: 2A Houston $/ft²	3A Memphis $/ft²	3B El Paso $/ft²	4A Baltimore $/ft²	5A Chicago $/ft²
Small Office	$125	$1.93	$1.59	$1.80	$2.75	$1.57
		1.55%	1.27%	1.44%	2.20%	1.25%
Large Office	$158	$0.90	$1.04	$0.90	$0.99	$0.50
		0.57%	0.66%	0.57%	0.62%	0.31%
Standalone Retail	$87	$2.11	$2.51	$1.55	$2.82	$2.00
		2.43%	2.89%	1.78%	3.24%	2.30%
Primary School	$132	$1.81	$2.02	$0.21	$2.02	$1.43
		1.37%	1.53%	0.16%	1.53%	1.09%
Small Hotel	$106	$0.11	-$0.12	-$0.02	$0.15	-$0.20
		0.11%	-0.11%	-0.01%	0.14%	-0.19%
Mid-rise Apartment	$111	$0.62	$0.62	$0.62	$0.62	$0.62
		0.56%	0.56%	0.56%	0.56%	0.56%

Construction cost adder ranges from -0.2% to 3.2% for 90.1-2010

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Cost Effectiveness Methods & Metrics

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Cost Effectiveness

- Full life cycle cost (LCC) over the life of the building
- Including parameters for
  - Energy costs
  - Escalation rates
  - Tax rates
  - Discount rate
  - Interest rate
- 90.1 simplifies and standardizes the LCC calculation process and refers to it as a **scalar**
- More common approach for public buildings is the Building LCC program developed by NIST

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Cost Effectiveness Method

Three ownership scenarios available

- **Scenario 1** (*publicly-owned*): Without borrowing or taxes. Economic inputs established for Federal projects.
- **Scenario 2**: (*privately-owned*): Includes loan and tax impacts. Typical commercial economic inputs, with initial costs being financed, and considers tax impacts for savings, interest and depreciation.
- **Scenario 3**: (*ASHRAE 90.1 committee scalar*): Private ownership point of view, and uses economic inputs established by the 90.1 ASHRAE SSPC for 90.1-2010.

For the 90.1-2007 to 2010 analysis, scenarios 1 & 3 were used.

Cost Effectiveness Metrics of merit

- Life cycle cost net savings (30 year life)
- Scalar ratio (20.2 year limit for 40 year life)

Also provided: Simple payback period

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Scenario 1 Public LCC Parameters

Economic Parameter	Commercial State Cost-Effectiveness Scenario 1 without Loans or Taxes	
	Value	Source
Nominal Discount Rate[1]	3.9%	Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis - 2011, NIST annual update – (2011, Rushing et al.).
Real Discount Rate[2]	3.0%	Calculated from nominal discount rate and inflation.
Inflation[3]	0.9%	Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis - 2011, NIST annual update (2011, Rushing et al.)
Electricity and Gas Price	\$0.0939/kWh, \$1.22/therm	SSPC-90.1 (Based on EIA national average)
Energy Price Escalation	Uniform present value factors Electricity: 18.88 Natural Gas: 20.90	Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis - 2011, NIST annual update – (2011, Rushing et al.). The NIST uniform present value factors are multiplied by the first year annual energy cost to determine the present value of 30 years of energy costs and are based on a series of different annual escalation rates for 30 years.

[1] Nominal discount rate is like a quoted interest rate and takes into account expectations about the impact of inflation on future values. Higher nominal rates imply higher expectations of inflation.
[2] Real discount rate excludes inflation so that future amounts can be defined in today's dollars in the calculations. This is not a quoted interest rate. If inflation is zero, real and nominal discount rates are the same. Inflation is captured in the process of using constant dollar costs and the modified discount rate.
[3] General inflation is the background level of price increases for all costs other than energy. This is applied to replacement and maintenance costs through the real discount rate.

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Scenario 3 90.1 Scalar Parameters

Input Economic Variables	Heating	Cooling
Economic Life - Years	40	40
Fuel Escalation Rate - %	3.7	3.7
Discount Rate - %	7.0	7.0
Loan Interest Rate - %	7.0	7.0
Federal Tax Rate - %	34.0	34.0
State Tax Rate - %	5.0	5.0
Heating – Natural Gas Price, \$/therm	1.22	
Cooling - Electricity Price \$/kWh		0.1032
Scalar Ratio Limit	20.2	20.2

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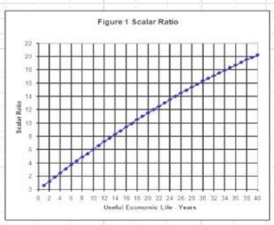
Scalar Ratio

Calculations based on WG2010 economic values approved in Spring 2007 by SSPC 90.1 as their Work Plan.

Year	Scalar Ratio
1	0.6
2	1.2
3	1.9
4	2.5
5	3.1
6	3.7
7	4.3
8	4.9
9	5.4
10	6.0
11	6.6
12	7.2
13	7.7
14	8.3
15	8.8
16	9.4
17	9.9
18	10.5
19	11.0
20	11.5
21	12.0
22	12.5
23	13.0
24	13.5
25	14.0
26	14.5
27	14.9
28	15.4
29	15.8
30	16.3
31	16.7
32	17.1
33	17.5
34	17.9
35	18.3
36	18.7
37	19.1
38	19.5
39	19.8
40	20.2



The scalar ratio is the maximum simple payback based on the life of the measure.

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Life Cycle Cost Metrics

- Scenario 1: Net PV of Savings (30 years)
  - Positive NPV indicates cost effectiveness

$$[PV\ Energy\ Savings] - [PV\ Maintenance\ Costs] - [First\ Cost] - [PV\ Replacement\ Costs] + [PV\ Residual\ Value]$$

- Scenario 3: Scalar Ratio (40 years)
  - Scalar ratio < threshold indicates cost effectiveness

$$\frac{[Annual\ Energy\ Savings] - [Annual\ Maintenance\ Costs]}{[First\ Cost] + [PV\ Replacement\ Costs] - [PV\ Residual\ Value]}$$

PV = Present Value

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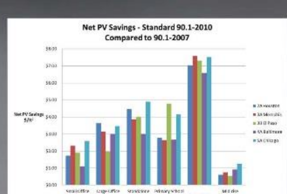
Results & Next steps



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Cost Effectiveness Results

Prototype		Climate Zone: 2A Houston	3A Memphis	3B El Paso	4A Baltimore	5A Chicago
Net Present Value Savings (Life Cycle Cost, 30 years)						
Small Office	Total	\$9,500	\$12,700	\$10,400	\$6,100	\$14,300
	\$/ft²	\$1.73	\$2.31	\$1.89	\$1.11	\$2.60
Large Office	Total	\$1,810,000	\$1,560,000	\$990,000	\$1,500,000	\$1,730,000
	\$/ft²	\$3.63	\$3.13	\$1.99	\$3.01	\$3.47
Standalone Retail	Total	\$110,000	\$95,600	\$99,200	\$74,000	\$121,000
	\$/ft²	\$4.46	\$3.87	\$4.02	\$3.00	\$4.90
Primary School	Total	\$205,000	\$195,000	\$354,000	\$197,000	\$307,000
	\$/ft²	\$2.77	\$2.64	\$4.79	\$2.66	\$4.15
Small Hotel	Total	\$304,450	\$328,000	\$316,000	\$284,700	\$325,000
	\$/ft²	\$7.05	\$7.59	\$7.31	\$6.59	\$7.52
Mid-rise Apt	Total	\$20,400	\$25,500	\$18,300	\$30,800	\$41,800
	\$/ft²	\$0.60	\$0.76	\$0.54	\$0.91	\$1.24
Scalar Ratio (Limit 20.2 for 40 year life)						
Small Office		9.7	6.5	8.7	14.1	5.9
Large Office		4.8	5.8	7.2	5.9	3.1
Standalone Retail		6.6	8.2	5.2	10.1	6.0
Primary School		8.9	9.6	0.7	9.8	6.4
Small Hotel		-23.4	-24.8	-24.8	-27.3	-27.9
Mid-rise Apt		9.0	7.8	9.6	7.0	5.6

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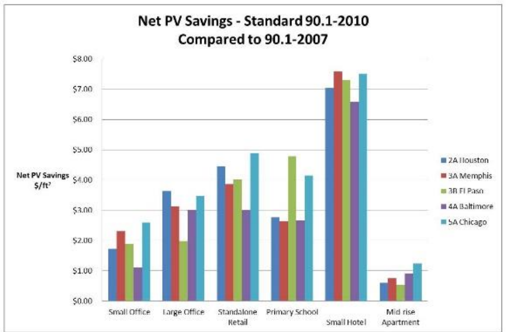
Cost-Effectiveness - Results



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Conclusion

- The upgrade from ASHRAE Standard 90.1-2007 to 90.1-2010 is cost effective
  - for all six buildings analyzed in five climate zones
  - Using the FEMP based public building method (scenario 1)
  - Using the ASHRAE 90.1 scalar method (scenario 3)
- Details are available in the report, available online

  http://www.pnnl.gov/main/publications/external/technical_reports/pnnl-22972.pdf

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Related Work

- PNNL evaluated the cost effectiveness of 90.1 for 21 States and Washington DC.
  - Considers state specific climate locations and weighting
  - Considers state specific fuel prices, tax rates, and construction cost adjustments
  - 90.1-2010 is cost effective where analyzed
- Savings established with the 2010 Progress Indicator

Both available at the same site:

www.energycodes.gov/development/commercial/cost_effectiveness

- PNNL will evaluate cost effectiveness of Standard 90.1-2013 using a similar approach to that used for 90.1-2010

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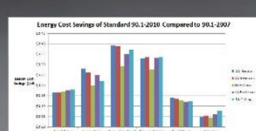
Questions



Backup Detailed Information:
Energy Savings from 90.1-2007 to 90.1-2010

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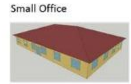
Savings from the Progress Indicator

- Prototypes
  - Small Office
  - Large Office
  - Standalone Retail
  - Primary School
  - Small Hotel
  - Mid-rise Apartment
- Climate locations
  - 2A Houston, Texas (hot, humid)
  - 4A Baltimore, Maryland (mixed, humid)
  - 3A Memphis, Tennessee (warm, humid)
  - 5A Chicago, Illinois (cool, humid)
  - 3B Albuquerque, New Mexico (hot, dry)

Small Office

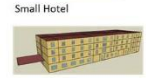


Standalone Retail

Large Office

Primary School

Small Hotel



Mid-rise Apartment

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Climate Zones and Locations

Climate Zone	Climate Zone Type	Representative City
1A	Very Hot - Humid	Miami FL
1B	Very Hot - Dry	Riyadh, Saudi Arabia
2A	Hot - Humid	Houston, TX
2B	Hot - Dry	Phoenix AZ
3A	Warm - Humid	Memphis, TN
3B	Warm - Dry	El Paso, TX
3C	Warm - Marine	San Francisco, CA
4A	Mixed - Humid	Baltimore, MD
4B	Mixed - Dry	Albuquerque NM
4C	Mixed - Marine	Salem OR
5A	Cool - Humid	Chicago IL
5B	Cool - Dry	Boise ID
5C	Cool - Marine	Vancouver, BC
6A	Cool - Humid	Burlington VT
6B	Cool - Dry	Helena MT
7	Very Cold	Duluth, MN
8	Subarctic	Fairbanks, AK

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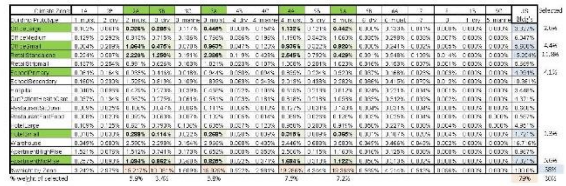
Simplified Analysis Approach



- Selected prototypes and climate zones give coverage of prototype US construction weighting
  - 79% of US construction in climate zones covered
  - 38% of US construction in prototypes covered
  - 30% of US construction matches climate zone/prototype combination

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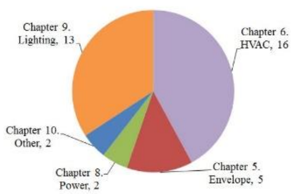
Energy Cost Savings Standard 90.1-2007 → 2010

- Savings established with the 2010 Progress Indicator
- Quantified Savings for 38 Addenda



http://www.energycodes.gov/sites/default/files/documents/BECP_Energy_Cost_Savings_STD2010_May2011_v00.pdf

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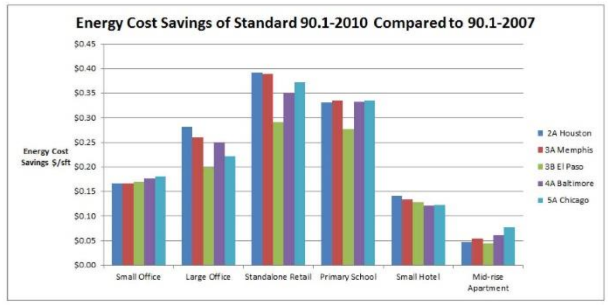
Energy Cost Savings 90.1-2007 → 2010



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Annual Energy Cost Savings

Prototype		Climate Location 2A Houston	3A Memphis	3B El Paso	4A Baltimore	5A Chicago
Small Office	Savings	$914	$919	$929	$973	$993
	Savings/ft²	$0.17	$0.17	$0.17	$0.18	$0.18
Large Office	Savings	$140,209	$129,662	$99,546	$124,939	$110,379
	Savings/ft²	$0.28	$0.26	$0.20	$0.25	$0.22
Standalone Retail	Savings	$9,674	$9,605	$7,193	$8,671	$9,176
	Savings/ft²	$0.39	$0.39	$0.29	$0.35	$0.37
Primary School	Savings	$24,431	$24,754	$20,485	$24,580	$24,810
	Savings/ft²	$0.33	$0.33	$0.28	$0.33	$0.34
Small Hotel	Savings	$6,075	$5,773	$5,514	$5,209	$5,320
	Savings/ft²	$0.14	$0.13	$0.13	$0.12	$0.12
Mid-rise Apartment	Savings	$1,608	$1,845	$1,498	$2,069	$2,593
	Savings/ft²	$0.05	$0.05	$0.04	$0.06	$0.08

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Backup Detailed Information: Costs

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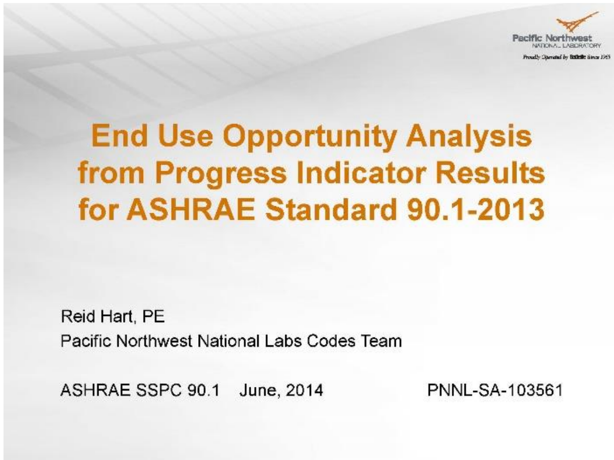
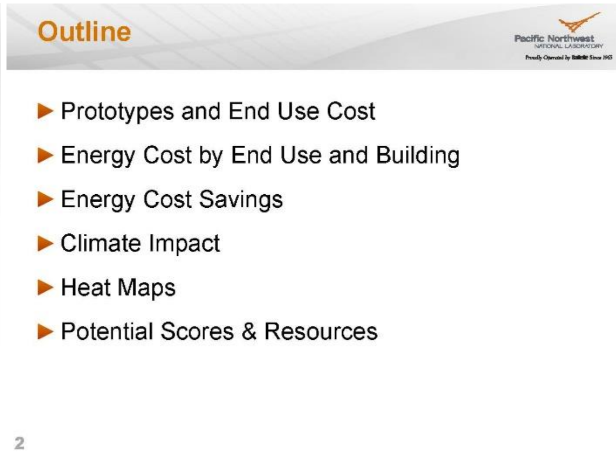
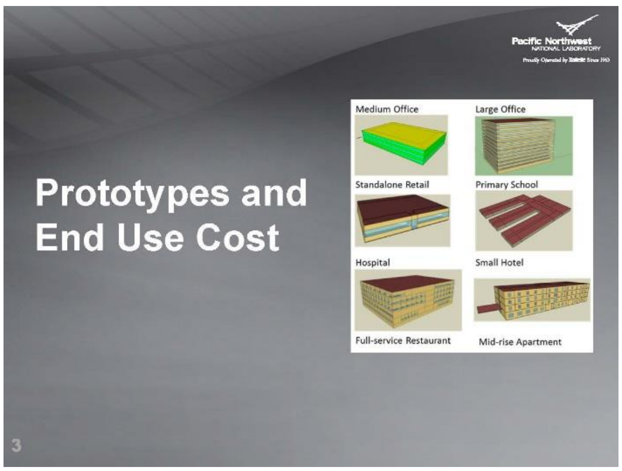
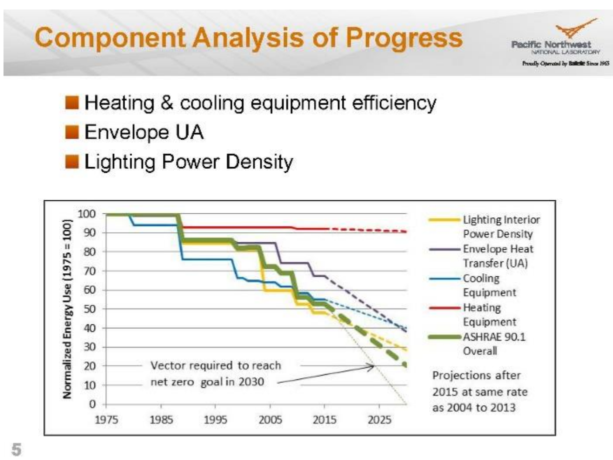
Prototype	Value	2A Houston	3A Memphis	3B El Paso	4A Baltimore	5A Chicago
Small Office	First Cost	$10,624	$8,749	$9,923	$15,112	$8,622
	$/ft²	$1.93	$1.59	$1.80	$2.75	$1.57
Large Office	First Cost	$446,971	$517,591	$451,173	$491,567	$248,074
	$/ft²	$0.90	$1.04	$0.90	$0.99	$0.50
Standalone Retail	First Cost	$52,140	$62,041	$38,255	$69,601	$49,333
	$/ft²	$2.11	$2.51	$1.55	$2.82	$2.00
Primary School	First Cost	$134,160	$149,396	$15,611	$149,768	$106,113
	$/ft²	$1.81	$2.02	$0.21	$2.02	$1.43
Small Hotel	First Cost	$4,922	-$5,113	-$681	$6,571	-$8,766
	$/ft²	$0.11	-$0.12	-$0.02	$0.15	-$0.20
Mid-rise Apartment	First Cost	$20,858	$20,858	$20,858	$20,858	$20,858
	$/ft2	$0.62	$0.62	$0.62	$0.62	$0.62

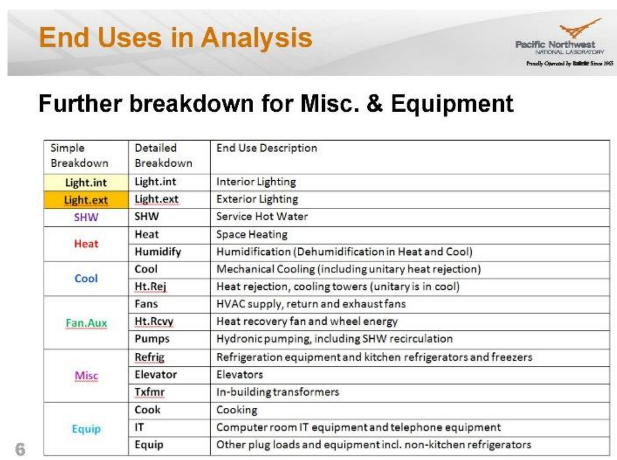
6.4.3.4 End Use Opportunity Analysis from Progress Indicator Results for ASHRAE Standard 90.1-2013. These slides are from the SSPC 90.1 at the ASHRAE Summer Conference in Seattle, Washington meeting.





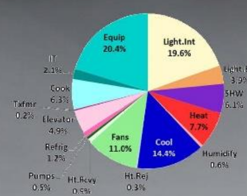






Simple Breakdown	Detailed Breakdown	End Use Description
Light.int	Light.int	Interior Lighting
Light.ext	Light.ext	Exterior Lighting
SHW	SHW	Service Hot Water
Heat	Heat	Space Heating
	Humidify	Humidification (Dehumidification in Heat and Cool)
Cool	Cool	Mechanical Cooling (including unitary heat rejection)
	Ht.Rej	Heat rejection, cooling towers (unitary is in cool)
Fan.Aux	Fans	HVAC supply, return and exhaust fans
	Ht.Rcvy	Heat recovery fan and wheel energy
	Pumps	Hydronic pumping, including SHW recirculation
Misc	Refrig	Refrigeration equipment and kitchen refrigerators and freezers
	Elevator	Elevators
	Txfmr	In-building transformers
Equip	Cook	Cooking
	IT	Computer room IT equipment and telephone equipment
	Equip	Other plug loads and equipment incl. non-kitchen refrigerators

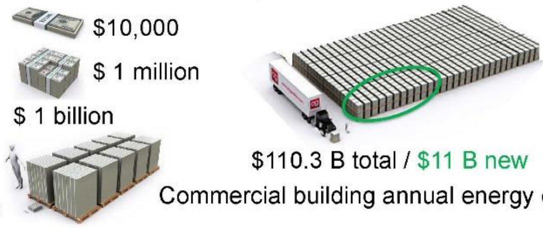
Energy Cost by End Use and Building



7

Commercial Building Energy Cost

- U.S. commercial building floor area 2013:
  - Total: 82.9 billion square feet (EIA Energy Data Book)
  - New: 8.2 billion square feet (2003-2007 dodge reports)
- Using throughout rates for 90.1-2013 analysis:
  Electric: $ 0.1032 /kWh; Fossil: $ 0.99/therm

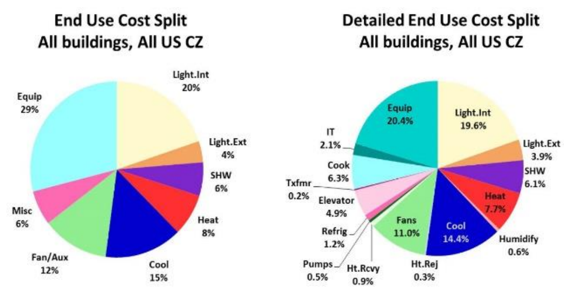


$110.3 B total / $11 B new
Commercial building annual energy cost

8

End Use Cost Splits – 90.1-2013

All US, weighted for new construction; ECI $/ft²/year



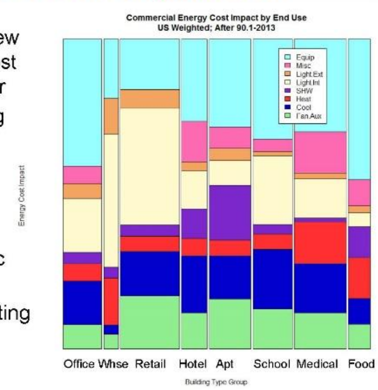
9

US Weighted Cost Impact by Building Type & End Use, 90.1-2013

Area = National new building energy cost $11 billion per year

Bar width=Building type ECI impact

Large areas:
- Retail Lighting
- Apt SHW
- Med & Food Svc heating
- Warehouse heating

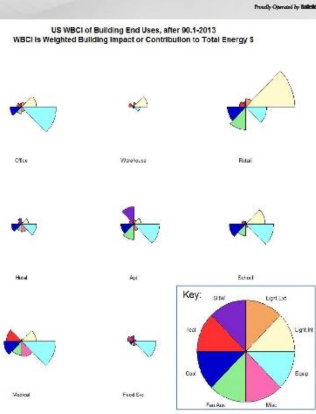


10

ECI Weighted for U.S. Construction

A segment view of the end use costs, weighted for US impact.

- Helps spot high impact standouts
  - Equipment
  - Apt SHW
  - Retail lighting
- Limitations
  - Retail prototypes do not include grocery or convenience stores
  - Commissioning not captured—everything works perfectly
  - Compliance and enforcement deducts not captured



11

Energy Cost Savings 90.1-2004 to 2013

12

US Weighted Cost by End Use

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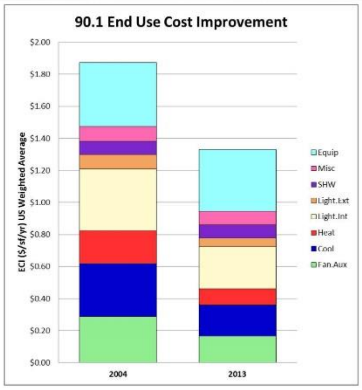
- Significant savings from 2004 to 2013
  - $1.87 to $1.33 $/sf/yr
- Loads without much reduction:
  - Equipment
  - Service hot water (SHW)
  - Miscellaneous: Refrigeration, elevators, transformers
- Good reduction shown in all other areas



13

US Weighted Cost Impact by Building Type & End Use, 90.1-2004

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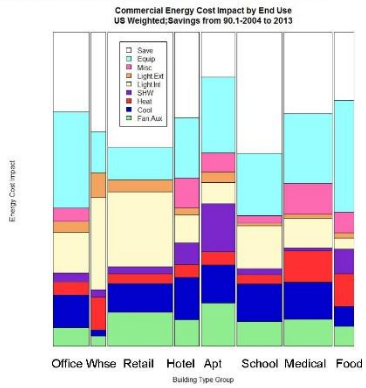
Area = National energy cost impact for 90.1-2004
$15.5 billion/year

Bar width=Building type energy cost impact

White = Savings from 90.1-2004 to 2013
$4.5 billion/year

Greatest savings:
- Retail & School

Least savings:
- Apartments



14

End Use Prioritization and Savings

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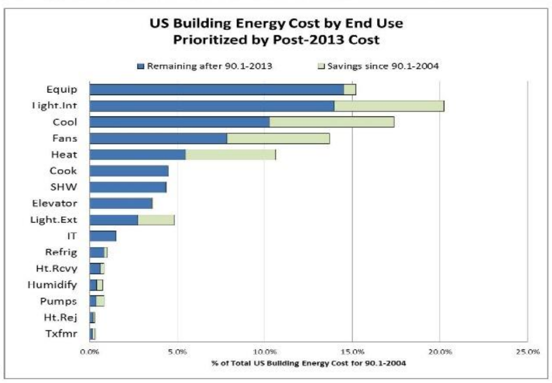

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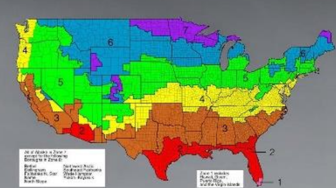
Climate Impact



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HVAC by Climate Zone

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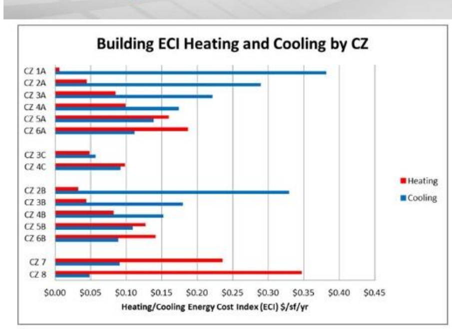

Only climate zones with US construction included as heat/cool ECI is weighted for building type construction within each climate zone

Grouped by moisture regime to help see a clearer pattern

17

HVAC by Climate Zone

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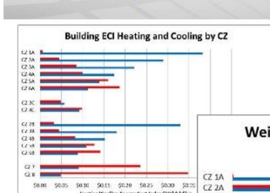
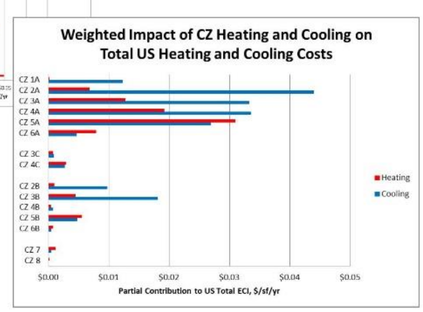


Only climate zones with US construction included

Weighting for overall US construction gives a different priority picture



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Heat Maps

% Cost Savings by end use and Building Type, 90.1-2004 to 90.1-2013 (% savings per individual end use)

	Light.Int	Light.Ext	SHW	Heat	Cool	Fan.Aux	Misc	Equip	Total
Office	37.1%	50.4%	0.3%	42.2%	39.5%	25.7%	10.0%	5.5%	25.4%
Warehouse	36.0%	33.1%	3.2%	36.4%	46.3%	50.6%		2.0%	31.8%
Retail	24.0%	48.0%	5.1%	64.2%	50.1%	49.9%		0.4%	36.7%
Hotel	36.6%	25.0%	0.3%	56.5%	35.7%	45.2%	5.8%	4.4%	27.2%
Apt	6.7%	32.4%	0.1%	41.3%	29.2%	21.0%	6.3%	0.3%	14.2%
School	43.0%	47.1%	0.9%	58.1%	50.0%	52.5%	19.2%	9.7%	38.5%
Medical	16.8%	47.0%	0.8%	54.8%	33.1%	33.4%	3.3%	1.5%	26.0%
Food.Svc	59.5%	43.3%	0.7%	15.9%	34.5%	55.7%	21.6%	0.0%	21.7%
US Weighted	30.9%	43.2%	1.0%	50.4%	41.4%	42.5%	8.6%	3.4%	29.0%

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ECI, Energy Cost Index, 90.1-2013

- "Heat map" shows higher remaining ECI darker red
- Weighted within each building type for CZ construction
- Weighted average US building $1.330/ft²/year

ECI Remaining after 90.1-2013, by building group; $/sf/year

	Light.Int	Light.Ext	SHW	Heat	Cool	Fan.Aux	Misc	Equip	Total
Office	$0.203	$0.055	$0.043	$0.066	$0.164	$0.093	$0.065	$0.479	$1.167
Warehouse	$0.170	$0.045	$0.014	$0.060	$0.012	$0.019		$0.075	$0.395
Retail	$0.482	$0.076	$0.047	$0.063	$0.184	$0.219		$0.209	$1.281
Hotel	$0.215	$0.052	$0.166	$0.099	$0.322	$0.205	$0.229	$0.463	$1.750
Apt	$0.092	$0.046	$0.207	$0.058	$0.163	$0.189	$0.081	$0.329	$1.165
School	$0.259	$0.016	$0.037	$0.056	$0.225	$0.151	$0.046	$0.376	$1.166
Medical	$0.381	$0.054	$0.037	$0.404	$0.476	$0.352	$0.398	$0.897	$3.000
Food.Svc	$0.371	$0.175	$0.806	$1.078	$0.668	$0.656	$0.690	$3.679	$8.124
US Weighted	$0.263	$0.052	$0.082	$0.103	$0.193	$0.166	$0.085	$0.386	$1.330

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National Energy Cost Impact

- The national energy cost impact for each building type and end use is the contribution to US new building energy cost remaining after 90.1-2013
- Deeper red is higher impact

Million $/y-US spend on New Commercial Building Energy; After 90.1-2013

	Light.Int	Light.Ext	SHW	Heat	Cool	Fan.Aux	Misc	Equip	Total
Office	$252M	$69M	$53M	$81M	$202M	$115M	$80M	$593M	$1,446M
Warehouse	$235M	$63M	$19M	$83M	$16M	$26M		$104M	$546M
Retail	$834M	$132M	$82M	$109M	$318M	$380M		$361M	$2,216M
Hotel	$118M	$29M	$91M	$55M	$177M	$113M	$126M	$255M	$965M
Apt	$124M	$62M	$279M	$78M	$219M	$254M	$109M	$443M	$1,568M
School	$329M	$21M	$46M	$71M	$286M	$192M	$58M	$477M	$1,480M
Medical	$246M	$35M	$24M	$261M	$308M	$228M	$257M	$580M	$1,939M
Food.Svc	$38M	$18M	$83M	$111M	$69M	$68M	$71M	$379M	$837M
US Weighted	$2,177M	$428M	$678M	$848M	$1,596M	$1,375M	$702M	$3,192M	$10,997M

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90.1-2004 to 2013 Cost Savings

- The percentage ECI reduction from 2004 to 2013
  - Darker green is higher savings
  - Darker red is lesser savings

% Cost Savings by end use and Building Type, 90.1-2004 to 90.1-2013 (% savings per individual end use)

	Light.Int	Light.Ext	SHW	Heat	Cool	Fan.Aux	Misc	Equip	Total
Office	37.1%	50.4%	0.3%	42.2%	39.5%	25.7%	10.0%	5.5%	25.4%
Warehouse	36.0%	33.1%	3.2%	36.4%	46.3%	50.6%		2.0%	31.8%
Retail	24.0%	48.0%	5.1%	64.2%	50.1%	49.9%		0.4%	36.7%
Hotel	36.6%	25.0%	0.3%	56.5%	35.7%	45.2%	5.8%	4.4%	27.2%
Apt	6.7%	32.4%	0.1%	41.3%	29.2%	21.0%	6.3%	0.3%	14.2%
School	43.0%	47.1%	0.9%	58.1%	50.0%	52.5%	19.2%	9.7%	38.5%
Medical	16.8%	47.0%	0.8%	54.8%	33.1%	33.4%	3.3%	1.5%	26.0%
Food.Svc	59.5%	43.3%	0.7%	15.9%	34.5%	55.7%	21.6%	0.0%	21.7%
US Weighted	30.9%	43.2%	1.0%	50.4%	41.4%	42.5%	8.6%	3.4%	29.0%

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Potential	Light.Int	Light.Ext	SHW	Heat	Cool	Fan.Aux	Misc	Equip
Office	5.9	3.5	6.4	4.1	5.3	5.4	6.1	10.8
Warehouse	5.7	4.4	6.0	4.4	3.2	3.1		6.7
Retail	10.5	4.0	6.3	2.8	5.2	5.6		8.6
Hotel	5.5	4.9	7.3	3.3	6.4	4.9	7.5	9.5
Apt	6.6	4.5	8.3	4.1	6.0	6.8	6.5	9.6
School	6.1	3.2	6.3	3.0	5.3	4.4	5.3	9.5
Medical	8.2	3.5	6.3	6.0	8.0	6.9	9.2	11.0
Food.Svc	4.7	4.5	9.3	8.4	7.1	5.8	7.9	10.4
US Weighted	7.1	4.0	6.7	3.8	5.3	5.2	4.1	9.2

Potential Scores & Detailed Resources

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Focus Potential Score

- To help focus where to look, a 'potential score'
  - 6 points for low savings from 90.1-2004 to 2013
  - 3 points for high individual average building type ECI
  - 3 points for high nationally weighted ECI

Potential	Light.Int	Light.Ext	SHW	Heat	Cool	Fan.Aux	Misc	Equip
Office	5.9	3.5	6.4	4.1	5.3	5.4	6.1	10.8
Warehouse	5.7	4.4	6.0	4.4	3.2	3.1		6.7
Retail	10.5	4.0	6.3	2.8	5.2	5.6		8.6
Hotel	5.5	4.9	7.3	3.3	6.4	4.9	7.5	9.5
Apt	6.6	4.5	8.3	4.1	6.0	6.8	6.5	9.6
School	6.1	3.2	6.3	3.0	5.3	4.4	5.3	9.5
Medical	8.2	3.5	6.3	6.0	8.0	6.9	9.2	11.0
Food.Svc	4.7	4.5	9.3	8.4	7.1	5.8	7.9	10.4
US Weighted	7.1	4.0	6.7	3.8	5.3	5.2	4.1	9.2

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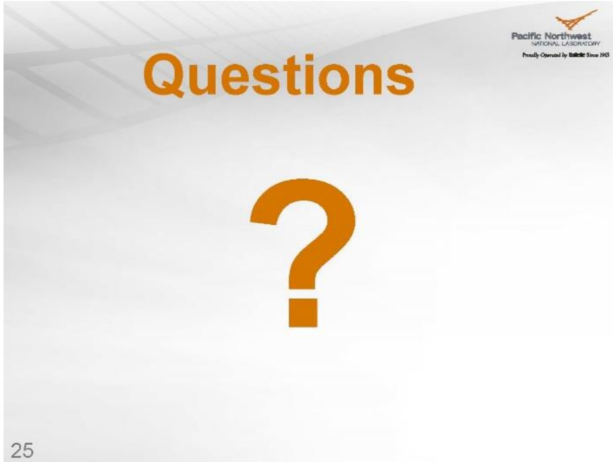
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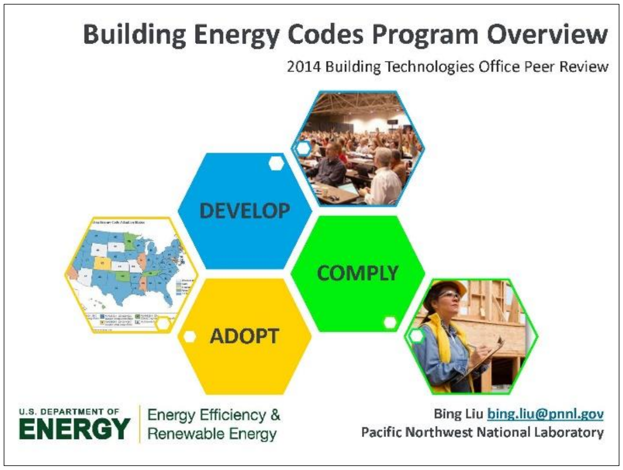
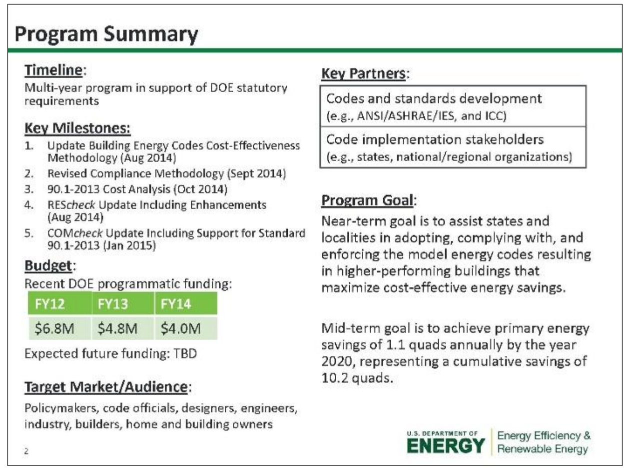
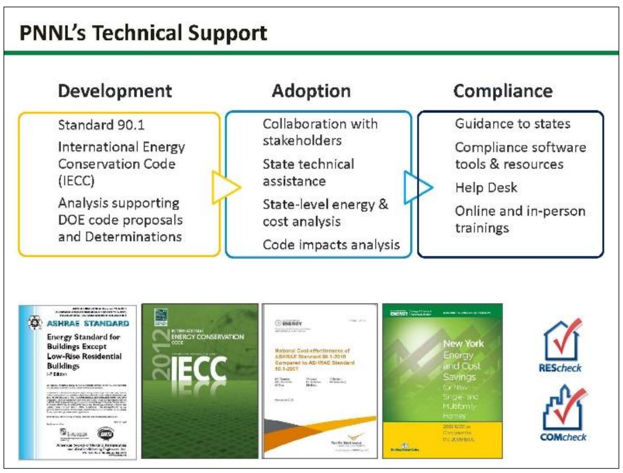
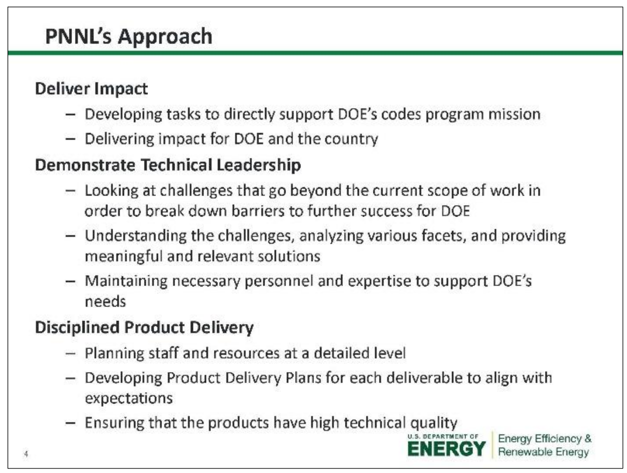
Questions
?
25

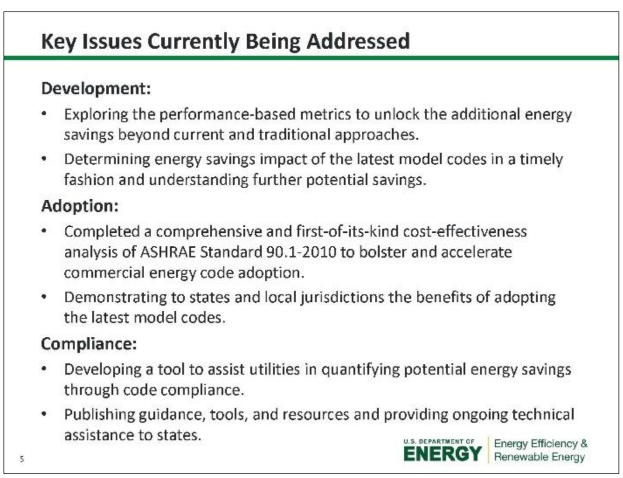
6.4.3.5 Building Energy Codes Program Overview. These slides are from the SSPC 90.1 at the ASHRAE Summer Conference in Seattle, Washington meeting.

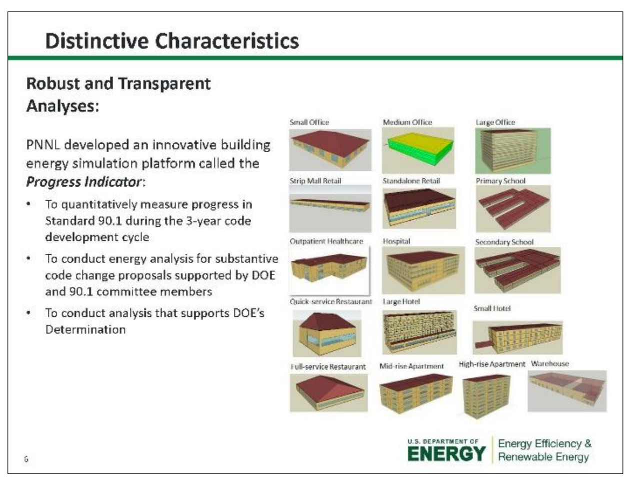








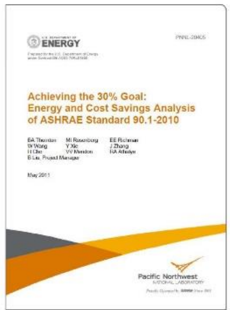




Distinctive Characteristics – Progress Indicator

Robust and Transparent Analyses:

- Consists of a suite of over 1,000 building models based on 16 prototype commercial buildings in all US climate zones, representing 80% of the U.S. commercial building stock.
- Models were peer reviewed by industry, documented in a technical report, and published online for easy public access, demonstrating analysis that is robust, transparent, and reproducible.
- Approach has been adopted by other researchers to evaluate the energy savings potential of emerging technologies and to develop code proposals at the state or local level.



http://www.energycodes.gov/development/commercial/90.1_models

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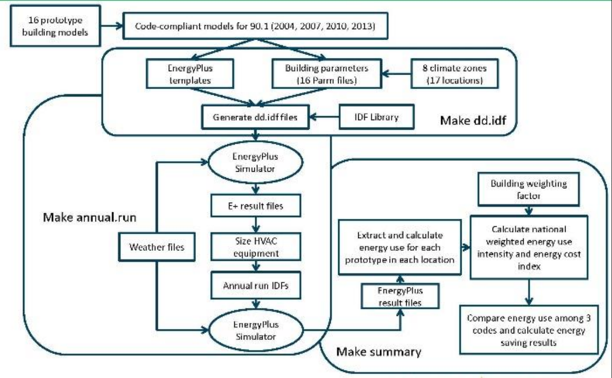
Distinctive Characteristics – Progress Indicator



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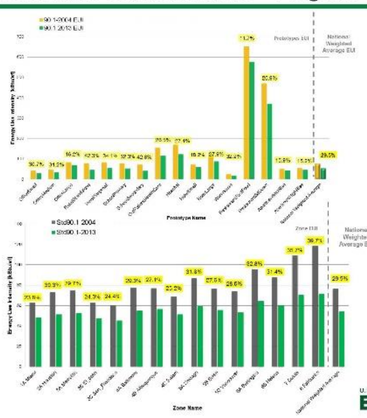
Distinctive Characteristics – Progress Indicator



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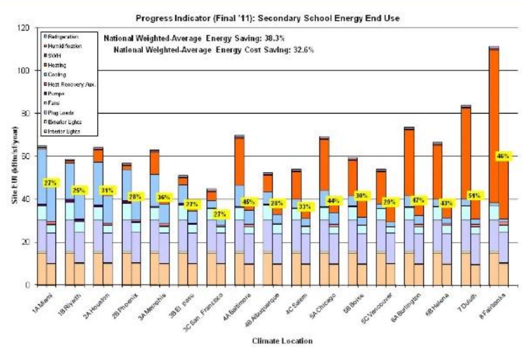
Distinctive Characteristics – Progress Indicator



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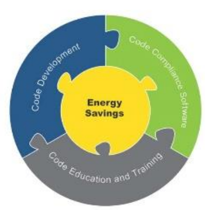
Distinctive Characteristics (continued)

PNNL Codes Ecosystem:

- Domain knowledge in codes carries to compliance software development, resulting in more efficient software implementation.
  - Code knowledge assisted implementation of difficult code requirement, including intent of requirement
  - Makes requirement more understandable for designers and more enforceable for code officials
- User feedback through technical support on the tools and trainings also loops back to the codes development team.



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Distinctive Characteristics (continued)

Supporting Trusted DOE Brands:

- Availability of free software is a key adoption and compliance driver.
- Several states have accelerated code adoption because of state-customized versions of COM*check* and RES*check*.
- Compliance is a legal process that requires assurance of consistency/quality.
- Software used as 'de facto' code in many jurisdictions.

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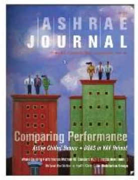
Recent Accomplishments

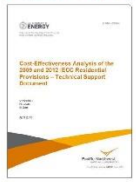
Strong Record of PNNL's Technical Leadership:

- In-depth knowledge in buildings and code development process that leads to the success in advancing the code development
  - Led and supported 35 of 110 addenda to Standard 90.1-2013
  - Developed language and supporting analysis for 60 proposals to the 2015 IECC with over 85% approval rate
- Published 4 journal articles and 5 technical reports
- 4 conference papers to be published at the ACEEE Summer Study and ASHRAE/IBPSA Energy Modeling Conference

Deliver High Quality and Impactful Products:

- Completed 49 deliverables since FY13
- All deliverables completed on time, within budget





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Recent Accomplishments (continued)

Provide resources, tools, and methodology to unlock savings from code compliance:

- Developed a model to quantify DOE Codes Program impact and published code benefit assessment report (**http://tinyurl.com/m5uqddf**)
- Developed compliance methodology and assisted DOE in issuing the Request for Information in the *Federal Register*
- Developed and released a new Utility Savings Calculator Tool that quantifies savings from improved code compliance for use by utility programs

https://www.energycodes.gov/resource-center/utility-savings-estimators

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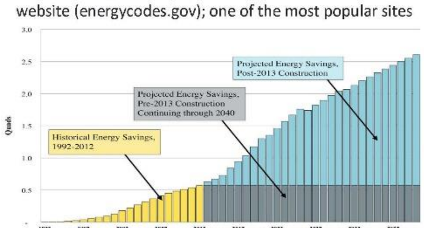
Market Impact

- Frequent reference to and use of PNNL's commercial prototype building models in the energy efficiency community
- Over 300,000 project uploads per year that use COM*check* and RES*check* to support code compliance
- More than 20,000 unique visitors per month to the website (energycodes.gov); one of the most popular sites



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Recognition

PNNL's code team technical analysis was highlighted by *ASHRAE News*.

Fierce Energy featured PNNL's report on DOE's Building Energy Codes Program cost benefit.

Recognition (continued)

I want to thank you and your staff for an excellent source document[1]. *This is most helpful in moving our rulemaking in New York State.*

- Joseph Hill, Assistant Director for Energy Services
New York State Department of State

The assistance you and PNNL have provided for our work in Nebraska has been invaluable. As part of the team that is investigating the scale and source of demand savings available through increased code compliance, I appreciate the resources, experience and insights PNNL has brought to the table. They have been of great benefit to both the working group and the entire Nebraska Energy Code Compliance Collaborative.

- Chris Burgess, Technical Manager for Codes Compliance
Midwest Energy Efficiency Alliance

Note 1: PNNL's report on 90.1-2010 Cost-Effectiveness Analysis

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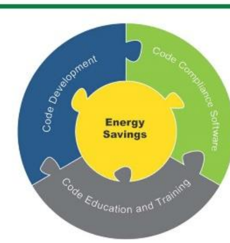
Integration and Collaboration

- Participate in the national codes and standards development processes to ensure the model codes provide the most energy efficient and cost-effective benefits to the consumer.
- Collaborate through the National Energy Codes Collaborative, including NASEO, REEOs and BCAP.
- Actively engage stakeholders through workshops and webinars to get immediate market feedback.
- Collaborate with the Commercial and Residential Building Integration Programs to carry the ready-for-the-mainstream technologies to code process.



Integration and Collaboration (continued)

- Provide objective information resources and technical guidance to states and localities to accelerate adoption and increase code compliance.

Commercial Codes Cost-Effectiveness Analysis			
Alabama	Georgia	New Jersey	Texas
Arkansas	Iowa	New York	Utah
Colorado	Kentucky	North Carolina	Virginia
Connecticut	Massachusetts	Oklahoma	Wisconsin
Delaware	Montana	Rhode Island	
DC	Nebraska	South Carolina	

http://www.energycodes.gov/development/commercial/cost_effectiveness

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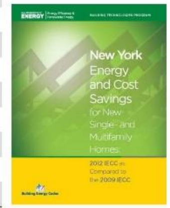
Integration and Collaboration (continued)

Residential Codes Cost-Effectiveness Analysis			
Alabama	Alaska	Arizona	Arkansas
Colorado	Connecticut	Delaware	District of Columbia
Georgia	Hawaii	Idaho	Indiana
Iowa	Kansas	Kentucky	Louisiana
Maine	Massachusetts	Michigan	Minnesota
Mississippi	Missouri	Montana	Nebraska
Nevada	New Hampshire	New Jersey	New Mexico
New York	North Dakota	Ohio	Oklahoma
Pennsylvania	Rhode Island	South Carolina	South Dakota
Tennessee	Texas	Utah	Vermont
Virginia	West Virginia	Wisconsin	Wyoming



http://www.energycodes.gov/development/residential/iecc_analysis

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Next Steps and Future Plans

Development

- Roadmap to explore the next generation of codes and standards
- Release 90.1-2013 prototype building models and supporting documentation
- Technical support for the development of Standard 90.1-2016 and 2018 IECC

Adoption

- Consumer benefits analysis of adoption of the 90.1-2013 standard
- State technical assistance
- Technical analyses to support the publication of DOE Determinations on the latest model codes (90.1-2013 and 2015 IECC)

Compliance

- Streamline compliance process by leveraging RES*check*/COM*check* software
- Develop Codes training curriculum for 90.1-2013 and 2015 IECC
- Support DOE compliance efforts and associated technical analysis
- Implement 90.1-2013 and 2015 IECC in RES*check* & COM*check*
- Continue technical assistance to code officials and designers

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REFERENCE SLIDES

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Project Budget

Project Budget: see table below

Cost to Date: $1.65M (October 2013 through March 2014)

Budget History					
FY2013 (past)		FY2014 (current)		FY2015 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$4.8M	$0	$4.0M	$0	TBD	$0

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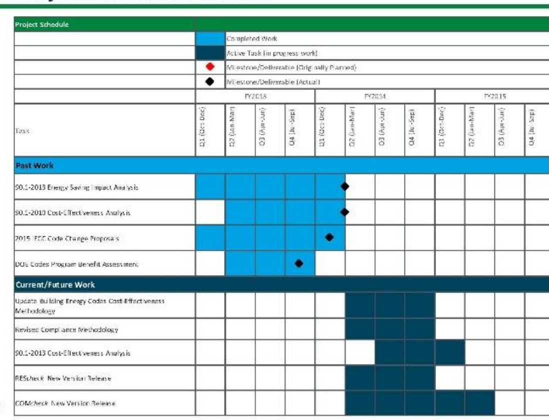
Project Plan and Schedule



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6.4.4 ASHRAE Standard 90.2 Standards Committee Activities

The following sections are the minutes and transactions of SSPC 90.2 at the ASHRAE Winter Conference in New York, New York, January 18-20, 2014 and the ASHRAE Summer Conference in Seattle, Washington, June 26-30, 2014.

6.4.4.1 SSPC 90.2 at the ASHRAE Winter Conference in New York, New York, January 18-20, 2014

The following paragraphs track the changes and discussion in the ASHRAE 90.2 Standard at the ASHRAE winter conference in New York, New York in 2014.

ASHRAE SSPC 90.2 Winter Meeting Draft Agenda
New York, NY
All meetings to be held at the New York Hilton Midtown
1335 Avenue of the Americas
Main Committee Meetings
Monday, 1/20/14, 2:15 p.m. – 6:15 p.m., Gramercy West, 2nd Floor (Hilton)
Tuesday, 1/21/14, 1:00 p.m. – 5:00 p.m., New York, 4th Floor (Hilton)

Subcommittee

Envelope – Monday, 1/20/14, 6:30 p.m. – 9:15 p.m., Gramercy West, 2nd Floor (Hilton)
Envelope – Tuesday, 1/21/14, 8:00 a.m. – 12 NOON, New York, 4th Floor (Hilton)
Lighting – Monday, 1/20/14, 6:30 p. m. – 9:15 p.m., Harlem, 4th Floor (Hilton)
Lighting – Tuesday, 1/21/14, 8:00 a.m. – 12 NOON, Concourse B, Concourse Level (Hilton)
Mechanical – Monday, 1/20/14, 6:30 p.m. – 9:15 p.m., Hudson, 4th Floor (Hilton)
Mechanical – Tuesday, 1/21/14, 8:00 a.m. – 12 NOON, Concourse H. Concourse Level (Hilton)

Monday, January 20, 2:15- 6:15 p.m.

- Call to Order
- Welcome and Introductions
- Sign-in and Quorum Determination (28 PCVM which requires 15 members for a quorum.)

No.	Member	Position	6/30	Guests	Affiliation	6/30
1	Phillip Fairey	CHAIR		Aaron Stotko	Uponor	
2	Theresa Weston	VICE CHAIR		Andrew Moore	Mitsubishi Electric	
3	Paul Cabot	PRI ORG/AGA		Aniruddh Roy	AHRI	
3A	Jim Ranfone	ALT ORG/AGA		Ben Edwards	Mathis Consulting	
4	Kym Carey	PCVM		Bill Healy	NIST	
5	Roy Crawford	PCVM		Billy Hinton	NC Dept. of Insurance	
6	Craig Drumheller	PRI ORG/NAHB		Brian Lieburn	DOW Chemical	
6A	Don Surrena	ALT ORG/NAHB		Bridget Herring	Mathis Consulting	
7	Isaac Elnecave	PCVM		Bruce Layman		
8	Merle McBride	PCVM		Cathy Chappell	HGM	
9	Deborah Frankhouser	PRI ORG/IALD		Dave Ware	CEC	
10	Jeff Inks	PRI ORG/WDMA		Eric Makela	PNNL	
11	Jim Larsen	PCVM		Florian Antrelles	Franhofer	
12	Chris Mathis	PCVM		Harrison Skye	NIST	
13	Tom Meyer	PCVM		Jennifer Hatfield	APSP	
14	Harry Misuriello	PCVM		Jeremy Williams	DOE	
15	Ron Nickson	PCVM		Jim Crawford		
16	Jerry Phelan	PCVM		Jim Gelvin	PMI	
17	Steve Rosenstock	PRI ORG/EEI		Joe Hayden	Pella	
17A	Chuck Foster	ALT ORG/EEI		Jonathan Lemmond		
18	Larry Ross	PCVM		JR Babineau	JM	
19	Loren Ross	PRI ORG AWC		Julie Ferguson	ADI	
19A	Jim Bowman	ALT ORG/ AWC		Kristen Schafer	Schaefer Engr	
20	Bill Roy	PCVM		Michael Rosenberg	PNNL	

21	Amy Schmidt	PCVM		Michael Woodford	AHRI	
22	Wayne Stoppelmoor	PCVM		Nancy McNabb	NIST	
23	Steve Szoke	PRI ORG/PCA		Neil Leslie	GTI	
24	Martha Van Geem	PCVM		Olga Livingston	PNNL	
25	Richard Watson	PCVM		Patricia Rowley	GTI	
				Patrick Crowley	SJC	
	Allan Fraser	Consultant		Rahul Athalye	PNNL	
	Mark Lessans	Consultant		Randal Higa	Southern CA Edison	
	Max Sherman	Consultant		Roger LeBrun	Velux	
	Jerry White	Consultant		Ron Burton	BOMA	
	Johnathan Humble	Consultant		Ron Miller		
	Mark Modera	SPLS Liaison		Roseby Bean	SSPC 55	
	Keith Emerson	TC 7.6 Liaison		Sean McDonald	PNNL	
	Steve Ferguson	Staff Liaison		Shirley Ellis	ESL-TAMU	
	Rita Harrold	IES Staff Liaison		Som Shrestra	ORNL	
				Stephanie Reiniche	ASHRAE MOS	
				Steve Skalko		
				Supriya Goel	PNNL	
				Tania Ulah	NIST	
				Tom Ponder	Certainteed	

- Note taker
- Review Agenda
- Announcements
  - Bias and Conflict of Interest Forms – Update with any changes – Send to ASHRAE HQ
  - Information Item – Residential Ad Hoc
  - SPC 189.2 meeting – first meeting (Saturday 1-2 PM)
- Membership
  - New members effective February 1, 2014
    Michael Jouaneh, Lutron Electronic Co. (Lighting subcommittee)
    Michael Lubliner, Washington State University (Envelope Subcommittee)
    Sanjeev Hingorani, Lennox Industries (Mechanical Subcommittee)
- Approval of minutes: Webinar – October 28, 2013
- Report on Updated Work Plan (Theresa Weston/ Mark Modera)
- Presentation and discussion on Rule Set Options (Chris Mathis)
- Presentation on Comparative Analysis Adjustment Factors (Theresa Weston)
- Determination of "Performance Method" (McBride/PF)
  - Energy Use/Cost Intensity Method
  - Dual simulation method
- Invited presentation of EUI method (David Goldstein)

Tuesday, July 1, 1:00 – 5:00 pm
- Unfinished business from Monday
- Subcommittee Reports and Discussion
  - Envelope subcommittee (Merle McBride)
  - Lighting subcommittee (Wayen Stoppelmoor)
  - Mechanical subcommittee (Roy Crawford)
- New Business
- Develop Schedule for Webinars
- Next meeting: Seattle, WA – June 30 – July 1, 2014
- Adjourn

6.4.4.2 SSPC 90.2 at the ASHRAE Summer Conference in Seattle, Washington, June 26-30, 2014

The following paragraphs track the changes and discussion in the ASHRAE 90.2 Standard at the ASHRAE summer conference in Seattle, Washington in 2014.

ASHRAE SSPC 90.2 Annual Meeting Draft Agenda
Seattle, WA
All meetings to be held at the Sheraton
1400 Sixth Avenue
Main Committee Meetings
Monday, 6/30/14, 2:15 p.m. – 6:15 p.m., Metropolitan Ballroom A (3, Sheraton)
Tuesday, 7/1/14, 1:00 p.m. – 5:00 p.m., Aspen (2, Sheraton)

Subcommittee
Envelope – Monday, 6/30/14, 2:15 p.m. – 6:15 p.m., Metropolitan Ballroom A (3, Sheraton)
Envelope – Tuesday, 7/1/14, 1:00 p.m. – 5:00 p.m., Aspen (2, Sheraton)
Lighting – Monday, 6/30/14, 2:15 p.m. – 6:15 p.m., Metropolitan Ballroom A (3, Sheraton)
Lighting – Tuesday, 7/1/14, 1:00 p.m. – 5:00 p.m., Aspen (2, Sheraton)
Mechanical – Monday, 6/30/14, 2:15 p.m. – 6:15 p.m., Metropolitan Ballroom A (3, Sheraton)
Mechanical – Tuesday, 7/1/14, 1:00 p.m. – 5:00 p.m., Aspen (2, Sheraton)

Monday, June 30, 2:15-6:15 p.m.

- Call to Order
- Welcome and Introductions
- Sign-in and Quorum Determination (28 PCVM which requires 15 members for a quorum.)

No.	Member	Position	6/30	Guests	Affiliation	6/30
1	Phillip Fairey	CHAIR		Aaron Stotko	Uponor	
2	Theresa Weston	VICE CHAIR		Andrew Moore	Mitsubishi Electric	
3	Paul Cabot	PRI ORG/AGA		Aniruddh Roy	AHRI	
3A	Jim Ranfone	ALT ORG/AGA		Ben Edwards	Mathis Consulting	
4	Kym Carey	PCVM		Bill Healy	NIST	
5	Roy Crawford	PCVM		Billy Hinton	NC Dept. of Insurance	
6	Craig Drumheller	PRI ORG/NAHB		Brian Lieburn	DOW Chemical	
6A	Don Surrena	ALT ORG/NAHB		Bridget Herring	Mathis Consulting	
7	Isaac Elnecave	PCVM		Bruce Layman		
8	Merle McBride	PCVM		Cathy Chappell	HGM	
9	Deborah Frankhouser	PRI ORG/IALD		Dave Ware	CEC	
10	Jeff Inks	PRI ORG/WDMA		Eric Makela	PNNL	
11	Jim Larsen	PCVM		Florian Antrelles	Franhofer	
12	Chris Mathis	PCVM		Harrison Skye	NIST	
13	Tom Meyer	PCVM		Jennifer Hatfield	APSP	
14	Harry Misuriello	PCVM		Jeremy Williams	DOE	
15	Ron Nickson	PCVM		Jim Crawford		
16	Jerry Phelan	PCVM		Jim Gelvin	PMI	
17	Steve Rosenstock	PRI ORG/EEI		Joe Hayden	Pella	
17A	Chuck Foster	ALT ORG/EEI		Jonathan Lemmond		
18	Larry Ross	PCVM		JR Babineau	JM	
19	Loren Ross	PRI ORG AWC		Julie Ferguson	ADI	
19A	Jim Bowman	ALT ORG/ AWC		Kristen Schafer	Schaefer Engr	
20	Bill Roy	PCVM		Michael Rosenberg	PNNL	
21	Amy Schmidt	PCVM		Michael Woodford	AHRI	
22	Wayne Stoppelmoor	PCVM		Nancy McNabb	NIST	
23	Steve Szoke	PRI ORG/PCA		Neil Leslie	GTI	
24	Martha Van Geem	PCVM		Olga Livingston	PNNL	
25	Richard Watson	PCVM		Patricia Rowley	GTI	

26	Michael Jouaneh	PCVM		Patrick Crowley	SJC	
27	Michael Lubliner	PCVM		Rahul Athalye	PNNL	
28	Sanjeev Hingorani	PCVM		Randal Higa	Southern CA Edison	
				Roger LeBrun	Velux	
	Allan Fraser	Consultant		Ron Burton	BOMA	
	Mark Lessans	Consultant		Ron Miller		
	Max Sherman	Consultant		Roseby Bean	SSPC 55	
	Jerry White	Consultant		Sean McDonald	PNNL	
	Johnathan Humble	Consultant		Shirley Ellis	ESL-TAMU	
	Mark Modera	SPLS Liaison		Som Shrestra	ORNL	
	Keith Emerson	TC 7.6 Liaison		Stephanie Reiniche	ASHRAE MOS	
	Steve Ferguson	Staff Liaison		Steve Skalko		
	Rita Harrold	IES Staff Liaison		Supriya Goel	PNNL	
				Tania Ulah	NIST	
				Tom Ponder	Certainteed	
				David Goldstein	NRDC	
				David Shepherd	PCA	

- Note taker
- Review Agenda
- Announcements
  - Bias and Conflict of Interest Forms – Update with any changes – Send to ASHRAE HQ
- Membership
  - New members effective July 3, 2014:
    Harry Misuriello: primary organizational member for ACEEE in general interest category with mechanical subcommittee assignment
    David Shepherd: alternate organizational for PCA in industry category with envelope subcommittee assignment
    David Goldstein: PCVM in general interest category with lighting subcommittee assignment
- Approval of Minutes
  - Webinar – March 19, 2014
  - Webinar – May 21, 2014
- Presidential Ad Hoc on Residential Construction Market – Final Report (Max Sherman)
- Discussion of 90.2 goals with respect to Ad Hoc report findings
  - Rigorous performance compliance standard (current 90.2 objective)
  - Collaborative partners (RESNET, ACCA, ICC)
  - Zero energy advanced energy design guide
  - Multifamily and 90.1, 62.2/62.1 coordination/collaboration
- Discussion of concepts for moving forward
  - Collaborative partners
  - Modeling & simulation rule set
  - Home size adjustment
  - Sub-committee charge (performance verification, etc.)

Tuesday, July 1, 1:00 – 5:00 pm

- Subcommittee Reports and Discussion
  - Envelope subcommittee (Merle McBride)
  - Lighting subcommittee (Wayne Stoppelmoor)
  - Mechanical subcommittee (Roy Crawford)
- New Business
- Develop Schedule for Webinars
- Next Meeting:
- Adjourn

6.4.5 ASHRAE Standard 189.1 Standards Committee Activities

The following sections are the minutes and transactions of SSPC 189.1 at the ASHRAE Winter Conference in New York, New York, January 18-20, 2014 and the ASHRAE Summer Conference in Seattle, Washington, June 26-30, 2014.

6.4.5.1 *SSPC 189.1 at the ASHRAE Winter Conference in New York, New York, January 18-20, 2014*

The following paragraphs track the changes and discussion in the ASHRAE 189.1 Standard at the ASHRAE winter conference in New York, New York in 2014.

ASHRAE/USGBC/IES SSPC 189.1, *Standard for High-Performance Green Buildings Except Low-Rise Residential Buildings*

Annual Meeting, New York

January 18-20, 2014

Meeting Minutes

(Draft)

These draft minutes must be approved by this committee to be the official approved record

Tuesday, January 21, 2014:

	Voting Members		**Non-Voting Members**	
1	Persily, Andrew, Chair	**Y**	Arunachlam, Senthil	
2	Heinisch, Richard, Vice Chair	**Y**	Bertuch, Charles	**Y**
3	Schoen, Larry, Vice Chair	**Y**	Boldt, Jeff	**Y**
4	Alevantis, Leon		Cline, Daryn	**Y**
5	Bowman, Jim	**Y**	Conrad, Ernest (BOMA-Alt)	**Y**
6	Burgett, Lee	**Y**	Gallo, Francis	
7	Burton, Ron (BOMA)	**Y**	Haglid, Klas	
8	Contoyannis, Dimitri	**Y**	Johnson, Greg	**Y**
9	Crawley, Dru		Koeller, John	
10	Cross, John	**Y**	Meyer, Tom	
11	Dolin, Jennifer	**Y**	Molnar-Port, Darren	
12	Eley, Charles (AIA)	**Y**	Paliaga, Gwelen	
13	Floyd, Anthony		Polukoshko, Lori	**Y**
14	Gitlin, Susan	**Y**	Riddle, Joseph	
15	Gress, Gregg	**Y**	Schmeida, Michael	**Y**
16	Horn, Donald	**Y**	Seyffer, Charles	**Y**
17	Hubbard, Roy	**Y**	Sovocool, Kent	
18	Josh Jacobs	**Y**	Stanke, Dennis	
19	Jouaneh, Michael		Sullens, Wesley	**Y**
20	Lawrence, Tom	**Y**	Swatkowski, Len	
21	Leslie, Neil	**Y**	Whittet, Dan	
22	Lord, Richard	**Y**		
23	McBride, Merle	**Y**		
24	McClendon, Jim		**Consultants**	
25	McGuire, Molly		Mathis, Chris	
26	McHugh, Jonathan	**Y**	Rhode, Jane	
27	Pape, Thomas		Hsieh, Chris	**Y**
28	Rainey, Teresa	**Y**		
29	Rosenstock, Steve	**Y**		

30	Ross-Bain, Jeff		**Liaisons**	
31	Setty, Boggarm	**Y**	Harrold, Rita SPLS, IES	**Y**
32	Stoppelmoor, Wayne	**Y**	Owens, Brendan USGBC	
33	Taber, Christian		Kohout, Frank SSPC 154	
34	VanGeem, Martha	**Y**	Etheredge, Bert ASHRAE	**Y**
35	Viola, David			
36	Williams, David			
37	Zhang, Jian	**Y**		

Guests		**Guests**	
Schwartz, Jerry		Case, Michael	
Rose, Loren		Mukhopadhyay, Jaya	
Frisino, Angela		Braun, Marc	
Higa, Randall		Thorp, Ellen	
Hayden, Joe		Delmonaco, James	
Cavazos, Josue		Wagner, Greg	
Culp, Tom		Nelson, Ron	
Galvin, James		Potter, Gary	
Caremer, Thom		Fang, Xia	
Volkman, Paul		Welford, Bede	
Rockwell, Kurmit			
Tucker, Doug			
McNabb, Nancy			

Wednesday, January 22, 2014:

	Voting Members		Non-Voting Members	
1	Persily, Andrew, Chair	Y	Arunachlam, Senthil	
2	Heinisch, Richard, Vice Chair	Y	Bertuch, Charles	Y
3	Schoen, Larry, Vice Chair	Y	Boldt, Jeff	Y
4	Alevantis, Leon		Cline, Daryn	Y
5	Bowman, Jim	Y	Conrad, Ernest (BOMA-Alt)	Y
6	Burgett, Lee	Y	Gallo, Francis	Y
7	Burton, Ron (BOMA)	Y	Haglid, Klas	
8	Contoyannis, Dimitri		Johnson, Greg	Y
9	Crawley, Dru	Y	Koeller, John	
10	Cross, John	Y	Meyer, Tom	
11	Dolin, Jennifer	Y	Molnar-Port, Darren	
12	Eley, Charles (AIA)	Y	Paliaga, Gwelen	
13	Floyd, Anthony		Polukoshko, Lori	Y
14	Gitlin, Susan	Y	Riddle, Joseph	
15	Gress, Gregg	Y	Schmeida, Michael	Y
16	Horn, Donald	Y	Seyffer, Charles	Y
17	Hubbard, Roy	Y	Sovocool, Kent	
18	Josh Jacobs	Y	Stanke, Dennis	Y
19	Jouaneh, Michael		Sullens, Wesley	Y
20	Lawrence, Tom	Y	Swatkowski, Len	
21	Leslie, Neil	Y	Whittet, Dan	
22	Lord, Richard	Y		
23	McBride, Merle	Y		
24	McClendon, Jim		**Consultants**	
25	McGuire, Molly		Mathis, Chris	Y
26	McHugh, Jonathan	Y	Rhode, Jane	
27	Pape, Thomas		Hsieh, Chris	Y
28	Rainey, Teresa	Y		
29	Rosenstock, Steve	Y		
30	Ross-Bain, Jeff		**Liaisons**	
31	Setty, Boggarm	Y	Harrold, Rita SPLS, IES	Y
32	Stoppelmoor, Wayne	Y	Owens, Brendan USGBC	
33	Taber, Christian		Kohout, Frank SSPC 154	
34	VanGeem, Martha	Y	Etheredge, Bert ASHRAE	Y
35	Viola, David			
36	Williams, David			
37	Zhang, Jian	Y		

Guests		Guests	
Novosel, Davor		Roy, Aniruddh	
Foster, Chuck		Humble, Jonathan	
Hassan, Samer		Hayden, Joe	
Culp, Tom		Cavazos, Josue	
Zaremba, Thom		Craig, Tyler	
DeMarco, Pete		Hast, Reid	
McNabb, Nancy		Trant, Troy	
Papageorge, Andrea			

List of Motions

Note: All vote counts are listed as [For – Against – Abstain]

1/21/2014 (7:30am – 9:30am Eastern)

Motion 1 was made by Ron Burton and seconded by Lee Burgett to approve the minutes from the 12/19/2013 and January 7, 2014 SSPC meeting. The motion passes by hand vote (23-0-1) with the Chair abstaining.

Motion 2 was made by Susan Gitlin and seconded by Josh Jacobs to recommend the waste management language be submitted for a code change proposal to the IgCC. The motion passes by hand vote (23-0-2) with the Chair and Lee Burgett abstaining.

Motion 3 was made by Wayne Stoppelmoor and seconded by Bogi Setty to recommend the vertical fenestration language be submitted for a code change proposal to the IgCC. The motion passes by hand vote (23-0-2) with the Chair and Richard Heinisch abstaining.

Motion 4 was made by Richard Heinisch and seconded by Ron Burton to recommend the approval of the response to the comment made on addendum ao as shown on 1/21/2014. The motion was approved by hand vote (25-0-1), with the Chair abstaining.

Motion 5 was made by Richard Heinisch and seconded by Josh Jacobs to recommend WG08DA23-Moisture Control (addendum bx) for publication public review as shown and modified on 1/21/2014. The motion stands by roll call vote (22-0 -1), with the Chair abstaining, pending outcome of a continuation letter ballot.

1/22/2014 (8:00am-12:00pm Eastern)

Motion 6 was made by Jenn Dolin and seconded by Tom Lawrence to recommend the approval of the response to the comment made on addendum ad as shown on 1/22/2014. The motion was approved by hand vote (23-0-1), with the Chair abstaining.

Motion 1 postponed from 1/7/2014 was made by Anthony Floyd and seconded by David Williams to recommend for publication public review of an ISC to addendum aj as shown on 1/22/2014. The motion stands by roll call vote (22-0 -2), with the Chair abstaining, pending outcome of a continuation letter ballot.

Motion 7 was made by Susan Gitlin and seconded by Larry Schoen to recommend the approval of the responses to the comments made on addendum aj as shown on 1/22/2014. The motion was approved by hand vote (23-0-1), with the Chair abstaining.

Motion 8 was made by Larry Schoen and seconded by Richard Heinisch to modify motion 7 by deleting Section 8.3.1.5.2 from addendum by. The motion was approved by hand vote (22-0-2) with the Chair and Jian Zhang abstaining.

Motion 8.5 was made by Larry Schoen and seconded by Richard Heinisch to modify motion 8 by deleting Section 8.3.1.5.2 from addendum by. The motion was approved by hand vote (22-0-2) with the Chair and Jian Zhang abstaining.

Motion 9 was made by Tom Lawrence and seconded by Jenn Dolin to recommend WG10DA15-Vehicle Emission (addendum bz) for publication public review as shown and modified on 1/21/2014. The motion stands by roll call vote (21-0-2), with the Chair abstaining, pending outcome of a continuation letter ballot.

Motion 10 was made by Jon McHugh and seconded by Jim Bowman to recommend an ISC to addendum an for publication public review as shown and modified on 1/21/2014. The motion stands by roll call vote (23-0-2), with the Chair abstaining, pending outcome of a continuation letter ballot.

Motion 11 was made by Steve Rosenstock and seconded by Jian Zhang to recommend the approval of the responses to the comments made on addendum an as shown on 1/22/2014. The motion was approved by hand vote (23-0-1), with the Chair abstaining.

Motion 12 was made by Martha VanGeem and seconded by Merle McBride to recommend the modifications to WG7DA40 (addendum bw) for publication public review as shown and modified on 1/22/2014. The motion stands by roll call vote (23-0-1), with the Chair abstaining, pending outcome of a continuation letter ballot.

Motion 13 was made by Jon McHugh and seconded by Ron Burton to recommend the modifications to WG7DA44 (addendum bq) for publication public review as shown and modified on 1/22/2014. The motion stands by roll call vote (23-0-1), with the Chair abstaining, pending outcome of a continuation letter ballot.
Motion 14 was made by Martha VanGeem and seconded by Merle McBride to recommend the approval of the responses to the comments made on addendum "as" as shown on 1/22/2014. The motion was approved by hand vote (23-0-3), with the Chair, Lee Burgett and Jian Zhang abstaining.
Motion 15 was made by Martha VanGeem and seconded by Ron Burton to recommend addendum am be discontinued. The motion stands by roll call vote (21-1-3), with the Chair abstaining, pending outcome of a continuation letter ballot.
Motion 16 was made by Martha VanGeem and seconded by Roy Hubbard to recommend the response, "accept", to CMP 13-12-0002/001, Jonathan Humble (Cool Roof Rating Council reference) as shown on 1/22/2014. The motion was approved by hand vote (22-0-1) with the Chair abstaining.
Motion 17 was made by Martha VanGeem and seconded by Merle McBride to recommend the response, "accept", to CMP 13-12-0006/001, Michael Ivanovich (7.4.3.5 fan efficiency requirements) as shown on 1/22/2014. The motion was approved by hand vote (22-0-1) with the Chair abstaining.
1/21/2014 (7:30 a.m. to 9:30 a.m. Eastern time)

- **Call to order**
- **Logistics – Staff**
  - Bias/conflict announcement
  - *Voting members* (Alevantis, Bowman, Burgett, Burton, Contoyannis, Crawley, Cross, Dolin, Eley, Floyd, *Gitli*n, Gress, Heinisch, Horn, Hubbard, Jacobs, Jouaneh, Lawrence, Leslie, Lord, McBride, McClendon, McGuire, McHugh, Pape, Persily, Rainey, Rosenstock, Ross-Bain, Schoen, Setty, Stoppelmoor, Taber, VanGeem, Viola, Williams, Zhang)
  - Guest Introductions
- **Review Agenda**
- **Review of Action Items – Persily**
- **Chair's Report – Persily**
  - It was announced that ASHRAE publications will be using 189.1-2014 to test some new ideas, but no more specifics were given.
  - The Chair announced that the SSPC will be reconsidering addenda that previously received "no" votes for publication/public review in order to comply with ANSI regulations.
  - If WG leaders are concerned about or receive complaints about the SSPC violating ANSI procedures please contact Andy Persily. The Chair wants WGs to concentrate on technical content and not get sidetracked by procedural tangents.
- **Approval of Meeting Minutes**
  - Meeting minutes from December 19, 2013 and January 7, 2014.
  - **Motion 1** was made by Ron Burton and seconded by Lee Burgett to approve the minutes from the 12/19/2013 and January 7, 2014 SSPC meeting. The motion passes by hand vote (23-0-1) with the Chair abstaining.
- **User's Manual Ad Hoc – Burgett**
  - 90.1 User's Manual is close to being completed. SSPC 189.1 should use this as a resource in the development of its User's Manual.
  - It was noted that WGs should start preparing language for the User's Manual. The members of 90.1 are finding out that doing this is much easier than marking up language provided by the contractor.
- **Membership update – Persily**
  - Larry Schoen has agreed to lead the Adhoc group.
  - Membership recommendations are due to the ASHRAE Standards Committee by May 9, 2014.
- **RFI status**

  None pending
- **CMP status**

- 13-12-0007/001, Ed Light (remove IAQ testing), assigned to WG8
- 13-12-0006/001, Michael Ivanovich (7.4.3.5 fan efficiency requirements), assigned to WG7
- 13-12-0005/001, Merle McBride (envelope tables), assigned to WG7
- 13-12-0002/001, Jonathan Humble (Cool Roof Rating Council reference), assigned to WG7
- 14-12-0001/001, Jerry Schwartz (renewable energy – biomass), assigned to WG7

- **Addenda Status Update**
  - Staff preparing galleys for publication approval: m, o, af, ag, ah, ap, at, av
  - PC voted for PPR: w-ISC, al-ISC, bg, bk, bl, bm
  - Public Review scheduled to start January 3, 2014: ae-ISC, ax, ay, bb, bc, bd, be, bf, bg, bh, bi, bj,
  - Outstanding PR comments: p, v, ad, ai, aj, am, an, ao, aj, aq, as, aw
  - PC vote for PPR approved: aw-ISC, bn, bo, bp, br, bs, bt, bu, bv, bw
  - PC vote for PPR pending: bq
- **Approval of IgCC Proposals**
  - Waste Management
    - The waste management proposal, developed by Wes Sullens, would revise sections 406 and 503 in the IgCC
    - Brief overview was provided by Wes Sullens.
    - **Motion 2** was made by Susan Gitlin and seconded by Josh Jacobs to recommend the waste management language be submitted for a code change proposal to the IgCC. The motion passes by hand vote (23-0-2) with the Chair and Lee Burgett abstaining.
  - Vertical Fenestration
    - The vertical fenestration proposal would revise section 605 of the IgCC.
    - Brief overview was provided by Tom Culp
    - **Motion 3** was made by Wayne Stoppelmoor and seconded by Bogi Setty to recommend the vertical fenestration language be submitted for a code change proposal to the IgCC. The motion passes by hand vote (23-0-2) with the Chair and Richard Heinisch abstaining.
      - There was an editorial revision made.
- **Presentation on DOD Criteria on High Performance and Sustainable Buildings**
  George Lea, U.S. Army Corps of Engineers
  - 89.1 was considered for adoption for all army new construction; however there were some conflicts that needed to be addressed. This presentation is to inform the committee of what the DOD criteria that were adopted.
- **Addenda for PPR discussion/approval (non-contentious)**
  - **WG 5**
    - Addendum ad-ISC
      - Susan Gitlin gave an overview
      - Opinions expressed during discussion
        - How can the gravel between the pavers be cleaned?
        - This proposal will need some additional work
  - **WG8**
    - Response to comment made on addendum ao
      - Brief overview was provided by Richard Heinisch.
      - **Motion 4** was made by Richard Heinisch and seconded by Ron Burton to recommend the approval of the response to the comment made on addendum ao as shown on 1/21/2014. The motion was approved by hand vote (25-0-1), with the Chair abstaining.
    - WG08DA23
    - Brief overview was provided by Richard Heinisch and Michael Schmeida.

        - **Motion 5** was made by Richard Heinisch and seconded by Josh Jacobs to recommend WG08DA23-Moisture Control (addendum bx) for publication public review as shown and modified on 1/21/2014. The motion stands by roll call vote (22-0 -1), with the Chair abstaining, pending outcome of a continuation letter ballot.

- **Action Items**
    - **January 21-22, 2014**

      AI 1: Call for members to be sent out by ASHRAE staff. **– Complete**

      AI 2: Bert Etheredge and Andy Persily to determine the best time to reschedule the April 29th meeting
    - **January 7, 2014**

      AI 1: Committee to provide Anthony Floyd, David Williams, and Susan Gitlin suggestions on the definition of low emission, hybrid and electric vehicles prior to January 11th. **– Complete**

      AI 2: Committee to provide suggestions to Jeff Ross-Bain on WG10DA15 by January 11th. **– Complete**

      AI 3: Chair to transmit official committee responses on p and ai to commenters. **– Complete**

1/22/2014 (8:00 a.m. to 12 NOON Eastern Time)

- **Call to order**
- **Logistics – Staff**
    - Bias/conflict/sign-in
    - Bias/conflict announcement
    - Voting members (Alevantis, Bowman, Burgett, Burton, Contoyannis, Crawley, Cross, Dolin, Eley, Floyd, Gitlin, Gress, Heinisch, Horn, Hubbard, Jacobs, Jouaneh, Lawrence, Leslie, Lord, McBride, McClendon, McGuire, McHugh, Pape, Persily, Rainey, Rosenstock, Ross-Bain, Schoen, Setty, Stoppelmoor, Taber, VanGeem, Viola, Williams, Zhang)
    - Guest Introductions
- **New Business**
    - **Working Group Reports**
        - **WG 5**
            - Addendum ad comments
                - Brief Overview provided by Susan Gitlin
                    - The comment was to revise the language in Section 10, such that all the maintenance for material be moved to Section 5
                - **Motion 6** was made by Jenn Dolin and seconded by Tom Lawrence to recommend the approval of the response to the comment made on addendum ad as shown on 1/22/2014. The motion was approved by hand vote (23-0-1), with the Chair abstaining.
            - Addendum aj-ISC, postponed motion from 1/7/14 web meeting
                - Brief overview provided by Susan Gitlin and Jenn Dolin
                - **Motion 1 postponed** from 1/7/2014 was made by Anthony Floyd and seconded by David Williams to recommend for publication public review of an ISC to addendum aj as shown on 1/22/2014. The motion stands by roll call vote (22-0 -2), with the Chair abstaining, pending outcome of a continuation letter ballot.
                    - Opinions expressed during discussion

- Does a Smartway vehicle get a window decal or sticker? It could but EPA does not currently provide stickers
- This is a list of US vehicles only but it is very comprehensive.
- What is the earliest model covered by the database? 2002 maybe the earliest models covered.
- The Smartway website has a list organized by model.
- The intent was not to push for exclusive/elite vehicles but try to push a more inclusive list of low emission vehicles.
- The list is updated annually.

- Responses to comments made on addendum aj
  - **Motion 7** was made by Susan Gitlin and seconded by Larry Schoen to recommend the approval of the responses to the comments made on addendum aj as shown on 1/22/2014. The motion was approved by hand vote (23-0-1), with the Chair abstaining.

- **WG 8**
  - WG08DA26
    - Brief overview provided by Richard Heinisch
    - **Motion 8** was made by Gregg Gress and seconded by Richard Heinisch to recommend WG08DA26-Building Pressure (addendum by) for publication public review as shown and modified on 1/21/2014. The motion stands by roll call vote (22-0 -3), with the Chair abstaining, pending outcome of a continuation letter ballot.
      - Opinions expressed during discussion
        - These requirements could be a little onerous.
        - Standard 90.1 handles this issue very well and should be referenced.
        - The damper leakage rates in Standard 90.1 are low enough.
        - A public review will help determine if the leakage rates are in fact too low.
        - AMCA is a trade association that makes leakage recommendation. These levels could be referenced as a possible tradeoff
        - An exemption for damper leakage should be added.
        - An exception could be added in Section 7 to exempt the Standard 90.1 reference that requires all dampers for economizers be motorized.
        - Gravity dampers will not open up at far as motorized dampers resulting in air drag.
        - Is it cost effective for a 3 ton unit or if there are multiple units on a roof top? This addendum would require that all of them have motorized dampers.
        - **Motion 8.5** was made by Larry Schoen and seconded by Richard Heinisch to modify motion 8 by deleting Section 8.3.1.5.2 from addendum by. The motion

was approved by hand vote (22-0-2) with the Chair and Jian Zhang abstaining.

- **WG 10**
  - WG10DA15 (Vehicle emissions)
    - Pollution Mitigation discussion
    - What issue does addendum resolve that addendum bz didn't? This proposal addresses a different issue of indoor pollution.
    - This language is meant to prevent someone from parking a generator or concrete truck next to the intake of a neighboring retail building that is already occupied.
    - This language is unenforceable. There are areas where a street out front of the site would fall under this requirement. How can you restrict street traffic?
    - This requirement falls only within the project site.
    - This may also create a situation where neighboring buildings may extort favors etc. from the construction site. This language limits the location of the exhaust of the equipment and not the equipment itself, so a builder could pipe the exhaust without having to move the equipment.
    - This never came out of WG 10 with a large consensus.
  - Brief overview provided by Tom Lawrence
  - **Motion 9** was made by Tom Lawrence and seconded by Jenn Dolin to recommend WG10DA15-Vehicle Emission (addendum bz) for publication public review as shown and modified on 1/21/2014. The motion stands by roll call vote (21-0-2), with the Chair abstaining, pending outcome of a continuation letter ballot.
    - Opinions expressed during discussion
      - The working group voted 8-0-1 for the language shown.
      - This is the first iteration of this addendum that has requirements that are enforceable.
      - The signage requirement is too loose.
      - States already have law limiting idling. This language was meant to compliment the laws already on the books.
      - This language is much easier to comply with than what was included in the previous draft.
      - This requirement is pointed toward the project owner.

BREAK FOLLOWED BY COMMITTEE PHOTO

- **Report from wood ad hoc**
  - Brief report provided by Neil Leslie
- **WG 7**
  - CMP 13-12-0006/001, Michael Ivanovich (7.4.3.5 fan efficiency requirements)
    - Brief overview provided by Martha VanGeem
    - **Motion 17** was made by Martha VanGeem and seconded by Merle McBride to recommend the response, "accept", to CMP 13-12-0006/001, Michael Ivanovich (7.4.3.5 fan efficiency requirements) as shown on 1/22/2014. The motion was approved by hand vote (22-0-1) with the Chair abstaining.
  - CMP 13-12-0002/001, Jonathan Humble (Cool Roof Rating Council reference)
    - Brief overview provided by Martha VanGeem

            - **Motion 16** was made by Martha VanGeem and seconded by Roy Hubbard to recommend the response, "accept", to CMP 13-12-0002/001, Jonathan Humble (Cool Roof Rating Council reference) as shown on 1/22/2014. The motion was approved by hand vote (22-0-1) with the Chair abstaining.
        - Addendum as responses
            - Brief overview was provided by Martha VanGeem.
                - The WG was almost unanimous
            - **Motion 14** was made by Martha VanGeem and seconded by Merle McBride to recommend the approval of the responses to the comments made on addendum "as" as shown on 1/22/2014. The motion was approved by hand vote (23-0-3), with the Chair, Lee Burgett and Jian Zhang abstaining.
                - Opinions expressed during discussion
                    - AHRI feels that the standard will violate Federal Preemption if adopted as a minimum code.
        - Addendum am – update
            - Brief overview was by Martha VanGeem
            - **Motion 15** was made by Martha VanGeem and seconded by Ron Burton to recommend addendum am be discontinued. The motion stands by roll call vote (21-1-3), with the Chair abstaining, pending outcome of a continuation letter ballot.
        - Addenda bq corrections
            - Brief overview was provided by Dick Lord and Martha VanGeem.
            - **Motion 13** was made by Jon McHugh and seconded by Ron Burton to recommend the modifications to WG7DA44 (addendum bq) for publication public review as shown and modified on 1/22/2014. The motion stands by roll call vote (23-0-1), with the Chair abstaining, pending outcome of a continuation letter ballot.
                - These corrections make the table much more useable.
        - Addenda bw corrections
            - Brief overview was provided by Martha VanGeem.
            - **Motion 12** was made by Martha VanGeem and seconded by Merle McBride to recommend the modifications to WG7DA40 (addendum bw) for publication public review as shown and modified on 1/22/2014. The motion stands by roll call vote (23-0-1), with the Chair abstaining, pending outcome of a continuation letter ballot.
    - **WG 7.5**
        - Addendum an responses
            - Brief overview was provided by Charles Eley.
            - **Motion 11** was made by Steve Rosenstock and seconded by Jian Zhang to recommend the approval of the responses to the comments made on addendum an as shown on 1/22/2014.The motion was approved by hand vote (23-0-1), with the Chair abstaining.
        - Addendum an-ISC
            - Brief overview was provided by Charles Eley.
                - We received a significant number of comments during the public review.

    - This ISC will delete Wood and Wood Waste, and Biomass from the table. These two fuels would now fall under the requirement for other fuels as specified in the table
    - The wood industry supported these changes. The addendum also received unanimous support.
  - **Motion 10** was made by Jon McHugh and seconded by Jim Bowman to recommend an ISC to addendum an for publication public review as shown and modified on 1/21/2014. The motion stands by roll call vote (23-0-2), with the Chair abstaining, pending outcome of a continuation letter ballot.
    - Opinions expressed during discussion
      - The wood industry does not like the current numbers and is willing work with the committee going forward.
      - This is an unusually complex issue with talks continuing with not only the wood industry but also others that have interest.
- **Unfinished Business**
- **Next Meeting**
  - **Currently scheduled web meetings:**

    January 28, February 25, March 25, April 29 and May 27
- **Adjournment**

6.4.5.2 SSPC 189.1 at the ASHRAE Summer Conference in Seattle, Washington, June 26-30, 2014

The following paragraphs track the changes and discussion in the ASHRAE 189.1 Standard at the ASHRAE summer conference in Seattle, Washington in 2014.

ASHRAE/USGBC/IES SSPC 189.1,
Standard for High-Performance Green Buildings
Except Low-Rise Residential Buildings
Annual Meeting, Seattle
July 1& 2, 2014
Meeting Minutes
(Draft)
These draft minutes must be approved by this committee to be the official approved record

Tuesday, July 1, 2014:

	Voting Members		**Non-Voting Members**	
1	Persily, Andrew, Chair	**Y**	Arunachlam, Senthil	
2	Heinisch, Richard, Vice Chair		Bertuch, Charles	
3	Schoen, Larry, Vice Chair	**Y**	Boldt, Jeff	
4	Alevantis, Leon		Cline, Daryn	**Y**
5	Bowman, Jim	**Y**	Conrad, Ernest (BOMA-Alt)	**Y**
6	Burgett, Lee		Gallo, Francis	**Y**
7	Burton, Ron (BOMA)	**Y**	Haglid, Klas	
8	Contoyannis, Dimitri		Johnson, Greg	**Y**
9	Crawley, Dru	**Y**	Koeller, John	
10	Cross, John	**Y**	Meyer, Tom	
11	Dolin, Jennifer	**Y**	Molnar-Port, Darren	
12	Eley, Charles (AIA)	**Y**	Paliaga, Gwelen	**Y**
13	Floyd, Anthony	**Y**	Polukoshko, Lori	**Y**
14	Gitlin, Susan	**Y**	Riddle, Joseph	
15	Gress, Gregg	**Y**	Schmeida, Michael	**Y**
16	Horn, Donald	**Y**	Seyffer, Charles	
17	Hubbard, Roy	**Y**	Sovocool, Kent	
18	Josh Jacobs	**Y**	Stanke, Dennis	**Y**
19	Jouaneh, Michael	**Y**	Sullens, Wesley	**Y**
20	Lawrence, Tom	**Y**	Swatkowski, Len	
21	Leslie, Neil	**Y**	Whittet, Dan	
22	Lord, Richard	**Y**		
23	McBride, Merle	**Y**		
24	McClendon, Jim		**Consultants**	
25	McGuire, Molly	**Y**	Mathis, Chris	
26	McHugh, Jonathan	**Y**	Rhode, Jane	
27	Pape, Thomas		Hsieh, Chris	**Y**
28	Rainey, Teresa	**Y**		
29	Rosenstock, Steve	**Y**		
30	Ross-Bain, Jeff		**Liaisons**	
31	Setty, Boggarm	**Y**	Harrold, Rita SPLS, IES	
32	Stoppelmoor, Wayne		Owens, Brendan USGBC	
33	Taber, Christian	**Y**	Kohout, Frank SSPC 154	
34	VanGeem, Martha	**Y**	Etheredge, Bert ASHRAE	**Y**

35	Williams, David	**Y**		
36	Zhang, Jian	**Y**		

Guests		**Guests**	
Braun, Marc		Roy, Aniruddh	
Shephard, David		Oyer, Brandon	
Culp, Tom		West, Scott	
Hart, Reid		Mason, Stephany	
Humble, Jonathan		Tucker, Doug	
LeBrun, Roger		Coufrey, John	
Higa, Randall		Tyler, Craig	
Papageorge, Andrea		Stroud, Tom	
Mecham, Brent		Johnson, Jay	
Wiggins, Stephen			

Wednesday, July 2, 2014:

	Voting Members		Non-Voting Members	
1	Persily, Andrew, Chair	Y	Arunachlam, Senthil	
2	Heinisch, Richard, Vice Chair		Bertuch, Charles	
3	Schoen, Larry, Vice Chair	Y	Boldt, Jeff	
4	Alevantis, Leon		Cline, Daryn	
5	Bowman, Jim	Y	Conrad, Ernest (BOMA-Alt)	Y
6	Burgett, Lee	Y	Gallo, Francis	
7	Burton, Ron (BOMA)	Y	Haglid, Klas	
8	Contoyannis, Dimitri	Y	Johnson, Greg	Y
9	Crawley, Dru	Y	Koeller, John	
10	Cross, John	Y	Meyer, Tom	
11	Dolin, Jennifer	Y	Molnar-Port, Darren	
12	Eley, Charles (AIA)	Y	Paliaga, Gwelen	
13	Floyd, Anthony	Y	Polukoshko, Lori	
14	Gitlin, Susan	Y	Riddle, Joseph	
15	Gress, Gregg	Y	Schmeida, Michael	
16	Horn, Donald	Y	Seyffer, Charles	Y
17	Hubbard, Roy	Y	Sovocool, Kent	
18	Josh Jacobs	Y	Stanke, Dennis	Y
19	Jouaneh, Michael	Y	Sullens, Wesley	Y
20	Lawrence, Tom	Y	Swatkowski, Len	
21	Leslie, Neil	Y	Whittet, Dan	
22	Lord, Richard	Y		
23	McBride, Merle	Y		
24	McClendon, Jim		**Consultants**	
25	McGuire, Molly	Y	Mathis, Chris	Y
26	McHugh, Jonathan	Y	Rhode, Jane	
27	Pape, Thomas		Hsieh, Chris	Y
28	Rainey, Teresa	Y		
29	Rosenstock, Steve	Y		
30	Ross-Bain, Jeff	Y	**Liaisons**	
31	Setty, Boggarm	Y	Harrold, Rita SPLS, IES	
32	Stoppelmoor, Wayne	Y	Owens, Brendan USGBC	Y
33	Taber, Christian	Y	Kohout, Frank SSPC 154	
34	VanGeem, Martha	Y	Etheredge, Bert ASHRAE	Y
35	Viola, David			
36	Williams, David	Y		
37	Zhang, Jian	Y		

Guests		Guests	
Humble, Jonathan		Pang, Xiufenlt (XP)	
Zhang, Jensen		Mecham, Brent	
Johnson, Jay		Tucker, Doug	
Roy, Aniruddh		Petrillo-Groh, Laura	
Phelan, Jerry		Amrane, Karim	
Tyler, Craig		Balaras, Costas	
West, Scott		Fallahi, Ali	
Shepherd, David			

List of Motions
Note: All vote counts are listed as [For – Against – Abstain]
7/1/2014 (7:30am – 9:30am Pacific)

Motion 1 was made by Jenn Dolin and seconded by Boggi Setty to recommend the approval of the minutes from the meeting on 4/22/2014. The motion passes by hand vote (21-0-1) with the Chair abstaining.
Motion 2 was made by Martha VanGeem and seconded by Dru Crawley to recommend the approval of informative Appendix X for inclusion in the 2014 version of the standard. The motion passes by hand vote (22-0-2) with the chair abstaining.
Motion 3 was made by Martha VanGeem and seconded by Steve Rosenstock to recommend addendum bv for publication with knowledge of objectors (voters). The motion stands by roll call vote (22-1-1) with chair abstaining, pending the outcome of a continuation letter ballot.
Motion 4 was made by Josh Jacobs and seconded by Jenn Dolin to recommend the approval of the proposal for development of the 189.1User's Manual. The motion passes by hand vote (23-0-1) with the Chair abstaining. (Molly McGuire and Martha VanGeem excused themselves from the discussion and voting, as they are included as subcontractors under the proposal.)
7/2/2014 (8:00am-12 NOON Pacific)

Motion 5 was made by Josh Jacobs and seconded by John Cross to recommend approval of comments on the ASHRAE proposal on waste and construction management for the IgCC. The motion passes by hand vote (25-0-2) with Roy Hubbard and Gregg Gress abstaining.
Motion 6 was made by Martha VanGeem and seconded by Ron Burton to recommend approving the committee response to the McBride CMP. The motion passes by hand vote (26-0-2) with chair abstaining.
Motion 7 was made by Anthony Floyd and seconded by Susan Gitlin to recommend the approval of addendum bg for publication with knowledge of objectors. The motion stands by roll call vote (22-4-5) with chair abstaining, pending the outcome of a continuation letter ballot
7/1/2014 (7:30 a.m. to 9:30 a.m.)

- **Call to order**
- **Logistics – Staff**
    - Bias/conflict announcement
    - Voting members (Alevantis, Bowman, Burgett, Burton, Contoyannis, Crawley, Cross, Dolin, Eley, Floyd, Gitlin, Gress, Heinisch, Horn, Hubbard, Jacobs, Jouaneh, Lawrence, Leslie, Lord, McBride, McClendon, McGuire, McHugh, Pape, Persily, Rainey, Rosenstock, Ross-Bain, Schoen, Setty, Stoppelmoor, Taber, VanGeem, Williams, Zhang)
    - Guest Introductions
- **Review agenda – Persily**
- **Review of Action Items – Persily**
- **Chair's Report**
    - Planning charge to WGs
        - The working groups should continue focusing on getting things done for the 2014 version, but should begin thinking about what's next and setting some priorities.
    - Addendum ce was approved by standards committee for publication public review.
    - Standards committee approved all of the addenda submitted to them with recommendations for publication at their meeting in Seattle.
    - Consolidation of 189.1 and IgCC
        - There has been no formal decision on the MOU.
- **Approval of Meeting Minutes**
    - PC meeting of 4/22/14

  - **Motion 1** was made by Jenn Dolin and seconded by Boggi Setty to recommend the approval of the minutes from the meeting on 4/22/2014. The motion passes by hand vote (21-0-1) with the Chair abstaining.

- **User's Manual update – Burgett**
  - Vote to accept proposal
  - Brief overview provided by Andy Persily
    - There was only one proposal submitted to the RFP issued by ASHRAE.
  - **Motion 4** was made by Josh Jacobs and seconded by Jenn Dolin to recommend the approval of the proposal for development of the 189.1User's Manual. The motion passes by hand vote (23-0-1) with the Chair abstaining. (Molly McGuire and Martha VanGeem excused themselves from the discussion and voting, as they are included as subcontractors under the proposal.)
    - Opinions expressed during discussion
      - The committee received copies of this proposal prior to this meeting.
      - The group that provided the proposal intends to subcontract with two committee members that are very knowledgeable and will be very helpful in developing the final product
      - The committee will be very involved with the development of the user's manual.
  - Assignment of addenda "experts"
    - There should be a WG member assigned as a resource on each addendum that will be published in the new version of the standard, which should help provide quick responses to questions or problems that arise. These individuals may be asked to help develop language for the User's Manual.
- **Membership update – Schoen**
  - Standards committee approved the membership recommendations made by the chair for the 2014-2015 Society year.
- **RFI status**

  None pending
- **CMP status**
  - 14-12-00002/001, Wagdy Anis, (Commissioning Reference) assigned to WG 10
  - 14-12-0001/001, Jerry Schwartz (renewable energy as biomass), assigned to WG7
  - 13-12-0005/001, Merle McBride (Envelope Tables), assigned to WG 7
- **Addenda Status Update**
  - Approved by BOD: b, m, o, r, u, z, af, ag and ah
  - BOD approval votes scheduled for Seattle: v, w, ad, ae, al, an, ao, ap, aq, as, at, au, av, aw, bb, bc, bd, bf, bh, bi, bj, bk, bm, bo, bp, bq, br, bs, bt, bu, bw, bz and cb
  - PC publication votes scheduled for 6/24/14: ai, aj, ax, ay, bx and cd
  - PC publication votes scheduled for Seattle: bg and bv
  - BOD approval votes scheduled for 8/4/14: ai, aj, ax, ay, bg, bv, bx and cd
  - Awaiting replies to PC responses to comments: bg and bv
  - Outstanding PR comments: p, be, and by
  - Addendum bl was previously pulled back from inclusion in the 2014 version.
- **Working Group Reports: Plans for Seattle meetings**
  - **WG 5**
    - Primary business will be discussion addendum bg and determining whether or not the main committee will be considering it for publication tomorrow
  - **WG 7**
    - SSPC vote on Informative Appendix X
      - Brief overview was provided by Martha VanGeem

        - Tom Culp checked the figures.
        - This document was distributed to the committee for review prior to this meeting.
      - **Motion 2** was made by Martha VanGeem and seconded by Dru Crawley to recommend the approval of informative Appendix X for inclusion in the 2014 version of the standard. The motion passes by hand vote (22-0-2) with the chair abstaining.
        - Opinions expressed during discussion
          - BOMA expressed their concern with this table. It follows from addendum al, which they did not support because they felt the stringency was too high.
      - Publication of addendum bv with knowledge of objectors
        - Brief overview was provided by Martha VanGeem
          - This had been distributed to the committee for review prior to this meeting.
        - **Motion 3** was made by Martha VanGeem and seconded by Steve Rosenstock to recommend addendum bv for publication with knowledge of objectors (voters). The motion stands by roll call vote (22-1-1) with chair abstaining, pending the outcome of a continuation letter ballot.
          - Opinions expressed during discussion
            - Doug Tucker, the sole public review commenter, was present but provided no input.
    - **WG 9**
      - The Working Group will be discussing a potential comment on an ASHRAE proposal to the IgCC.
- **New MTG Multidisciplinary Task Group (Bob Baker)**
    - The Chair is currently seeking individuals interested in participating.
    - Looking for deficiencies in data used in utility and state rebate programs, particularly in California.
    - The group would serve as a technical conduit for regulatory agencies helping to clarify incentive based efficiency scores.
    - It is unclear how long the MTG will be needed.
    - The primary reason for this MTG is to provide input to State and regulatory groups when the need arises.
- **SSPC Meeting Times**
    - Is there any way the face to face meeting schedule could be revised?
    - One suggestion is to do away with the full meeting on Tuesday.
    - When the merger with IgCC happens the Tuesday meeting will become even more important.
    - Another suggestion was to start the meeting later on Tuesday and shorten the WG meeting. The Chair will be discussing these options with the WG leaders.

7/2/2014 (8:00 a.m. to 12 NOON) Metropolitan Ballroom B (3, Sheraton)

- **Call to order**
- **Logistics – Staff**
    - Bias/conflict/sign-in
    - Bias/conflict announcement
    - Voting members (Alevantis, Bowman, Burgett, Burton, Contoyannis, Crawley, Cross, Dolin, Eley, Floyd, Gitlin, Gress, Heinisch, Horn, Hubbard, Jacobs, Jouaneh, Lawrence, Leslie, Lord, McBride, McClendon, McGuire, McHugh, Pape, Persily, Rainey, Rosenstock, Ross-Bain, Schoen, Setty, Stoppelmoor, Taber, VanGeem, Williams, Zhang)

- Guest Introductions

- **Votes on comments on ASHRAE proposal to IgCC**
  - Building Site Waste Management and Construction Waste Management
  - Brief overview was provided by Don Horn
  - **Motion 5** was made by Josh Jacobs and seconded by John Cross to recommend the approval of comments on the ASHRAE proposal on waste and construction management for the IgCC. The motion passes by hand vote (25-0-2) with Roy Hubbard and Gregg Gress abstaining.
    - Opinions expressed during discussion
      - The material destination is noted on the waste management plan required by the standard.
- **Working Group Report**
  - **WG 5**
    - Publication of addendum bg with knowledge of objectors
      - Brief overview was provided by Anthony Floyd and Susan Gitlin
        - There are several unresolved commenters.
      - **Motion 7** was made by Anthony Floyd and seconded by Susan Gitlin to recommend the approval of addendum bg for publication with knowledge of objectors. The motion stands by roll call vote (22-4-5) with chair abstaining, pending the outcome of a continuation letter ballot.
        - Opinions expressed during discussion
          - The FAA states that airport landscape design should be left to experts aware of safety issues rather than rely on the requirements of this standard. The scope of the standard states that this standard shall not circumvent life safety issues.
          - There are several different plant species that fall under the requirements of this standard and still meet airport safety issues. The requirement’s main focus is to promote the use of native species of plants.
          - If there is a conflict, would the FAA rules take precedence? I believe the FAA rules would trump requirements that we have
          - There could be an exception for airports included in the standard later on. Losing the broader benefits of this addendum based on this point is not the desire of the Working Group
          - It was stated that the FAA will defer to local codes for private airports.
          - Greg Johnson: Addendum bq violates the scope of the standard in that it relates to items other than new systems. The provisions in 5.5.5 (b) require that landscape be improved outside of the disturbed area required by construction of the project site.
          - This proposal is strongly supported by Working Groups 5 and 6.
  - **WG 7**
    - Response to McBride CMP
      - Brief overview was provided by Martha VanGeem

        - **Motion 6** was made by Martha VanGeem and seconded by Ron Burton to recommend approving the committee response to the McBride CMP. The motion passes by hand vote (26-0-2) with chair abstaining.
    - **WG 6**
        - Anthony Floyd, filling in for the chair of WG 6, gave a brief update on the goals for the 2018 version.
    - **WG 8**
        - Working Group 8 is currently working on the responses to comments made on by (envelope pressure) and a potential ISC.
        - Working Group 8 is currently working on the responses to comments made on be (unvented combustion) and a potential ISC.
    - **WG 9**
        - The working group assigned User Manual responsibilities to group members.
    - **WG 10**
        - Gerald Kettler (Chair of ASHRAE Standard 202-2013) gave a presentation on commissioning during the meeting yesterday.
        - Standard 202 is different from ASHRAE Guideline 0 in that it is an actual standard.
- **Direction of 2017 Workplan and Direction Forward**
    - Below are some bullet points from the discussion:
        - There was concern over the integration of the IgCC and 189.1.
        - Integrative design should be included as a requirement in the standard.
        - The electronic document should include live links to the referenced document/provision.
        - Improve indoor air quality by ventilation of specific equipment such as copiers.
        - Improve lighting quality.
        - Include daylighting redirecting systems.
        - Introduce compliance worksheets.
        - Maintain balance between usability, simplicity and performance.
        - Include more on water quality
        - Marketing and education for code/building officials.
        - Resilient envelope vs efficient envelope.
        - Increasing water efficiency.
        - Increasing consistency between industry terminologies.
        - Realistic approach to product transparency and LCA.
        - Access to ASHRAE standards should be provided to members of standard writing bodies.
        - Apply content of 189.1 to existing buildings.
        - Prioritize measured performance.
        - Come up with a simple tool for modeling small building with smaller budgets
        - Move the standard away from the prescriptive compliance method and more towards performance.
        - Electronic standard that has interactive capabilities.
        - Constantly update standard with published addenda.
        - Use ASHRAE's bEQ as a way of compliance within 189.1.
        - Adding cost justification to discussions.
        - Including Climate Zone 0 in the requirements of the standard.
- **Unfinished Business**
- **New Business**
    - Integration of IgCC, USGBC and SSPC 189.1

- **Roster changes**
    - Thank you to outgoing members
    - Welcome to New Members
- **Future Meetings**
- **Scheduled web meetings:**
  July 22, August 26, September 23, October 28
- **Adjournment (11:17 am)**

6.4.6 Other Meetings

6.4.6.1 North Central Texas Council Government (NCTCG) Meetings from 2014.

The following pages are meeting notes, agendas, and summaries from the NCTCG meetings from 2014.

North Central Texas Council of Governments

AGENDA

Regional Codes Coordinating Committee
Tuesday, January, 28, 2014
9:30 AM, Regional Forum Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: David Kerr, City of Plano

1. **Welcome and Introductions.**

DISCUSSION / PRESENTATION / ACTION ITEMS

- **Action Item- Service award presentation to Debbie Carlin and Ernesto Lopez.** The RCCC Chair, David Kerr comment on the years of service the RCCC has received from both Debbie and Ernesto followed with the presentation of awards.

- **Discussion- Development of a survey for code adoption in the region.** The benefits and use of a well-developed survey. One of the details that could be included in such a survey would be one that would also include some big issues facing the code world such as the debate over the 3 year vs. 6 year adoption cycle.

INFORMATION ITEMS

- **Solar Ready Challenge II Project**
  NCTCOG is one of the nine regional councils working with National Association of Regional Councils on the U.S. Department of Energy's Rooftop Solar Challenge II award. This project is intended to promote solar best management practices and implement more streamlined and standardized solar processes.

  The final results of the project will yield a reduction in solar market barriers, fewer soft costs, and a more streamlined and standardized process for multiple solar energy implementation options.

  COG staff will report ongoing activity in regards to developing proven engagement and implementation of tested best management practices, training curricula and adoption strategies.

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- **NCTCOG Strategic Planning**
  NCTCOG would like to announce that the agency's strategic planning activities are underway, with plans to distribute a survey in the near future that will seek input on the services, deliverables and outcomes that communities receive from NCTCOG, as well as what new or revised activities you would like to see NCTCOG pursue over the next 3-5 years.

- **2015 ICC Codes**
  Discuss the date and location of the code adoption process from ICC.

- **Building Professional Institute (BPI)**
  Encourage all cities to attend the 2014 BPI for CE credit.

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

2. **Future Agenda Items.**

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

4. **Schedule for the Next RCCC Meeting.** The next RCCC meeting will be tentatively scheduled at the meeting on January 28, 2014.

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Sandra Barba by phone at (817) 608-2368 or by email at sbarba@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

North Central Texas Council of Governments

Summary

Regional Codes Coordinating Committee
Tuesday, January 28, 2014
9:30 AM, Regional Forum Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: David Kerr, City of Plano

1. **Welcome and Introductions.**

DISCUSSION / PRESENTATION / ACTION ITEMS

2. **Service Award Presentation to Debra Carlin and Ernesto Lopez**. David Kerr, Chair of the Regional Codes Coordinating Committee (RCCC), will comment on the years of service the RCCC has received from both Debra Carlin and Ernesto Lopez, followed with the presentation of awards.

   Ms. Carlin and Mr. Lopez were not able to attend the meeting. NCTCOG staff will reschedule the awards presentation.

3. **Development of a Survey for Code Adoption in the Region**. The RCCC will discuss the benefits and use of a well-developed survey. One of the details that could be included in such a survey would be one that would also include some big issues facing the code world such as the debate over the three year versus six year adoption cycle.

   After some discussion regarding this issue, it was determined that a subcommittee will be created to formulate questions for the survey. Several entities offered databases that could be used to construct the survey. It was suggested that students compile the data. If any RCCC member wishes to volunteer, they were directed to contact David Kerr or Paul Ward.

INFORMATION ITEMS

4. **Solar Ready Challenge II Project**. The NCTCOG is one of the nine regional councils working with National Association of Regional Councils on the U.S. Department of Energy's Rooftop Solar Challenge II award. This project is intended to promote solar best management practices and implement more streamlined and standardized solar processes. The NCTCOG staff will report ongoing activity in regards to developing proven

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engagement and implementation of tested best management practices, training curricula and adoption strategies.

The US Department of Energy has identified Texas as one of the ideal states for incorporating the use of solar energy and wants to promote it in this area. With that goal in mind, a stakeholders meeting was held in December 2013 to ascertain information such as best management practices and any obstacles or barriers that might need to be overcome regarding the use of solar energy. A much larger meeting will be held in early February 2014 where the topics will include technology status, cost ratios, available rebates, and notification for emergency responders. Although other types of alternative energy were discussed at the initial meeting, the focus was on solar. Paul Ward said as an attendee of the December meeting, his feeling was that one of the goals was to streamline and standardize the solar installation process. Uniformity will be sought in the processes for permitting, submittal checklists, plan review, and inspection. Changes may be necessary to the electrical and fire codes. The Electrical Advisory Board will be involved.

5. **NCTCOG Strategic Planning**. The NCTCOG would like to announce that the Agency's strategic planning activities are underway, with plans to distribute a survey in the near future that will seek input on the services, deliverables, and outcomes that communities receive from the NCTCOG, as well as what new or revised activities you would like to see the NCTCOG pursue over the next three to five years.

   NCTCOG is currently updating its strategic plan. The Environment and Development (ED) Department is using a survey seeking input with regards to the services they currently offer, and are soliciting any suggestions for future endeavors. ED welcomes any and all comments at any time from our members, not just during strategic planning activities. Feedback received by ED will be shared with other NCTCOG departments.

   Bahmin Yasdani asked since energy codes have had a direct energy savings on buildings and power plants, can NCTCOG devise a method to measure how many dollars have actually been saved due to new and improved codes?

   The 2013 Municipal Fee Survey is available in the NCTCOG Public Affairs Department.

6. **2015 International Codes Council (ICC) Codes**. The RCCC will discuss the date and location of the ICC code adoption process.

   The 2015 codes should be available in May.

   Paul Ward, Chair of the Electrical Advisory Board (EAB), updated the RCCC on EAB activities. The EAB met on December 12, 2013, to begin the review of the 2014 National Electrical Code (NEC). Jerry Daniel, a guest presenter from the Texas Department of Licensing and Regulation, reviewed issues in Texas such as non-licensed workers, not using the correct equipment, and solar panel installation problems. Review of the 2014 NEC is well underway. The EAB has broken the codes in to segments and assigned working groups to review specific portions. The next EAB meeting is scheduled on February 25, 2014.

Ed Dryden, Chair of the Energy and Green Advisory Board (EGAB), gave a status report on EGAB activities. The advisory board, in an information gathering phase, has had presenters at their last three meetings which included the City of Dallas, Texas Society of Architects, and the Dallas Builders Association. There is an interest in developing a concept for NCTCOG to facilitate a third party program to assist member cities with the implementation of code adoption. The next EGAB meeting is on January 31, 2014.

The RCCC thanked Ed Dryden for his willingness to serve as Chair of the Energy and Green Advisory Board which is a new addition.

7. **Building Professional Institute (BPI)**. The NCTCOG encourages all cities to attend the 2014 BPI for CE credit.

   The 2014 BPI event will be held at UTA from May 20-24, 2014, at Nedderman Hall. To learn more, visit http://civileng.uta.edu/BPISite/Files/Doc/21stbpi.pdf.

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

8. **Future Agenda Items**.

   The RCCC was encouraged to send any suggestions for future agenda items to David Kerr or Sandra Barba.

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

   Jack Thompson made a motion to approve the RCCC June 19, 2013 draft meeting summary. Selso Mata seconded the motion. The RCCC was unanimous in its approval.

   The Texas A&M AgriLife Extension and the UTA will host "Understanding the WaterSense Labeled Home" on March 26, 2014, from 8 a.m. to 5 p.m.

10. **Schedule for the Next RCCC Meeting**. The next RCCC meeting is tentatively scheduled for April 22, 2014, at 9:30 a.m., in the William J. Pitstick Executive Board Room, NCTCOG Offices, CPII, 616 Six Flags Drive, Arlington, Texas 76011.

11. **Adjournment.**

    The meeting adjourned at 10:40 a.m.

Regional Codes Coordinating Committee
9:30 a.m., Tuesday, January 28, 2014
Regional Forum Room

MEMBER SIGN IN SHEET

NAME	SIGNATURE	ORGANIZATION
Judy Armstrong		Ellis County
Larry Bartlett	[illegible]	Associated General Contractors
Jack Baxley		Associated General Contractors
Warren Bonisch		Society of Fire Protection Engineers
Steve Covington	[illegible]	City of Frisco
Jack Craycroft		American Institute of Architects, East
Phil Crone	David Lehde (for)	Home Builders Association of Great Dallas
Ed Dryden	[illegible]	City of Dallas
Tommy Ford		Home Builders Association of Great Dallas
Teresa Foster		Building Owners and Managers Association - Dallas
Danny Hartz	[illegible]	Town of Flower Mound
Gary Jones		Associated General Contractors
David Kerr	[illegible]	City of Plano
Selso Mata	Present	City of Plano
Gary Miller	Gary Miller	City of Irving
Bob Morgan	[illegible]	City of Fort Worth
Ted Padgett, Jr.	[illegible]	City of Dallas
Carroll Pruitt		American Institute of Architects, West
Allison Craig ~~Evan Roberts~~	(For) [illegible]	City of Fort Worth
Cliff Schaefer	[illegible]	City of Granbury
Keith Smith	[illegible]	City of Mesquite
Jack Thompson	[illegible]	City of DeSoto
Gilbert Urvina		City of Frisco
Paul D. Ward	Paul Ward	City of Southlake
Scott Williams		City of Grapevine
Richard Wright		City of Mansfield
Bahman Yazdani	[illegible]	Texas A&M Energy Systems Laboratory

North Central Texas Council of Governments

AGENDA

Energy and Green Advisory Board
Friday, January 31, 2014
9:30 AM, Regional Forum Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden, City of Dallas

1. **Welcome and Introductions.**

DISCUSSION / PRESENTATION / ACTION ITEMS

- **DISCUSSION:** Recommended regional amendments to the 2012 Edition of the International Green Construction Code.

INFORMATION ITEMS

- **NCTCOG Strategic Planning**
  As a reminder, please accept and complete the NCTCOG Strategic Planning survey. NCTCOG values your input on the services, deliverables and outcomes that your community receives from our agency. NCTCOG is also interested in what new or revised activities you would like to see NCTCOG pursue over the next 3-5 years.

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

2. **Future Agenda Items.**
3. **Roundtable Topics/Other Business.** EGAB members and NCTCOG staff may share additional items of interest as time allows.
4. **Schedule for the Next EGAB Meeting.** The next EGAB meeting will be tentatively scheduled at the meeting on January 31, 2014.

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Sandra Barba by phone at (817) 608-2368 or by email at sbarba@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

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SUMMARY

Energy and Green Advisory Board
Friday, January 31, 2014
9:30 AM, Regional Forum Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden, City of Dallas

1. **Welcome and Introductions.**

DISCUSSION / PRESENTATION / ACTION ITEMS

- **DISCUSSION:** Recommended regional amendments to the 2012 Edition of the International Green Construction Code.
    - Ed Dryden, the EGAB Chair, proposed the group first state the goal of the advisory board in regards to NCTCOG's charge to the Energy and Green Advisory Board.
    - Various board members expressed their concern about the Energy Codes portion of the IgCC as well as the time span of finishing the 2012 IgCC and the fast approaching release of the 2015 IgCC.
    - The board decided that the IgCC should be referred to as an "Overlay" and a "Starting Point."
    - Concern was expressed about the term "*Maintenance*" in **Chapter 1 Scope and Administration, 101.3.** The group as a whole decided to come back to re-visit this issue at a later time.
    - The following question was posed and discussed: "Where does the State currently stand in regards to the 2012 Codes?"

INFORMATION ITEMS

- **NCTCOG Strategic Planning**
  As a reminder, please accept and complete the NCTCOG Strategic Planning survey. NCTCOG values your input on the services, deliverables and outcomes that your community receives from our agency. NCTCOG is also interested in what new or revised activities you would like to see NCTCOG pursue over the next 3-5 years.
    - COG staff offered the board another opportunity to receive the NCTCOG Strategic Planning survey for completion and submittal.

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

2. **Future Agenda Items.**
    - Presentation and discussion of IgCC Section 303 "**Whole Building Life Cycle Assessment**" by Shirley Ellis, Presenter, Energy Systems Laboratory, Texas A&M
    - Continuation of recommended regional amendments to the 2012 Edition of the International Green Construction Code, Specifically Chapter 3

3. **Roundtable Topics/Other Business.** EGAB members and NCTCOG staff may share additional items of interest as time allows.

    - COG staff shared information about the upcoming **"Solar Ready Kick-Off"** meeting to occur on March 6, 2014 and committed to send an email-blast about the upcoming event.

    - Ed Dryden asked COG staff to send an email-blast about the upcoming EPA "Water Sense" and "Agri Life" Builder Symposium to the EGAB.

4. **Schedule for the Next EGAB Meeting.** The next EGAB meeting will be tentatively scheduled at the meeting on February 28, 2014.

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Sandra Barba by phone at (817) 608-2368 or by email at sbarba@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

Energy and Green Advisory Board

Friday, January 31, 2014
9:30 a.m., Regional Forum Room

MEMBER SIGN-IN SHEET

NAME	SIGNATURE	AGENCY
Mike Arellano	[illegible]	City of Coppell
Jack Baxley		TEXO
Warren Bonisch		Schirmer Engineering Corporation
Steve Covington		City of Frisco
Phil Crone		Greater Dallas HBA
Ed Dryden	[illegible]	City of Dallas
Larry Ewing		City of Mesquite
Stan Folsom	[illegible]	Systemhause
Mike Gaiter		City of Garland
Daniel Garcia		City of Carrollton
Kurt Hansen		City of Denton
Danny Hartz		Town of Flower Mound
Gerald Kettler		Air Engineering and Testing, Inc.
Doug Lewin		SPEER
Cyndi Lewis	[illegible]	City of University Park
C. T. Loyd	[illegible]	TxHERO
Traci Nielsen	Traci Nielsen	City of Southlake
Carroll Pruitt		Pruitt Consulting
Rick Ripley		City of Arlington
Evan Roberts	[illegible]	City of Fort Worth
Little David Sessions	[illegible]	City of Dallas
Robert Smouse		City of Plano
Clint Sparks		City of Irving
Jack Thompson		City of DeSoto
Jason Vandever	[illegible]	City of Granbury
Bahman Yazdani	[illegible]	Energy Systems Labs

SUMMARY

Energy and Green Advisory Board
February 28, 2014
9:30 AM, Metroplex Conference Room
NCTCOG Offices
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden City of Dallas

1. **Welcome and Introductions.**

   Ed Dryden welcomed everyone to the meeting. Thirteen board members were present.

DISCUSSION / PRESENTATION / ACTION ITEMS

- **PRESENTATION and DISCUSSION** of IgCC Section 303 Whole Building Life Cycle Assessment; Shirley Ellis, Presenter, Energy Systems Laboratory, Texas A&M

  Shirley discussed IgCC Section 303 Whole Building Life Cycle Assessment with the advisory board.

- **DISCUSSION:** Continuation of recommended regional amendments to the 2012 Edition of the International Green Construction Code, Specifically Chapter 3

  A motion was passed to delete the entire Section 303 Whole Building Life Cycle Assessment.

  1st Motion: Jack Baxley
  2nd Motion: C.T. Loyd

- **DISCUSSION:** Continuation of recommended regional amendments to the 2012 Edition of the International Green Construction Code

  Various members felt that it would be best that some sections should perhaps wait until the 2015 Edition is published.

  The board continued to discuss Section 302.1.1 zEPI in relation to Energy Codes.

INFORMATION ITEMS

- **Solar Ready II Project Kick-Off**
  As a reminder, COG staff sent a "*Mark Your Calendar*" email blast asking you to save the date of March 6, 2014 to attend the "Solar Ready II Kick-Off" event. This event will begin at 1:30 p.m. in the Transportation Council Room.

  COG staff reminded the board about the upcoming Solar Ready II Kick-Off Meeting.

North Central Texas Council of Governments

AGENDA

Energy and Green Advisory Board
February 28, 2014
9:30 AM, Metroplex Conference Room
NCTCOG Offices
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden City of Dallas

1. **Welcome and Introductions.**

DISCUSSION / PRESENTATION / ACTION ITEMS

- **PRESENTATION and DISCUSSION** of IgCC Section 303 Whole Building Life Cycle Assessment; Shirley Ellis, Presenter, Energy Systems Laboratory, Texas A&M
- **DISCUSSION:** Continuation of recommended regional amendments to the 2012 Edition of the International Green Construction Code, Specifically Chapter 3
- **DISCUSSION:** Continuation of recommended regional amendments to the 2012 Edition of the International Green Construction Code

INFORMATION ITEMS

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  As a reminder, COG staff sent a "*Mark Your Calendar*" email blast asking you to save the date of March 6, 2014 to attend the "Solar Ready II Kick-Off" event. This event will begin at 1:30 p.m. in the Transportation Council Room.

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

2. **Future Agenda Items.**
3. **Roundtable Topics/Other Business.** Energy and Green Advisory Board members and NCTCOG staff may share additional items of interest as time allows.
4. **Schedule for the Next Energy and Green Advisory Board Meeting.** The next Energy and Green Advisory Board meeting will be tentatively scheduled at the meeting on February 28, 2014.

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Sandra Barba by phone at (817) 608-2368 or by email at sbarba@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

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SUMMARY

Energy and Green Advisory Board
February 28, 2014
9:30 AM, Metroplex Conference Room
NCTCOG Offices
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden City of Dallas

1. **Welcome and Introductions.**

   Ed Dryden welcomed everyone to the meeting. Thirteen board members were present.

DISCUSSION / PRESENTATION / ACTION ITEMS

- **PRESENTATION and DISCUSSION** of IgCC Section 303 Whole Building Life Cycle Assessment; Shirley Ellis, Presenter, Energy Systems Laboratory, Texas A&M

  Shirley discussed IgCC Section 303 Whole Building Life Cycle Assessment with the advisory board.

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  A motion was passed to delete the entire Section 303 Whole Building Life Cycle Assessment.

  1st Motion: Jack Baxley
  2nd Motion: C.T. Loyd

- **DISCUSSION:** Continuation of recommended regional amendments to the 2012 Edition of the International Green Construction Code

  Various members felt that it would be best that some sections should perhaps wait until the 2015 Edition is published.

  The board continued to discuss Section 302.1.1 zEPI in relation to Energy Codes.

INFORMATION ITEMS

- **Solar Ready II Project Kick-Off**
  As a reminder, COG staff sent a "*Mark Your Calendar*" email blast asking you to save the date of March 6, 2014 to attend the "Solar Ready II Kick-Off" event. This event will begin at 1:30 p.m. in the Transportation Council Room.

  COG staff reminded the board about the upcoming Solar Ready II Kick-Off Meeting.

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

2. **Future Agenda Items.**

   Continuation of discussion about zEPI and Chapter 6. Sections 302,608, 609, 610, and 611.

3. **Roundtable Topics/Other Business.** Energy and Green Advisory Board members and NCTCOG staff may share additional items of interest as time allows.

4. **Schedule for the Next Energy and Green Advisory Board Meeting.** The next Energy and Green Advisory Board meeting will be tentatively scheduled at the meeting on February 28, 2014.

   COG staff shared a six month Energy and Green Advisory Board schedule of upcoming meeting dates.

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Liz Zecckine by phone at (817) 695-2931 or by email at ezecckine@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

North Central Texas Council of Governments

AGENDA

Energy and Green Advisory Board
March 24, 2014
9:30 AM, William J. Pitstick Executive Board Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden City of Dallas

1. **Welcome and Introductions.**

DISCUSSION / PRESENTATION / ACTION ITEMS

- **DISCUSSION:** Continuation of recommended regional amendments to the 2012 Edition of the International Green Construction Code
  - Continue discussion about zEPI and Chapter 6. Sections 602,608, 609, 610, and 611.

INFORMATION ITEMS

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

2. **Future Agenda Items.** Tentative: A representative from BPI
3. **Roundtable Topics/Other Business.** Energy and Green Advisory Board members and NCTCOG staff may share additional items of interest as time allows.
4. **Schedule for the Next Energy and Green Advisory Board Meeting.** The Energy and Green Advisory Board meeting(s) have been scheduled as follows:

Energy and Green Advisory Board Tentative Meeting Dates For the Next Six Months	
Monday, March 24, 2014 @ 9:30 am	William J. Pitstick Executive Board Room (CPII)
Thursday, April 24, 2014 @ 9:30 am	Tejas Conference Room (CPIII)
Thursday, May 29, 2014 @ 9:30 am	William J. Pitstick Executive Board Room (CPII)
Thursday, June 26, 2014 @ 9:30 am	William J. Pitstick Executive Board Room (CPII)
Thursday, July 24, 2014 @ 9:30 am	Regional Forum Room (CPII)
Thursday, August 28, 2014 @ 9:30 am	William J. Pitstick Executive Board Room (CPII)

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Sandra Barba by phone at (817) 608-2368 or by email at sbarba@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

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North Central Texas Council of Governments

SUMMARY

Energy and Green Advisory Board
March 24, 2014
9:30 AM, William J. Pitstick Executive Board Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden City of Dallas

1. **Welcome and Introductions.**

   Ed Dryden welcomed everyone to the meeting. Fourteen members were present.

DISCUSSION / PRESENTATION / ACTION ITEMS

- **DISCUSSION:** Continuation of recommended regional amendments to the 2012 Edition of the International Green Construction Code
  - Continue discussion about zEPI and Chapter 6. Sections 602,608, 609, 610, and 611.

  Chris Herbert of SPEER led the discussion about zEPI.

INFORMATION ITEMS

The Energy and Green Advisory Board will continue discussion of recommended regional amendments to the 2012 Edition of the International Green Construction Code-Chapter 4 "Site Development and Land Use."

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

2. **Future Agenda Items.** Tentative: A representative from BPI

   A suggestion was made that a representative from IgCC could come to discuss Green Codes.
3. **Roundtable Topics/Other Business.** Energy and Green Advisory Board members and NCTCOG staff may share additional items of interest as time allows.
4. **Schedule for the Next Energy and Green Advisory Board Meeting.** The Energy and Green Advisory Board meeting(s) have been scheduled as follows:

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If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Sandra Barba by phone at (817) 608-2368 or by email at sbarba@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

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North Central Texas Council of Governments

AGENDA

Regional Codes Coordinating Committee
Tuesday, April, 22, 2014
9:30 AM, William J. Pitstick Executive Board Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: David Kerr, City of Plano
Vice Chair: Paul Ward, City of Southlake

1. **Welcome and Introductions.**

DISCUSSION/PRESENTATION/ACTION ITEMS

2. **Service Award Presentation for Debbie Carlin.** The Regional Codes Coordinating Committee (RCCC) Chair, David Kerr will comment on the years of service the RCCC has received from Debbie followed with the presentation of awards.

3. **Approval will be sought for Appointment of Advisory Board Members.** Paul Ward, Chair of the Electrical Advisory Board (EAB), and Ed Dryden, Chair of the Energy and Green Advisory Board, will both seek appointments of advisory board members for approval.

4. **Approval will be sought for the National Electric Code (NEC) 2014 Recommended Regional Amendments.** The EAB will present the NEC 2014 Local Recommended Regional Amendments for approval.

5. **Continuation of Discussion about Development of a Survey for Code Adoption in the Region.** The RCCC will discuss the benefits and use of a well-developed survey. One of the details that could be included in such a survey would be one that would also include some big issues facing the code world such as the debate over the three year versus six year adoption cycle.

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INFORMATION ITEMS

6. **WaterSense New Homes Specification Program**. The North Central Texas Council of Governments (NCTCOG) staff will share information about a program that is scheduled for presentation at the next RCCC meeting titled, "***WaterSense New Homes Specification Program***". The program was designed in partnership between the Texas A&M AgriLife Research and Extension Center-Dallas, and the Environmental Protection Agency, Region 6. The WaterSense program was designed to promote the building of water-efficient homes in North Texas and compliment other green building programs.

7. **Building Professional Institute (BPI)**. All cities are encourage to attend the 2014 BPI to be held in Arlington, TX, May 19-23. CE credit will be available.

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

8. **Future Agenda Items.**

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

10. **Schedule for the Next RCCC Meeting.** The next RCCC meeting will be tentatively scheduled at the meeting on April 22, 2014, with consideration of holding the next RCCC meeting late July, or anytime during the month of August.

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

Thank you

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Liz Zecckine by phone at (817) 695-9231 or by email at ezecckine@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

North Central Texas Council of Governments

AGENDA

Energy and Green Advisory Board
April 24, 2014
9:30 AM, Tejas Conference Room
NCTCOG Offices, CPIII
600 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden City of Dallas

1. **Welcome and Introductions.**

DISCUSSION / PRESENTATION / ACTION ITEMS

- **DISCUSSION:** Continuation of recommended regional amendments to the 2012 Edition of the International Green Construction Code
    - Begin discussion of Chapter 4 "**Site Development and Land Use.**"

INFORMATION ITEMS

- Recent approval of new Energy and Green Advisory Board members at the RCCC meeting held on April 22, 2014.

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

2. **Future Agenda Items.**

3. **Roundtable Topics/Other Business.** Energy and Green Advisory Board members and NCTCOG staff may share additional items of interest as time allows.

4. **Schedule for the Next Energy and Green Advisory Board Meeting.** The Energy and Green Advisory Board meeting(s) have been scheduled as follows:

Energy and Green Advisory Board Tentative Meeting Dates For the Next Six Months	
~~Monday, March 24, 2014 @ 9:30 am~~	~~William J. Pitstick Executive Board Room (CPII)~~
Thursday, April 24, 2014 @ 9:30 am	Tejas Conference Room (CPIII)
Thursday, May 29, 2014 @ 9:30 am	William J. Pitstick Executive Board Room (CPII)
Thursday, June 26, 2014 @ 9:30 am	William J. Pitstick Executive Board Room (CPII)
Thursday, July 24, 2014 @ 9:30 am	Regional Forum Room (CPII)
Thursday, August 28, 2014 @ 9:30 am	William J. Pitstick Executive Board Room (CPII)

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North Central Texas Council of Governments

SUMMARY

Energy and Green Advisory Board
Thursday, April 24, 2014
9:30 AM, Tejas Conference Room
NCTCOG Offices, CPIII
600 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden City of Dallas

1. **Welcome and Introductions.**

Ed Dryden, EGAB Chair welcomed everyone to the meeting. Thirteen members were present. New appointees Rick Ripley, Linda Brown and David Lehde recognized. Chair noted that EGAB did not have a vice chair. The EGAB unanimously voted for Evan Roberts of Fort Worth to be the EGAB Vice-Chair. Name will be submitted to RCCC for formal appointment.

DISCUSSION / PRESENTATION / ACTION ITEMS

- **DISCUSSION:** Continuation of recommended regional amendments to the 2012 Edition of the International Green Construction Code
  - Carryover Discussion of Chapter 1

Section 101.3 – all exceptions- add commentary to point out:
ICC-700 must be used
As published code applies to commercial only
AHJs should consider other pathways to compliance to provide for more than one compliance approach

Continue New Construction vs. Remodel as scoping provision at a later date

  - Begin discussion of Chapter 4 "**Site Development and Land Use.**"

Section 401.2-Consensus made to delete this section and add cautionary commentary.
Sections 402.1 thru 402.9 - Consensus made to add cautionary commentary.
Section 403 - Consensus made to add cautionary commentary.
Section 404 - Consensus made to add cautionary commentary.
Section 405 - Consensus made to add cautionary commentary.

INFORMATION ITEMS

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OTHER BUSINESS AND ROUNDTABLE DISCUSSION

2. **Future Agenda Items.**

3. **Roundtable Topics/Other Business.** Energy and Green Advisory Board members and NCTCOG staff may share additional items of interest as time allows.

4. **Schedule for the Next Energy and Green Advisory Board Meeting.** The Energy and Green Advisory Board meeting(s) have been scheduled as follows:

Energy and Green Advisory Board Tentative Meeting Dates For the Next Six Months	
Thursday, April 24, 2014 @ 9:30 am	Tejas Conference Room (CPIII)
Thursday, May 29, 2014 @ 9:30 am	William J. Pitstick Executive Board Room (CPII)
Thursday, June 26, 2014 @ 9:30 am	William J. Pitstick Executive Board Room (CPII)
Thursday, July 24, 2014 @ 9:30 am	Regional Forum Room (CPII)
Thursday, August 28, 2014 @ 9:30 am	William J. Pitstick Executive Board Room (CPII)

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North Central Texas Council of Governments

AGENDA

Energy and Green Advisory Board
Thursday, May 29, 2014
9:30 AM, William J. Pitstick Executive Board Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden City of Dallas

1. **Welcome and Introductions.**

DISCUSSION / PRESENTATION / ACTION ITEMS

- **UPDATE:** Zaida Basora will provide an update of the IgCC Committee Action Hearings to took place April 27 – May 4, 2014 in Memphis
- **DISCUSSION:** Continuation of recommended regional amendments to the 2012 Edition of the International Green Construction Code
  - Continue discussion of Chapter 4 "**Site Development and Land Use**" then onward to Chapter 5 "**Material Resource Conservation and Efficiency.**"

INFORMATION ITEMS

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

2. **Future Agenda Items.**
3. **Roundtable Topics/Other Business.** Energy and Green Advisory Board members and NCTCOG staff may share additional items of interest as time allows.
   - **Invitation to Roundtable Discussion with Lunch:** Immediately following the June 26, 2014 EGAB meeting, Chris Herbert, SPEER representative, would like to facilitate a roundtable to discuss energy code compliance; how to encourage better practices; training needs, best forum for providing this support to building professionals; code enforcement personnel; and other associated businesses or trades.
4. **Schedule for the Next Energy and Green Advisory Board Meeting.** The Energy and Green Advisory Board meeting(s) have been scheduled as follows:

Energy and Green Advisory Board Tentative Meeting Dates For the Next Six Months	
Thursday, May 29, 2014 @ 9:30 am	William J. Pitstick Executive Board Room (CPII)
Thursday, June 26, 2014 @ 9:30 am	William J. Pitstick Executive Board Room (CPII)
Thursday, July 24, 2014 @ 9:30 am	Regional Forum Room (CPII)
Thursday, August 28, 2014 @ 9:30 am	William J. Pitstick Executive Board Room (CPII)

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North Central Texas Council of Governments

SUMMARY

Energy and Green Advisory Board
Thursday, May 29, 2014
9:30 AM, William J. Pitstick Executive Board Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden City of Dallas

1. **Welcome and Introductions.**

   Ed Dryden, EGAB Chair welcomed everyone to the meeting. Seventeen EGAB members were present and five guests.

DISCUSSION / PRESENTATION / ACTION ITEMS

- **UPDATE:** Zaida Basora will provide an update of the IgCC Committee Action Hearings to took place April 27 – May 4, 2014 in Memphis

  Zaida Basora, FAIA, Assistant Director, City of Dallas Public Works Department gave a brief overview of the IgCC Committee Action Hearings that were conducted in Memphis, TN from April 27-May 4, 2014.

- **DISCUSSION:** Continuation of recommended regional amendments to the 2012 Edition of the International Green Construction Code.

  Continue discussion of Chapter 4 "**Site Development and Land Use**" then onward to Chapter 5 "**Material Resource Conservation and Efficiency**."

  Ed Dryden shared the draft 2012 IgCC Position Statement with EGAB members and guests, then proceeded with continued discussion of the following:

Chapter 4- Site Development and Land Use

- **Section 406: Building Site Waste Management**- Perhaps consider lowering land-clearing debris and excavated soils from 75% to 50%.
  - 406.1 **Building site waste management plan.** Concerns were expressed in regard to items #3 and #6. Steve Covington, Frisco BO, will research "invasive plant species" for additional discussion. There was a suggestion to delete #6. *No decision was made.*
- **Section 407: Transportation Impact**
  - Following some discussion the board voted to delete Section 407.2 through 407.4 in entirety. 407.1 remains as written – noted that the accessible route provided will satisfy this section.

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Zaida Basora suggested that the EGAB should consider a task force to develop tools to assist in the implementation of the IgCC
For example, the task force could review and/or develop:
- templates for site and waste management plans that contractors would have to submit (the city has one that we could refine through this task force)
- sample green specifications to include with plans for: waste management, site waste management, material selection, heat island mitigation, etc.
- templates for the materials selection section like a matrix listing all materials with unit cost and providing the attributes to choose and calculate the 55% (or 75% if new threshold is kept for the 2015 code)
- sample logs and receipts for disposal of materials
- sample checklists of requirements
- etc.

INFORMATION ITEMS

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

2. **Future Agenda Items.**
3. **Roundtable Topics/Other Business.** Energy and Green Advisory Board members and NCTCOG staff may share additional items of interest as time allows.
   - **Invitation to Roundtable Discussion with Lunch:** Immediately following the June 26, 2014 EGAB meeting, Chris Herbert, SPEER representative, would like to facilitate a roundtable to discuss energy code compliance; how to encourage better practices; training needs, best forum for providing this support to building professionals; code enforcement personnel; and other associated businesses or trades.

     Chris Herbert extended an invitation to all attendees to attend a roundtable discussion with lunch immediately following the next EGAB meeting on June 26, 2014.

4. **Schedule for the Next Energy and Green Advisory Board Meeting.** The Energy and Green Advisory Board meeting(s) have been scheduled as follows:

Energy and Green Advisory Board Tentative Meeting Dates For the Next Six Months	
Thursday, May 29, 2014 @ 9:30 am	William J. Pitstick Executive Board Room (CPII)
Thursday, June 26, 2014 @ 9:30 am	William J. Pitstick Executive Board Room (CPII)
Thursday, July 24, 2014 @ 9:30 am	Regional Forum Room (CPII)
Thursday, August 28, 2014 @ 9:30 am	William J. Pitstick Executive Board Room (CPII)

The next EGAB meeting will be Thursday, June 26, 2014 at 9:30 am in the William J. Pitstick Executive Board Room (CPII).

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Sandra Barba by phone at (817) 608-2368 or by email at sbarba@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

Energy and Green Advisory Board

Thursday, May 29, 2014
9:30 AM William J. Pitstick Executive Board Room

MEMBER SIGN-IN SHEET

NAME	SIGNATURE	AGENCY
Mike Arellano		City of Coppell
Jack Baxley		TEXO
Linda Brown		American Institute of Architects
Steve Covington		City of Frisco
Ed Dryden		City of Dallas
Larry Ewing		City of Mesquite
Stan Folsom		Systemhause
Mike Gaiter		City of Garland
Daniel Garcia		City of Carrollton
Kurt Hansen		City of Denton
Danny Hartz		Town of Flower Mound
Gerald Kettler		Air Engineering and Testing, Inc.
Doug Lehde		HBA of Greater Dallas
Doug Lewin		SPEER
Cyndi Lewis		City of University Park
C. T. Loyd		TxHERO
Traci Nielsen		City of Southlake
Carroll Pruitt		Pruitt Consulting
Rick Ripley		City of Arlington
Evan Roberts		City of Fort Worth
Robert Smouse		City of Plano
Clint Sparks		City of Irving
Jack Thompson		City of DeSoto
Jason Vandever		City of Granbury
Bahman Yazdani		Energy Systems Labs

North Central Texas Council of Governments

AGENDA

Regional Codes Coordinating Committee
Tuesday, June 3, 2014
9:30 AM, William J. Pitstick Executive Board Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: David Kerr, City of Plano
Vice-Chair: Paul Ward, City of Southlake

1. **Welcome and Introductions.**

ACTION/DISCUSSION/PRESENTATION ITEMS

2. **Summary of the April 22, 2014 Meeting**. The April 22, 2014 draft meeting summary is available online for your review and consideration.

3. **WaterSense" Presentation by the Environmental Protection Agency (EPA), Region 6**. Julie Hankinson, Environmental Scientist with the Water Quality Section of the EPA, Region 6, will provide a "WaterSense" presentation. This EPA partnership seeks to protect the future of our water supply by offering a simple way to use less water with water-efficient products, new homes, and services.

   The WaterSense program was designed to promote the building of water-efficient homes in North Texas and compliment other green building programs. "WaterSense offers people a simple way to make product choices that use less water with no sacrifice to quality or product performance."

4. **Approval sought for National Electric Code (NEC) 2014 Recommended Regional Amendments**. The Electrical Advisory Board will present the NEC 2014 Local Recommended Regional Amendments for approval.

5. **Approval will be sought for Appointment of Advisory Board Member**. Ed Dryden, Chair of the Energy and Green Advisory Board (EGAB) will seek appointment of an advisory board member for the vacant EGAB Vice-Chair seat.

6. **Regional Codes Coordinating Committee "Operating Procedures."** The Regional Codes Coordinating Committee (RCCC) will review the procedures for the appointment/re-appointment process, membership, and meeting attendance.

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7. **Committee Re-Appointments.** In July, NCTCOG staff will be seeking the FY2014-2015 RCCC member appointments/re-appointments. Currently there are 15 members due for re-appointment of two year terms and officer's re-appointment of annual terms.

INFORMATION ITEMS

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

8. **Future Agenda Items.**
9. **Roundtable Topics/Other Business.** RCCC members and NCTCOG staff may share additional items of interest as time allows.
10. **Schedule for the Next RCCC Meeting.** The next RCCC meeting is tentatively scheduled for July 3, 2014.
11. **Adjournment.**

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

Thank you.

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Liz Zecckine by phone at (817) 695-2931 or by email at ezecckine@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

North Central Texas Council of Governments

SUMMARY

Regional Codes Coordinating Committee
Tuesday, June 3, 2014
9:30 AM, William J. Pitstick Executive Board Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: David Kerr, City of Plano
Vice-Chair: Paul Ward, City of Southlake

1. **Welcome and Introductions.**

   David Kerr, Regional Codes Coordinating Committee Chair welcomed everyone to the meeting. Nineteen members were present with six guests.

ACTION/DISCUSSION/PRESENTATION ITEMS

2. **Summary of the April 22, 2014 Meeting.** The April 22, 2014 draft meeting summary is available online for your review and consideration.

   Steve Covington made a motion to approve the April 22, 2014 RCCC meeting summary. Gilbert Urvina seconded the motion. The RCCC was unanimous in its approval.

3. **"WaterSense" Presentation by the Environmental Protection Agency (EPA), Region 6.** Julie Hankinson, Environmental Scientist with the Water Quality Section of the EPA, Region 6, will provide a "WaterSense" presentation. This EPA partnership seeks to protect the future of our water supply by offering a simple way to use less water with water-efficient products, new homes, and services.

   The WaterSense program was designed to promote the building of water-efficient homes in North Texas and compliment other green building programs. "WaterSense offers people a simple way to make product choices that use less water with no sacrifice to quality or product performance."

   Julie Hankinson, Environmental Scientist with the Water Quality Section of the EPA, Region 6 gave a brief overview of the WaterSense Labeled New Home, "*WaterSense New Homes 101.*" NCTCOG staff has posted this presentation on the following NCTCOG website: http://www.nctcog.org/envir/committees/rccc/index.asp

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4. **Approval sought for National Electric Code (NEC) 2014 Recommended Regional Amendments.** The Electrical Advisory Board will present the NEC 2014 Local Recommended Regional Amendments for approval.

   Paul Ward, Chair of the Electrical Advisory Board presented the NEC 2014 Local Recommended Regional Amendments to the RCCC for approval. Concerns were made about *** **Article 90.4 (B) Supervision of Work** by various RCCC members, yet resolved with the addition of text (see highlighted text below) then approved.

   Bahman Yazdani made a motion to approve revised ***Article 90.4 (B) Supervision of Work. Cliff Schaefer seconded the motion. Motion carried with one opposition. The RCCC was unanimous in its approval to recommend the 2014 NEC Local Recommended Regional Amendments to the Executive Board.

Article 90.4 Enforcement: Create a new (B) and add the following language:

(A) Enforcement. Existing language to remain

(B) Supervision of Work. In the actual work of installing, maintaining, altering or repairing any electrical conductors or equipment for which requires a permit, apprentice electricians require on-site supervision (as defined by Texas Administrative Code, Title 16, Chapter 73, Subsection 73.10) by a qualified licensee of a proper grade classification of electrical license when electrical work is being performed.

Informational Note: As defined by the State of Texas in Title 8, Occupational Code Chapter 1305 administered by the Texas Department of Licensing and Regulation for proper grade classifications of electrical license.

(REASON FOR CHANGE: To provide consistent licensing requirements for supervision of apprentice electricians in the North Central Texas region, which is currently the accepted practice in the region.)

5. **Approval will be sought for Appointment of Advisory Board Member.** Ed Dryden, Chair of the Energy and Green Advisory Board (EGAB) will seek appointment of an advisory board member for the vacant EGAB Vice-Chair seat.

   Ed Dryden, Chair of the Energy and Green Advisory Board sought approval for appointing Evan Roberts, Building Codes Administrator, City of Fort Worth to the vacant EGAB Vice-Chair seat. All RCCC Members in favor.

6. **Regional Codes Coordinating Committee "Operating Procedures."** The Regional Codes Coordinating Committee (RCCC) will review the procedures for the appointment/re-appointment process, membership, and meeting attendance.

   NCTCOG staff reported that the RCCC BY-LAWS "Meeting Attendance" was discussed with the Chair of the EAB and EGAB advisory board due to the lack of quorum at recent meetings. Both Chairs, agreed to allow NCTCOG staff to send an email to the EAB and EGAB members addressing the need for meeting attendance in order to allow voting to occur and keep items on schedule.

North Central Texas Council of Governments

7. **Committee Re-Appointments.** In July, NCTCOG staff will be seeking the FY2014-2015 RCCC member appointments/re-appointments. Currently there are 15 members due for re-appointment of two year terms and officer's re-appointment of annual terms.

   David Kerr announced that NCTCOG staff will be addressing the Committee Re-Appointments in July.

INFORMATION ITEMS

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

8. **Future Agenda Items.**

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

   Tommy Ford announced the Texas Builders Foundation, Fall 2014 Scholarship availability. More information can be found at the following website: http://www.texasbuildersfoundation.org/who-we-are.html

10. **Schedule for the Next RCCC Meeting.** The next RCCC meeting is tentatively scheduled for ~~July 3, 2014.~~

    The decision was made to have the next RCCC meeting on August 19, 2014 at NCTCOG offices at 9:30 AM in the William J. Pitstick Executive Board Room.

11. **Adjournment.**

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

Thank you.

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Regional Codes Coordinating Committee
9:30 a.m., Tuesday, June 3, 2014
William J. Pitstick Executive Board Room

MEMBER SIGN IN SHEET

NAME	SIGNATURE	ORGANIZATION
Judy Armstrong		Ellis County
Larry Bartlett		Associated General Contractors
Jack Baxley		Associated General Contractors
Warren Bonisch		Society of Fire Protection Engineers
Steve Covington		City of Frisco
Jack Craycroft		American Institute of Architects, East
Phil Crone		Home Builders Association of Great Dallas
Ed Dryden		City of Dallas
Tommy Ford		Home Builders Association of Great Dallas
Teresa Foster		Building Owners and Managers Association - Dallas
Allison Gray		City of Fort Worth
Danny Hartz		Town of Flower Mound
Gary Jones		Associated General Contractors
David Kerr		City of Plano
Selso Mata		City of Plano
Gary Miller		City of Irving
Bob Morgan		City of Fort Worth
Ted Padgett, Jr.		City of Dallas
Carroll Pruitt		American Institute of Architects, West
Rick Ripley		City of Arlington
Cliff Schaefer		City of Granbury
Keith Smith		City of Mesquite
Jack Thompson		City of DeSoto
Gilbert Urvina		City of Frisco
Paul D. Ward		City of Southlake
Scott Williams		City of Grapevine
Richard Wright		City of Mansfield
Bahman Yazdani		Texas A&M Energy Systems Laboratory

North Central Texas Council of Governments

AGENDA

Energy and Green Advisory Board
Thursday, June 26, 2014
9:30 AM, William J. Pitstick Executive Board Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden Name: City of Dallas

1. **Welcome and Introductions.**

DISCUSSION / PRESENTATION / ACTION ITEMS

- **Discussion:** Continuation of recommended regional amendments of the 2012 Edition of the International Green Construction Code (IgCC).
  - Continuation of IgCC Chapter 4 beginning with Section 406.

INFORMATION ITEMS

- **Invasive Plant Species Information:** Discussion of Invasive Plant Species was discussed at the last EGAB meeting during review of IgCC Chapter 4, Section 406. EGAB member Steve Covington, Chief Building Official for the City of Frisco will share information with the board regarding Invasive Plant Species. http://www.texasinvasives.org/i101/ecoalert.php

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

2. **Future Agenda Items.**

3. **Roundtable Topics/Other Business.** Energy and Green Advisory Board members and NCTCOG staff may share additional items of interest as time allows.

4. **Schedule for the Next Energy and Green Advisory Board Meeting.** The next Energy and Green Advisory Board meeting (s) have been scheduled as follows:

Energy and Green Advisory Board Tentative Meeting Dates For the Next Six Months	
Thursday, June 26, 2014 @ 9:30 am	William J. Pitstick Executive Board Room (CPII)
Thursday, July 24, 2014 @ 9:30 am	Regional Forum Room (CPII)
Thursday, August 28, 2014 @ 9:30 am	William J. Pitstick Executive Board Room (CPII)

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Sandra Barba by phone at (817) 608-2368 or by email at sbarba@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

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North Central Texas Council of Governments

SUMMARY

Energy and Green Advisory Board
Thursday, June 26, 2014
9:30 AM, William J. Pitstick Executive Board Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden Name: City of Dallas

1. **Welcome and Introductions.**

   Ed Dryden, EGAB Chair welcomed everyone to the meeting. Nineteen EGAB members were in attendance and five guests.

DISCUSSION / PRESENTATION / ACTION ITEMS

- **Discussion:** Continuation of recommended regional amendments of the 2012 Edition of the International Green Construction Code (IgCC).
  - Continuation of IgCC Chapter 4 beginning with Section 406.

Section 406
(1st paragraph) Divert less than 50% rather than 75%
1st Motion: Linda Brown / 2nd Motion: Gerald Ketter

Section 406.1
Delete #3 and keep #6
1st Motion: David Lehde / 2nd Motion: Stan Folsom

Section 408
Unanimous vote to keep.

Section 409
Complex section and decision was made to table this section for now and include the City of Dallas language as an alternate for consideration.

Chapter 5 Material Resources Conservation Efficiency

Section 502.1
Section 502.1.2
Section 504
Section 505.1- Deleted exception #2

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Section 505.2
Motion to reduce to 30% of total building materials.
1st Motion: Stan Folsom / 2nd Motion: Jack Baxley

Section 505.2.5
Section 506
Unanimous vote to keep.

Section 507
Table until Chapter 9.

INFORMATION ITEMS

- **Invasive Plant Species Information:** Discussion of Invasive Plant Species was discussed at the last EGAB meeting during review of IgCC Chapter 4, Section 406. EGAB member Steve Covington, Chief Building Official for the City of Frisco will share information with the board regarding Invasive Plant Species. http://www.texasinvasives.org/i101/ecoalert.php

  Shirley Ellis of Energy Systems Lab shared the following AgriLife Extension website information about Texas Invasive Plant Species: http://wildlife.tamu.edu/know-your-plants/ Also, TexasInvasives.org

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

2. **Future Agenda Items.**

3. **Roundtable Topics/Other Business.** Energy and Green Advisory Board members and NCTCOG staff may share additional items of interest as time allows.

   Shirley Ellis and Bahman Yazdani shared information about IECC 2015/ Residential Green Builders / ICC 700

4. **Schedule for the Next Energy and Green Advisory Board Meeting.** The next Energy and Green Advisory Board meeting (s) have been scheduled as follows:

Energy and Green Advisory Board Tentative Meeting Dates For the Next Six Months	
~~Thursday, June 26, 2014 @ 9:30 am~~	~~William J. Pitstick Executive Board Room (CPII)~~
~~Thursday, July 24, 2014 @ 9:30 am~~	~~Regional Forum Room (CPII)~~
Thursday, August 28, 2014 @ 9:30 am	William J. Pitstick Executive Board Room (CPII)

The next EGAB meeting has changed and will be conducted on Monday, July 21, 2014 at 9:30 am in the Metroplex Conference Room, NCTCOG Offices (CPII).

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Sandra Barba by phone at (817) 608-2368 or by email at sbarba@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

North Central Texas Council of Governments

AGENDA

Energy and Green Advisory Board
Monday, July 21, 2014
9:30 AM, Metroplex Conference Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden Name: City of Dallas

1. **Welcome and Introductions.**

DISCUSSION / PRESENTATION / ACTION ITEMS

- **Discussion:** Continuation of recommended regional amendments of the 2012 Edition of the International Green Construction Code (IgCC).
    - IgCC Chapter 6

INFORMATION ITEMS

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

2. **Future Agenda Items.**
3. **Roundtable Topics/Other Business.** Energy and Green Advisory Board members and NCTCOG staff may share additional items of interest as time allows.
4. **Schedule for the Next Energy and Green Advisory Board Meeting.** The next Energy and Green Advisory Board meeting (s) have been scheduled as follows:

Energy and Green Advisory Board Tentative Meeting Dates For the Next Six Months	
Monday, July 21, 2014 @ 9:30 am	Metroplex Conference Room (CPII)
~~Thursday, August 28, 2014 @ 9:30 am~~	~~William J. Pitstick Executive Board Room (CPII)~~

The Energy and Green Advisory Board will need to choose a replacement date for the August EGAB meeting.

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Sandra Barba by phone at (817) 608-2368 or by email at sbarba@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

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

North Central Texas Council of Governments

SUMMARY

Energy and Green Advisory Board
Monday, July 21, 2014
9:30 AM, Metroplex Conference Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden, City of Dallas
Vice Chair: Evan Roberts, City of Fort Worth

1. **Welcome and Introductions.**

DISCUSSION / PRESENTATION / ACTION ITEMS

- **Discussion:** Ed Dryden to review and discuss 2012 IgCC Regional Discussion Draft.
  - 2012 IgCC Regional Discussion Draft.

    Ed Dryden presented the draft discussion document he has compiled with the advisory board members. This document includes suggested elements and reason statements the advisory board has discussed thus far related to the IgCC.

- **Discussion:** Continuation of recommended regional amendments of the 2012 Edition of the International Green Construction Code (IgCC).
  - IgCC Chapter 6

    Gerald Kettler, Managing Principal, Air Engineering and Testing, Inc. presented information the City of Dallas considered amending to the IgCC Chapter 6 before choosing not to adopt the chapter. Mr. Kettler and others shared several aspects of the chapter that weighted heavily in the City of Dallas' decision not to move forward with this Chapter at this time.

    The group decided to review Mr. Kettler's notes in detail along with the original Chapter 6, prior to the next EGAG meeting. A discussion will be made at the next EGAB meeting on how to move forward in regards to Chapter 6.

INFORMATION ITEMS

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

2. **Future Agenda Items.**

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3. **Roundtable Topics/Other Business.** Energy and Green Advisory Board members and NCTCOG staff may share additional items of interest as time allows.

Shirley Ellis, Energy Code Specialist, Energy Systems Laboratory, shared information regarding the upcoming **CATEE 2014 Conference** to be held at the Sheraton Dallas Hotel in Dallas, TX. The CATEE 2014 Conference will be hosted by Texas A&M University System, Energy Systems Laboratory on November 18-20, 2014.

Mr. Kettler shared information about the Dallas 2030 District **"Existing Building Commissioning Summit"** to be held in Dallas, TX at the Centre for Building Performance on September 19, 2014. This summit involves the Building Commissioning Association, USGBC of North Texas, and SPEER.

4. **Schedule for the Next Energy and Green Advisory Board Meeting.** The next Energy and Green Advisory Board meeting (s) have been scheduled as follows:

Energy and Green Advisory Board Tentative Meeting Dates For the Next Six Months	
Monday, July 21, 2014 @ 9:30 am	Metroplex Conference Room (CPII)
~~Thursday, August 28, 2014 @ 9:30 am~~	~~William J. Pitstick Executive Board Room (CPII)~~

The Energy and Green Advisory Board will need to choose a replacement date for the August EGAB meeting.

The next Energy and Green Advisory Board meeting (s) have been scheduled as follows:

Energy and Green Advisory Board Meeting Dates and Locations	
Thursday, August 21, 2014 @ 1:00 pm	William J. Pitstick Executive Board Room (CPII)
Thursday, September 18, 2014 @ 9:00 am	William J. Pitstick Executive Board Room (CPII)
Thursday, October 16, 2014 @ 9:00 am	Metroplex Conference Room (CPII)

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Sandra Barba by phone at (817) 608-2368 or by email at sbarba@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

North Central Texas Council of Governments

AGENDA

Regional Codes Coordinating Committee
Tuesday, August 12, 2014
9:30 AM, Regional Forum Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: David Kerr, City of Plano
Vice-Chair: Paul Ward, City of Southlake

1. **Welcome and Introductions.**

ACTION/DISCUSSION/PRESENTATION ITEMS

2. **Summary of the June 3, 2014 Meeting.** The June 3, 2014 draft meeting summary is available online for your review and consideration.

3. **Timelines for Advisory Boards.** Proposed number of meetings, completion date(s) and recommended adoption date for the 2015 I-Codes.

4. **Development of a Survey Questionnaire for Code Adoption** (for use within the region). Discuss benefits and use of a well-developed survey and receive input on the survey questionnaire.

5. **Approval sought for National Electric Code (NEC) 2014 Recommended Regional Amendments.** The Electrical Advisory Board will present the NEC 2014 Local Recommended Regional Amendments for approval with recommendations on revisions of Article 90.4 (B) Supervision of Work.

6. **Approval sought for Appointment of Advisory Board Members.** Ed Dryden, Chair of the Energy and Green Advisory Board, will seek approval of advisory board member(s) appointments.

INFORMATION ITEMS

7. **Regional Codes Coordinating Committee Reappointments.** Of the 28 members of the RCCC, 15 are scheduled for reappointment to the RCCC for a two-year term beginning October 1, 2014. The reappointment acceptance form was due to NCTCOG on August 6, 2014.

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OTHER BUSINESS AND ROUNDTABLE DISCUSSION

8. **Future Agenda Items.**

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

10. **Schedule for the Next RCCC Meeting.** The next RCCC meeting will be scheduled at the meeting on August 12, 2014.

11. **Adjournment.**

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

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Liz Zecckine by phone at (817) 695-2931 or by email at ezecckine@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

North Central Texas Council of Governments

AGENDA

Energy and Green Advisory Board
Thursday, August 21, 2014
1:00 PM, William J. Pitstick Executive Board Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden, City of Dallas
Vice Chair: Evan Roberts, City of Fort Worth

1. **Welcome and Introductions.**

DISCUSSION

Continuation of recommended regional amendments of the 2012 Edition of the International Green Construction Code (IgCC).

- IgCC Chapter 6
  (References will be made to documents sent to the advisory board members following the July 21, 2014 meeting.)

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

2. **Future Agenda Items.**

3. **Roundtable Topics/Other Business.** Energy and Green Advisory Board members and NCTCOG staff may share additional items of interest as time allows.

4. **Schedule for the Next Energy and Green Advisory Board Meeting.** The next Energy and Green Advisory Board meeting(s) have been scheduled as follows:

Energy and Green Advisory Board Meeting Dates For the Next Three Months	
Thursday, August 21, 2014 @ 1:00 pm	William J. Pitstick Executive Board Room (CPII)
Thursday, September 18, 2014 @ 9:00 am	William J. Pitstick Executive Board Room (CPII)
Thursday, October 16, 2014 @ 9:00 am	Metroplex Conference Room (CPII)

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Sandra Barba by phone at (817) 608-2368 or by email at sbarba@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

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North Central Texas Council of Governments

SUMMARY

Energy and Green Advisory Board
Thursday, August 21, 2014
1:00 PM, William J. Pitstick Executive Board Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden, City of Dallas
Vice Chair: Evan Roberts, City of Fort Worth

1. **Welcome and Introductions.**

DISCUSSION

Continuation of recommended regional amendments of the 2012 Edition of the International Green Construction Code (IgCC).

- IgCC Chapter 6
  (References will be made to documents sent to the advisory board members following the July 21, 2014 meeting.)

EGAB discussed their thoughts about the City of Dallas choosing to delete IgCC Chapter 6 then, reviewed the "IgCC Chapter 6 Recommendations" presented by Gerald Kettler, and acted on each section as follows (Note: not yet voted on as a recommended amendment package to Chapter 6):

1. 603.1.1- Add an exception for existing buildings; and, re-visit Chapter 2 to review Existing Building definition

   Motion: Carroll Pruitt 2nd: Gerald Kettler No opposition.

2. 603.3.2 and 603.3.3 – no action, leave as is.

3. 603.6 - Make this a jurisdictional option by adding to Table 302.1.
   1st Motion: Carroll Pruitt 2nd: Motion: Linda Brown No opposition.

4. 605.1.1 - delete in its entirety.

5. 605.1.1.1 – Renumber and make this a jurisdictional option by adding to Table 302.1.
   Motion: CT Loyd 2nd: Bahman Yazdani No opposition.

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6. 605.1.2.2 - no action, leave as is.

7. 605.2 - no action, leave as is.

8. 606.3.1 - no action, leave as is.

9. 607.2.2 - no action, leave as is.

10. 607.5 - Delete in its entirety.

    Motion: Carroll Pruitt 2nd: Gerald Kettler No opposition.

11. Amend 608.4.1 and 608.4.2 to read as follows:

    608.4.1 Exterior light reduction. Exterior lighting shall be controlled by a time switch and that may be configured so that the total exterior lighting power is automatically reduced by not less than 30 percent within 2 hours after facility operations conclude.

    608.4.2 Exterior lighting and signage shutoff. The lighting of building facades, signage, and landscape features shall be controlled by a time switch control that may be configured so that the lighting automatically shuts off from within 1 hour after facility operations conclude until within 1 hour before facility operations begin or as established by the jurisdiction. Where facility operations are continuous, decorative lighting of building facades and landscape features shall automatically shut off from midnight until 6:00 a.m.

    Motion: Stan Folsom 2nd: Bahman Yazdani No opposition.

12. 608.8.1.2 and 608.8.1.3 -- delete in its entirety

    Motion: Gerald Kettler 2nd: Carroll Pruitt No opposition.

13. 610 - Make this a jurisdictional option by adding to Table 302.1.

    Motion: Carroll Pruitt 2nd: Gerald Kettler No opposition.

14. 611 Systems Commissioning and Completion to be reviewed at next meeting.

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

2. **Future Agenda Items.**

3. **Roundtable Topics/Other Business.** Energy and Green Advisory Board members and NCTCOG staff may share additional items of interest as time allows.

   Christine Herbert, Managing Director of **The South-central Partnership for Energy Efficiency as a Resource** (SPEER), announced the unveiling of the Texas Energy Code Compliance Collaborative (TECCC) 2014 Energy Code Adoption Report. The TECCC is an industry stakeholder group that was established in 2011 with the purpose of supporting

North Central Texas Council of Governments

improved compliance with the state energy code, and to measure improvement on an annual basis, per the American Recovery and Reinvestment Act.

In this report (*link to report provided below*), SPEER identifies state law, current practices and barriers to compliance, and lists the 217 Largest Cities in Texas with their current residential energy code.

4. **Schedule for the Next Energy and Green Advisory Board Meeting.** The next Energy and Green Advisory Board meeting(s) have been scheduled as follows:

Energy and Green Advisory Board Meeting Dates For the Next Three Months	
~~Thursday, August 21, 2014 @ 1:00 pm~~	~~William J. Pitstick Executive Board Room (CPII)~~
Thursday, September 18, 2014 @ 9:00 am	William J. Pitstick Executive Board Room (CPII)
Thursday, October 16, 2014 @ 9:00 am	Metroplex Conference Room (CPII)

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Sandra Barba by phone at (817) 608-2368 or by email at sbarba@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

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(817) 640-3300 FAX: 817-608-2372
www.nctcog.org

North Central Texas Council of Governments

AGENDA

Energy and Green Advisory Board
Thursday, September 18, 2014
9:00 AM, William J. Pitstick Executive Board Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden, City of Dallas
Vice Chair: Evan Roberts, City of Fort Worth

1. **Welcome and Introductions.**

DISCUSSION

2. **Continuation of Recommended Regional Amendments of the 2012 Edition of the International Green Construction Code (IgCC).**

    - IgCC Chapter 6: (References will be made to the "*IgCC Chapter 6 Recommendations*" document shared with Energy and Green Advisory Board (EGAB) members by Gerald Kettler at the August 21, 2014 meeting.)

    Section 611

    "SYSTEMS COMMISSIONING AND COMPLETION"

    EGAB members have agreed to read this section and discuss it at the September 18, 2014 EGAB meeting.

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

3. **Future Agenda Items.**

4. **Roundtable Topics/Other Business.** EGAB members and NCTCOG staff may share additional items of interest as time allows.

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North Central Texas Council of Governments

SUMMARY

Energy and Green Advisory Board
Thursday, September 18, 2014
9:00 AM, William J. Pitstick Executive Board Room
NCTCOG Offices, CPII
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden, City of Dallas
Vice Chair: Evan Roberts, City of Fort Worth

1. **Welcome and Introductions.**

DISCUSSION

2. **Continuation of Recommended Regional Amendments of the 2012 Edition of the International Green Construction Code (IgCC).**

   - IgCC Chapter 6: (References will be made to the "*IgCC Chapter 6 Recommendations*" document shared with Energy and Green Advisory Board (EGAB) members by Gerald Kettler at the August 21, 2014 meeting.)

EGAB members voted to offer Chapter 6 as a jurisdictional option,
1st Motion: Carroll Pruitt 2nd Motion: Linda Brown No Opposition

EGAB members voted to accept amendments made to Chapter 6.
1st Motion: Carroll Pruitt 2nd Motion: Cindy Lewis No Opposition

Summary: Chapter 6 is amended and will be a jurisdictional option.

EGAB discussed "Section 611 "SYSTEMS COMMISSIONING AND COMPLETION." EGAB members have agreed to view this section as it correlates to other chapters and code editions which address similar information at the October 16, 2014 EGAB meeting.

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OTHER BUSINESS AND ROUNDTABLE DISCUSSION

3. **Future Agenda Items.**

4. **Roundtable Topics/Other Business.** EGAB members and NCTCOG staff may share additional items of interest as time allows.

   Mr. Kettler shared information about Existing Building Commissioning Summit to take place in Dallas, TX on September 19, 2014. The topic: Existing Building Commissioning: Tuning Up a Building.

5. **Schedule for the Next EGAB Meeting.** The next Energy and Green Advisory Board meetings have been scheduled as follows:

Energy and Green Advisory Board Meeting Dates For the Next Three Months	
Thursday, September 18, 2014 @ 9:00 am	William J. Pitstick Executive Board Room (CPII)
Thursday, October 16, 2014 @ 9:00 am	Metroplex Conference Room (CPII)

6. **Adjournment.**

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

Thank you.

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Sandra Barba by phone at (817) 608-2368 or by email at sbarba@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

North Central Texas Council of Governments

AGENDA

Energy and Green Advisory Board
Thursday, October 16, 2014
9:00 AM, Metroplex Conference Room (CPII)
NCTCOG Offices
616 Six Flags Drive, Arlington, Texas 76011

Chair: Ed Dryden, City of Dallas
Vice Chair: Evan Roberts, City of Fort Worth

1. **Welcome and Introductions.**

DISCUSSION

Continuation of Recommended Regional Amendments of the 2012 Edition of the International Green Construction Code (IgCC).

- IgCC Chapter 6: (References will be made to the "*IgCC Chapter 6* ***Section 611 "Systems Commissioning and Completion"*** *and Recommendations* shared by committee member Gerald Kettler. The advisory board will view a side by side format submitted by committee member Linda Brown.

OTHER BUSINESS AND ROUNDTABLE DISCUSSION

2. **Future Agenda Items.** EGAB Members and NCTCOG staff may suggest future agenda items.

3. **Roundtable Topics/Other Business.** EGAB members and NCTCOG staff may share additional items of interest as time allows.

4. **Schedule for the Next EGAB Meeting.** The next EGAB meeting has been scheduled as follows:

Energy and Green Advisory Board Meeting Dates	
Thursday, October 16, 2014 @ 9:00 am	Metroplex Conference Room (CPII)
Thursday, January 15, 2015 @ 9:00 am	William J. Pitstick Executive Board Room (CPII)
Thursday, February 19, 2015 @ 9:00 am	William J. Pitstick Executive Board Room (CPII)
Thursday, March 19, 2015 @ 9:00 am	William J. Pitstick Executive Board Room (CPII)
Thursday, April 16, 2015 @ 9:00 am	William J. Pitstick Executive Board Room (CPII)
Thursday, May 28, 2015 @ 9:00 am	William J. Pitstick Executive Board Room (CPII)

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

5. **Adjournment.**

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

Thank you.

If you plan to attend this public meeting and you have a disability that requires special arrangements at the meeting, please contact Sandra Barba by phone at (817) 608-2368 or by email at sbarba@nctcog.org, 72 hours in advance of the meeting. Reasonable accommodations will be made to assist your needs.

6.4.6.2 North Texas Assciation of Energy Engineers (NTAEE).

The following pages are meeting notes, agendas, and summaries from the NTAEE meetings from 2014.

Tammy Persky

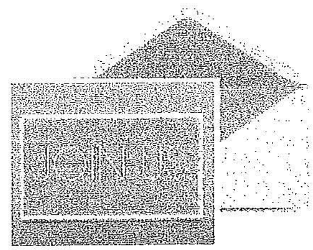
From: Evite <info@mailva.evite.com>
Sent: Tuesday, January 21, 2014 2:39 AM
To: byazdani@tamu.edu
Subject: Event Reminder: NTAEE January Meeting

Event Reminder

NTAEE January Meeting

HOSTED BY:
Jim Phillips
WHEN:
Thursday, January 23, 2014
11:30 AM - 01:00 PM
WHERE:
Brookhaven Country Club
3333 Golfing Green Dr
Farmers Branch TX 75234
Your reply is: **NOT YET REPLIED**

View Invitation



1

Tammy Persky

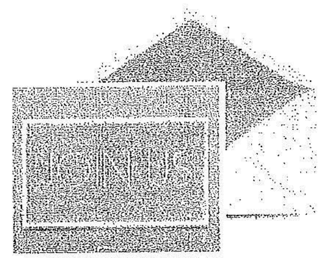
From: Evite <info@mailva.evite.com>
Sent: Tuesday, February 18, 2014 2:34 AM
To: byazdani@tamu.edu
Subject: Event Reminder: NTAEE February Meeting

Event Reminder

NTAEE February Meeting

HOSTED BY:
Jim Phillips
WHEN:
Thursday, February 20, 2014
11:15 AM - 02:15 PM
WHERE:
Brookhaven Country Club
3333 Golfing Green Dr
Farmers Branch TX 75234
Your reply is: **NOT YET REPLIED**

View Invitation

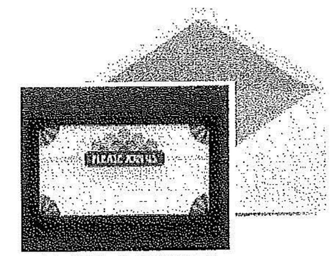


Tammy Persky

From: Evite <info@mailva.evite.com>
Sent: Tuesday, March 18, 2014 3:43 AM
To: byazdani@tamu.edu
Subject: Event Reminder: NTAEE March Meeting

Event Reminder

NTAEE March Meeting



HOSTED BY:
Jim Phillips
WHEN:
Thursday, March 20, 2014
11:15 AM - 01:00 PM
WHERE:
Brookhaven Country Club
3320 Golfing Green Dr
Farmers Branch TX 75234
Your reply is: **NOT YET REPLIED**

View Invitation

1

To: Mark.Berdoll@twc.state.tx.us; Art.Hinojosa@tyc.state.tx.us; farshad.shahsavary@tfc.state.tx.us; mmchang@Central.UH.EDU; myancey@Central.UH.EDU; pbrokhin@central.uh.edu; SAKapileshwari@Central.UH.EDU; myerskj@uhv.edu; alan.stucky@untsystem.edu; charles.jackson@unt.edu; jmorton@unt.edu; steve.mathis@unt.edu; sbarrett@hsc.unt.edu; patty@uta.edu; juan.ontiveros@austin.utexas.edu; patrick.mazur@austin.utexas.edu; dagoberto.rodriguez@utsa.edu; cclark@uttyler.edu; Rich_Legler@uttyler.edu; clint.thomas@utsouthwestern.edu; cbrady@utsystem.edu; Dcolvin@utsystem.edu; Dhollingsworth@utsystem.edu; dpowell@utsystem.edu; rstarkey@utsystem.edu; scollins@utsystem.edu; darrell@iwfa.com; mhodgson@consol.ws

Subject: March SAEAG Meeting

State Agency Energy Advisory Group

Wednesday, March 19, 2014
9:00 a.m. – 11:45 a.m.
LBJ Office Building
111 E. 17th Street
Corner of 17th and Brazos
Room 212B
Austin, Texas 78711

AGENDA

9:00 a.m. – 10:00 a.m. Case Update from OAG (not open to public)

10:00 a.m. – 10:15 a.m. BREAK

10:15 a.m. – 10:30 a.m. **SB700 (83R) Reporting Template Update for State Agencies and Institutions of Higher Education**

10:30 a.m. – 11:00 a.m. Darrell Smith (International Window Film Association (www.iwfa.com). Overview of window film, impact on buildings, housing and schools, and analysis tools

11:00 a.m. – 11:15 a.m. General discussion of current and upcoming issues and events

Parking is approved for Parking Garage B. (see enclosed map).

CapitolComplex...

If you will be attending remotely, the participation process has been updated. Register to attend the SAEAG meeting at the following hyperlink.

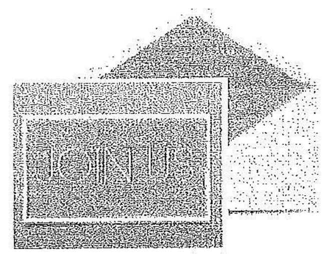
https://www1.gotomeeting.com/register/413318977

Tammy Persky

From: Evite <info@mailva.evite.com>
Sent: Tuesday, April 15, 2014 3:33 AM
To: byazdani@tamu.edu
Subject: Event Reminder: NTAEE April Meeting - AT&T Stadium

Event Reminder

NTAEE April Meeting - AT&T Stadium



HOSTED BY:
Jim Phillips
WHEN:
Thursday, April 17, 2014
09:30 AM - 11:30 AM
WHERE:
Cowboy (AT&T) Stadium
One AT&T Way
Arlington TX 76019
Your reply is: **NOT YET REPLIED**

View Invitation

Tammy Persky

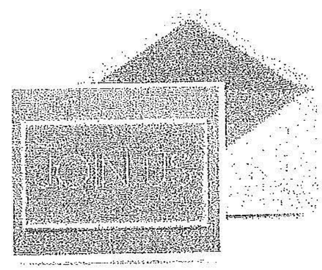
From: Evite <info@mailva.evite.com>
Sent: Tuesday, May 13, 2014 3:38 AM
To: byazdani@tamu.edu
Subject: Event Reminder: NTAEE May Meeting

Event Reminder

NTAEE May Meeting

HOSTED BY:
Jim Phillips
WHEN:
Thursday, May 15, 2014
11:15 AM - 01:00 PM
WHERE:
Brookhaven Country Club
3333 Golfing Green Dr
Farmers Branch TX 75234
Your reply is: **NOT YET REPLIED**

View Invitation



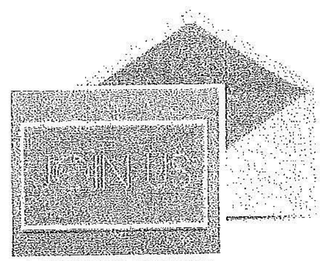
1

Tammy Persky

From:	Evite <info@mailva.evite.com>
Sent:	Tuesday, June 17, 2014 3:44 AM
To:	byazdani@tamu.edu
Subject:	Event Reminder: NTAEE June Meeting

Event Reminder

NTAEE June Meeting



HOSTED BY:
Jim Phillips
WHEN:
Thursday, June 19, 2014
11:30 AM - 01:00 PM
WHERE:
Brookhaven Country Club
3333 Golfing Green Dr
Farmers Branch TX 75234
Your reply is: MAYBE

View Invitation

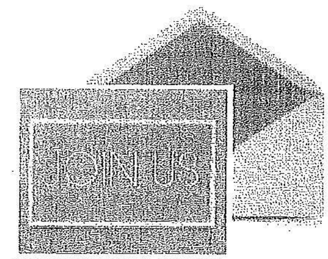
1

Tammy Persky

From:	Jim Phillips <info@mailva.evite.com>
Sent:	Tuesday, July 01, 2014 7:09 PM
To:	byazdani@tamu.edu
Subject:	Evite Invitation: NTAEE July Meeting

Jim Phillips invited you to

NTAEE July Meeting



Thursday, July 17, 2014
11:30 AM - 01:00 PM

WHERE:
Brookhaven Country Club
3333 Golfing Green Dr
Farmers Branch TX 75234

WILL YOU ATTEND?

✓ YES | ? MAYBE | ✗ NO

VIEW THIS INVITATION

Is this email going to your junk/bulk folder? Add info@mailva.evite.com to your address book to ensure that you receive all future Evite invitations in your inbox.

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If you no longer wish to receive notifications from Evite for this event only, update your notification settings.

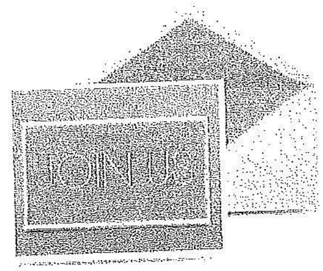
Note: Replies to this email will go directly to the person who sent this message, not to Evite.

Tammy Persky

From: Evite <info@mailva.evite.com>
Sent: Tuesday, July 15, 2014 3:33 AM
To: byazdani@tamu.edu
Subject: Event Reminder: NTAEE July Meeting

Event Reminder

NTAEE July Meeting



HOSTED BY:
Jim Phillips
WHEN:
Thursday, July 17, 2014
11:30 AM - 01:00 PM
WHERE:
Brookhaven Country Club
3333 Golfing Green Dr
Farmers Branch TX 75234
Your reply is: YES

View Invitation

1

Tammy Persky

From: Evite <info@mailva.evite.com>
Sent: Tuesday, August 19, 2014 3:53 AM
To: byazdani@tamu.edu
Subject: Event Reminder: NTAEE August Meeting @ TCU

Event Reminder

NTAEE August Meeting @ TCU

HOSTED BY:
Jim Phillips
WHEN:
Thursday, August 21, 2014
11:30 AM - 01:00 PM
WHERE:
TCU Stadium - Founders Plaza
Bellaire Dr
Fort Worth TX 76109
Your reply is: MAYBE

View Invitation

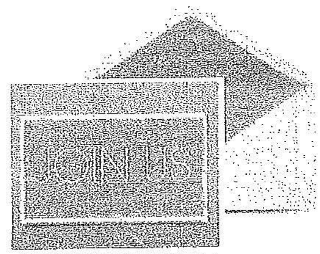
1

Tammy Persky

From:	Evite <info@mailva.evite.com>
Sent:	Tuesday, September 16, 2014 3:42 AM
To:	byazdani@tamu.edu
Subject:	Event Reminder: NTAEE September Meeting

Event Reminder

NTAEE September Meeting



HOSTED BY:
Jim Phillips
WHEN:
Thursday, September 18, 2014
11:30 AM - 01:00 PM
WHERE:
Brookhaven Country Club
3333 Golfing Green Dr
Farmers Branch TX 75234
Your reply is: **NOT YET REPLIED**

View Invitation

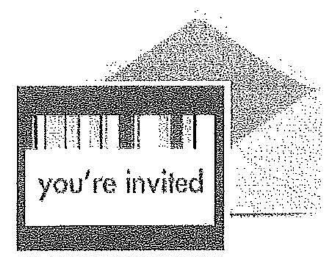
1

Tammy Persky

From: Evite <info@mailva.evite.com>
Sent: Tuesday, October 14, 2014 3:33 AM
To: byazdani@tamu.edu
Subject: Event Reminder: 2014 NTAEE Energy Conference

Event Reminder

2014 NTAEE Energy Conference



HOSTED BY:
Dietmar Zeidler
WHEN:
Thursday, October 16, 2014
09:00 AM - 03:00 PM
WHERE:
Univ. of North Texas Coliseum
600 Ave D
Denton TX 76201
Your reply is: MAYBE

View Invitation

Tammy Persky

From:	Evite <info@mailva.evite.com>
Sent:	Tuesday, November 18, 2014 2:46 AM
To:	byazdani@tamu.edu
Subject:	Event Reminder: NTAEE November Meeting

Event Reminder

NTAEE November Meeting

HOSTED BY:
Jim Phillips
WHEN:
Thursday, November 20, 2014
11:30 AM - 01:00 PM
WHERE:
Brookhaven Country Club
3333 Golfing Green Dr
Farmers Branch TX 75234
Your reply is: **NOT YET REPLIED**

View Invitation

1

6.4.6.3 State Agency Energy Advisory Group (SAEAG)

The following pages are meeting notes, agendas, and summaries from the SAEAG meetings from 2014.

Tammy Persky

Subject:	State Agency Energy Advisory Group Meeting - Presentation Update
Location:	LBJ Office Building, 111 E. 17th Street, Room 212B, Austin, Texas 78711
Start:	Wed 1/15/2014 9:00 AM
End:	Wed 1/15/2014 12:00 PM
Show Time As:	Tentative
Recurrence:	(none)
Organizer:	Eddy Trevino

State Agency Energy Advisory Group

Wednesday, January 15, 2014
9:00 a.m. - 11:45 a.m.
LBJ Office Building
111 E. 17th Street
Corner of 17th and Brazos
Room 212B
Austin, Texas 78711
[X]

AGENDA

9:00 a.m. - 10:00 a.m. Case Update from OAG

10:00 a.m. - 10:15 a.m. BREAK

10:15 a.m. - 11:00 a.m. SB700 (83R) Reporting Template Update for State Agencies and Institutions of Higher Education

11:00 a.m. - 11:30 a.m. Best Practices in Reroofing - Guest speaker: Edis T. Oliver, Wiss, Janney, Elstner Associates, Inc.

11:30 a.m. - 11:45 a.m. General discussion of current and upcoming issues and events

Parking is approved for Parking Garage B. (see enclosed map).

If you will be attending remotely, the participation process has been updated. Register to attend the SAEAG meeting at the following hyperlink.

Wed, Jan 15, 2014 9:00 AM - 12:00 PM CST<https://www1.gotomeeting.com/register/398379905>

1

SAEAG MEETING

State Agency Energy Advisory Group

Wednesday, February 19, 2014
9:00 a.m. – 11:30 a.m.
Office of the Attorney General
William Clements Building
NW Corner of 15th and Lavaca
12th Floor Large Conference Room by Receptionist Area
Austin, Texas 78701

AGENDA

Note: This Agenda contains updated information for those not attending in person

9:00 a.m. – 10:00 a.m.	Update from the Office of Attorney General ("OAG")
10:00 a.m. – 10:15 a.m.	BREAK
10:15 a.m. – 11:00 a.m.	Guest speaker: Mr. Erik Norwood of Curb, Inc., who will discuss various metering options that can assist in energy efficiency. This presentation will include a real-time demonstration of remote metering capabilities.
11:00 a.m. – 11:15 a.m.	State Energy Conservation Office ("SECO") Report
11:15 a.m. – 11:30 a.m.	General discussion of current and upcoming issues and events

FOR THOSE UNABLE TO ATTEND IN PERSON:

The first hour of the meeting (OAG Update) may be accessed via teleconference:

Call-in Number: 888-391-2102
Passcode: 7253903#

The speaker portion, beginning at 10:15, may also be accessed on-line by following this link: https://www1.gotomeeting.com/register/404897616. To see the real-time demonstration of remote metering, you will need to do so on-line.

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

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

SAEAG MEETING

State Agency Energy Advisory Group

Wednesday, April 16, 2014
9:00 a.m. – 11:30 a.m.
Office of the Attorney General
William Clements Building
NW Corner of 15th and Lavaca
12th Floor Large Conference Room by Receptionist Area
Austin, Texas 78701

AGENDA

9:00 a.m. – 10:00 a.m.	Case Update from OAG
10:00 a.m. – 10:15 a.m.	BREAK
10:15 a.m. – 11:00 a.m.	Guest speaker: John Barton, Texas Public Finance Authority, who will speak about "Master Lease Purchase Program."
11:00 a.m. – 11:15 a.m.	SECO Report
11:15 a.m. – 11:30 a.m.	General discussion of current and upcoming issues and events

If you are going to join the meeting via telephone conference please call 1-888-391-2102 and during the message punch in 7253903#.

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

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

Tammy Persky

Subject:	SAEAG Meeting
Location:	LBJ Office Building
Start:	Wed 5/21/2014 9:00 AM
End:	Wed 5/21/2014 12:00 PM
Show Time As:	Tentative
Recurrence:	(none)
Organizer:	Alison Nathan

SAEAG MEETING
Wednesday, May 21, 2014
9:00 a.m. – 11:45 a.m.

Agenda
9:00 a.m. – 9:45 a.m. Case Update from OAG (not open to public)
9:45 a.m. – 10:30 a.m. Kudret Utebay, ENERGY STAR Portfolio Manager reporting for SB700
10:30 a.m. – 10:45 a.m. BREAK
10:45 a.m. – 11:45 a.m. Paul Bundshuh, Ideal Power

Attending in Person
LBJ Office Building
111 E. 17th Street, Room 212B
Austin, Texas 78711
Please be sure to "Accept" this invitation or RSVP to my email if you are able to attend. We will need to give prior notice of all attendees to security at the front desk.
Parking- TBD. An email regarding parking arrangements will be sent to all who "accept".

Attending by Phone/Online
Please register to attend the webinar at: https://www1.gotomeeting.com/register/172158089

SAEAG MEETING

State Agency Energy Advisory Group

Wednesday, June 18, 2014
9:00 a.m. – 11:30 a.m.
Office of the Attorney General
William Clements Building
NW Corner of 15th and Lavaca
12th Floor Large Conference Room by Receptionist Area
Austin, Texas 78701

REVISED AGENDA

9:00 a.m. – 9:45 a.m.	Case Update from OAG
9:45 a.m. – 10:00 a.m.	SECO Report
10:00 a.m. – 10:15 a.m.	BREAK
10:15 a.m. – 11:00 a.m.	Guest speaker: Tom "Smitty" Smith, Texas director of Public Citizen, and a representative from the Association of Electric Companies of Texas will talk about the challenges and opportunities that may be anticipated from the coming changes to air quality and CO_2 standards.
11:00 a.m. – 11:15 a.m.	Special report on the Energy Future Holdings bankruptcy from Assistant Attorney General Hal Morris, Managing Attorney of the OAG Bankruptcy Regulatory Section. Hal is the lead attorney for the PUC in the EFH bankruptcy proceeding, and will report on the status of TXU Energy contracts and answer any questions about what to expect.
11:15 a.m. – 11:30 a.m.	General discussion of current and upcoming issues and events

If you are going to join the meeting via telephone conference please call 1-888-391-2102 and during the message punch in 7253903#.

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

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

Tammy Persky

Subject: SAEAG MEETING
Location: LBJ Office Building, 111 E. 17th Street, Room 305, Austin, Texas 78711

Start: Wed 7/16/2014 9:00 AM
End: Wed 7/16/2014 11:30 AM
Show Time As: Tentative

Recurrence: (none)

Organizer: Eddy Trevino

SAEAG MEETING AGENDA

Wednesday, July 16, 2014
9:00 a.m. - 11:45 a.m.
LBJ Office Building
111 E. 17th Street, Room 305
Austin, Texas 78711

Agenda
9:00 a.m. - 10:00 a.m. Case Update from OAG (not open to public)
10:00 a.m. - 10:15 a.m. BREAK
10:15 a.m. - 10:45 a.m. SECO Energy and Water Conservation Design Standards and Major Renovation Projects Update
10:45 a.m. - 11:15 a.m. ENERGY STAR Portfolio Manager reporting for SB700 update
11:15 a.m. - 11:30 a.m. General Discussion

Webinar
https://www1.gotomeeting.com/register/418611088

Parking
TBD

SAEAG MEETING

State Agency Energy Advisory Group

Wednesday, August 20, 2014
9:00 a.m. – 11:30 a.m.
Office of the Attorney General
William Clements Building
NW Corner of 15th and Lavaca
12th Floor Large Conference Room by Receptionist Area
Austin, Texas 78701

AGENDA

9:00 a.m. – 10:00 a.m.	Case Update from OAG
10:00 a.m. – 10:15 a.m.	BREAK
10:15 a.m. – 11:00 a.m.	Guest speaker: Chrissy Mann, Public Utility Commission, will discuss the Transition of Water Utility Regulatory oversight from TCEQ to the Public Utility Commission
11:00 a.m. – 11:15 a.m.	SECO Report
11:15 a.m. – 11:30 a.m.	General discussion of current and upcoming issues and events

If you are going to join the meeting via telephone conference please call 1-888-391-2102 and during the message punch in 7253903#.

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

You may pre-register to obtain unescorted clearance (you will still need to bring a picture I.D.) to our floor by emailing or calling before our meeting is scheduled nancy.villarreal@texasattorneygeneral.gov [512-475-4164] or susan.kelley@texasattorneygeneral.gov [512-475-4173]

SAEAG MEETING AGENDA

Wednesday, September 17, 2014
9:30 a.m. – 11:45 a.m.
Philips Gardco Lighting
1611 Clovis Barker Road
San Marcos, TX 78666

Agenda
(No legal review this month)
9:30- SB700 Update
10:00- SAEAG planning for 2015
10:15- Break
10:30- Philips Technical Update
11:00- Philips Facility Tour

Webinar
https://www1.gotomeeting.com/register/418611088

SAEAG MEETING

State Agency Energy Advisory Group

Wednesday, October 15, 2014
9:00 a.m. – 11:30 a.m.
Office of the Attorney General
William Clements Building
NW Corner of 15th and Lavaca
12th Floor Large Conference Room by Receptionist Area
Austin, Texas 78701

Dear SAEAG attendees: Please note the change in our schedule for next week's meeting- our speaker will be presented first, at 9:00, so he can make the Texas Facilities Commission meeting. The legal update will be after the coffee break.

AGENDA

9:00 a.m. – 9:45 a.m.	Guest speaker: Farshad Shahsavary, Texas Facilities Commission, will discuss the Energy Efficiency and Sustainability Status at Texas Facilities Commission (TFC).
9:45 a.m. – 10:10 a.m.	BREAK
10:00 a.m. – 11:00 a.m.	Case Update from OAG
11:00 a.m. – 11:15 a.m.	SECO Report
11:15 a.m. – 11:30 a.m.	General discussion of current and upcoming issues and events

If you are going to join the meeting via telephone conference please call 1-888-391-2102 and during the message punch in 7253903#.

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

You may pre-register to obtain unescorted clearance (you will still need to bring a picture I.D.) to our floor by emailing or calling before our meeting is scheduled nancy.villarreal@texasattorneygeneral.gov [512-475-4164] or susan.kelley@texasattorneygeneral.gov [512-475-4173]

SAEAG MEETING AGENDA

Wednesday, November 12, 2014
9:00 a.m. – 11:30 a.m.
LBJ Office Building
111 E. 17th Street, Room 212B
Austin, Texas 78711

Agenda

9:00 a.m. – 10:00 a.m.	Case Update from OAG (not open to public)
10:00 a.m. – 10:15 a.m.	BREAK
10:15 a.m. – 11:00 a.m.	Guide to Texas Energy-Related Legislative Information – Dub Taylor (Director, SECO) and Eddy Trevino (Program Manager, SECO)
11:00 a.m. – 11:15 a.m.	ENERGY STAR Portfolio Manager Recap for SB700
11:15 a.m. – 11:30 a.m.	General Discussion

6.4.6.4 The South-central Partnership for Energy Efficiency as a Resource (SPEER) Meetings from 2014. The following pages are meeting notes, agendas, and summaries from the SPEER meetings from 2014.

SPEER
The South-central Partnership for Energy Efficiency as a Resource

Home About Energy Upgrade SPEER Summit SPEER Initiatives News

Second Annual Summit Schedule

Monday, February 10, 2014

4:30 pm – Registration

5:30 pm – Welcome Reception – Sponsored by: PEW Charitable Trusts; Mitsubishi Electric Cooling & Heating

Tuesday, February 11, 2014

8:30 am – Annual Member Meeting (Members Only)
9:30 am – Breakfast and Registration
10:00 am – Welcome by SPEER Chairman of the Board Steve Saunders
10:15 am – 2013 Highlights by SPEER Executive Director Doug Lewin
10:30 am – Keynote Speaker – Sam Rashkin of the Department of Energy's Building Technologies Office

11:30 am – Lunch and Networking Break – Sponsored by: Carlisle HVAC Products

1:00 pm – Plenary Panel

- Net Zero Homes – Chris Little
- Combined Heat & Power / Distributed Generation – Christine Brinker, U.S. DOE Southwest CHP Technical Assistance Partnership
- City Initiatives for Energy Efficiency – Cliff Majersik, Institute for Market Transformation

1:45 pm – Individual Working Sessions on the above topics

3:00 pm – Break

3:30 pm – Plenary Panel

- Building Energy Codes – Jay Murdoch, Owens Corning
- 2030 Districts & Net Zero Buildings and the Role of Water Efficiency – Vincent Martinez, Architecture 2030 and Paul Faeth, CNA
- Air Emissions Policy Driving Additional Efficiency – Ken Colburn, Regulatory Assistance Project

4:15 pm – Individual Working Sessions on the above topics

5:30 pm – Reception – Sponsored by: Austin Energy

Wednesday, February 12, 2014

8:30 am – Keynote Speaker Hal Harvey of Energy Innovation: Policy and Technology, LLC.

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RT @DowChemical: The average #home has over a half mile of gaps and cracks. See where you might be losing #energy ow.ly/tekVp 1 day ago

DOE issues #energyefficiency standard to make our External Power Supplies (adapters/bricks) use less energy. bit.ly/MTkJUa 1 day ago

Check out "Commercial PACE: Raising Confidence in Savings to Ramp Investment & Demand." Starting in 30 minutes! commercialpace.eventbrite.com/?aff=estw 5 days ago

SPEER #energyefficiency Summit starts in 2 weeks. Join @hal_harvey @energy's Sam Rashkin and hundreds more in Austin! eepartnership.org/summit2014 1 week ago

#FF to SPEER Summit sponsors @dowbuilding @BASF @austinenergy @CarlisleHVAC @MitsubishiHVAC @AmChemistry @accausa goo.gl/u0ZtEY 1 week ago

Follow @eepartnership

Follow

9:30 am - Break

10:00 am – Plenary Panel

- Energy Efficiency as a Resource – Robert King, Senior Advisor to SPEER
- Multifamily – Steve Saunders, US-EcoLogic & TexEnergy Solutions
- Performance Contracting – Dub Taylor, Texas State Energy Conservation Office

10:45 am – Individual Working Sessions on the above topics

12:00 pm – Lunch and Networking Break

1:00 pm – Plenary Panel

- Valuing Energy Efficiency: Green MLS / Appraisals – Laura Stukel, CNT Energy
- Consumers and the Smart Grid – Annie Haas, Smart Grid Consumer Collaborative and Barry Haaser, Open ADR Alliance
- Building Investor Confidence – Matt Golden, Investor Confidence Project

1:45 pm – Individual Working Sessions on the above topics

3:00 – 4:00 pm – Wrap-up

Register today!

Return to Summit main page

Return to Summit Working Session topics

*Please note all times and presenters are subject to change without notice.

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SECOND ANNUAL SPEER SUMMIT

AUSTIN, TEXAS ★ FEBRUARY, 11-12, 2014

www.eepartnership.org/summit2014

"SPEER is a partnership of energy efficiency industry stakeholders committed to the accelerated adoption of advanced building systems and energy efficiency products and services in the South-central US."

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Silver

Dow

Powerhouse Solar

US-Eco Logic

TexEnergy Solutions

BASF The Chemical Company

HERO Home Energy Rating Organization

ACCA Quality Assured QA HVAC

American Chemistry Council

SPEER

The South-central Partnership for Energy Efficiency as a Resource

Dear Summit Participants,

Last year, at SPEER's First Annual Summit, we asked you, the participants, to help us identify the initiatives on which we should focus. We were only one year old, fledgling in many ways, and looking for a solid footing. With your help, and with the direction of our members, we have now identified the areas in which we will focus. The organization has grown tremendously and our capacity to accelerate existing efficiency efforts and initiate new ones is high and still growing.

This year, we planned this Summit to help us identify or fine tune initiatives to speed up the pace of adoption in the areas in which we have decided to focus. The agenda is very ambitious, covering everything from building energy codes and net zero homes, to Architecture 2030 Districts, performance contracting, and smart grid. There is something for everyone.

The timing is good to advance the efficiency agenda in Texas and Oklahoma, states with significant growth while many areas of the country are still sluggish. There are challenges in both states that can be met with increased efficiency, but we have to band together, tell the story, communicate the benefits, and begin to accumulate success stories that will inspire and feed more success.

We invite you to join SPEER's current membership and become a part of this effort. And we're thrilled you are with us for our Second Summit. Last year, many of the initiatives identified grew into full fledged efforts and have begun to have an impact on the region. As one example, our keynote speaker last year Ed Mazria encouraged us to pursue 2030 districts in the region and there are now two "emerging districts" in Texas. Similar efforts will emerge from this year's Summit and we hope you'll not only network and listen, but participate and stay involved to see these initiatives through, with us.

Thank you for attending and collaborating with us to move efficiency forward in Texas and Oklahoma.

Sincerely,

Doug Lewin
Executive Director

SPEER Summit • Monday, February 10, 2014

4:30	**Early Registration**
5:30	**Welcome Reception** **5:30 - 6:30pm** **Sponsored by:** THE PEW CHARITABLE TRUSTS; MITSUBISHI ELECTRIC COOLING & HEATING Live Better

SPEER Summit • Tuesday, February 11, 2014

DAY 1

8:30	**SPEER Annual Member Meeting (Members Only)**		
9:30	**Breakfast and Registration**		
10:00	**(Ballroom D-F) Welcome by SPEER Chairman of the Board, Steve Saunders**		
10:15	**(Ballroom D-F) 2013 Highlights by SPEER Executive Director, Doug Lewin**		
10:30	**Ballroom D-F** **Keynote Speaker** **Sam Rashkin, Department of Energy's Building Technologies Office**		
11:30	**Lunch and Networking Break** **Sponsored by:** CARLISLE HVAC PRODUCTS		
1:00	**(Ballroom D-F) Plenary Panel** **Net Zero Homes, CHP & Distributed Generation, City Initiatives**		
1:45	**Room: Ballroom B** **Working Session** *"City Initiatives for Energy Efficiency"*	**Ballroom C** **Working Session** *"Net Zero Homes"*	**SouthPark A & B** **Working Session** *"Combined Heat & Power / Distribtuted Generation"*
3:00	**Networking Break**		
3:30	**(Ballroom D-F) Plenary Panel** **Building Energy Codes, 2030 Districts & Net Zero Buildings, Air Emissions Policy Driving Efficiency**		
4:15	**Room: Ballroom B** **Working Session** *"2030 Districts & Net Zero Buildings"*	**Ballroom C** **Working Session** *"Building Energy Codes"*	**SouthPark A & B** **Working Session** *"Air Emissions Policy Driving Additional Efficiency"*
5:30	**RECEPTION - 5:30 - 6:30pm** **Sponsored By:** AUSTIN ENERGY		

SPEER Summit • Wednesday, February 12, 2014

DAY 2

8:30	**Ballroom D-F** **Keynote Speaker** **Hal Harvey, Energy Innovation: Policy and Technology, LLC**		
9:30	**Networking Break**		
10:00	**(Ballroom D-F) Plenary Panel** **Energy Efficiency as a Resource, Multifamily, Performance Contracting**		
10:45	Room: **Ballroom B** **Working Session** *"Multifamily"*	**Ballroom C** **Working Session** *"Energy Efficency as a Resource"*	**SouthPark A & B** **Working Session** *"Performance Contracting"*
12:00	**Lunch and Networking Break** **Sponsored by:** ENVIRONMENTS FOR Living®		
1:00	**(Ballroom D-F) Plenary Panel** ***Valuing Energy Efficiency: Green MLS / Apparisals, Intelligent Energy Management, Building Investor Confidence***		
1:45	Room: **Ballroom B** **Working Session** *"Building Investor Confidence"*	**Ballroom C** **Working Session** *"Valuing Energy Efficiency: Green MLS / Appraisals"*	**SouthPark A & B** **Working Session** *"Intelligent Energy Management"*
3:00	**Ballroom D-F** **Wrap - up**		
4:00	**Adjourn**		

Sam Rashkin, Chief Architect for the Department of Energy's Buildings Technologies Office

Rashkin's primary role is leading deployment of successful research for new and existing high performance homes. In his prior position, he managed the growth of Energy Star for Homes from its inception in 1996 to more than 8,500 builder partners, over one million labeled homes, and over 25 percent market penetration nationwide. Mr. Rashkin has recently been recognized for his contributions to sustainable housing with the 2012 Hanley Award and authored a new book titled ***"Retooling the U.S. Housing Industry: How It Got Here, Why It's Broken, and How to Fix It".***

Hal Harvey, CEO of Energy Innovation: Policy and Technology, LLC

Harvey founded the ClimateWorks Foundation, a network of 13 regional foundations and expert teams that promote policies to reduce the threat of climate change. He is also the founder and and former President of the Energy Foundation, a joint initiative of six large U.S. Foundations. Harvey is currently a Senior Fellow for Energy and the Environment at the Paulson Institute located at the University of Chicago. Mr. Harvey has served on energy panels appointed by Presidents Bush (41) and Clinton, has published two books and dozens of articles on energy and national security issues. He is President of the Board of Directors of the New-Land Foundation, and Chairman of the Board of MB Financial Corporation, a $10 billion Chicago bank holding company. Earlier in his career, he designed and built solar homes. Few have done as much or had as big an impact in the clean energy world as Harvey.

SPEER Second Annual Summit
Summit Working Sessions

Net Zero Homes
Plenary Presenter: Chris Little

Recent years have seen the development of numerous net zero energy homes and buildings, and even adoption of net zero capable code requirements. As more are built, costs go down and experience and knowledge about methods and materials increase, making more net zero construction possible. What is needed for the industry to embrace net zero, or for customers to begin to demand it? This session will be led by Chris Little and Richard Morgan of Austin Energy Green Building Program.

Combined Heat and Power/Distributed Generation
Plenary Presenter: Christine Brinker, Director, U.S. DOE Southwest CHP Technical Assistance Partnership

Our region is a leader in installed Combined Heat and Power (CHP). The U.S. Department of Energy has been given a goal of increasing by nearly 50% the capacity of CHP, District Energy Systems with CHP, and Waste Heat to Power projects in the U.S. SPEER plays an active role in supporting that effort in Texas and Oklahoma through the U.S. DOE's Southwest CHP Technical Assistance Partnership (CHP TAP), part of a national network of such partnerships. Newly adopted state legislation opens up new opportunities for CHP in Texas, and ERCOT rules support other forms of distributed generation as well. Oklahoma is updating their CHP/DG Interconnection rules, although its overall environment for CHP is much less welcoming. This SPEER working meeting is designed to bring together experts and stakeholders in the region to discuss how to strengthen collaboration and identify new opportunities and resources. The session will be hosted by the U.S. DOE Southwest CHP TAP and will be led by Christine Brinker, Director of the Southwest CHP TAP, along with Paul Cauduro of the Texas CHP Initiative (TXCHPI).

City Initiatives for Energy Efficiency
Plenary Presenter: Cliff Majersik, Institute for Market Transformation

Texas and Oklahoma cities have adopted many advanced initiatives to increase the efficiency of their buildings, their local businesses, and their citizens' homes. Through coordination of these initiatives, and the sharing of expertise within the region, SPEER hopes to encourage even more. Participants in this session will discuss city initiatives such as Better Buildings Challenges, PACE Districts, Building Codes, energy efficiency in municipal buildings, Building Operator Certification, as well as rating and disclosure policies. The session will be led by representatives of the State Energy Conservation Office and Doug Lewin of SPEER.

Building Energy Codes
Plenary Presenter: Jay Murdoch, Owens Corning

Energy codes have pushed the building industry to improve building practices, providing very high levels of efficiency in the built environment. But compliance varies as it is implemented at the local level and often takes a back-seat to other priorities in building departments. There is an additional challenge to document and capture the massive energy savings from code compliance in home rule environments, such as in Texas and Oklahoma. He will touch on SPEER's work facilitating the Texas Energy Code Compliance Collaborative (TECCC). This breakout session will then be led by Jay Murdoch and Chris Herbert of SPEER.

2030 Districts and Net Zero Buildings and the Role of Water Efficiency
Plenary Presenter: Vincent Martinez, Architecture 2030 and Paul Faeth, CNA

This session will focus on establishing and successfully implementing a 2030 district in Dallas, and spreading that success to other cities in the region. Six US cities have embraced the ambitious 2030 challenge to reduce energy and water usage by more than 50% in existing buildings, and to achieve net zero energy for all new construction. Known as 2030

Districts, these privately organized efforts are setting a standard for what is possible. SPEER is encouraging communities in this region to consider establishing 2030 districts, and seeking funding to support these important efforts, so we will discuss the goals, design, and next steps for developing the first one here. This session will be led by Vincent Martinez of Architecture 2030, Jerry Kettler of Facility Performance Associates, Heather Holdridge of Lake Flato and Paul Faeth, Director of Energy, Water and Climate at CNA.

Air Emissions Policy Driving Additional Efficiency
Plenary Presenter: Ken Colburn, Regulatory Assistance Project

Energy efficiency can help reduce emissions of all air pollutants, alleviating air quality compliance issues facing the region. In fact, many states, local governments, and utilities are exploring how to get environmental credit for their efficiency efforts. As carbon emission regulations under the Clean Air Act (section 111(d)) are adopted and enforced, and as many areas strive for attainment with ozone, NOx, SO2, and PM standards, energy efficiency efforts may be among the most cost-effective methods for Texas and Oklahoma to comply. This session will explore the opportunity to address forthcoming environmental regulations through additional investment in energy efficiency, state/local support initiatives, and/or utility incentive programs. This session will be led by David Claridge of Texas A&M Energy Systems Lab and Kate Zerrenner, Environmental Defense Fund.

Energy Efficiency as a Resource
Plenary Presenter: Bob King, Senior Advisor to SPEER

Oklahoma has increased funding for energy efficiency programs while Texas' efficiency acquisition programs are stagnant or in decline. In the last American Council for an Energy Efficient Economy (ACEEE) scorecard, Texas got zero points for its efficiency goal, and has slid from 11th place among the states to 33rd. Despite legislative and regulatory measures adopted to increase efficiency in Texas, incentive program funding is declining, incentive levels have been reduced, and more and more customers are being allowed to opt out altogether. Meanwhile, Oklahoma rose from 47th to 37th over the same period, improving but leaving room for improvement. Interestingly, Texas leaders express real concerns about the ERCOT market's ability to meet peak loads reliably, and are considering significant changes to this electric market. Oklahoma, which has experienced record peaks in recent years, will also be experiencing some significant changes in the SPP market design next year. This session will explore what should be done to expand the acquisition of cost-effective efficiency measures in Oklahoma and Texas. We will discuss whether the most effective route toward this end would be expansion of utility incentive programs, inclusion of energy efficiency in the electric market designs of ERCOT and SPP, a combination of both, or a purely public sector approach. The session will be led by Colin Meehan of Comverge and Bob King of SPEER.

Multifamily
Plenary Presenter: Steve Saunders, US Eco Logic and TexEnergy Solutions

One of the most difficult areas in which to sell energy efficiency retrofits is the multifamily sector. This particular segment of the built environment faces many unique barriers, such as the split benefits of owners and renters, lack of sufficient data to support financing, and return on investment for owners. This session will examine incentive programs which are successfully retrofitting multifamily buildings, and explore the potential for a SPEER initiative to better document multifamily savings and encourage private sector financing of energy efficiency. This breakout session will be led by SPEER Chairman, Steve Saunders of Tex Energy Solutions and US EcoLogic, David Wolpa of Energy Savvy and Fred Yebra of Austin Energy.

Performance Contracting
Plenary Presenter: Eddy Trevino, Texas State Energy Conservation Office (SECO)

This session will be focused on developing strategies to increase the use of performance contracting in Texas and Oklahoma, and to stimulate more energy efficiency activity among governmental entities. Performance contracting is mostly used in the public sector, where identifying money to invest in energy efficiency—even when it pays for itself—

may require legislative appropriations, were this creative financing mechanism not available. The practice has evolved over the years and SPEER is working with the states of Texas and Oklahoma to reinvigorate efforts to achieve greater efficiency, and reduce revenue requirements for hard-pressed governmental entities, by using this approach. The session will be lead by Eddy Trevino, Project Manager at Texas SECO.

Valuing Energy Efficiency: Green MLS and Appraisal Issues
Plenary Presenter: Laura Stukel, CNT Energy

Often, when homeowners make improvements to an existing house, the most important aspects of home performance – including safety, comfort, energy efficiency, durability, and environmental impact – are invisible during key steps of any home sale or refinance transaction. One result is that energy efficiency investments are overlooked or inaccurately valued at the time of a home sale. The practice of having clear documentation of home energy upgrades supports improved marketing of these high-performance homes in a Multiple Listing Services (MLS). This in turn, creates more access to the "comps" or comparable properties appraisers need for their opinion of value on these homes. This session will focus on how to bring the practice to our region that link these key tasks and actors and begins to reflect the real value of high performance homes. This session will be led by Laura Stukel of CNT Energy, Beth Johnson of Keller Williams Realty and CT Loyd of Texas Home Energy Rating Organization.

Consumers and the Smart Grid
Plenary Presenter: Annie Haas, Smart Grid Consumer Collaborative and Barry Haaser, Open ADR Alliance

Texas has deployed smart meters to nearly every customer in the competitive regions of the state, covering nearly 80% of the state's consumption. Yet the promise of the smart grid and smart energy technology is far from fully realized. Oklahoma too has begun to adopt smart grid technologies. There is push-back against the smart meters from small but vocal minority, however, which has led the smart grid news for too long. SPEER can team with the Smart Grid Consumer Collaborative to help educate leaders and consumers about the potential benefits of smart energy management, and the role of technology to further energy efficiency efforts. In addition, widespread adoption of innovative services will require a plug-and-play environment. SPEER wants to help application developers use the smart grid as a platform for innovation, while encouraging reliance on evolving standards and accelerating the advent of interoperability. This session will be used to discuss how we can all work together to help launch these initiatives and facilitate private sector innovation. The session will be led by Kenneth Van Meter of Intelligent Energy Systems.

Building Investor Confidence
Plenary Presenter: Matt Golden, Investor Confidence Project

One of the biggest barriers to efficiency of all kinds is the upfront capital it requires. How can the energy efficiency industry improve access to capital? SPEER has become a regional ally for the Investor Confidence Project (ICP), an Environmental Defense Fund project. Developing and adopting common, acceptable standards for predicting, monitoring, and verifying energy efficiency costs and savings will provide the underpinning of success for PACE, performance contracting, WHEEL, on bill repayment or financing, and other mechanisms of project finance. The goal of this workshop will be to help deepen the collaboration between this important national effort and our regional efforts to improve access to financing for energy efficiency. This session will be led by Matt Golden of the Investor Confidence Project and Matt Worth of Noesis Energy.

A Special Thank You to our Members

6.4.6.5 Other

The following pages are meeting notes, agendas, and summaries from the multiple meetings from 2014.

Building Energy Codes Program

Building Energy Codes

BECP Stakeholder Meeting

The U.S. Department of Energy will hold a public meeting to present and receive comments on overall program direction and in anticipation of its future residential code development activities.

- *Date & Time*: Thursday, April 24, 2014 (8:00 a.m. to 3:30 p.m.)
- *Location*: DoubleTree Hotel – Crystal City, 300 Army Navy Drive, Arlington, Virginia

Participation

To participate in the meeting,.please submit an official request to BuildingEnergyCodes@ee.doe.gov , including attendee name and organizational affiliation. ***Note that space is limited and advanced registration is required.*** Requests will be honored in the order they are received.

Public Comments

Comments from the public will be accepted at the meeting. Additionally, following the meeting, a docket will be made available to accept public comment on topics discussed at the meeting. Official comments following the meeting must be submitted by **May 30, 2014**. Interested parties may submit comments by following the instructions outlined in the official meeting Notice published in the *Federal Register.*

Agenda

DOE will present an overview of current program activities and organization in support of its mission to achieve energy savings through building energy codes. In addition, DOE seeks stakeholder input in anticipation of future residential code development activities.

8:00 a.m. – 12:00 p.m. Morning Session: General Program Input

- Welcome & Opening Remarks
- Introductions
- Statutory Basis for DOE Activities
- Overview of Current Program Activities
- Discussion of Key Topics
  - RES*check* & COM*check* Compliance Software Policy
  - Compliance Funding Opportunity Announcement (FOA)
  - Federal Advisory Committee (FACA)
  - Building Energy Codes Summit
- Participant Feedback
- Closing Remarks

1:00 p.m. – 3:30 p.m. Afternoon Session: Residential Code Development

- Energy Code Formats and Compliance Paths
- DOE Role in Residential Code Development
- Energy Efficiency in the 2018 IECC

DOE will solicit discussion and feedback surrounding information presented. A public docket is also available and will contain a summary of the meeting along with all associated public comments. The *Regulations.gov* website contains instructions on how to access all documents in the docket, including public comments received.

Additional information and materials will be added as they are made available.

2014 GROUP C COMMITTEE ACTION HEARING SCHEDULE

April 27 – May 3, 2014

Memphis Cook Convention Center, Memphis, TN

Hearings will start at 1:00 pm on Sunday, April 27th. Prior to the hearings the Building Official, Fire Service, PMG Official and Sustainability Membership Councils will be holding meetings during the Saturday/Sunday morning time period. Be sure to consult the Membership Councils webpage for details as they become available.

The code change volume is such that a single track will be utilized. The IgCC – General hearing will start at 1:00 pm on Sunday, April 27th.The IgCC – Energy/Water hearing will start no earlier than 1:00 pm on Wednesday, April 30th, as indicated on the schedule. The schedule anticipates that the hearings will finish by 2:00 pm on Saturday, May 3rd.

Sunday April 27	Monday April 28	Tuesday April 29	Wednesday April 30	Thursday May 1	Friday May 2	Saturday May 3
Start 1 pm	Start 8 am	Start 8 am	Start 8 am	Start 8 am	Start 8 am	Start 8 am
IgCC - General	IgCC - General	IgCC - General	IgCC – General IgCC – Energy/Water (Start no earlier than 1 pm)	IgCC – Energy/Water	IgCC – Energy/Water	IgCC – Energy/Water
End 7 pm	End 7 pm	End 7 pm	End 7 pm	End 7 pm	End 7 pm	Finish 2 pm

Notes:

1. IgCC General: Chapters 1, 3 – 5, 8 – Appendices. Be sure to consult the hearing order for code changes to be heard by the IgCC – Energy/Water code committee.
2. IgCC- Energy/Water: Chapters 6 & 7. Be sure to consult the hearing order for code changes to be heard by the IgCC – General code committee.
3. Consult the hearing order to determine which committee will consider code changes to the definitions in Chapter 2.
4. Hearing times may be modified at the discretion of the Chairman.
5. Breaks will be announced. A lunch break is planned. A dinner break is not planned. The hearings are scheduled to adjourn at the dinner break and resume the next day, unless necessary to complete the agenda.
6. Due to uncertainties in hearing progress, the start time indicated as "start no earlier than 1 pm" is conservatively estimated and is not intended to be scheduled hearing progress target.

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Did not attend Sunday or Monday Sessions
Saturday Session was cancelled

wbcsd buildings

Guidance for the interview

Energy Efficiency in Buildings Laboratory (EEB Lab.)

Interviews on October 8, 2014

Venue: Thompson & Knight LLP, Three Allen Center, 333 Clay Street, Suite 3300
Houston, Texas 77002-4499

The 2 pager of the EEB Laboratory is available here.

1. Objectives of the EEB Laboratory

- **Understand the "state of play"** of energy efficiency in buildings in the Houston market – what are the drivers and barriers, from the viewpoint of practitioners in the building market
- **Generate insights on how barriers can be overcome**, in the form of awareness raising / business case, market incentives, regulatory approaches, etc.
- **Encourage building sector stakeholders to drive change** within their own operational scope as well as through collaboration along the value chain.

Deliverable
An action plan for the Houston market for energy efficient properties that motivated local partners will commit to implement.

2. Process of the EEB Lab.

- Oct.8 - A panel of experts[1] will interview approx. 40 building market stakeholders.
- Oct. 9 - The panel of experts will interpret and consolidate the interviews; they will also facilitate dialogue across a series of roundtables (*see below Interview discussion themes*) to analyze the perceived and known barriers for creating energy efficiency marketplaces around central themes that have been developed by the EEB2.0 project.
- Oct. 10 - Plenary session will conclude the Lab. with the feedback on the actions, commitments and next steps defined during the lab.

Interview discussion themes (also topics for Roundtables on October 9)

- **Increasing Value to Stakeholders through Energy Efficiency**
  The benefits of EEB investments for each category of building market stakeholders can be substantiated. This roundtable will seek to understand how to develop, communicate and reach a comprehensive value proposition that provides a proportional benefit to all stakeholders.

[1] WBCSD EEB members (UTC, Schneider Electric, AGC, Lafarge, Siemens) and local partners (architend, ALC, C40, CenterPoint, City of Houston, EDF, Gensler, HARC, Hines, IMT, Keeping PACE, NRG, Rice University, Shell, SPEER, Thompson and Knight LLP, ULI Houston, US BCSD, USGBC)

2014 Central Texas Environmental Summit
"Collaboration Along the Corridor"
A Program of the TCEQ

Agenda
December 8, 2014
Bastrop Convention Center, Bastrop, TX

Registration/Continental Breakfast ....8:00–8:30 a.m.

Introduction ....8:30–8:35 a.m.

Brian Christian, Director, Environmental Assistance Division, Texas Commission on Environmental Quality (TCEQ)

Welcome and Opening Remarks..8:35–9:30 a.m.

- *The Honorable Kirk Watson, Texas Senate, District 14*
- *Bryan W. Shaw, Ph.D., P.E., TCEQ Chairman*
- *Toby Baker, TCEQ Commissioner*
- *Zak Covar, TCEQ Commissioner*

Open House Exhibits..9:30–10:00 a.m.

Keynote Speakers..10:00–11:30 a.m.

Texas Water Update: Drought, Water Conservation, and State's Role

- *L'Oreal Stepney, P.E., Deputy Director, TCEQ Office of Water*
- *Ramiro Garcia, Deputy Director, TCEQ Office of Compliance and Enforcement*

Central Texas Air Quality Update

- *Steve Hagle, Deputy Director, TCEQ Office of Air*

Open House Exhibits ....11:30–1:30 p.m.

Exhibitors: *TCEQ Office of Water, Air, Waste, Small Business & Local Government Assistance, and Take Care of Texas, Railroad Commission, Texas Parks & Wildlife, Guadalupe-Blanco River Authority, Plum Creek Conservation District, Capital Area Council of Government, Texas AgriLife Extension, Texas Department of Agriculture, Texas Water Development Board, U.S. Geological Survey, Groundwater Protection Committee*

Note: Subject-matter experts will staff exhibits and can answer specific technical questions related to keynote speeches as well as other regulatory issues.

Home Innovation
RESEARCH LABS

National Green Building Standard™
2015 UPDATE

Consensus Committee and Task Groups Meeting
Agenda

June 9-10, 2014

National Housing Center | 1201 15th Street, NW | Washington, DC 20005 | 202-266-8200

Purpose: *Orient all participants on the 2015 National Green Building Standard update process, initiate Task Group review of the proposed changes, and discuss options for direction on several key areas of the Standard*

Monday, June 9

GENERAL SESSION (8:30 am-12:00 pm)

1.0 Welcome

2.0 Introductions

3.0 Approve Agenda

4.0 Overview and Orientation

a. Background on the National Green Building Standard (NGBS)
b. ANSI Standard Development Process
c. Consensus Committee Charge
d. Development Schedule
e. Proposed Changes
f. Experience with Implementation of the NGBS
g. Task Groups

5.0 Questions and Discussion

LUNCH (12:00 pm-1:00 pm) – provided (for CC and TG members)

TASK GROUP SESSIONS (1:00 pm-5:00 pm)

Tuesday, June 10

GENERAL SESSION (8:00 am-10:00 am)

TASK GROUP SESSIONS (10:00 am-11:30 am)

LUNCH BREAK (11:30 am-1:00 pm) – off site

WORKING LUNCH for TG Chairs and Alternates - Provided

TASK GROUP SESSIONS (1:00 pm-3:00 pm)

April 18, 2014

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Proposed DFW SIP Revisions for the 2008 Eight-Hour Ozone NAAQS

12/10/2014

On December 10, 2014, the commission approved proposal of revisions to the Texas SIP for the Dallas-Fort Worth (DFW) nonattainment area for the 2008 eight-hour ozone national ambient air quality standard (NAAQS): the DFW Attainment Demonstration (AD) SIP Revision for the 2008 Eight-Hour Ozone NAAQS (Non-Rule Project No. 2013-015-SIP-NR) and the DFW Reasonable Further Progress (RFP) SIP Revision for the 2008 Eight-Hour Ozone NAAQS (Non-Rule Project No. 2013-014-SIP-NR). The proposed AD SIP revision would incorporate proposed revisions to 30 Texas Administrative Code Chapters 101, 115, and 117.

- Proposed Attainment Demonstration SIP Revision
- Proposed Reasonable Further Progress SIP Revision

Two public hearings will be held on these proposed SIP revisions: in Arlington on January 15, 2015 at 6:30 p.m. in the City of Arlington Council Chamber at the Arlington Municipal Building located at 101 W. Abram Street; and in Austin on January 22, 2015 at 10:00 a.m. in Building E, Room 201S, at the commission's central office located at 12100 Park 35 Circle. The public comment period is from December 26, 2014 through January 30, 2015.

For additional information, please visit the Dallas-Fort Worth: Latest Ozone Planning Activities Web page.

You are subscribed to SIP Hot Topics (State Implementation Plan) for the Texas Commission on Environmental Quality. This information has recently been updated, and is now available.

BLUE BONNET CHAPTER ASSOCIATION

AGENDA

MEETING DATE: **Thursday, December 18, 2014**

TIME: **Meeting starts at 6:30 please try to arrive early so we can start on time.**

LOCATION: **Rudy's Country Store & Bar-B-Q, 2510 Circle Rd, Waco**

1. **CALL TO ORDER**
   A. Bobby Horner, Chapter President
   Prayer / Pledge

2. **New Members ?**

3. **GUEST SPEAKER:**
   Barry Lightfoot – Robinson Code Officer speaking on "Sovereign Citizen" with Tracy Lankford and Bob Cervenka

4. **APPROVE / DISAPPROVE MINUTES:**

5. **TREASURERS REPORT:**

6. **OLD BUSINESS:**
   A. By-Law updates
   B. Region 10 membership
   C. Annual Banquet Update
   D. Member of the Year

7. **NEW BUSINESS:**
   A. Election of new officers
   B. Future Scholarship Plans
   C. Electrical Class in Killeen
   D. Any other topic as needed

8. **ADJOURN**

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

Tammy Persky

From: Sandra Barba <SBarba@nctcog.org>
Sent: Tuesday, February 04, 2014 5:27 PM
To: byazdani@tamu.edu
Subject: Invitation to Solar Ready II Kick-Off and Registration for "Solar 101" Webinar

Importance: High

!!!** MARK YOUR CALENDAR **!!!

The **Solar Ready II Kick-Off** meeting is scheduled for:

On: Thursday, March 6, 2014
At: 1:30 p.m.-4:00 p.m.
In: Transportation Council Room
NCTCOG Offices, CPII
616 Six Flags Drive
Arlington, Texas 76011

Local Government officials, planners, utility representatives, solar industry experts, and interested parties, please join NCTCOG to kick-off the Solar Ready II project for the DFW region. Topics to be discussed include:

- Establishing solar obstacles and goals in the DFW Region;
- Prioritizing areas of focus; and
- Implementing strategies to streamline solar implementation.

If you would like more information about this project, please visit the following website for details and updates: www.nctcog.org/solar. In addition, a "Solar 101" webinar will also be hosted on Tuesday, February 18th, at 2 p.m. This webinar will provide an introduction to available solar options, as well as details on understanding the technology and design considerations. It may be beneficial to see this information before the March 6th Kick-Off meeting. To register for this webinar, please click here. Due to reservation limitations, if more than one person from your office is planning to attend, please view the webinar together.

An agenda will be provided as the kick-off meeting date draws closer. We hope your schedule will allow you to attend.

Sincerely,

Sandra Barba

Environment and Development Planner III
North Central Texas Council of Governments
T 817.608.2368

Texas Energy Manager Association
Brazos Valley Chapter Agenda

TAMU Energy System Lab Office Building
402 Harvey Mitchell Pkwy S, College Station, TX
August 14, 2014

1) Call to order
2) Chapter business
   a. Election of Chapter Vice President
   b. Membership Committee update
   c. Future meeting locations
3) Chillers presentation by Scott Steffen with Hunton Trane
4) Networking
5) Closing Remarks
6) Adjourn

NEWPORT VENTURES

2014 ECCC NYS Training for Code Officials
Preliminary Meeting
March 19, 2014
RIT Inn and Conference Center
Attendees: Liza Bowles, Margo Thompson, Jim Burton, Scott Copp, Shirley Ellis

Time: Wednesday, March 19: ~~3~~ 1:00 pm -5 pm

I. Review course topics, number of sessions to be delivered, targeted audience size
   a. 226 sessions: 210 standard sessions (15-40 attendees), 16 large sessions (> 40 attendees)

II. Discuss approaches to marketing and successfully delivering 226 sessions in three-year timeframe

III. Discuss roles of Newport, TY Lin, and ICC in curriculum development, review, scheduling, and delivery

IV. Discuss process of internal team review of curriculum and review and approval by NYSERDA and DOS

V. Action plan for preliminary activities, marketing strategies, templates, flyers

VI. Update, if any, on NYS Energy Code rule-making and adoption schedule

22 Jay Street
Schenectady, New York 12305
(518) 377-9410

Agenda

Feasibility Chapter of the Technology Innovation Guide SME's Meeting
Wednesday March 19, 2014
Evening introductory discussion available for any attendees already in town

Thursday March 20, 2014
8:00 AM – 2:00 PM

Location:
RIT Inn and Conference Center
5257 W Henrietta Rd, West Henrietta, NY 14586

Objectives:

- *Identify essential content for the Feasibility section of the Guide*
- *Discuss and identify the best structure/format for the Guide*
- *Identify available resources for end users*

8-8:15	**Welcome and Introductions**
8:15-8:30	**The Guide - Overview**
8:30-9:30	**Identify Important Feasibility Content**
9:30-9:45	**Break**
9:45-10:45	**Content (continue discussion)- Elements of Feasbility**
10:45-11:30	**Exercises-** • **Triggers for Guide Use** • **Discussion of Building Owner/Manager Perspective**
11:30-12:30	**Break for Lunch**
12:30-1:45	**Revisit Tech Guide Layout**
1:45-2:00	**Wrap-up**

6.4.7 Published Papers, Theses, etc.

6.4.7.1 Theses and Dissertations.

The following theses and dissertations were published in 2014 incorporating work related to the Texas Emissions Reduction Plan (TERP).

Jong-hyo Choi, "Analysis of the Impact if Using Improved Multi-layer Window Models for Code-Compliant Residential Building Energy Simulation in Texas,"M. S., Department of Architecture, December 2014.

> In most urban areas of United States, newly constructed buildings have to comply with building codes from the International Code Council (ICC) or from the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE). Windows are a crucial building component that affects a building's heating and cooling energy. Currently, there are two window modeling methods, the Transmittance, Absorbance and Reflectance (TAR) method, and the Multi-Layer Window (MLW) method. MLW method is more accurate than the TAR method, because it includes improved equations that better represent the actual window properties. However, at present both building codes (i.e., ICC or ASHRAE) do not use the MLW method to model the windows in a building. Therefore, there is a need to analyze annual building energy simulation results differences between the two different window modeling methods applied building model, in order for code officials to better determine the impact of the code change. This study analyzed both window modeling methods with the International Energy Conservation Code (IECC) 2009 and the IECC 2012 conditions for climate zones in Texas. The results show that there are significant differences in annual building energy end-use, heating and cooling energy use, and peak heating and cooling loads for identical code-compliant houses using the two different window models. In addition, such differences become larger as the building energy code improves, from the IECC 2009 to the IECC 2012. Suggestions for future work are also included for other climate zones, different building footprints, and other various building operating schedules.
>
> Link: http://oaktrust.library.tamu.edu/handle/1969.1/153805

Kee Han Kim, "Development of an Improved Methodology for Analyzing Existing Single-FamilyResidential Energy Use," Department of Architecture, August 2014.

> The purpose of this study was to develop an improved methodology for analyzing the energy use from existing single-family. The overall goal of this work is to make home energy audits more effective by providing homeowners and energy auditors with an improved and reliable tool to identify over-consumption in a residence by showing where the energy is inefficiently being used in the residence when compared to buildings of similar size in similar climates. Such a tool can be used by auditors to quickly assess the problems in the building, determine accurately what needs to be fixed and to provide useful guidance before arriving on-site. In order to accomplish this, an improved methodology for an easy-to-use, semi-automatic calibrated simulation that can determine potential energy conservation measures for Single-Familyresidences was developed and tested. As a first step, an easy-to-use simulation which can be used by homeowners who are not familiar with residential building energy analysis was developed. Users of this easy-to-use simulation are only required to input basic information of their houses such as construction year, size and location of the house, with the other inputs for building energy simulation being filled-in automatically using a newly established statistical house information database for Texas. Next, the easy-to-use simulation is calibrated using the semi-automatic calibrated simulation methodology that matches the simulated and actual utility electricity and natural gas use of the house. In order to develop this methodology, a sensitivity analysis was performed using a three-parameter change-point regression model that regresses the energy use against ambient temperature. The analysis showed the most significant simulation parameters that affect residential energy use that are decomposed into the baseload, the change-point temperature, and the cooling or heating slope. These parameters were used to calibrate each part of the building energy use against the actual monthly electricity and natural gas use. In the next step, the calibrated simulation parameters were compared with similar input parameters of a standard house that is compliant with the

2009 IECC to determine the differences in the parameters and give guidance about what characteristics of the house were below the energy efficient characteristics of the 2009 IECC-compliant house. Using this comparison, the less energy-efficient parameters of the house were determined as potential energy conservation measures for a future retrofit, and finally, the most cost effective measures were determined through a simple pay-back cost analysis. In order to verify the methodology, the both methods were tested on actual residence and the results were compared to determine if both procedures identified the same potential energy conservation measures. Once the procedure was demonstrated on the first case-study house, two additional houses were also tested to verify how well the procedure worked. The comparisons showed that the easy-to-use and the actual simulations resulted in the same potential energy conservation measures with the similar pay-back period, and thus was verified that the easy-to-use simulation can be used for a home energy audit procedure with reliability.

Link: http://oaktrust.library.tamu.edu/handle/1969.1/153252

Sung Lok Do, “Development and Application of a Ground-Coupled Heat Pump Simulation Model for Residential Code-Compliant Simulation in Texas," Department of Architecture, May 2014.

The intent of this study was to improve residential energy efficiency in Texas by developing an improved tool for home builders and code officers to use for evaluating their designs. It was achieved by developing a new ground-coupled heat pump (GCHP) model for residential systems to be used with the DOE-2.1e simulation program. To accomplish this, this study investigated closed-loop ground heat exchanger (GHX) models, including horizontal, surface water, and vertical GHX models. This study selected a case-study house in Texas which has a custom-built GHX using a combination of a horizontal GHX and a surface water GHX. This study developed a custom-built GHX model for the case-study house to calculate the entering water temperatures (EWTs). The custom-built GHX model was then validated using the measured EWT data from the case-study house. The results showed the monthly average EWTs differences between the measured and calculated EWTs were observed to be about 2.2 F during the heating season and about 3.2 F during the cooling season. Therefore, this study concluded the slightly over-estimated EWTs were acceptable considering the other uncertainties of the field conditions. In addition, a vertical GHX DOE-2.1e model was developed by using the DOE-2.1e FUNCTION command. The g-function values approximated in this study was used for the vertical GHX DOE-2.1e model. To develop a new DOE-2.1e GCHP simulation model, this study then incorporated the vertical GHX DOE-2.1e input FUNCTION within an air-source heat pump (ASHP) simulation module by modifying existing DOE-2 calculation algorithms. To evaluate the new DOE-2.1e GCHP model, this study also developed simplified residential ASHP/GCHP base-case models for Houston and Dallas, using DOE-2.1e, eQUEST, IC3, REM/Rate, and EnergyGauge. The DOE-2.1e simulation results were then compared against the other programs to verify the accuracy of the new DOE-2.1e GCHP model. The comparison showed good agreement in the total site energy use within 3.3 MMBtu/yr (5.3%) differences. In addition, the simulation results showed the GCHP system benefits: for the total site energy savings, 9.7% in Houston and 13.1% in Dallas, and for the heating plus cooling energy savings, 27.3% in Houston and 35.3% in Dallas

Link: http://oaktrust.library.tamu.edu/handle/1969.1/152691

Amy Kim, "A Comparative Analysis of Predicting Energy Savings From Energy Service Projects," Department of Civil Engineering, May 2014.

Implementation of energy service projects continue to increase as building owners are faced with higher utility bills, rigorous environmental regulations, and shrinking capital allocation for such projects. Different techniques and guidelines are available to select and quantify energy service projects. These methods range from various Technical reference manuals (TRMs) developed by state agencies in conjunction with energy consultants to standard protocols developed by energy professional organizations. All of these methods require gathering or estimating representative input variables, with various approaches to data collection that vary from stipulation to measurement-based values. The methods to quantify the savings range widely from engineering algorithms to as-built calibrated whole-building energy simulation models. In this study, a comparison is made between the engineering algorithms supported by many TRMs and a more accurate as-built calibrated whole-building energy simulation model. The methods to performing the comparison included identifying industry methods through literature reviews, expert interviews, a desk audit of a typical utility assessment report, and constructing an as-built calibrated whole-building energy simulation model of a well-instrumented, large office building near the Texas A&M University campus. Lighting and lighting control energy conservation measures (ECMs) were selected to demonstrate the methodology. As part of the process of constructing the simulation model, a data collection protocol was also created. The data collection protocol included gathering building and site specific information including sub-hourly measured energy consumption data and measured climatic data for the baseline year. The study results showed that the industry methods of quantifying the total energy savings for lighting and lighting control ECMs were consistently under-reporting the savings as compared to the calibrated as-built whole-building energy simulation model. In particular, the breakdown of savings was inconsistent between the various industry methods that are currently in use. The differences were perceived to be location specific and weather driven and also included agreements with the local utility companies to quantify the demand savings. Finally, the study results also indicated that the current industry methods could be significantly improved by measuring the occupancy schedule and indoor temperature.

Link: http://oaktrust.library.tamu.edu/handle/1969.1/152649

6.4.7.2 Published Papers

The following papers were published in 2014 incorporating work related to the Texas Emissions Reduction Plan (TERP).

Baltazar, J.C.; Mao, C.; Haberl, J. S., June 2014 “Verification of Energy Savings from the Implementation of the Residential Building Codes in Texas”, ASHRAE Conference paper, Seattle..

The International Energy Conservation Code (IECC) was adopted in 2001 by the State of Texas to help reduce annual heating and cooling loads in residential buildings. After 2006, the Texas Legislature required that the IECC 2006 be adopted and requested our Laboratory to track the annual energy savings and NOx emission reductions from the implementation of the Texas Building Energy Performance Standards (TBEPS).This paper discusses the verification of the energy savings from the implementation of the IECC 2000/2001 and IECC 2006 building codes in Texas using a utility bill analysis methodology. In the methodology, a sample of analyzed houses was carefully selected and separated into three groups of Single-Familyresidential houses that were constructed by the same builder, with very similar construction types. Each group was built in different period to account for the impact of the different adopted codes. This study shows that the electricity savings from the application of the2000/2001 IECC and the 2006 IECC are approximately 20% and 19%, respectively when compared to houses built to prior standards.

Link: http://www.techstreet.com/ashrae/products/1879336#jumps

Kim, J. B.; Jeong, W.; Clayton, M., Haberl, J. S.; Yan, W., 2015. “Developing a Physical BIM Library for Building Thermal Energy Simulation,” Automation in Construction, Elsevier. Volume 50.

Insufficient interoperability resulting from complex data exchange between architectural design and building energy simulation prevents the efficient use of energy performance analyses in the early design stage. This paper presents the development of a Modelica library for Building Information

Modeling (BIM)-based building energy simulation (ModelicaBIM library) using an Object-Oriented Physical Modeling (OOPM) approach and Modelica, an equation-based OOPM language. By using the ModelicaBIM library, our project investigates system interfaces between BIM and energy simulation, which can perform semi-automatic translation from the building models in BIM to building energy modeling (BEM) using a BIM's authoring tool's Application Programming Interface (API).The ModelicaBIM library consists of OOPM-based BIM classes and OOPM-based BIM structure. OOPM-based BIM classes represent building component information. OOPM-based BIM structure consists of test case models that demonstrate (i) how building information in BIM can be transformed to OOPM and (ii) how design operations in BIM, such as changing a building geometry and editing building components, can be translated into BEM. A case study for simulation result comparisons has been conducted using (i) OOPM-based BIM models in the ModelicaBIM library and (ii) LBNL Modelica Buildings library (a Modelica-based building thermal simulation library developed by Lawrence Berkeley National Laboratory). Our implementation shows that the ModelicaBIM library enables (i) objects in BIM to be translated into the OOPM-based energy models and (ii) existing OOPM library to be utilized as a simulation solver for BIM-based energy simulation.

Link: http://www.researchgate.net/publication/268883461_Developing_a_physical_BIM_library_for_building_thermal_energy_simulation

Kota, S., Haberl, J. S., Clayton, M.; Yan, W., 2014. "Building Information Modeling (BIM)-Based Daylighting Simulation and Analysis," Energy and Buildings, Elsevier. Volume 81.

Daylighting is an important aspect in designing high performance buildings. Many simulation tools have been developed to study the daylighting performance of buildings. These tools primarily use CAD environments for creating architectural models, which are then converted into daylighting models to run on the daylighting simulation engines. Once the architect defines the architectural model in CAD, a simulation expert creates the simulation input file to perform daylighting analysis. Each tool has its own rules that the architect and the engineer have to follow to prepare the simulation input files, and the complexity depends on the tools. Currently, Building Information Modeling (BIM) is widely used in the AECO industries and BIM models are used as a means of exchanging data among different professionals involved in the design and construction of buildings. The present paper discusses the use of BIM for building performance simulations and mainly focuses on how daylighting analysis can be incorporated into a BIM environment, and what challenges and benefits exist in the process of integrating BIM with daylighting simulation tools. The paper presents the development and validation of a prototype to integrate the BIM tool, Revit with the daylighting simulation tools, Radiance and DAYSIM.

Link: http://www.sciencedirect.com/science/article/pii/S0378778814005258

Jeong, W.; Kim, J. B.; Claytin, M. J.; Haberl, J. S.; Yan, W., 2014. "Translating Building Information Modeling to Building Energy Modeling Using Model View Definition," The Scientific World Journal, Vol 2014, Article ID 638276.

This paper presents a new approach to translate between Building Information Modeling (BIM) and Building Energy Modeling (BEM) that uses Modelica, an object-oriented declarative, equation-based simulation environment. The approach (BIM2BEM) has been developed using a data modeling method to enable seamless model translations of building geometry, materials, and topology. Using data modeling, we created a Model View Definition (MVD) consisting of a process model and a class diagram. The process model demonstrates object-mapping between BIM and Modelica-based BEM (ModelicaBEM) and facilitates the definition of required information during model translations. The class diagram represents the information and object relationships to produce a class package intermediate between the BIM and BEM. The implementation of the intermediate class package enables system interface (Revit2Modelica) development for automatic BIM data translation into ModelicaBEM. In order to demonstrate and validate our approach, simulation result comparisons have been conducted via three test cases using (1) the BIM-based Modelica models generated from Revit2Modelica and (2) BEM models manually created using LBNL Modelica Buildings library. Our implementation shows that BIM2BEM (1) enables BIM models to be translated into ModelicaBEM models, (2) enables system interface development based on the MVD for thermal simulation, and (3) facilitates the reuse of original BIM data into building energy simulation without an import/export process.

Link: http://www.hindawi.com/journals/tswj/2014/638276/

Kim, H.; Haberl, J. S., 2014. "Development and Application of Weather-normalized Monthly Building Water Use Model," Energy and Buildings, Elsevier. Volume 69.

This study proposes a new monthly whole-building water use regression model for weather-normalized water performance evaluation: a combination three-parameter multi-variable regression (3-P MVR) cooling model using outdoor temperature in a change-point model and precipitation amount/occurrence as an additional independent variable. To select appropriate weather variables influencing a building's water use, previous studies on the water use models at the municipal level were reviewed. The selected weather variables were then tested using the multi-year monthly water use data collected from the two separate water meters (i.e., the main building meter for indoor water use; and sprinkler meter for landscape water use) of the case-study office building in central TX. The proposed water use model is based on twelve monthly, building-level water use data, which should be available for most buildings that are supplied water from a municipal provider. This model allows a year-to-year, weather-normalized comparison for self-referencing as well as savings calculations from various water conservation measures. This new method will reduce uncertainty about reported water savings from water conservation measures applied and improve the credibility of water conservation programs

Link: http://www.sciencedirect.com/science/article/pii/S0378778813006907?np=y

Mukhopadhyay, J., Haberl. 2014. "Reducing Energy Consumption in Grocery Stores" Energy Efficiency Measures for Grocery Stores", *ASHRAE Transactions-Research,* Vol. 120, Pt. 1 (January).

According to the Commercial Building Energy Consumption Survey (CBECS) data, the energy use intensity (EUI) for a typical grocery store is approximately 179 kBtu/[ft.sup.2] (564.6 kWh/[m.sup.2]) per year, which is almost double than that of a typical office building (US EIA 2012). These numbers indicate that energy consumption in grocery stores needs to be further researched for potential areas where it can be reduced.
A survey of literature for efficiency measures to reduce energy (or energy efficiency measures [EEMs]) in grocery stores concluded that the current measures for reducing energy consumption in a conventional grocery store focus on reducing energy consumption in individual building components in the refrigeration system, the lighting system, the HVAC system, and the building envelope system. Whole-building energy consumption reduction and the potential interaction of these building components in terms of energy consumption and energy savings in grocery stores was not appropriately addressed. The literature review identified only one study that provides an analysis on the whole-building energy consumption in the grocery store The study performed at the National Renewable Energy Laboratory (NREL) described 50% whole-building energy savings in a grocery store prototype across the eight major climate zones in the United States (Leach et al. 2009). The NREL study utilized a simulation model of a grocery store compiled using specifications in the ASHRAE Standard 90.1-2004 (ASHRAE

2004a). The NREL study however, did not address several issues. First, the report did not provide the user with sufficient documented evidence regarding the calibration of the simulation model used for the analysis. Second, several potential technologies, such as alternative HVAC systems, solar thermal technologies, advanced humidity control, strategies to use waste heat from equipment, tri-generation technologies, multiple compressor types, and under-case HVAC return air systems were omitted due to modeling constraints and a lack of reliable input data.

Link: http://www.thefreelibrary.com/

6.5 Solar Test Bench

This section introduces the activities that were carried out to STB during the calendar year of 2014, and the activities summary is listed as follow:

- Regular maintenance
- Weekly report.
- Multy-Pyranometer Array Research

6.5.1 Solar Test Bench Setup

The whole STB setup has been detail described in the annual report for calendar year 2010. Thus, no more description about the setup is stated here, but the table for the sensor summary (see Table 34) is updated due to sensor changes. This table gives the sensor name, make, model and serial number along with the multiplier, offset and unit.

Table 34. List of the sensors updated to the end of 2014

Index Number	Sensor Name	Make	Model	Serial Number	Multiplier	Offset	Unit
1	TOA/RH[1]	Vaisala	HMP45A	D2430006	0.18	-40	° F
					0.10	NA	%
2	TOA/RH[2]	Vaisala	HMP155A	G3220004	0.18	-40	° F
					0.10	NA	%
3	WS/WD[1]	Met One	034B	H4735	1.79	0.629	MPH
					712	NA	Degree
4	WS/WD[2]	Met One	034B	M5048	1.79	0.629	MPH
					712	NA	Degree
5	LICOR[3]	Licor	Li-cor	PY15L25	75.59	NA	W/m^2
6	LICOR[4]	Licor	Li-cor	PY49745	75.03	NA	W/m^2
7	LICOR[5]	Licor	Li-cor	PY 74409	200	NA	W/m^2
8	LICOR[6]	Licor	Li-cor	PY 74438	200	NA	W/m^2
9	LICOR[7]	Licor	Li-cor	PY 74439	200	NA	W/m^2
10	LICOR[8]	Licor	Li-cor	PY 474450	200	NA	W/m^2
11	PSP[1]	Eppley	PSP	13673F3	125.63	NA	W/m^2
12	PSP[2]	Eppley	PSP	16881F3	103.09	NA	W/m^2
13	PSP[3]	Eppley	PSP	35417F3	112.74	NA	W/m^2
14	NIP[1]	Eppley	NIP	14851E6	118.06	NA	W/m^2
15	NIP[2]	Eppley	NIP	16620E6	117.79	NA	W/m^2
16	BW[1]	Eppley	8-48	20226	96.99	NA	W/m^2
17	BW[2]	Eppley	8-48	33886	98.62	NA	W/m^2

6.5.2 2014 STB Activities

6.5.2.1 Regular Maintenance

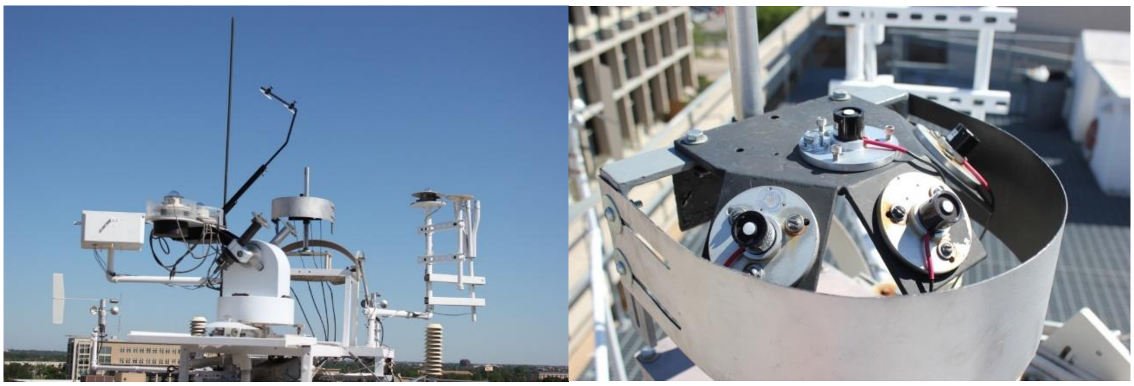
Every two weeks, the desiccants for PSPs, B&Ws and the junction boxes were replaced, and the used desiccants were recycled. The alignment for the solar tracker and the covers for the B&Ws were checked, and the occurred problems were fixed by restarting the solar tracker and manually adjusting the devices. The sensor wiring connections were checked and fixed, if some sensor readings were wrong.

6.5.2.2 Weekly Report

The data logger downloaded data were checked every week, and the STB data was compared with NOAA data in STB weekly report.

6.5.2.3 Multi-Pyranometer Array

The Multi-Pynanometer Array (MPA) was installed on the STB in 2012, which consisted of 4 LI-COR sensors: one mounded in a horizontal plane, and three others tilted 40 degrees and distributed in azimuth angles of -60, 0, 60 degrees – toward southeast, south and southwest. And a shadow band is applied as an artificial horizon to block the reflected sunlight coming from the ground. The location, sensors and devices for MPA are shown in Figure 58.



(a) (b)

Figure 58: (a) MPA located on STB; (b) MPA sensors positons.

Based on the measured data from MPA experiment rig, some research about using MPA to estimate normal incident solar radiation has been conducted. The research paper "Improved Methodology to Measure Normal Incident Solar Radiation with a Multi-Pyranometer Array" was presented in 2013 ISES Solar World Congress, Cancun, Mexico, and was published on Energy Procedia.

6.5.3 Future work Plan

6.5.3.1 Camera Installation

The solar tracker may stop sometimes due to different reasons, and covers may not perfectly shade the B&Ws as well. It is useful to have a camera to 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 were outside the junction boxes. It is necessary to install conduits for wire protection and rearrange the wires.

6.5.4 Acknowledgements

This task could not be completed without the help of many students/staffs among another Mr. Sukjoon Oh, Mr. Minjae Shin, Ms. Chunliu Mao, Mr. Yifu Sun, Dr. Sunglok Do, from ESL, TAMU. Also the advice of Mr. Tom Kirk from EPPLEY Inc. was well appreciated.

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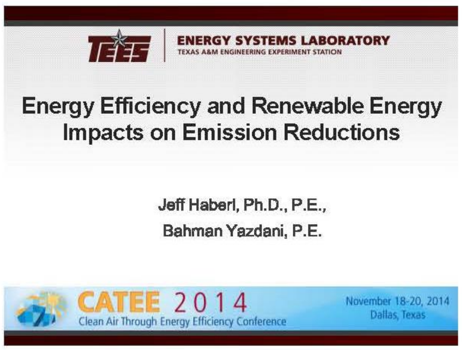
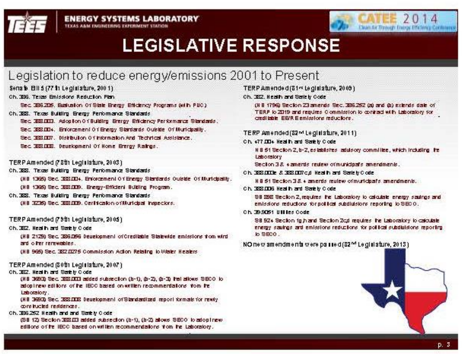
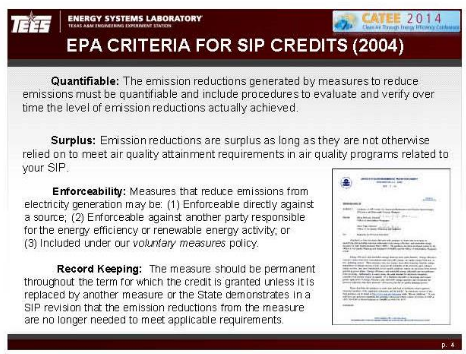
Appendix: Presentations to Various Entities at Conferences and Workshops in 2014

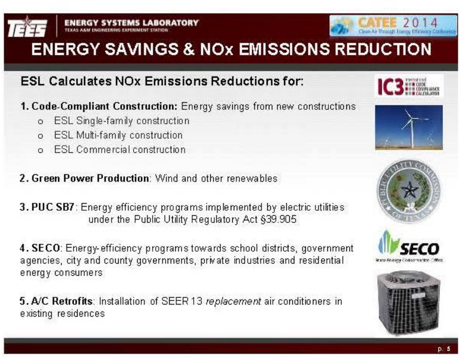
The Energy Systems Laboratory made presentations at several conferences and workshops about ways to save energy, and the appendix shows the presentation slides.

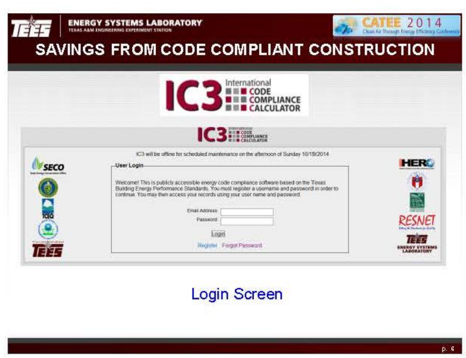
"Energy Efficiency and Renewable Energy Impacts on Emissions Reductions," presented by Jeff Haberl.

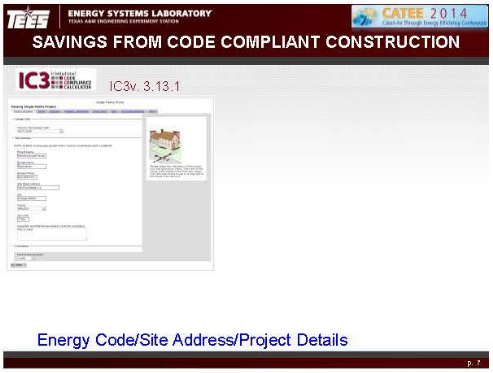








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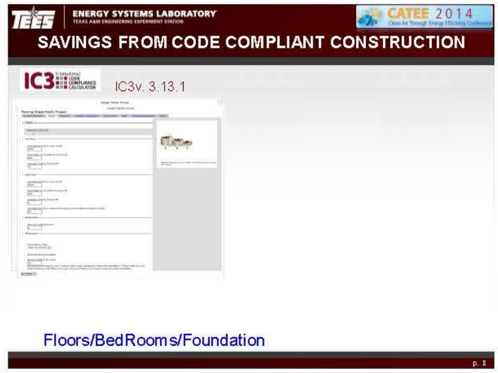
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3v. 3.13.1
Energy Code/Site Address/Project Details
p. 7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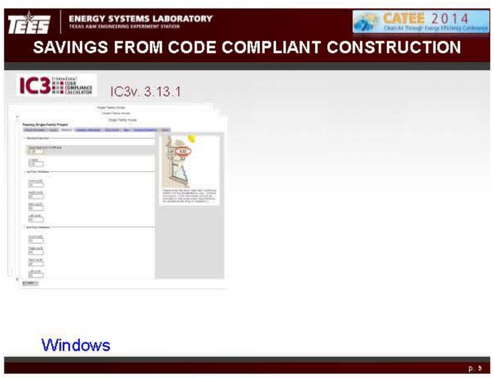
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3v. 3.13.1
Floors/BedRooms/Foundation
p. 8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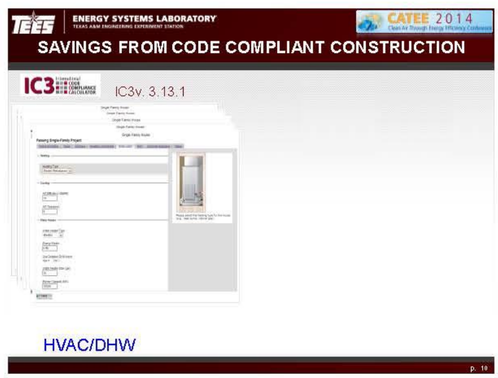
Windows
p. 9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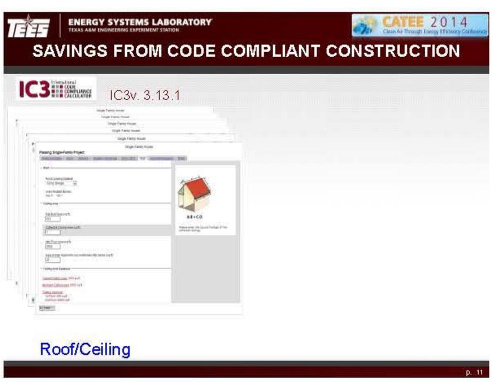
HVAC/DHW
p. 10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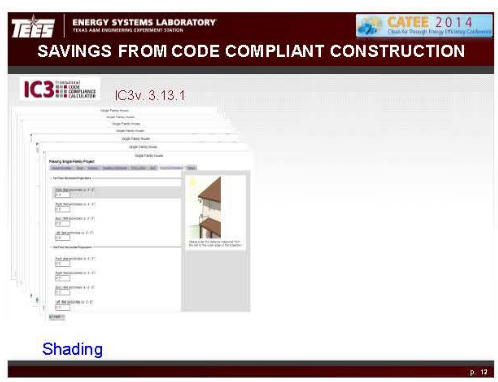
IC3v. 3.13.1
Roof/Ceiling
p. 11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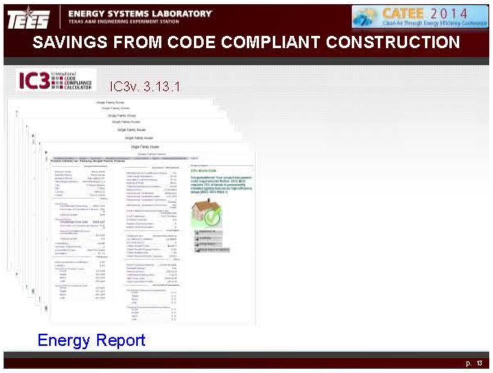
IC3v. 3.13.1
Shading
p. 12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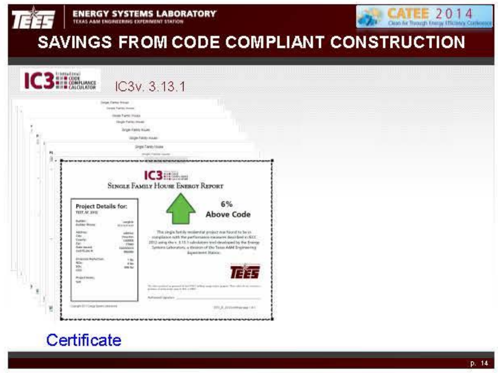
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3v. 3.13.1
Energy Report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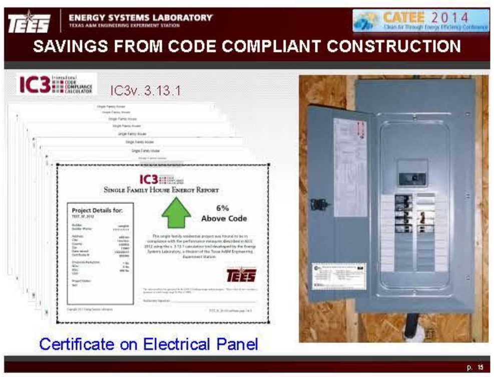
IC3v. 3.13.1
Single Family House Energy Report
6% Above Code
Certificate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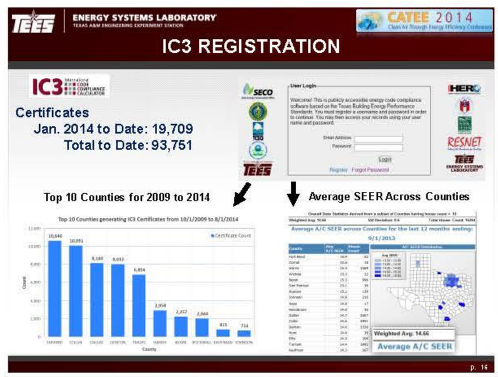
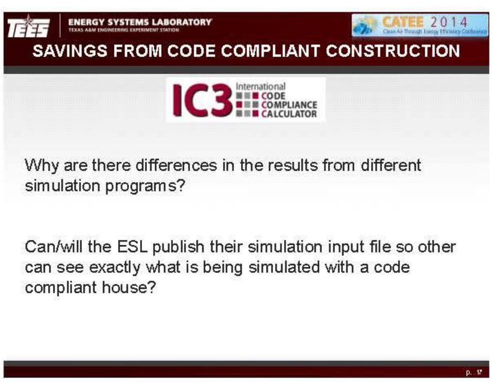
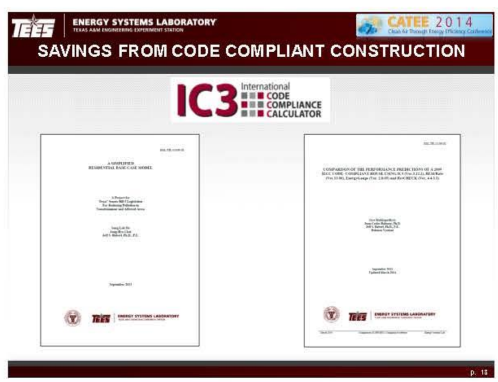
IC3v. 3.13.1
Single Family House Energy Report
6% Above Code
Certificate on Electrical Panel


ENERGY SYSTEMS LABORATORY
CATEE 2014
IC3 REGISTRATION
Certificates
Jan. 2014 to Date: 19,709
Total to Date: 93,751
Top 10 Counties for 2009 to 2014
Average SEER Across Counties
RESNET


ENERGY SYSTEMS LABORATORY
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR
Why are there differences in the results from different simulation programs?
Can/will the ESL publish their simulation input file so other can see exactly what is being simulated with a code compliant house?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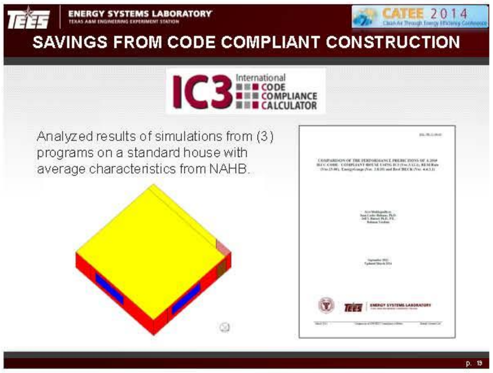
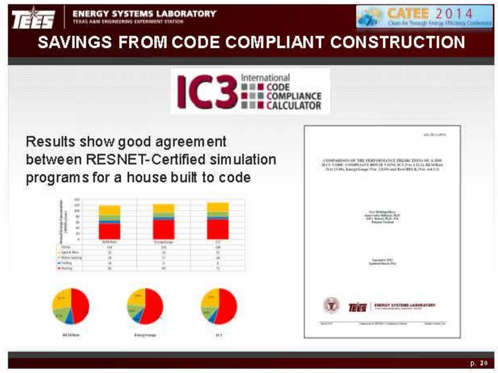
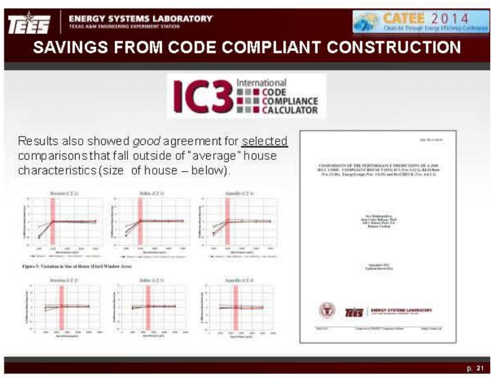
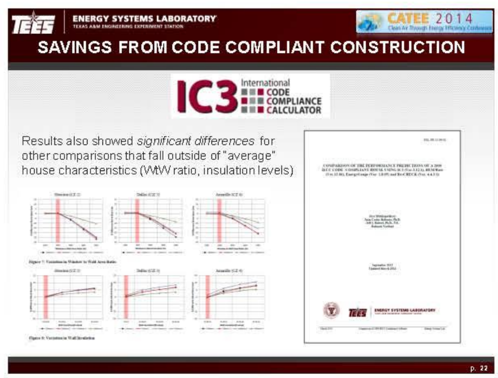
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR


ENERGY SYSTEMS LABORATORY
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR
Analyzed results of simulations from (3) programs on a standard house with average characteristics from NAHB.
p. 19


ENERGY SYSTEMS LABORATORY
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR
Results show good agreement between RESNET-Certified simulation programs for a house built to code
p. 20


ENERGY SYSTEMS LABORATORY
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR
Results also showed good agreement for selected comparisons that fall outside of "average" house characteristics (size of house – below).
p. 21


ENERGY SYSTEMS LABORATORY
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
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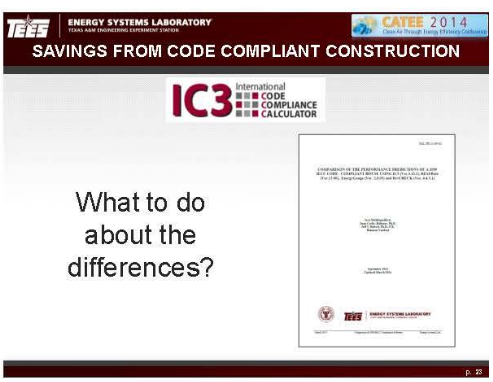
Results also showed significant differences for other comparisons that fall outside of "average" house characteristics (WtW ratio, insulation levels)
p. 22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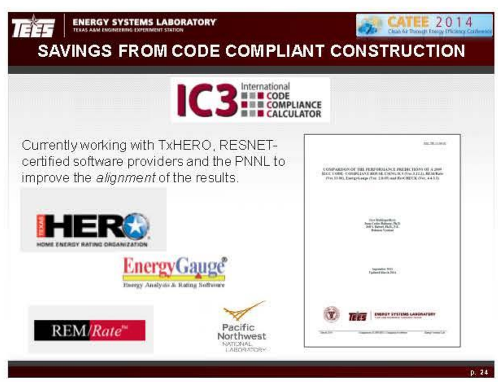
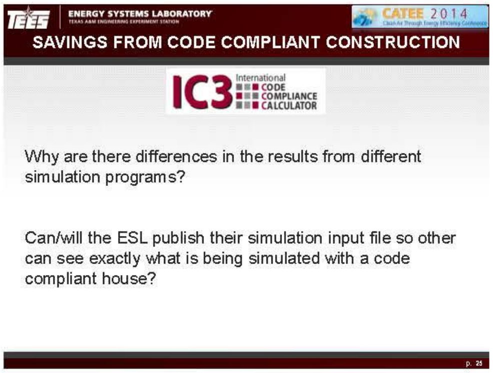
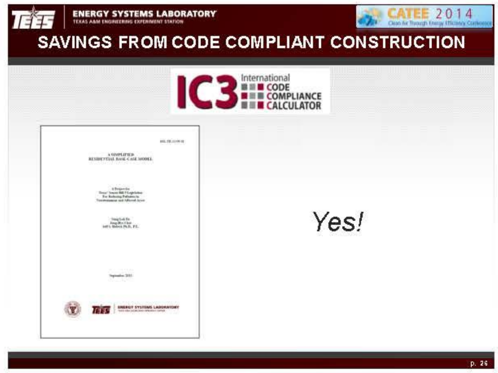
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR
What to do about the differences?
p. 23


ENERGY SYSTEMS LABORATORY
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR
Currently working with TxHERO, RESNET-certified software providers and the PNNL to improve the alignment of the results.
HERO
HOME ENERGY RATING ORGANIZATION
EnergyGauge
Energy Analysis & Rating Software
REM/Rate
Pacific Northwest NATIONAL LABORATORY
p. 24


ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR
Why are there differences in the results from different simulation programs?
Can/will the ESL publish their simulation input file so other can see exactly what is being simulated with a code compliant house?
p. 25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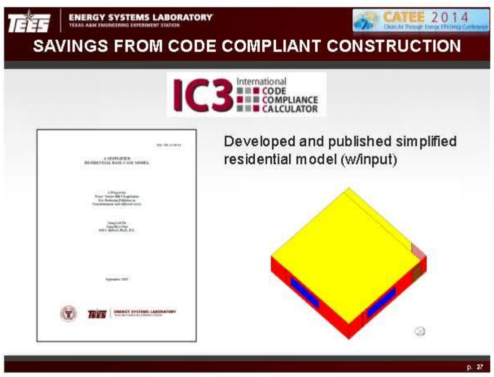
TEXAS A&M ENGINEERING EXPERIMENT STATION
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR
Yes!
p. 26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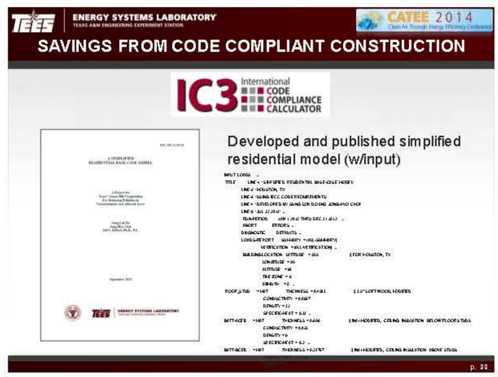
TEXAS A&M ENGINEERING EXPERIMENT STATION
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR
Developed and published simplified residential model (w/input)
p. 27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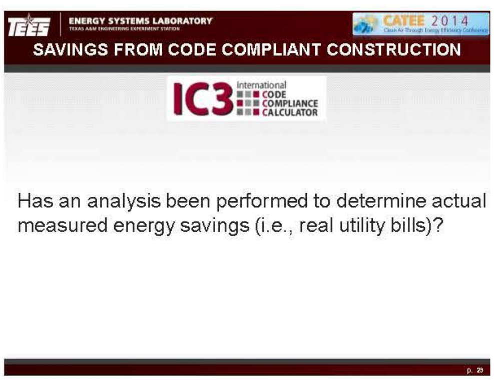
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR
Developed and published simplified residential model (w/input)
p. 28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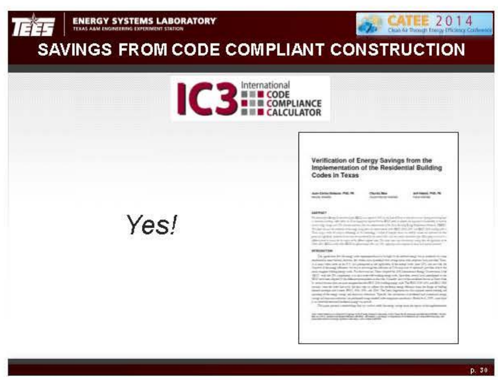
TEXAS A&M ENGINEERING EXPERIMENT STATION
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR
Has an analysis been performed to determine actual measured energy savings (i.e., real utility bills)?
p. 29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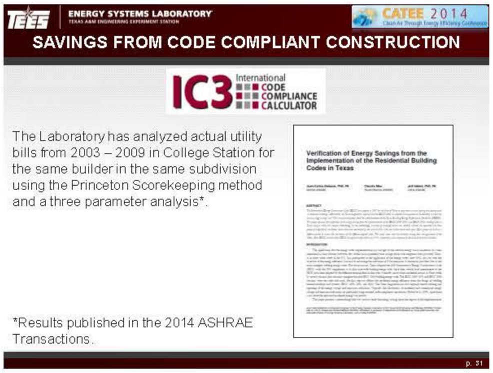
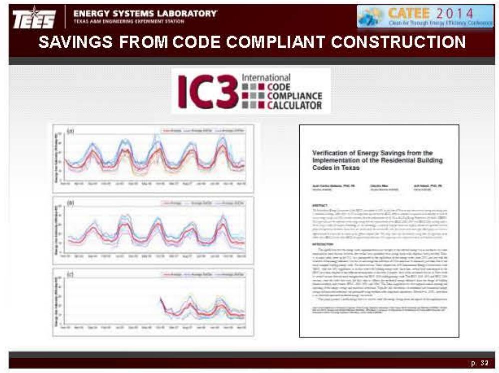
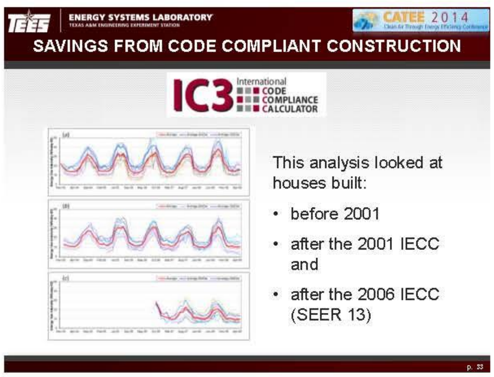
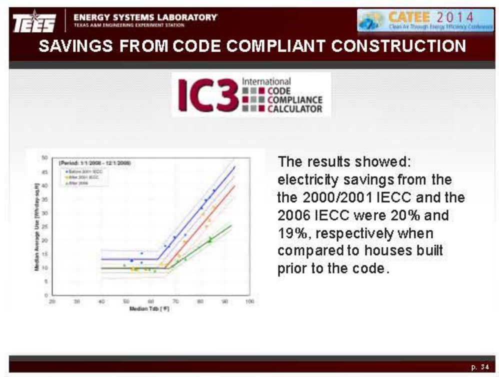
TEXAS A&M ENGINEERING EXPERIMENT STATION
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR
Yes!
Verification of Energy Savings from the Implementation of the Residential Building Codes in Texas
p. 30


ENERGY SYSTEMS LABORATORY
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR
The Laboratory has analyzed actual utility bills from 2003 – 2009 in College Station for the same builder in the same subdivision using the Princeton Scorekeeping method and a three parameter analysis*.
Verification of Energy Savings from the Implementation of the Residential Building Codes in Texas
*Results published in the 2014 ASHRAE Transactions.
p. 31


ENERGY SYSTEMS LABORATORY
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR
Verification of Energy Savings from the Implementation of the Residential Building Codes in Texas
p. 32


ENERGY SYSTEMS LABORATORY
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR
This analysis looked at houses built:
• before 2001
• after the 2001 IECC and
• after the 2006 IECC (SEER 13)
p. 33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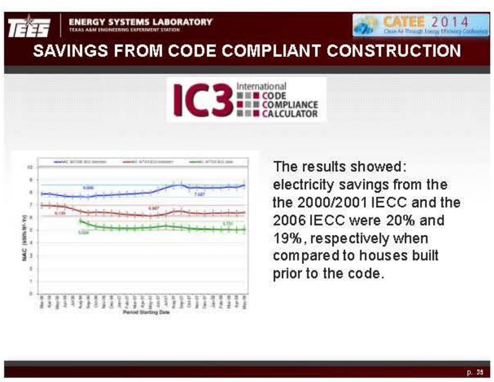
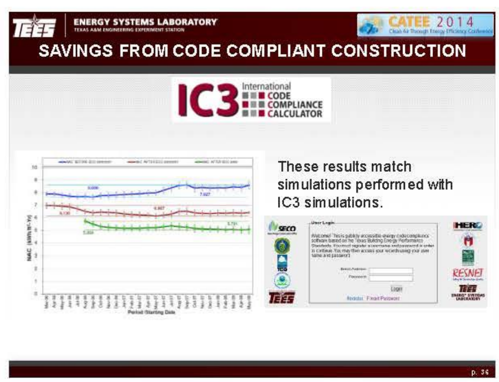
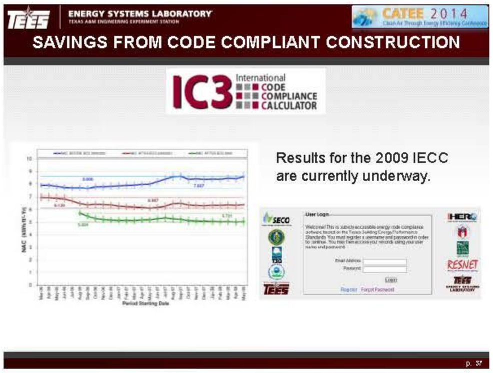
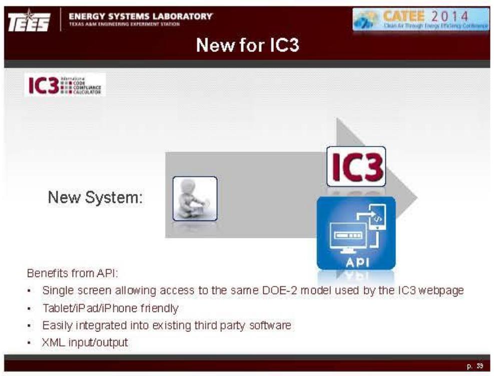
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR
The results showed: electricity savings from the the 2000/2001 IECC and the 2006 IECC were 20% and 19%, respectively when compared to houses built prior to the code.
p. 34


ENERGY SYSTEMS LABORATORY
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR
The results showed: electricity savings from the the 2000/2001 IECC and the 2006 IECC were 20% and 19%, respectively when compared to houses built prior to the code.
p. 35

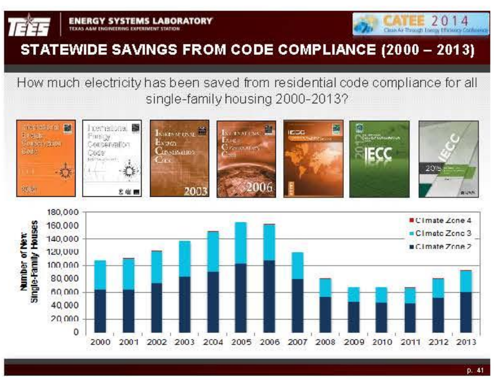

ENERGY SYSTEMS LABORATORY
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR
These results match simulations performed with IC3 simulations.
p. 36

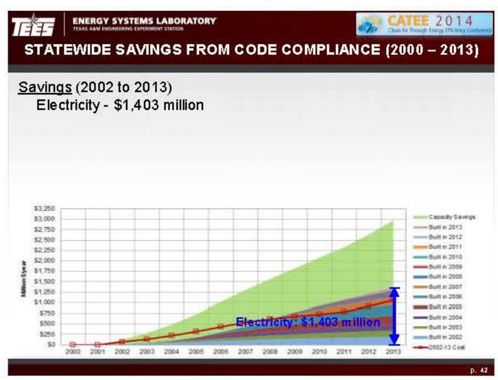

ENERGY SYSTEMS LABORATORY
CATEE 2014
SAVINGS FROM CODE COMPLIANT CONSTRUCTION
IC3 International CODE COMPLIANCE CALCULATOR
Results for the 2009 IECC are currently underway.
p. 37

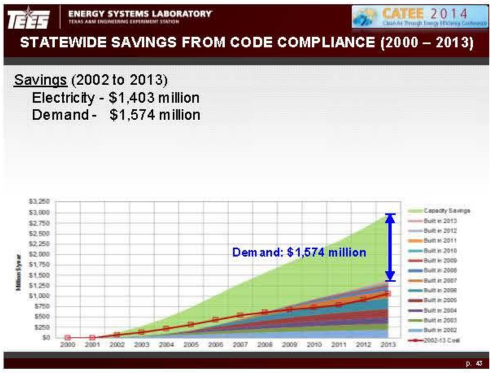

ENERGY SYSTEMS LABORATORY
CATEE 2014
New for IC3
Current System:
IC3
IC3 Web: http://ic3.tamu.edu
p. 38

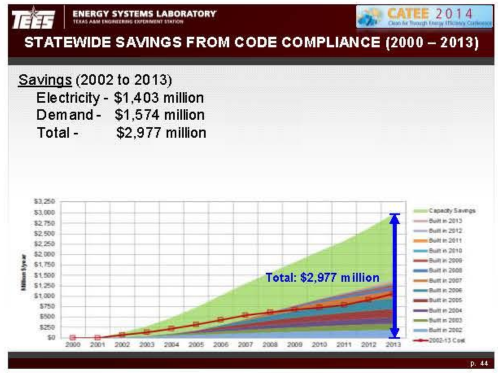

ENERGY SYSTEMS LABORATORY
CATEE 2014
New for IC3
New System:
IC3
API
Benefits from API:
• Single screen allowing access to the same DOE-2 model used by the IC3 webpage
• Tablet/iPad/iPhone friendly
• Easily integrated into existing third party software
• XML input/output
p. 39

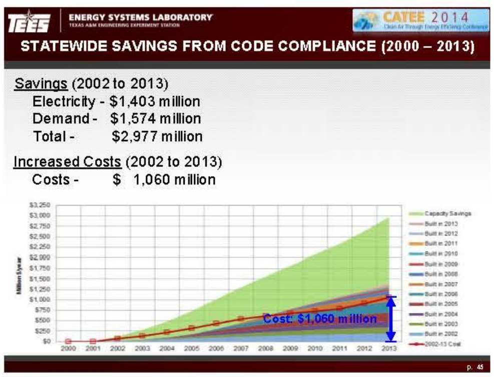

ENERGY SYSTEMS LABORATORY
CATEE 2014
STATEWIDE SAVINGS FROM CODE COMPLIANCE (2000 – 2013)
How much electricity has been saved from residential code compliance for all single-family housing 2000-2013?
2003
2006
IECC
2015
p. 40

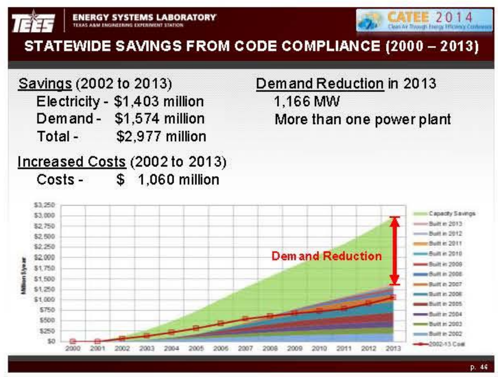

ENERGY SYSTEMS LABORATORY
CATEE 2014
STATEWIDE SAVINGS FROM CODE COMPLIANCE (2000 – 2013)
How much electricity has been saved from residential code compliance for all single-family housing 2000-2013?
Number of New Single-Family Houses
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Climate Zone 4
Climate Zone 3
Climate Zone 2
p. 41

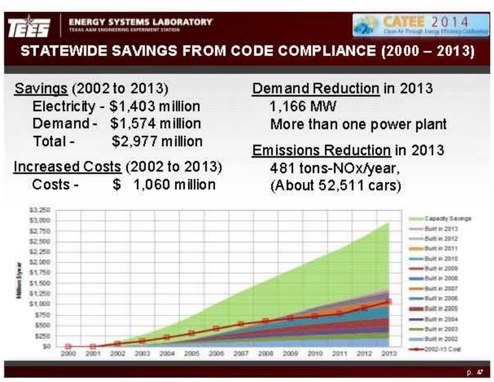

ENERGY SYSTEMS LABORATORY
CATEE 2014
STATEWIDE SAVINGS FROM CODE COMPLIANCE (2000 – 2013)
Savings (2002 to 2013)
Electricity - $1,403 million
Electricity: $1,403 million
p. 42

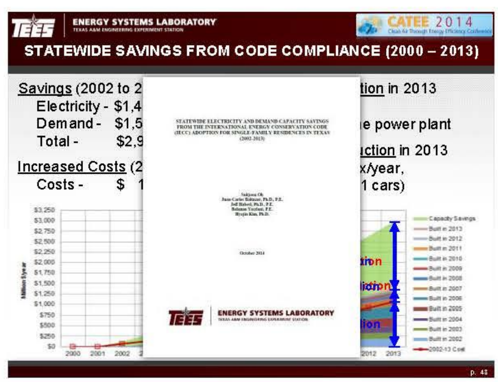

ENERGY SYSTEMS LABORATORY
CATEE 2014
STATEWIDE SAVINGS FROM CODE COMPLIANCE (2000 – 2013)
Savings (2002 to 2013)
Electricity - $1,403 million
Demand - $1,574 million
Demand: $1,574 million
p. 43

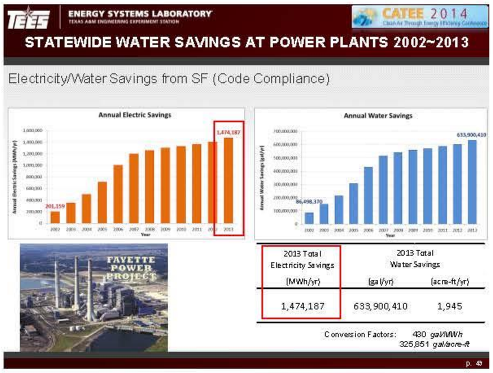

ENERGY SYSTEMS LABORATORY
CATEE 2014
STATEWIDE SAVINGS FROM CODE COMPLIANCE (2000 – 2013)
Savings (2002 to 2013)
Electricity - $1,403 million
Demand - $1,574 million
Total - $2,977 million
Total: $2,977 million
p. 44

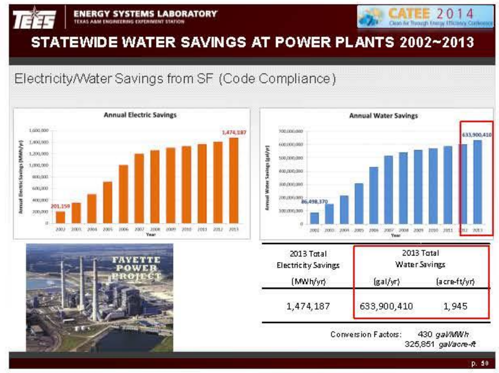

ENERGY SYSTEMS LABORATORY
CATEE 2014
STATEWIDE SAVINGS FROM CODE COMPLIANCE (2000 – 2013)
Savings (2002 to 2013)
Electricity - $1,403 million
Demand - $1,574 million
Total - $2,977 million
Increased Costs (2002 to 2013)
Costs - $ 1,060 million
Cost: $1,060 million
p. 45


ENERGY SYSTEMS LABORATORY
CATEE 2014
STATEWIDE SAVINGS FROM CODE COMPLIANCE (2000 – 2013)
Savings (2002 to 2013)
Electricity - $1,403 million
Demand - $1,574 million
Total - $2,977 million
Increased Costs (2002 to 2013)
Costs - $ 1,060 million
Demand Reduction in 2013
1,166 MW
More than one power plant
Demand Reduction
p. 46


ENERGY SYSTEMS LABORATORY
CATEE 2014
STATEWIDE SAVINGS FROM CODE COMPLIANCE (2000 – 2013)
Savings (2002 to 2013)
Electricity - $1,403 million
Demand - $1,574 million
Total - $2,977 million
Increased Costs (2002 to 2013)
Costs - $ 1,060 million
Demand Reduction in 2013
1,166 MW
More than one power plant
Emissions Reduction in 2013
481 tons-NOx/year,
(About 52,511 cars)
p. 47

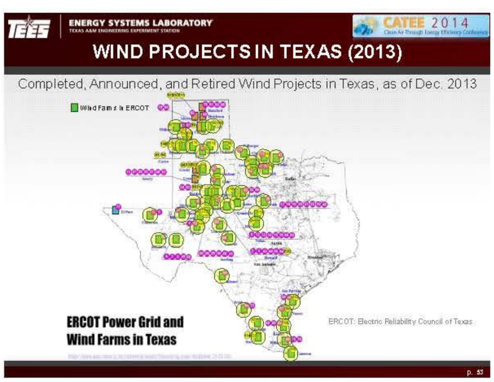

ENERGY SYSTEMS LABORATORY
CATEE 2014
STATEWIDE SAVINGS FROM CODE COMPLIANCE (2000 – 2013)
ENERGY SYSTEMS LABORATORY
p. 48

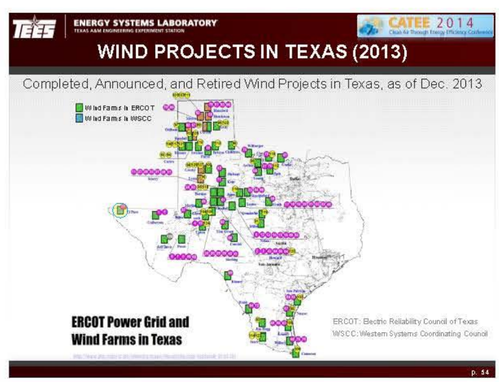

ENERGY SYSTEMS LABORATORY
CATEE 2014
STATEWIDE WATER SAVINGS AT POWER PLANTS 2002~2013
Electricity/Water Savings from SF (Code Compliance)
Annual Electric Savings
1,474,187
201,159
Annual Water Savings
633,900,410
86,498,370
FAYETTE POWER PROJECT
2013 Total Electricity Savings (MWh/yr)
2013 Total Water Savings (gal/yr) (acre-ft/yr)
1,474,187
633,900,410
1,945
Conversion Factors: 430 gal/MWh
325,851 gal/acre-ft
p. 49

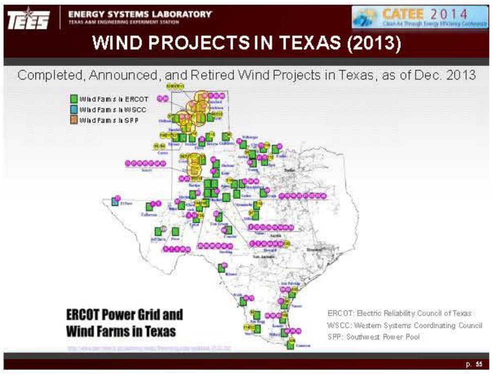

ENERGY SYSTEMS LABORATORY
CATEE 2014
STATEWIDE WATER SAVINGS AT POWER PLANTS 2002~2013
Electricity/Water Savings from SF (Code Compliance)
Annual Electric Savings
1,474,187
201,159
Annual Water Savings
633,900,410
86,498,370
FAYETTE POWER PROJECT
2013 Total Electricity Savings (MWh/yr)
2013 Total Water Savings (gal/yr) (acre-ft/yr)
1,474,187
633,900,410
1,945
Conversion Factors: 430 gal/MWh
325,851 gal/acre-ft
p. 50

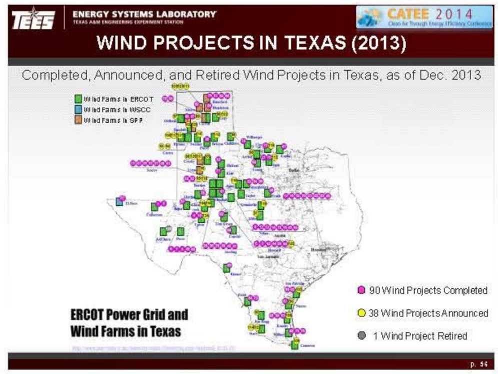

ENERGY SYSTEMS LABORATORY
CATEE 2014
SAVINGS FROM RENEWABLES
Webberville Solar Project, Austin, TX.
Residential Solar Thermal System
Dam at Elephant Butte, El Paso, TX
Solar PV
Solar Thermal
Hydro
Nacogdoches Biomass Plant, Sacul, TX
McCommas Bluff Landfill, Dallas, TX
Ground Source Heat Pump
Biomass
Landfill Gas
Geothermal
p. 51

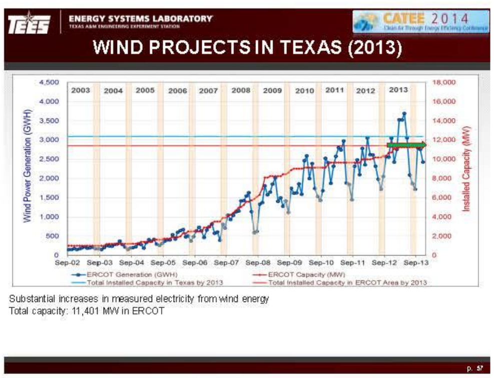

ENERGY SYSTEMS LABORATORY
CATEE 2014
SAVINGS FROM RENEWABLES
Webberville Solar Project, Austin, TX.
Residential Solar Thermal System
Dam at Elephant Butte, El Paso, TX
Wind
Biomass
Landfill Gas
Geothermal
p. 52

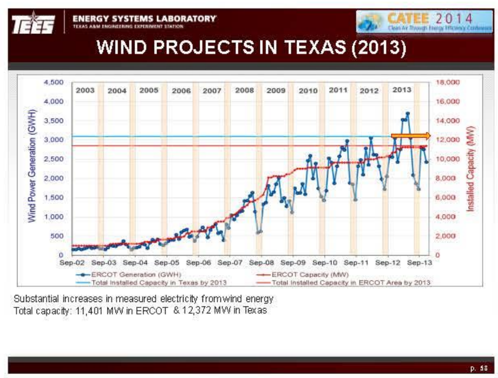

ENERGY SYSTEMS LABORATORY
CATEE 2014
WIND PROJECTS IN TEXAS (2013)
Completed, Announced, and Retired Wind Projects in Texas, as of Dec. 2013
Wind Farms in ERCOT
ERCOT Power Grid and
Wind Farms in Texas
ERCOT: Electric Reliability Council of Texas
p. 53

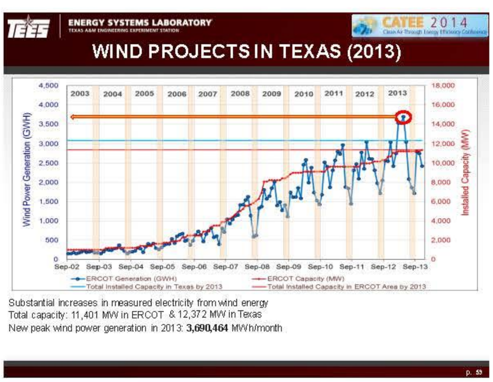

ENERGY SYSTEMS LABORATORY
CATEE 2014
WIND PROJECTS IN TEXAS (2013)
Completed, Announced, and Retired Wind Projects in Texas, as of Dec. 2013
Wind Farms in ERCOT
Wind Farms in WSCC
ERCOT Power Grid and
Wind Farms in Texas
ERCOT: Electric Reliability Council of Texas
WSCC: Western Systems Coordinating Council
p. 54

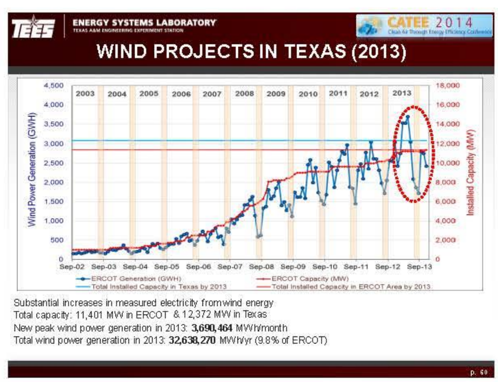

ENERGY SYSTEMS LABORATORY
CATEE 2014
WIND PROJECTS IN TEXAS (2013)
Completed, Announced, and Retired Wind Projects in Texas, as of Dec. 2013
ERCOT Power Grid and Wind Farms in Texas
ERCOT: Electric Reliability Council of Texas
WSCC: Western Systems Coordinating Council
SPP: Southwest Power Pool
p. 55

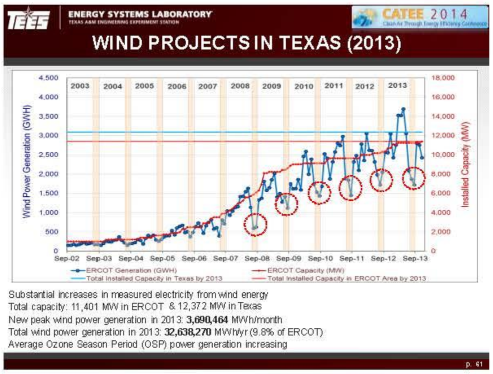

ENERGY SYSTEMS LABORATORY
CATEE 2014
WIND PROJECTS IN TEXAS (2013)
Completed, Announced, and Retired Wind Projects in Texas, as of Dec. 2013
ERCOT Power Grid and Wind Farms in Texas
90 Wind Projects Completed
38 Wind Projects Announced
1 Wind Project Retired
p. 56

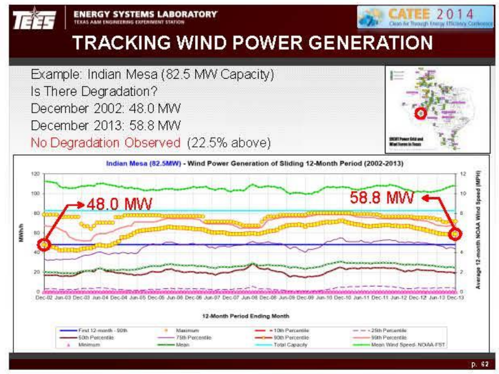

ENERGY SYSTEMS LABORATORY
CATEE 2014
WIND PROJECTS IN TEXAS (2013)
Wind Power Generation (GWH)
Installed Capacity (MW)
ERCOT Generation (GWH)
ERCOT Capacity (MW)
Total Installed Capacity in Texas by 2013
Total Installed Capacity in ERCOT Area by 2013
Substantial increases in measured electricity from wind energy
Total capacity: 11,401 MW in ERCOT
p. 57

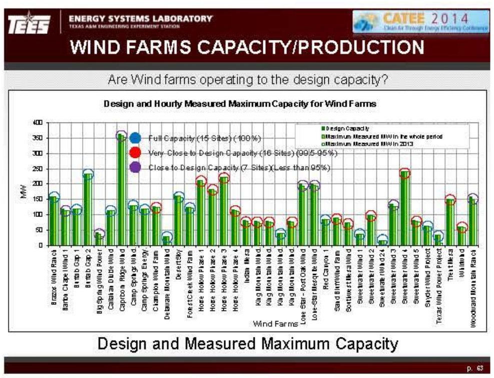

ENERGY SYSTEMS LABORATORY
CATEE 2014
WIND PROJECTS IN TEXAS (2013)
Wind Power Generation (GWH)
Installed Capacity (MW)
ERCOT Generation (GWH)
ERCOT Capacity (MW)
Total Installed Capacity in Texas by 2013
Total Installed Capacity in ERCOT Area by 2013
Substantial increases in measured electricity from wind energy
Total capacity: 11,401 MW in ERCOT & 12,372 MW in Texas
p. 58

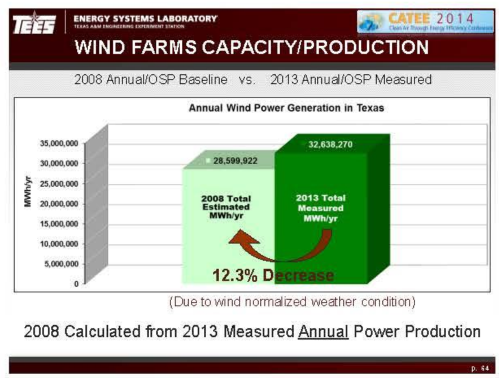

ENERGY SYSTEMS LABORATORY
CATEE 2014
WIND PROJECTS IN TEXAS (2013)
Wind Power Generation (GWH)
Installed Capacity (MW)
ERCOT Generation (GWH)
ERCOT Capacity (MW)
Total Installed Capacity in Texas by 2013
Total Installed Capacity in ERCOT Area by 2013
Substantial increases in measured electricity from wind energy
Total capacity: 11,401 MW in ERCOT & 12,372 MW in Texas
New peak wind power generation in 2013: 3,690,464 MWh/month
p. 59

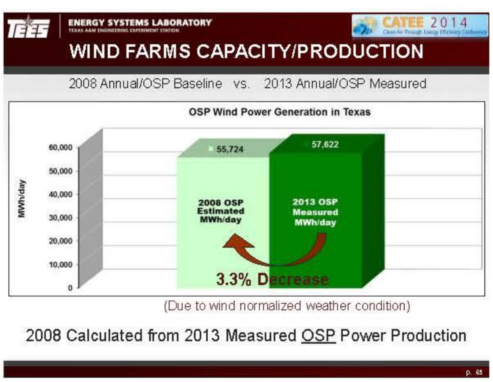

ENERGY SYSTEMS LABORATORY
CATEE 2014
WIND PROJECTS IN TEXAS (2013)
Wind Power Generation (GWH)
Installed Capacity (MW)
ERCOT Generation (GWH)
ERCOT Capacity (MW)
Total Installed Capacity in Texas by 2013
Total Installed Capacity in ERCOT Area by 2013
Substantial increases in measured electricity from wind energy
Total capacity: 11,401 MW in ERCOT & 12,372 MW in Texas
New peak wind power generation in 2013: 3,690,464 MWh/month
Total wind power generation in 2013: 32,638,270 MWh/yr (9.8% of ERCOT)
p. 60

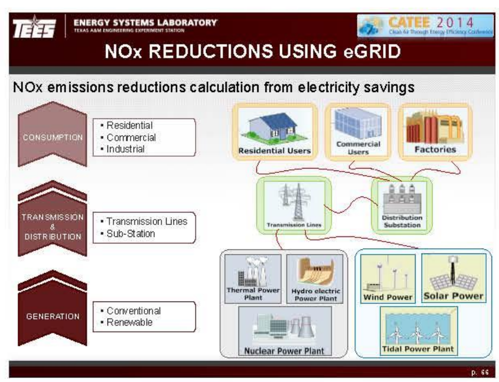

ENERGY SYSTEMS LABORATORY
CATEE 2014
WIND PROJECTS IN TEXAS (2013)
Wind Power Generation (GWH)
Installed Capacity (MW)
ERCOT Generation (GWH)
ERCOT Capacity (MW)
Total Installed Capacity in Texas by 2013
Total Installed Capacity in ERCOT Area by 2013
Substantial increases in measured electricity from wind energy
Total capacity: 11,401 MW in ERCOT & 12,372 MW in Texas
New peak wind power generation in 2013: 3,690,464 MWh/month
Total wind power generation in 2013: 32,638,270 MWh/yr (9.8% of ERCOT)
Average Ozone Season Period (OSP) power generation increasing
p. 61

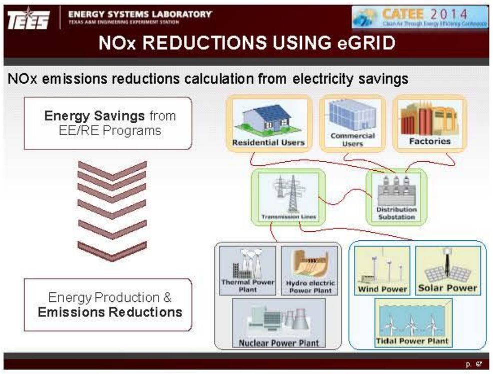

ENERGY SYSTEMS LABORATORY
CATEE 2014
TRACKING WIND POWER GENERATION
Example: Indian Mesa (82.5 MW Capacity)
Is There Degradation?
December 2002: 48.0 MW
December 2013: 58.8 MW
No Degradation Observed (22.5% above)
Indian Mesa (82.5MW) - Wind Power Generation of Sliding 12-Month Period (2002-2013)
48.0 MW
58.8 MW
12-Month Period Ending Month
p. 62

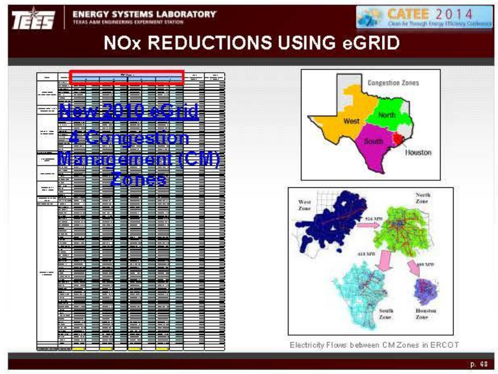

ENERGY SYSTEMS LABORATORY
CATEE 2014
WIND FARMS CAPACITY/PRODUCTION
Are Wind farms operating to the design capacity?
Design and Hourly Measured Maximum Capacity for Wind Farms
Full Capacity (15 Sites) (100%)
Very Close to Design Capacity (16 Sites) (90.5-95%)
Close to Design Capacity (7 Sites)(Less than 95%)
Wind Farms
Design and Measured Maximum Capacity
p. 63

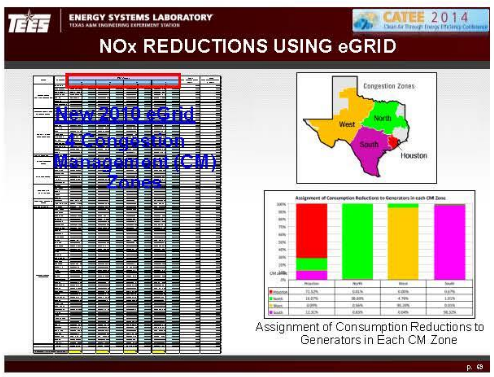

ENERGY SYSTEMS LABORATORY
CATEE 2014
WIND FARMS CAPACITY/PRODUCTION
2008 Annual/OSP Baseline vs. 2013 Annual/OSP Measured
Annual Wind Power Generation in Texas
MWh/yr
28,599,922
32,638,270
2008 Total Estimated MWh/yr
2013 Total Measured MWh/yr
12.3% Decrease
(Due to wind normalized weather condition)
2008 Calculated from 2013 Measured Annual Power Production
p. 64

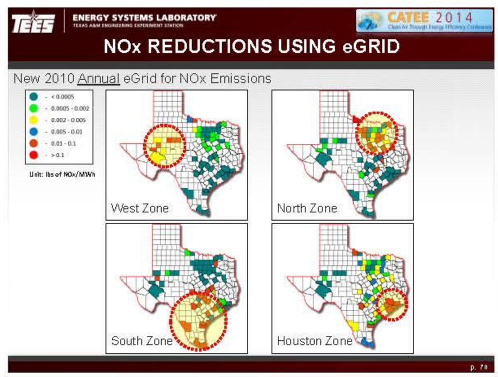

ENERGY SYSTEMS LABORATORY
CATEE 2014
WIND FARMS CAPACITY/PRODUCTION
2008 Annual/OSP Baseline vs. 2013 Annual/OSP Measured
OSP Wind Power Generation in Texas
MWh/day
55,724
57,622
2008 OSP Estimated MWh/day
2013 OSP Measured MWh/day
3.3% Decrease
(Due to wind normalized weather condition)
2008 Calculated from 2013 Measured OSP Power Production
p. 65

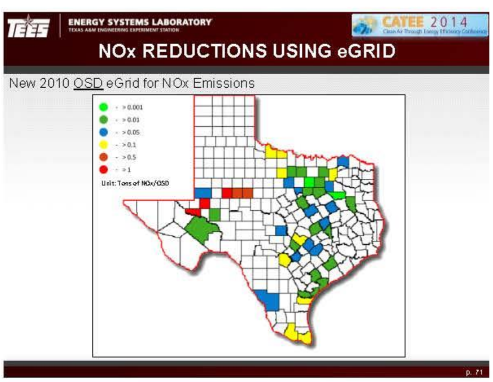

ENERGY SYSTEMS LABORATORY
CATEE 2014
NOx REDUCTIONS USING eGRID
NOx emissions reductions calculation from electricity savings
CONSUMPTION
• Residential
• Commercial
• Industrial
Residential Users
Commercial Users
Factories
TRANSMISSION & DISTRIBUTION
• Transmission Lines
• Sub-Station
Transmission Lines
Distribution Substation
GENERATION
• Conventional
• Renewable
Thermal Power Plant
Hydro electric Power Plant
Wind Power
Solar Power
Nuclear Power Plant
Tidal Power Plant
p. 66

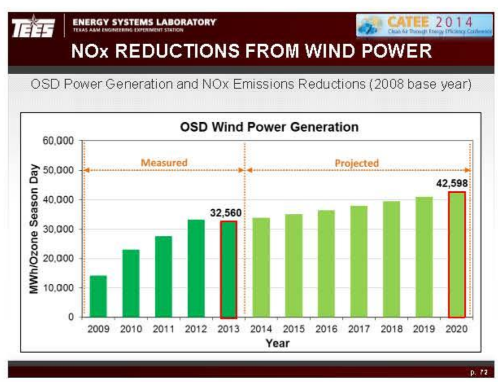

ENERGY SYSTEMS LABORATORY
CATEE 2014
NOx REDUCTIONS USING eGRID
NOx emissions reductions calculation from electricity savings
Energy Savings from EE/RE Programs
Energy Production & Emissions Reductions
Residential Users
Commercial Users
Factories
Transmission Lines
Distribution Substation
Thermal Power Plant
Hydro electric Power Plant
Wind Power
Solar Power
Nuclear Power Plant
Tidal Power Plant
p. 67

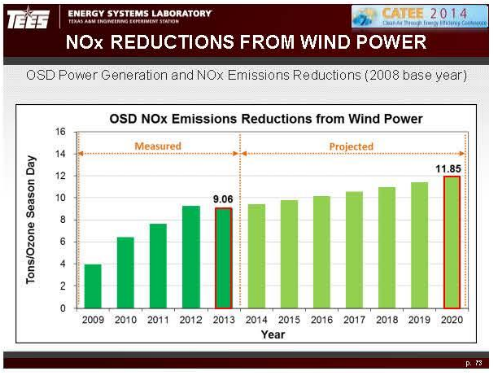

ENERGY SYSTEMS LABORATORY
CATEE 2014
NOx REDUCTIONS USING eGRID
New 2010 eGrid
4 Congestion Management (CM) Zones
Congestion Zones
West
North
South
Houston
Electricity Flows between CM Zones in ERCOT
p. 68

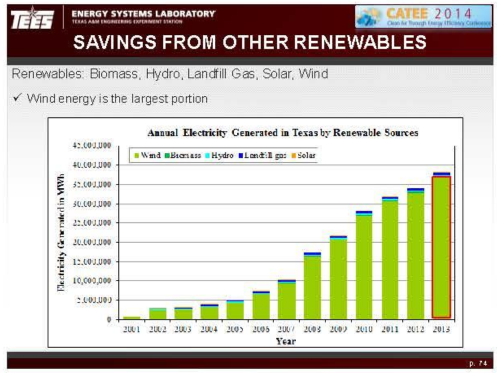

ENERGY SYSTEMS LABORATORY
CATEE 2014
NOx REDUCTIONS USING eGRID
New 2010 eGrid
4 Congestion Management (CM) Zones
Congestion Zones
West
North
South
Houston
Assignment of Consumption Reductions to Generators in Each CM Zone
p. 69

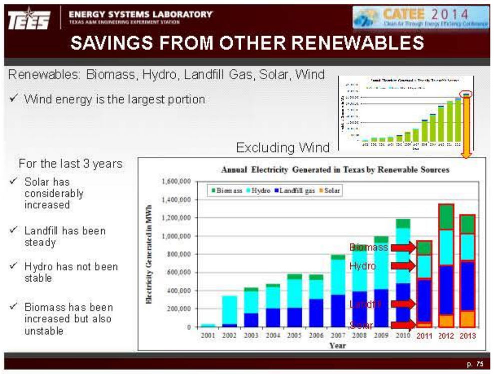

ENERGY SYSTEMS LABORATORY
CATEE 2014
NOx REDUCTIONS USING eGRID
New 2010 Annual eGrid for NOx Emissions
West Zone
North Zone
South Zone
Houston Zone
p. 70

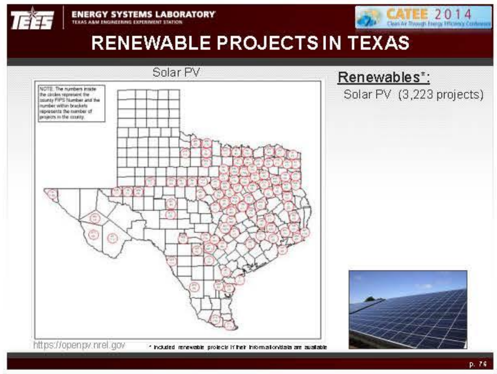

ENERGY SYSTEMS LABORATORY
CATEE 2014
NOx REDUCTIONS USING eGRID
New 2010 OSD eGrid for NOx Emissions
p. 71

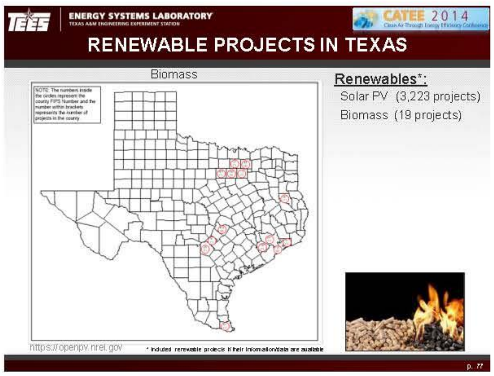

ENERGY SYSTEMS LABORATORY
CATEE 2014
NOx REDUCTIONS FROM WIND POWER
OSD Power Generation and NOx Emissions Reductions (2008 base year)
OSD Wind Power Generation
Measured
Projected
MWh/Ozone Season Day
60,000
50,000
40,000
30,000
20,000
10,000
0
32,560
42,598
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Year
p. 72

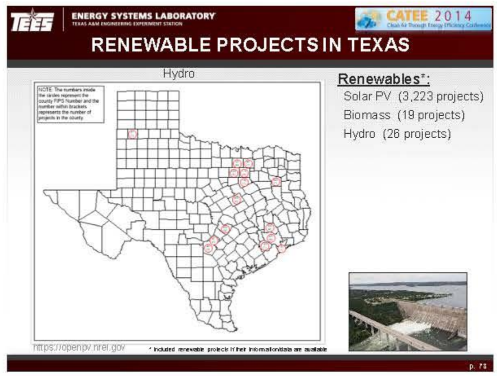

ENERGY SYSTEMS LABORATORY
CATEE 2014
NOx REDUCTIONS FROM WIND POWER
OSD Power Generation and NOx Emissions Reductions (2008 base year)
OSD NOx Emissions Reductions from Wind Power
Measured
Projected
Tons/Ozone Season Day
9.06
11.85
2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020
Year
p. 73

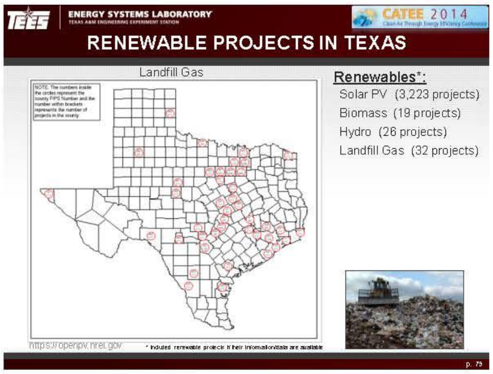

ENERGY SYSTEMS LABORATORY
CATEE 2014
SAVINGS FROM OTHER RENEWABLES
Renewables: Biomass, Hydro, Landfill Gas, Solar, Wind
✓ Wind energy is the largest portion
Annual Electricity Generated in Texas by Renewable Sources
Wind Biomass Hydro Landfill gas Solar
Electricity Generated in MWh
Year
p. 74

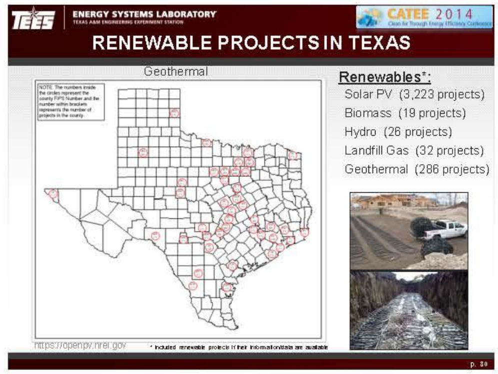

ENERGY SYSTEMS LABORATORY
CATEE 2014
SAVINGS FROM OTHER RENEWABLES
Renewables: Biomass, Hydro, Landfill Gas, Solar, Wind
✓ Wind energy is the largest portion
Excluding Wind
For the last 3 years
✓ Solar has considerably increased
✓ Landfill has been steady
✓ Hydro has not been stable
✓ Biomass has been increased but also unstable
Annual Electricity Generated in Texas by Renewable Sources
Biomass Hydro Landfill gas Solar
Electricity Generated in MWh
Biomass
Hydro
Landfill
Solar
Year
p. 75


ENERGY SYSTEMS LABORATORY
CATEE 2014
RENEWABLE PROJECTS IN TEXAS
Solar PV
Renewables*:
Solar PV (3,223 projects)
https://openpv.nrel.gov
* Included renewable projects if their information/data are available
p. 76


ENERGY SYSTEMS LABORATORY
CATEE 2014
RENEWABLE PROJECTS IN TEXAS
Biomass
Renewables*:
Solar PV (3,223 projects)
Biomass (19 projects)
https://openpv.nrel.gov
* Included renewable projects if their information/data are available
p. 77


ENERGY SYSTEMS LABORATORY
CATEE 2014
RENEWABLE PROJECTS IN TEXAS
Hydro
Renewables*:
Solar PV (3,223 projects)
Biomass (19 projects)
Hydro (26 projects)
https://openpv.nrel.gov
* Included renewable projects if their information/data are available
p. 78


ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION
CATEE 2014
RENEWABLE PROJECTS IN TEXAS
Landfill Gas
Renewables*:
Solar PV (3,223 projects)
Biomass (19 projects)
Hydro (26 projects)
Landfill Gas (32 projects)
https://openpv.nrel.gov
p. 79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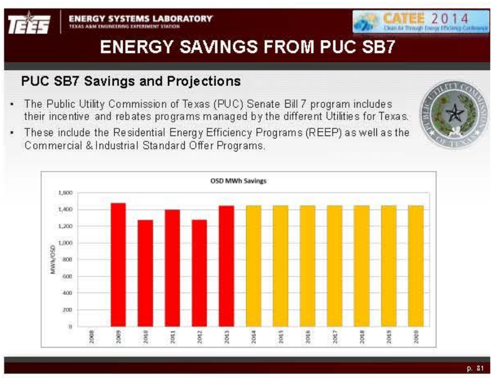
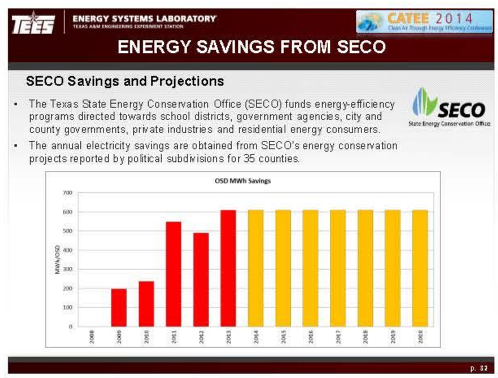
TEXAS A&M ENGINEERING EXPERIMENT STATION
CATEE 2014
RENEWABLE PROJECTS IN TEXAS
Geothermal
Renewables*:
Solar PV (3,223 projects)
Biomass (19 projects)
Hydro (26 projects)
Landfill Gas (32 projects)
Geothermal (286 projects)
https://openpv.nrel.gov
p. 80


ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION
CATEE 2014
ENERGY SAVINGS FROM PUC SB7
PUC SB7 Savings and Projections
The Public Utility Commission of Texas (PUC) Senate Bill 7 program includes their incentive and rebates programs managed by the different Utilities for Texas.
These include the Residential Energy Efficiency Programs (REEP) as well as the Commercial & Industrial Standard Offer Programs.
OSD MWh Savings
MWh/OSD
p. 81


ENERGY SYSTEMS LABORATORY
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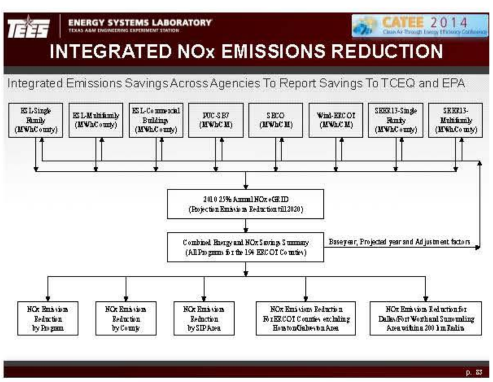
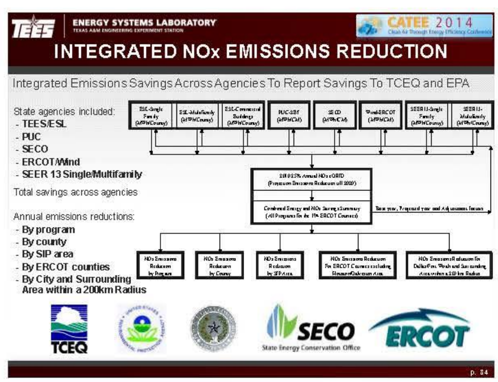
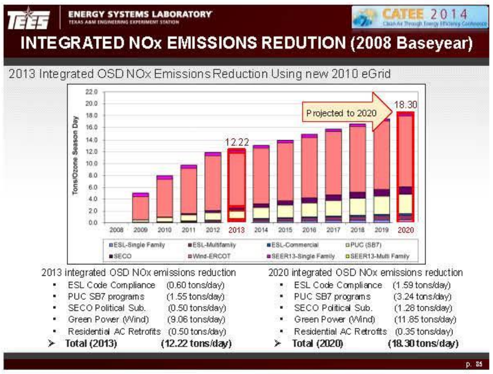
CATEE 2014
ENERGY SAVINGS FROM SECO
SECO Savings and Projections
The Texas State Energy Conservation Office (SECO) funds energy-efficiency programs directed towards school districts, government agencies, city and county governments, private industries and residential energy consumers.
The annual electricity savings are obtained from SECO's energy conservation projects reported by political subdivisions for 35 counties.
SECO
State Energy Conservation Office
OSD MWh Savings
MWh/OSD
p. 82


ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION
CATEE 2014
INTEGRATED NOx EMISSIONS REDUCTION
Integrated Emissions Savings Across Agencies To Report Savings To TCEQ and EPA
ESL-Single Family (MWh/County)
ESL-Multifamily (MWh/County)
ESL-Commercial Buildings (MWh/County)
PUC-SB7 (MWh/CM)
SECO (MWh/CM)
Wind-ERCOT (MWh/CM)
SEER13-Single Family (MWh/County)
SEER13-Multifamily (MWh/County)
2010 25% Annual NOx eGRID (Projection Emissions Reduction till 2020)
Combined Energy and NOx Savings Summary (All Programs for the 194 ERCOT Counties)
Base year, Projected year and Adjustment factors
NOx Emissions Reduction by Program
NOx Emissions Reduction by County
NOx Emissions Reduction by SIP Area
NOx Emissions Reduction For ERCOT Counties excluding Houston/Galveston Area
NOx Emissions Reduction for Dallas/Fort Worth and Surrounding Area within a 200 km Radius
p. 83


ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION
CATEE 2014
INTEGRATED NOx EMISSIONS REDUCTION
Integrated Emissions Savings Across Agencies To Report Savings To TCEQ and EPA
State agencies included:
- TEES/ESL
- PUC
- SECO
- ERCOT/Wind
- SEER 13 Single/Multifamily
Total savings across agencies
Annual emissions reductions:
- By program
- By county
- By SIP area
- By ERCOT counties
- By City and Surrounding Area within a 200km Radius
TCEQ
SECO
State Energy Conservation Office
ERCOT
p. 84


ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION
CATEE 2014
INTEGRATED NOx EMISSIONS REDUTION (2008 Baseyear)
2013 Integrated OSD NOx Emissions Reduction Using new 2010 eGrid
Tons/Ozone Season Day
Projected to 2020
12.22
18.30
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020
ESL-Single Family
ESL-Multifamily
ESL-Commercial
PUC (SB7)
SECO
Wind-ERCOT
SEER13-Single Family
SEER13-Multi Family
2013 integrated OSD NOx emissions reduction
ESL Code Compliance (0.60 tons/day)
PUC SB7 programs (1.55 tons/day)
SECO Political Sub. (0.50 tons/day)
Green Power (Wind) (9.06 tons/day)
Residential AC Retrofits (0.50 tons/day)
Total (2013) (12.22 tons/day)
2020 integrated OSD NOx emissions reduction
ESL Code Compliance (1.59 tons/day)
PUC SB7 programs (3.24 tons/day)
SECO Political Sub. (1.28 tons/day)
Green Power (Wind) (11.85 tons/day)
Residential AC Retrofits (0.35 tons/day)
Total (2020) (18.30 tons/day)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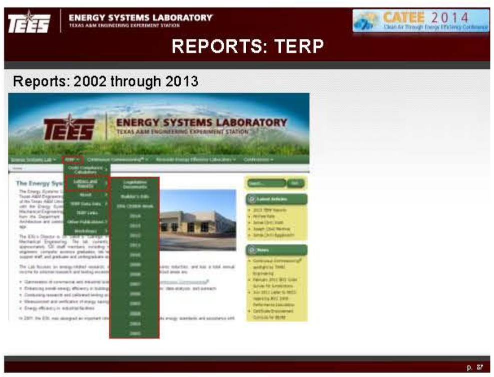
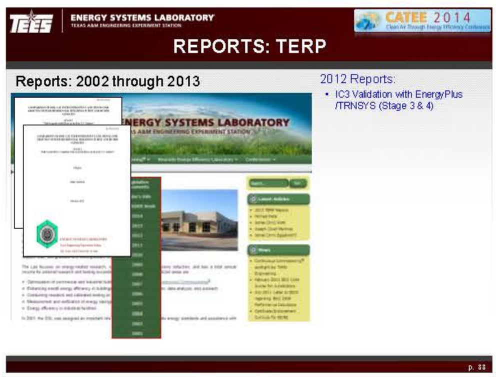
CATEE 2014
REPORTS: TERP
ESL Homepage: http://esl.eslwin.tamu.edu/
ENERGY SYSTEMS LABORATORY


ENERGY SYSTEMS LABORATORY
CATEE 2014
REPORTS: TERP
Reports: 2002 through 2013
ENERGY SYSTEMS LABORATORY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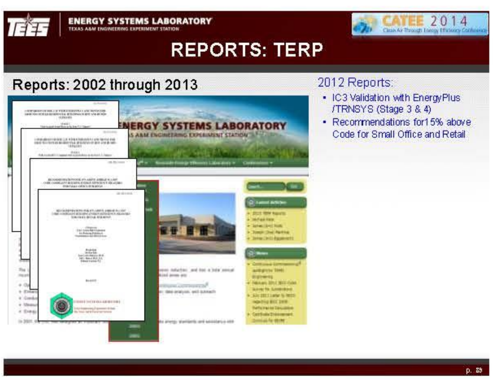
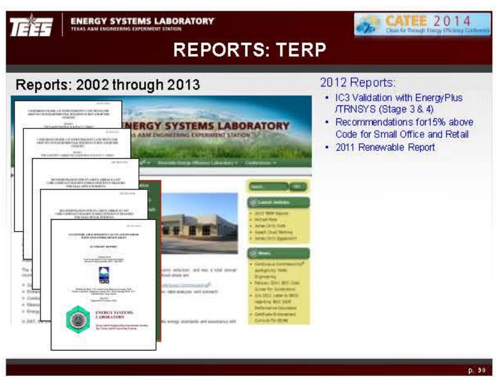
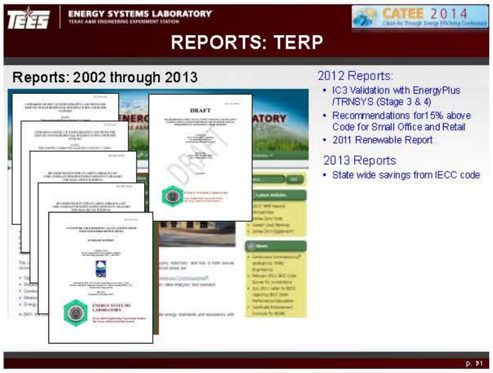
CATEE 2014
REPORTS: TERP
Reports: 2002 through 2013
2012 Reports:
IC3 Validation with EnergyPlus /TRNSYS (Stage 3 & 4)


ENERGY SYSTEMS LABORATORY
CATEE 2014
REPORTS: TERP
Reports: 2002 through 2013
2012 Reports:
IC3 Validation with EnergyPlus /TRNSYS (Stage 3 & 4)
Recommendations for15% above Code for Small Office and Retail


ENERGY SYSTEMS LABORATORY
CATEE 2014
REPORTS: TERP
Reports: 2002 through 2013
2012 Reports:
IC3 Validation with EnergyPlus /TRNSYS (Stage 3 & 4)
Recommendations for15% above Code for Small Office and Retail
2011 Renewable Report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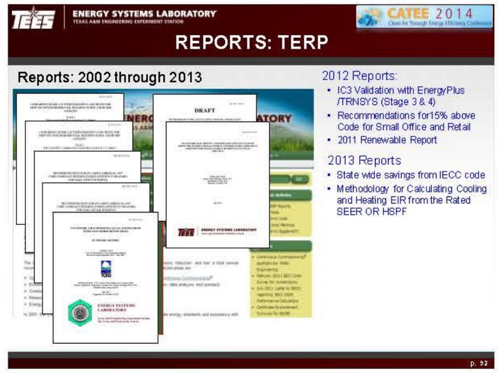
CATEE 2014
REPORTS: TERP
Reports: 2002 through 2013
2012 Reports:
• IC3 Validation with EnergyPlus /TRNSYS (Stage 3 & 4)
• Recommendations for15% above Code for Small Office and Retail
• 2011 Renewable Report
2013 Reports
• State wide savings from IECC code
DRAFT
p. 31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CATEE 2014
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Reports: 2002 through 2013
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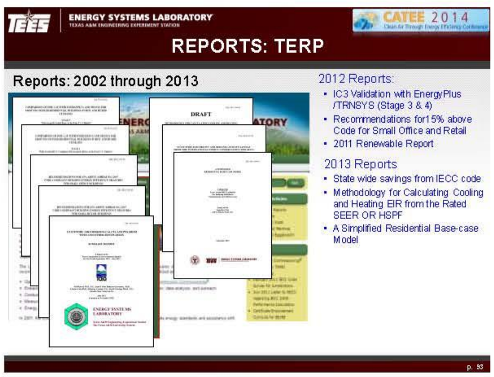
• 2011 Renewable Report
2013 Reports
• State wide savings from IECC code
• Methodology for Calculating Cooling and Heating EIR from the Rated SEER OR HSPF
DRAFT
p. 32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TEXAS A&M ENGINEERING EXPERIMENT STATION
CATEE 2014
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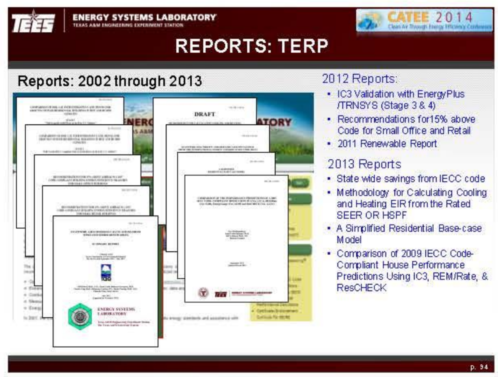
• 2011 Renewable Report
2013 Reports
• State wide savings from IECC code
• Methodology for Calculating Cooling and Heating EIR from the Rated SEER OR HSPF
• A Simplified Residential Base-case Model
DRAFT
p. 33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2013 Reports
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• Methodology for Calculating Cooling and Heating EIR from the Rated SEER OR HSPF
• A Simplified Residential Base-case Model
• Comparison of 2009 IECC Code-Compliant House Performance Predictions Using IC3, REM/Rate, & ResCHECK
DRAFT
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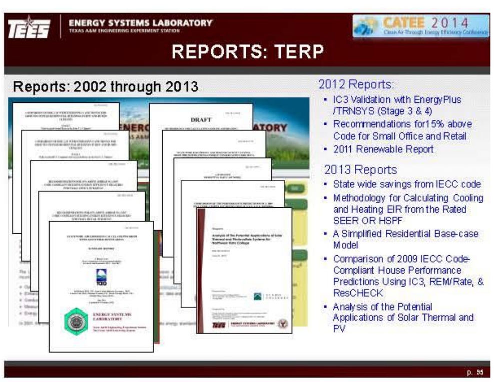
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• IC3 Validation with EnergyPlus /TRNSYS (Stage 3 & 4)
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2013 Reports
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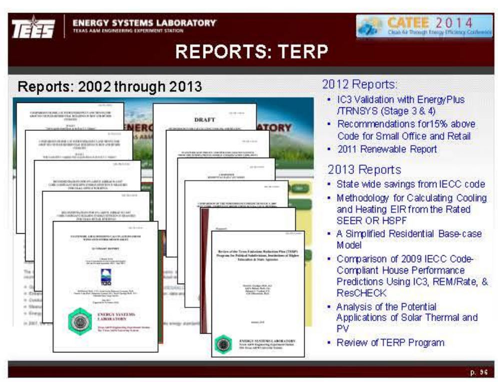
• Methodology for Calculating Cooling and Heating EIR from the Rated SEER OR HSPF
• A Simplified Residential Base-case Model
• Comparison of 2009 IECC Code-Compliant House Performance Predictions Using IC3, REM/Rate, & ResCHECK
• Analysis of the Potential Applications of Solar Thermal and PV
DRAFT
p. 35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CATEE 2014
REPORTS: TERP
Reports: 2002 through 2013
2012 Reports:
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2013 Reports
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• A Simplified Residential Base-case Model
• Comparison of 2009 IECC Code-Compliant House Performance Predictions Using IC3, REM/Rate, & ResCHECK
• Analysis of the Potential Applications of Solar Thermal and PV
• Review of TERP Program
DRAFT
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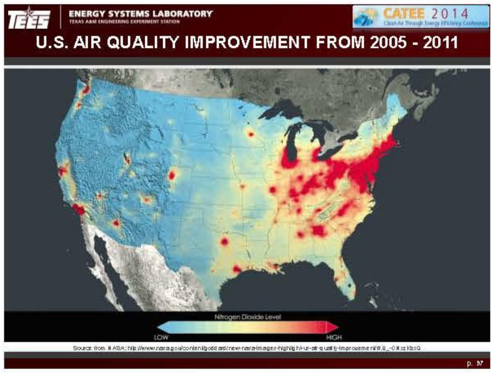
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CATEE 2014
U.S. AIR QUALITY IMPROVEMENT FROM 2005 - 2011
Nitrogen Dioxide Level
LOW
HIGH
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CATEE 2014
ESL Contact Information
Jeff Haberl: jeffhaberl@tees.tamus.edu
Bahman Yazdani: bahmanyazdani@tees.tamus.edu
http://esl.tamu.edu/terp
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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.

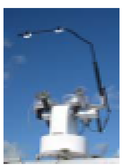
Solar World Congress 2013 ◦ Cancún, Q.R., Mexico

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.



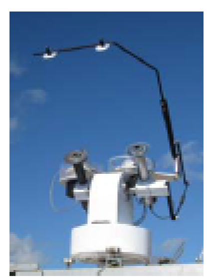
Measurement Test Rig Setup

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

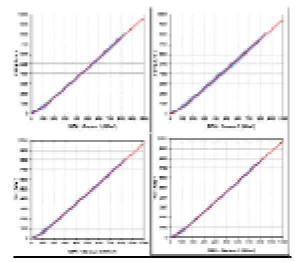
- Multi-pyranometer Array

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.

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

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.

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

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

Methodology and Improvement

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

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

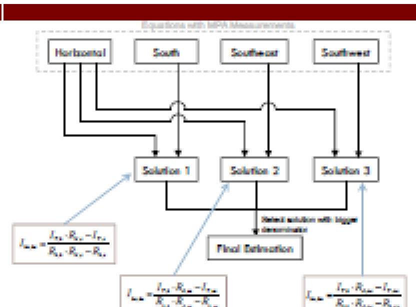
Methodology and Improvement

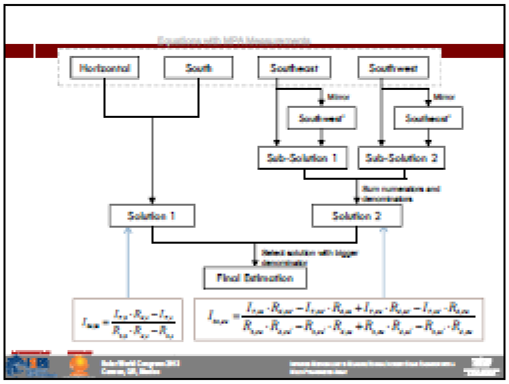
- Expression for Normal Incident solar radiation estimated by horizontal and south facing sensor.

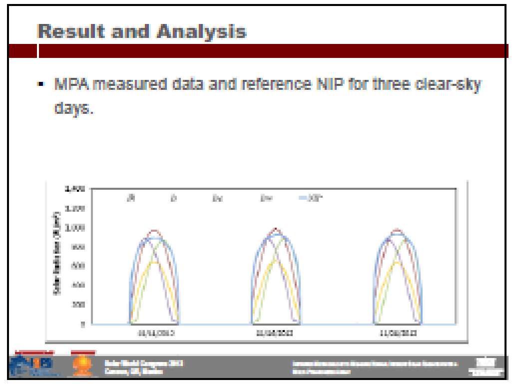
$$I_{bn,hs} = \frac{I_{T,h} \cdot R_{d,s} - I_{T,s}}{R_{b,h} \cdot R_{d,s} - R_{b,s}}$$

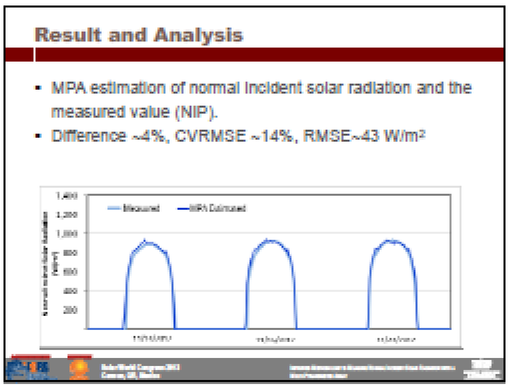
- Expression for Normal Incident solar radiation estimated using southeast and southwest facing sensor and their corresponding mirrored value.

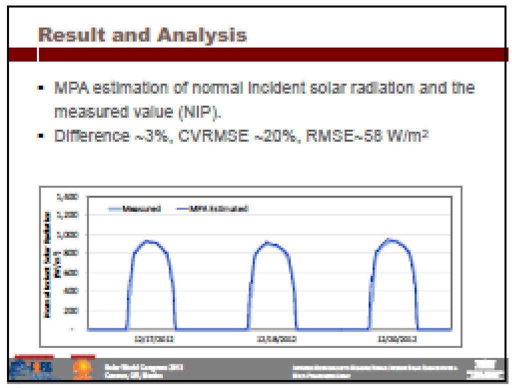
$$I_{bn} = \frac{I_{T,se} \cdot R_{d,sw'} - I_{T,sw'} \cdot R_{d,se} + I_{T,sw} \cdot R_{d,se'} - I_{T,se'} \cdot R_{d,sw}}{R_{b,se} \cdot R_{d,sw'} - R_{b,sw'} \cdot R_{d,se} + R_{b,sw} \cdot R_{d,se'} - R_{b,se'} \cdot R_{d,sw}}$$

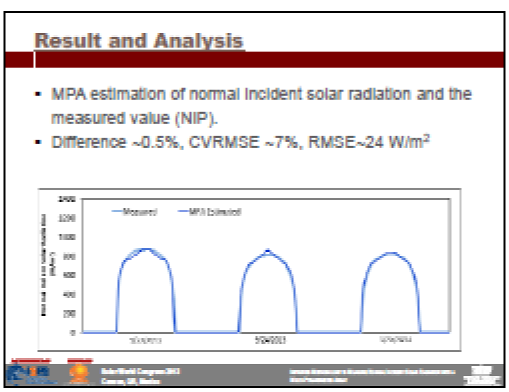


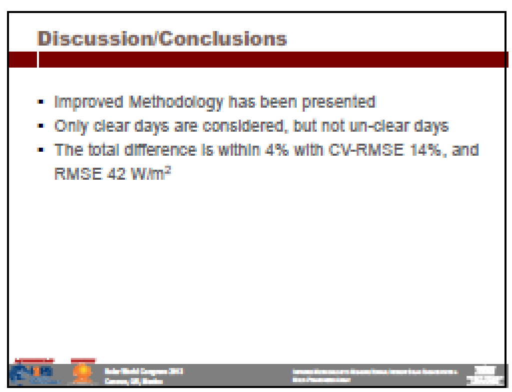

Horizontal
South
Southeast
Southwest
Mirror
Mirror
Southwest*
Southeast*
Sub-Solution 1
Sub-Solution 2
Solution 1
Solution 2
Final Estimation


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
Measured
MPA Estimated


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


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


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

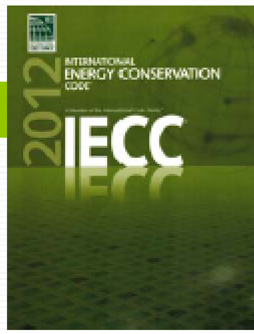
Energy Codes Specialist

Energy Systems Laboratory

Texas A&M Engineering Experiment Station

3

2012 IECC



Agenda

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

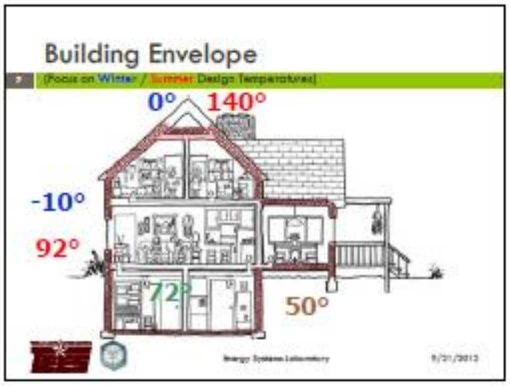
Seminar Goal

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

Seminar Objectives

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°
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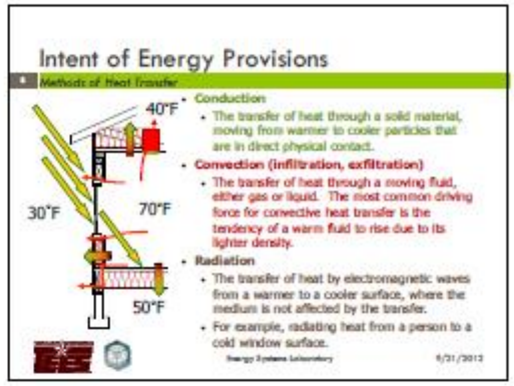
Intent of Energy Provisions
Methods of Heat Transfer
40°F
30°F
70°F
50°F
Conduction
The transfer of heat through a solid material, moving from warmer to cooler particles that are in direct physical contact.
Convection (infiltration, exfiltration)
The transfer of heat through a moving fluid, either gas 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.
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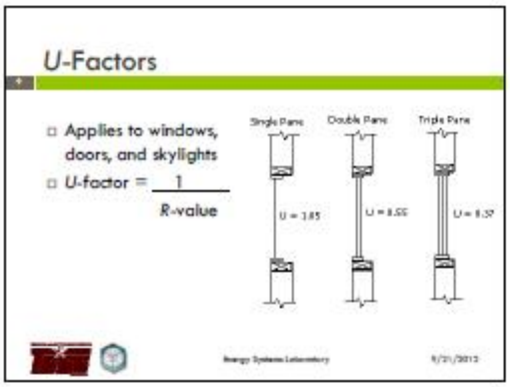
U-Factors
Applies to windows, doors, and skylights
U-factor = 1 / R-value
Single Pane
Double Pane
Triple Pane
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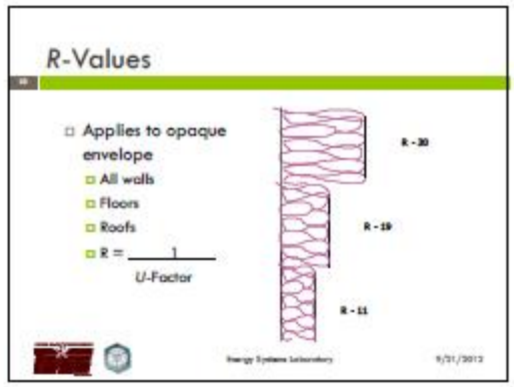
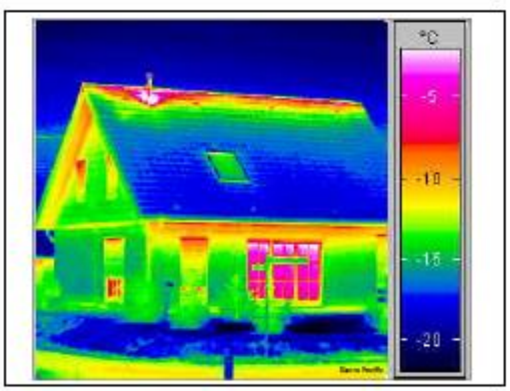

R-Values
Applies to opaque envelope
All walls
Floors
Roofs
R = 1 / U-Factor
R - 30
R - 19
R - 11
Energy Systems Laboratory


°C
-5
-10
-15
-20


2012 IECC
ENERGY CONSERVATION
2012
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
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El Paso Adoption

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El Paso Details

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

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Objectives of the Code

The following are regulated:

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

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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

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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

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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

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Chapter 4 (CE) – Table C402.2

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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*

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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

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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.

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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

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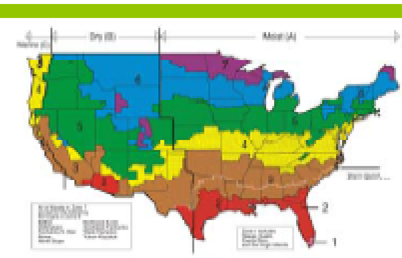
Three separate moisture regimes overlay the eight climate zones



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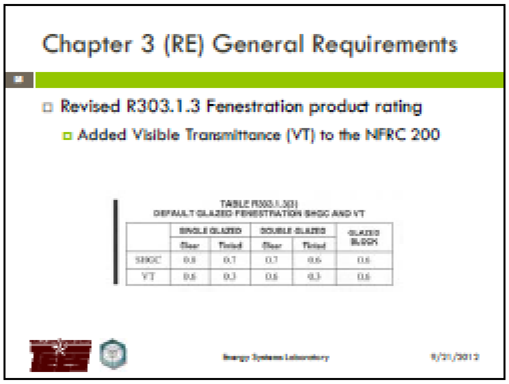
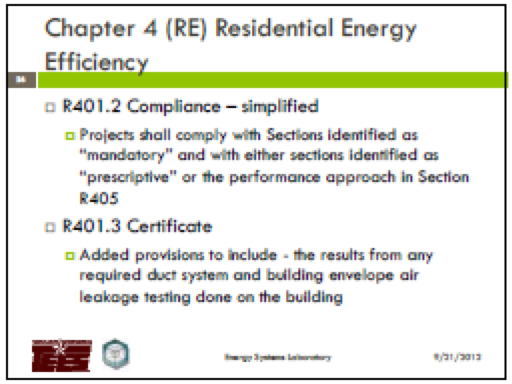
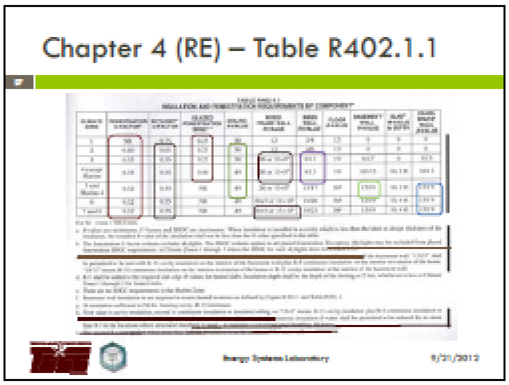
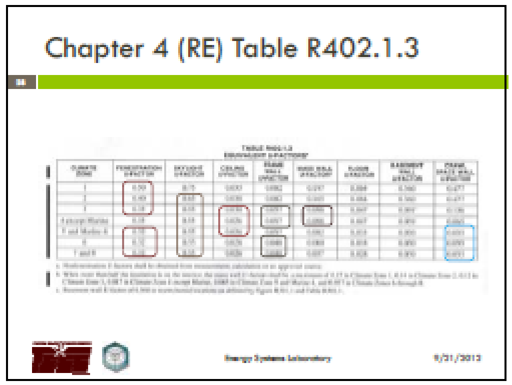
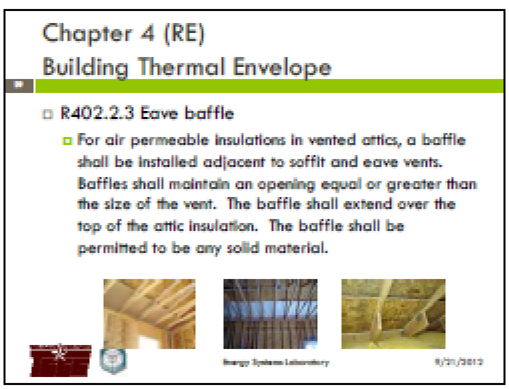


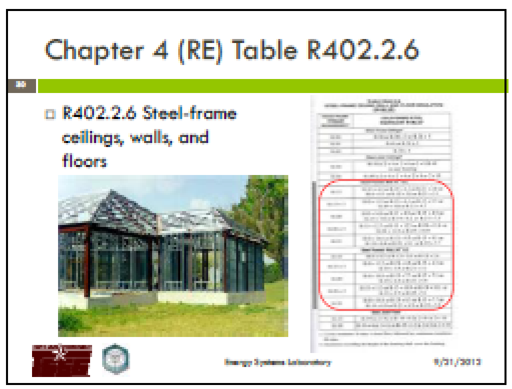
	SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
	Clear	Tinted	Clear	Tinted	
SHGC	0.8	0.7	0.7	0.6	0.6
VT	0.6	0.3	0.6	0.3	0.6



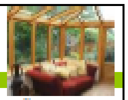








Chapter 4 (RE) Building Thermal Envelope



- 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

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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

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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

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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

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Chapter 4 (RE) Building Thermal Envelope

- R402.4.1.1 Installation.

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Chapter 4 (RE) Table R402.4.1.1

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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

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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~~

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Chapter 4 (RE) Air Leakage

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

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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~~

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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)

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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

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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

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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

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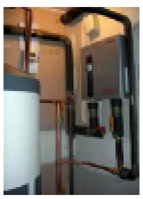
Chapter 4 (RE) Systems

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



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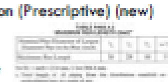
Chapter 4 (RE) Systems

- 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



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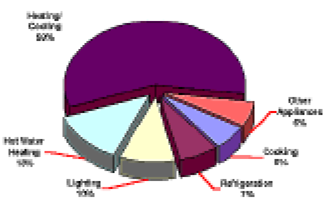
Where Your Energy Goes



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Chapter 4 (RE) Systems

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

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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

TABLE R403.5.1
MECHANICAL VENTILATION SYSTEM FAN EFFICACY

FAN LOCATION	AIR FLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY (CFM/WATT)	AIR FLOW RATE MAXIMUM (CFM)
Range hoods	Any	2.8 cfm/watt	Any
In-line fan	Any	2.8 cfm/watt	Any
Bathroom, utility room	10	1.4 cfm/watt	< 90
Bathroom, utility room	90	2.8 cfm/watt	Any

For SI: 1 cfm = 28.3 L/min.

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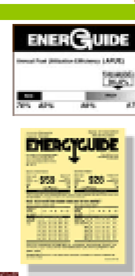
Terminology



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

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HVAC Efficiency Requirements

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

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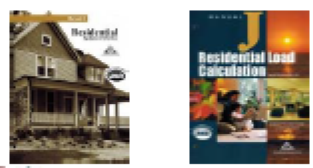
Chapter 4 (RE) Systems

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



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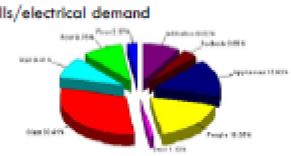
HVAC Sizing

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



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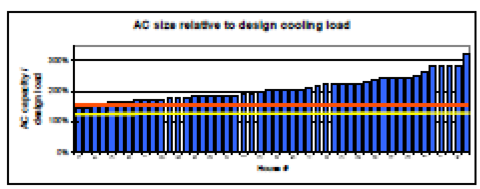
Equipment Sizing – Case Study

Average AC size ~ 2x what's needed



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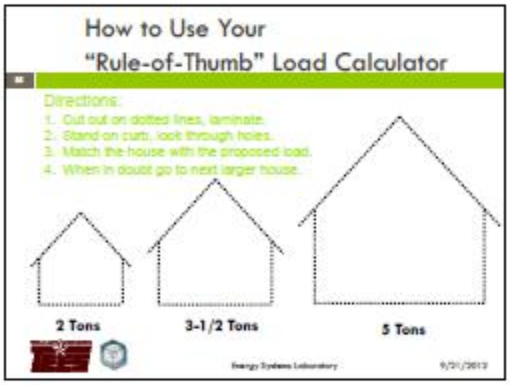
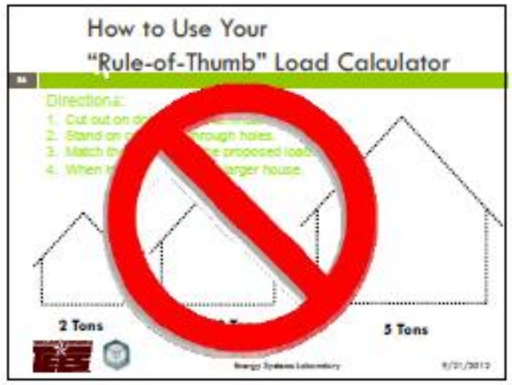

How to Use Your
"Rule-of-Thumb" Load Calculator
Directions:
1. Cut out on dotted lines, laminate.
2. Stand on curb, look through holes.
3. Match the house with the proposed load.
4. When in doubt go to next larger house.
2 Tons
3-1/2 Tons
5 Tons


How to Use Your
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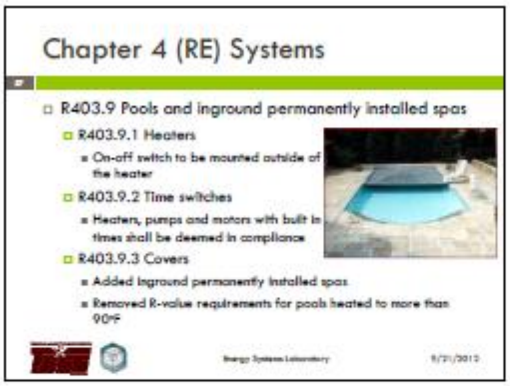
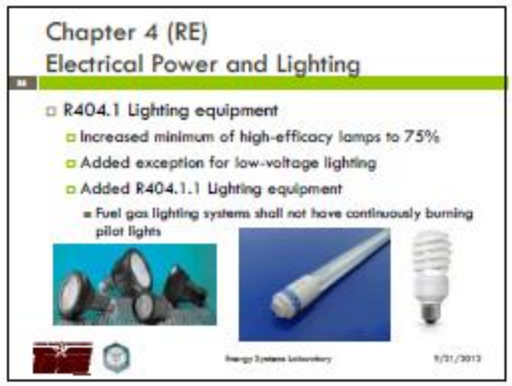
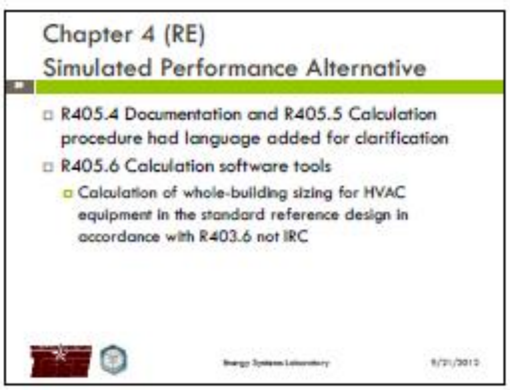
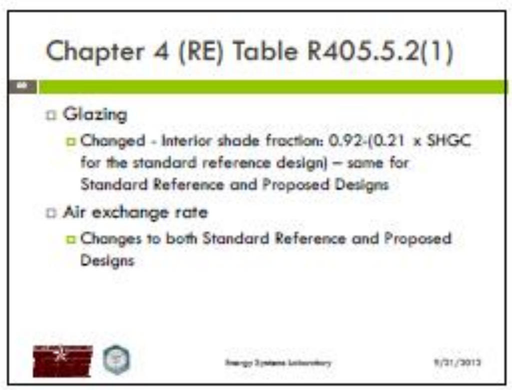
5 Tons


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 90ºF


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

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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)

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Chapter 5 (RE) Referenced Standards

- No changes

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2009 IECC®
Commercial Provisions

Based on the 2009 International Energy Conservation Code

Shirley Ellis
Codes Specialist
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Energy Systems Laboratory
Texas A&M Engineering Experiment Station
Texas A&M University System

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.

"Building Professional Institute" is a Registered Provider with The American Institute of Architects Continuing Education Systems. Credit earned on completion of this program will be reported to CES Records for AIA members. Certificates of Completion for non-AIA members are available on request.

This program is registered with the AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product. Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

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.

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.

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

Energy Systems Laboratory 7

Objectives of the Code

The following are regulated:

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

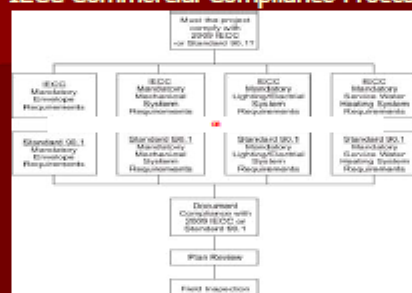
Energy Systems Laboratory 8

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

Energy Systems Laboratory 9

IECC Commercial Compliance Process



Energy Systems Laboratory 10

Chapter 1 Administration and Enforcement

Energy Systems Laboratory

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

Energy Systems Laboratory 12


101 – Scope and General Requirements
Newly Conditioned Space – New Buildings
New Construction - Hotel
Energy Systems Laboratory


101 – Scope and General Requirements
Newly Conditioned Space – Previously Unconditioned
Energy Systems Laboratory


101 – Scope and General Requirements
101.3 – Intent
Life safety, health and environmental requirements take precedence over energy provisions.
1st
2nd
Energy Systems Laboratory


101 – Scope and General Requirements
▪ 101.4 – Applicability
▪ 101.4.2 – Historic buildings
Energy Systems Laboratory


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.
Energy Systems Laboratory


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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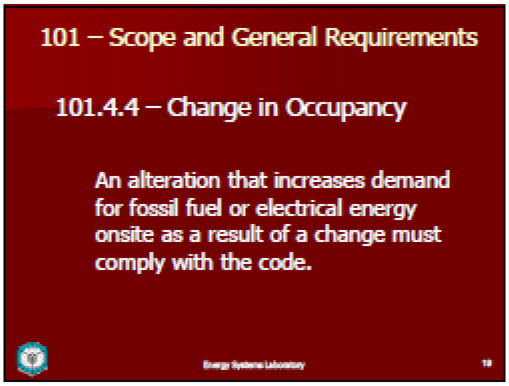
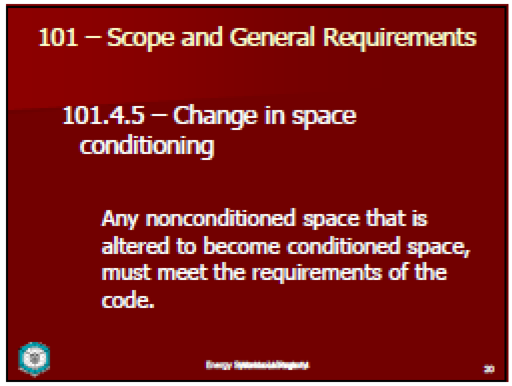
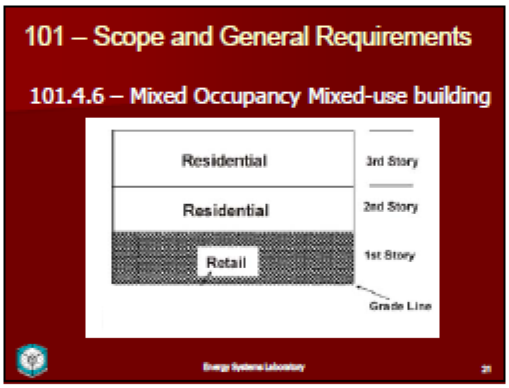
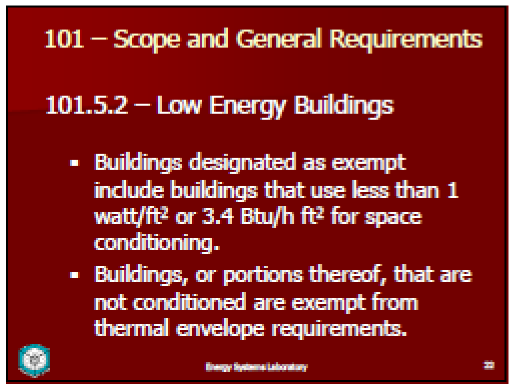
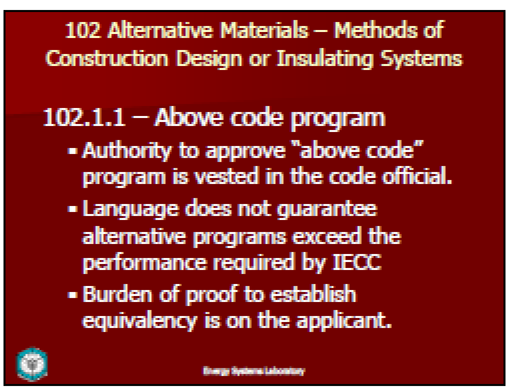
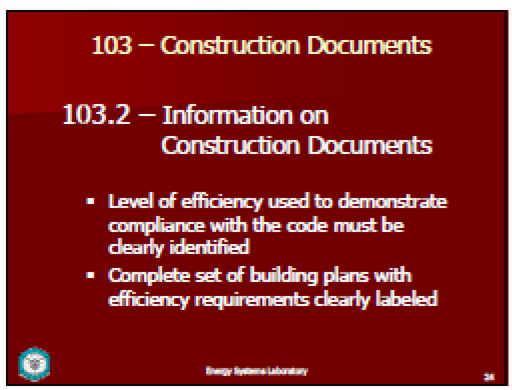

101 – Scope and General Requirements
101.4.4 – Change in Occupancy
An alteration that increases demand for fossil fuel or electrical energy onsite as a result of a change must comply with the code.

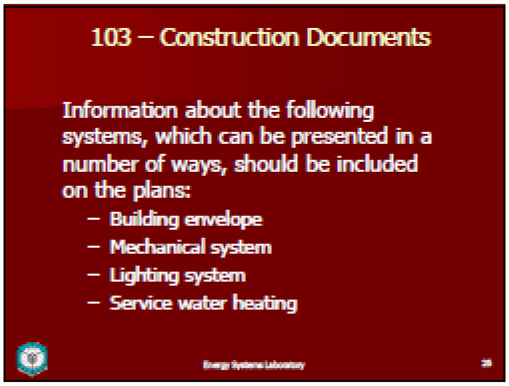

101 – Scope and General Requirements
101.4.5 – Change in space conditioning
Any nonconditioned space that is altered to become conditioned space, must meet the requirements of the code.

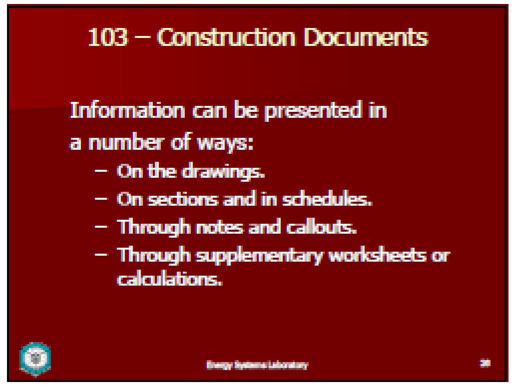

101 – Scope and General Requirements
101.4.6 – Mixed Occupancy Mixed-use building
Residential
Residential
Retail
3rd Story
2nd Story
1st Story
Grade Line

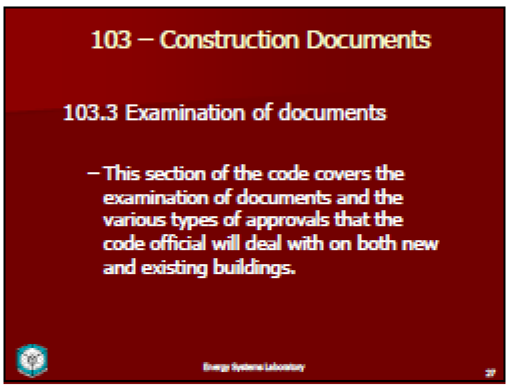

101 – Scope and General Requirements
101.5.2 – Low Energy Buildings
Buildings designated as exempt include buildings that use less than 1 watt/ft² or 3.4 Btu/h ft² for space conditioning.
Buildings, or portions thereof, that are not conditioned are exempt from thermal envelope requirements.

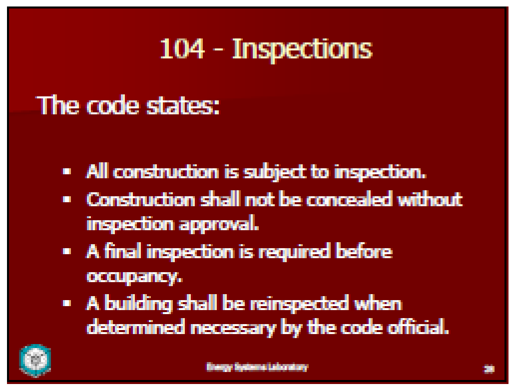

102 Alternative Materials – Methods of Construction Design or Insulating Systems
102.1.1 – Above code program
Authority to approve "above code" program is vested in the code official.
Language does not guarantee alternative programs exceed the performance required by IECC
Burden of proof to establish equivalency is on the applicant.

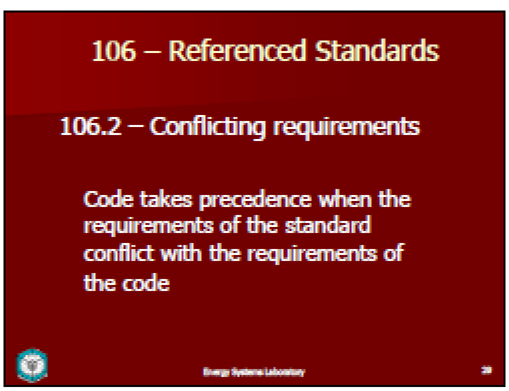

103 – Construction Documents
103.2 – Information on Construction Documents
Level of efficiency used to demonstrate compliance with the code must be clearly identified
Complete set of building plans with efficiency requirements clearly labeled

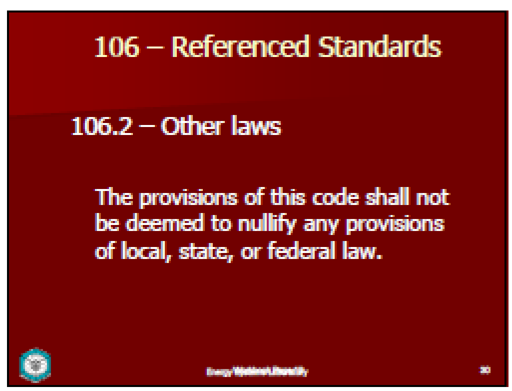

103 – Construction Documents
Information about the following systems, which can be presented in a number of ways, should be included on the plans:
– Building envelope
– Mechanical system
– Lighting system
– Service water heating


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

Energy Systems Laboratory

202 – General Definitions

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

Energy Systems Laboratory

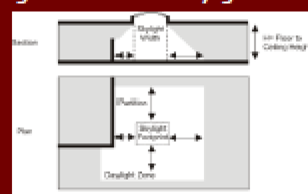
202 – New Definitions

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

Energy Systems Laboratory

202 – General Definitions

- Day light Zone Under Skylight



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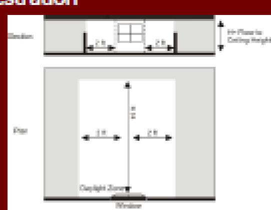
202 – General Definitions

- Day light Zone Adjusted to Vertical Fenestration



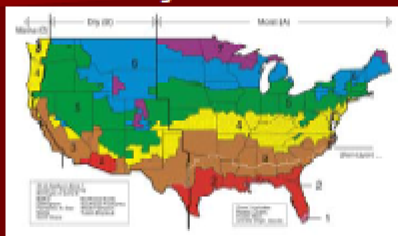
Energy Systems Laboratory

Chapter 3
Design Conditions

Energy Systems Laboratory

Design Conditions

Three separate moisture regimes overlay the eight climate zones



303 – Materials, Systems, and Equipment

303.1 – Identification

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

303 – Materials, Systems, and Equipment

303.1.3 – Fenestration product rating

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	SKYLIGHT 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

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

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

Chapter 5 Commercial Energy Efficiency

Energy Systems Laboratory

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.

Energy Systems Laboratory

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

Energy Systems Laboratory

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

Energy Systems Laboratory

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

Energy Systems Laboratory

502 - Building Envelope Requirements

The building envelope requirements focus on three types of provisions:

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

Energy Systems Laboratory

502 - Building Envelope Requirements

502.2 – Specific insulation requirements (prescriptive)

Based on:
- Climate zone
- Window wall ratio and
- Construction assembly

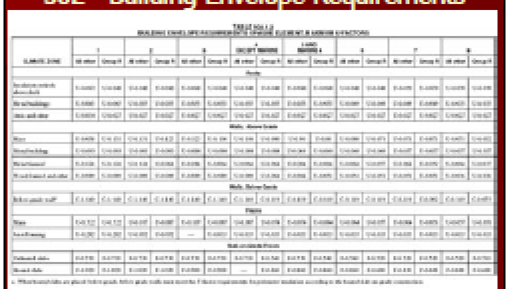
All components must meet or exceed building envelope requirements.

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

502 - Building Envelope Requirements



502 - Building Envelope Requirements

Metal buildings

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.

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

Energy Systems Laboratory

502 - Building Envelope Requirements

TABLE 502.3
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration (40% maximum of above-grade wall)								
U-factor								
Framing materials other than metal with or without metal reinforcement or cladding								
U-factor	1.20	0.75	0.65	0.40	0.35	0.35	0.35	0.35
Metal framing with or without thermal break								
Curtain wall/storefront U-factor	1.0	0.70	0.60	0.50	0.45	0.45	0.40	0.40
Entrance door U-factor	1.20	1.10	0.90	0.85	0.80	0.80	0.80	0.80
All other U-factor[a]	1.20	0.75	0.65	0.55	0.55	0.55	0.45	0.45
SHGC-all frame types								
SHGC: PF < 0.25	0.25	0.25	0.25	0.40	0.40	0.40	0.45	0.45
SHGC: 0.25 ≤ PF < 0.5	0.33	0.33	0.33	NR	NR	NR	NR	NR
SHGC: PF ≥ 0.5	0.40	0.40	0.40	NR	NR	NR	NR	NR
Skylights (3% maximum)								
U-factor	0.75	0.75	0.65	0.60	0.60	0.60	0.60	0.60
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No requirement.
PF = Projection factor (see Section 502.3.2).
a. All others includes operable windows, fixed windows and nonentrance doors.

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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

Energy Systems Laboratory

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.

Energy Systems Laboratory

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

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502.4.6 Loading Dock Weatherseals

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

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502 - Building Envelope Requirements

502.4.7 – Vestibules

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502 – Building Envelope Requirements

502.4.8 – Recessed luminaries

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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.

Energy Systems Laboratory

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

Energy Systems Laboratory

503 - Building Mechanical Systems

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

Energy Systems Laboratory

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.

Energy Systems Laboratory

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.

Energy Systems Laboratory

503 – Building Mechanical Systems

503.2.3 – HVAC equipment performance requirements

- Equipment efficiency

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

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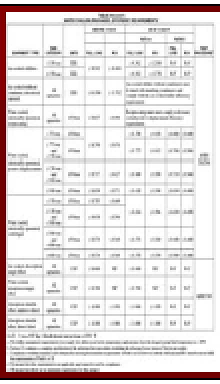
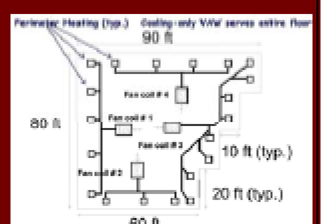


503.2.4 – HVAC system controls

503.2.4.1 – Thermostatic controls



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503 – Building Mechanical Systems

503.2.4.4 – Shutoff damper controls

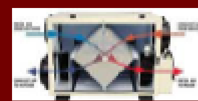
503.2.4.5 – Snow melt system controls

503.2.5 –Ventilation

503 – Building Mechanical Systems

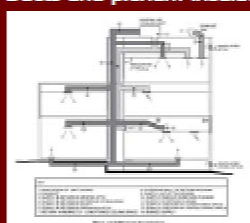
503.2.5.1 – Demand control ventilation

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.

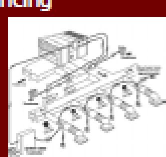
TABLE 503.2.8
MINIMUM PIPE INSULATION
(thickness in inches)

FLUID	NOMINAL PIPE DIAMETER	
	≤ 1.5"	> 1.5"
Steam	1½	3
Hot water	1½	2
Chilled water, brine or refrigerant	1½	1½

503 – Building Mechanical Systems

503.2.9 – HVAC system completion

503.2.9.1 – Air system balancing

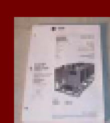


503 – Building Mechanical Systems

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.

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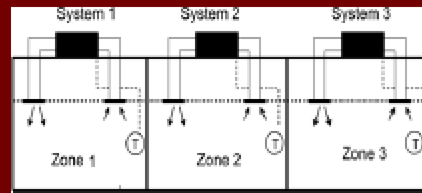
503 – Building Mechanical Systems

503.3 – Simple HVAC systems and equipment



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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.

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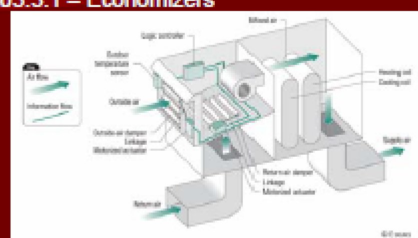
503 – Building Mechanical Systems

503.3.1 – Economizers



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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.

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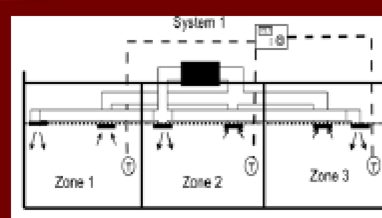
503 – Building Mechanical Systems

503.4 – Complex HVAC systems and equipment



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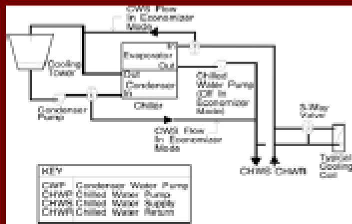
503 – Building Mechanical Systems

503.4.1 – Economizers



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503 – Building Mechanical Systems

503.4.2 – Variable air volume (VAV) fan control

Individual VAV fan motors $\geq$10 Hp (7.5 kW)

– Driven by mechanical or electrical variable speed drive,

or

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

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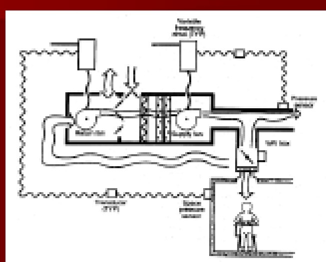
Variable Air Volume



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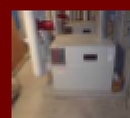
503 – Building Mechanical Systems

503.4.3 – Hydronic systems controls

503.4.3.1 – Three-pipe systems

503.4.3.2 – Two-pipe changeover system

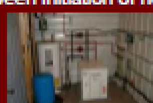


Energy Systems Laboratory

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.



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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.

Energy Systems Laboratory


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
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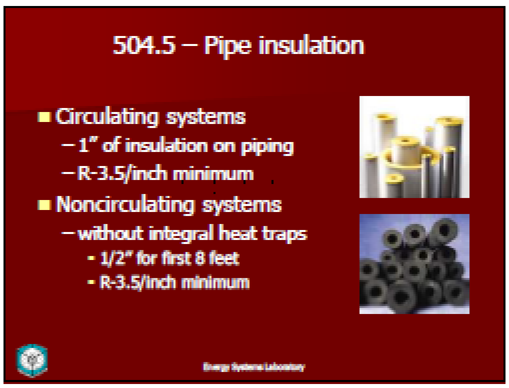
504 – Service Water Heating
504.4 – Heat traps
Heat Trap
Heat Trap
Insulation
CWS Inlet
SHW Outlet
Manufactured Heat Trap Device
Energy Systems Laboratory


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
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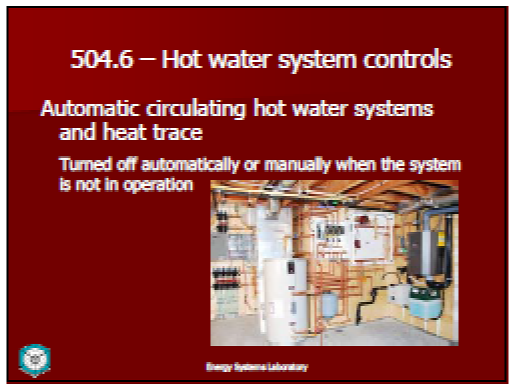
504.6 – Hot water system controls
Automatic circulating hot water systems and heat trace
Turned off automatically or manually when the system is not in operation
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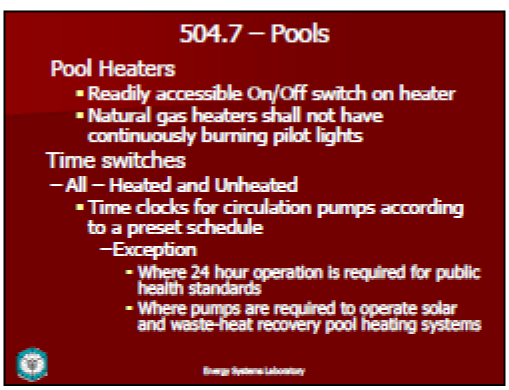
504.7 – Pools
Pool Heaters
▪ Readily accessible On/Off switch on heater
▪ Natural gas heaters shall not have continuously burning pilot lights
Time switches
– All – Heated and Unheated
▪ Time clocks for circulation pumps according to a preset schedule
– Exception
▪ Where 24 hour operation is required for public health standards
▪ Where pumps are required to operate solar and waste-heat recovery pool heating systems
Energy Systems Laboratory


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
Energy Systems Laboratory

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.

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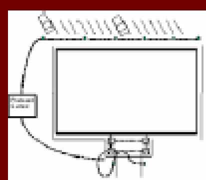
505 – Electrical Power and Lighting Systems

505.2.3 – Sleeping units

Energy Systems Laboratory 104

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

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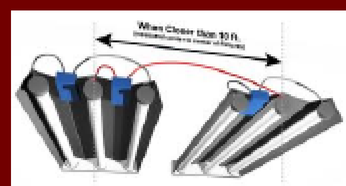
505 – Electrical Power and Lighting Systems

505.3 – Tandem wiring



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505 – Electrical Power and Lighting Systems

505.4 – Exit signs

Energy Systems Laboratory 107

505 – Electrical Power and Lighting Systems

505.5 – Interior lighting power requirement

505.5.1 – Total connected interior lighting power

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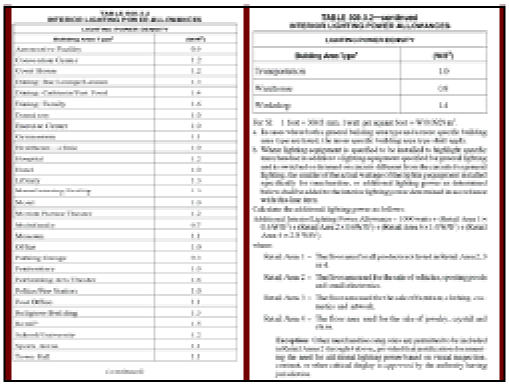
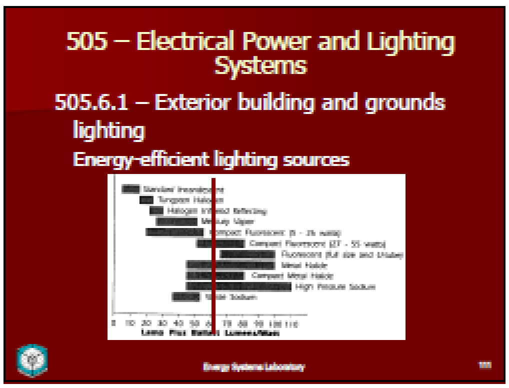
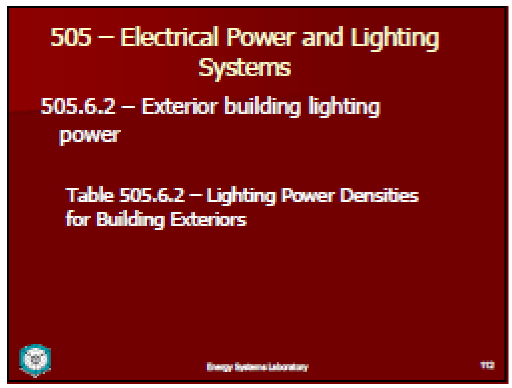



505 – Electrical Power and Lighting Systems
Additional Lighting Power Allowances
Table 505.5.2, Note b – Merchandise Display
Merchandise Display - (Note b)
The additional lighting allowance for merchandise display lighting applies to:
Retail sales
Energy Systems Laboratory
110


505 – Electrical Power and Lighting Systems
505.6.1 – Exterior building and grounds lighting
Energy-efficient lighting sources
Standard Incandescent
Tungsten Halogen
Halogen Infrared Reflecting
Mercury Vapor
Compact Fluorescent (5 - 26 watts)
Compact Fluorescent (27 - 55 watts)
Fluorescent (full size and U-tube)
Metal Halide
Compact Metal Halide
High Pressure Sodium
White Sodium
Lamp Plus Ballast Lumens/Watt
Energy Systems Laboratory
111


505 – Electrical Power and Lighting Systems
505.6.2 – Exterior building lighting power
Table 505.6.2 – Lighting Power Densities for Building Exteriors
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112


113


506 – Total Building Performance
506.1 – General
The Total Building Performance Method allows trade-offs among the building envelope, mechanical systems, and lighting systems in commercial buildings.
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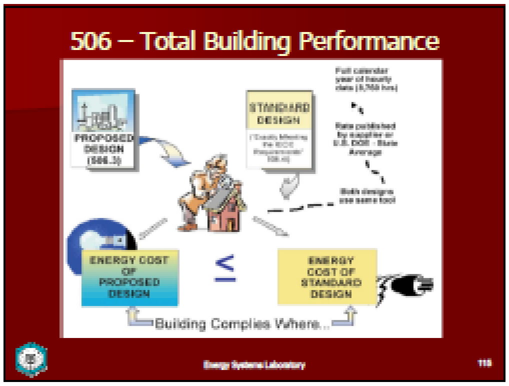
114


506 – Total Building Performance
Full calendar year of hourly data (8,760 hrs)
STANDARD DESIGN
PROPOSED DESIGN (506.3)
Rate published by supplier or U.S. DOE - State Average
Both designs use same tool
ENERGY COST OF PROPOSED DESIGN
≤
ENERGY COST OF STANDARD DESIGN
Building Complies Where...
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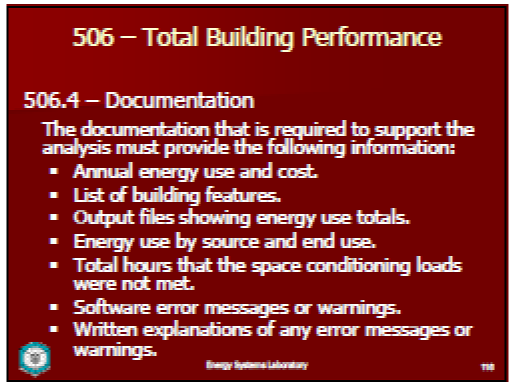
506 – Total Building Performance
506.4 – Documentation
The documentation that is required to support the analysis must provide the following information:
▪ Annual energy use and cost.
▪ List of building features.
▪ Output files showing energy use totals.
▪ Energy use by source and end use.
▪ Total hours 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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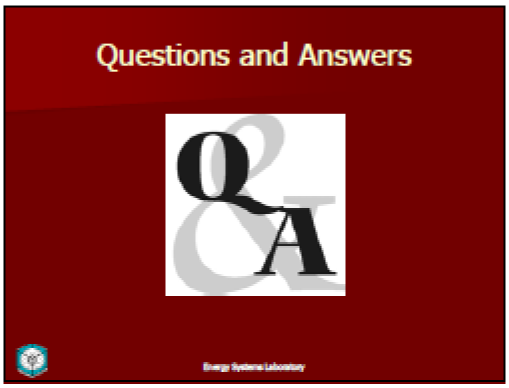
Questions and Answers
Q&A
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Energy Systems Laboratory
Texas A&M Engineering Experiment Station
Texas A&M University System

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CODES SPECIALIST

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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.

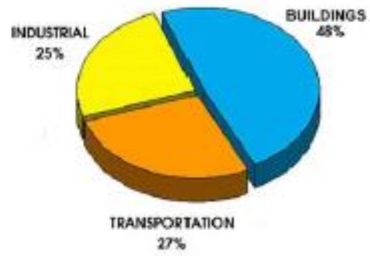
OBJECTIVES

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

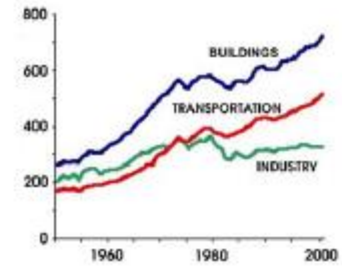
- Locate general topics in the 2009 IECC
- Locate applicable tables in the 2009 IECC for specific situations
- Apply code requirements to real-world situations
- Explain the intent behind a code requirement
- Identify borderline scenarios as compliant or noncompliant
- Identify essential code compliant 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



U.S. ENERGY CONSUMPTION



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

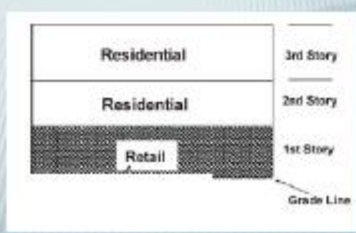
101.4.4 – Change in Occupancy

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

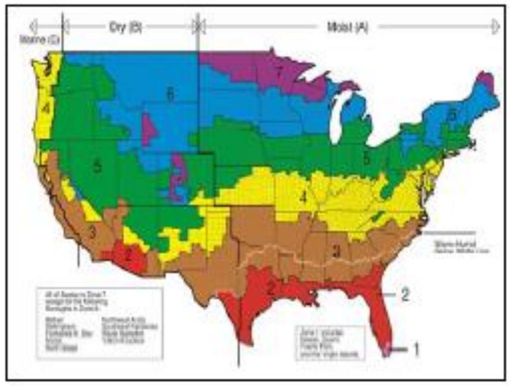
NEW DEFINITIONS

- 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		GLAZED BLOCK
Clear	Tinted	Clear	Tinted	
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 402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION U-FACTOR[b]	SKYLIGHT[b] U-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE[i]	FLOOR R-VALUE	BASEMENT[c] WALL R-VALUE	SLAB[d] R-VALUE & DEPTH	CRAWL SPACE[c] WALL R-VALUE
1	1.2	0.75	0.30	30	13	3/4	13	0	0	0
2	0.65[j]	0.75	0.30	30	13	4/6	13	0	0	0
3	0.50[j]	0.65	0.30	30	13	5/8	19	5/13[f]	0	5/13
4 except Marine	0.35	0.60	NR	38	13	5/10	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.35	0.60	NR	38	20 or 13+5[h]	13/17	30[g]	10/13	10, 2 ft	10/13
6	0.35	0.60	NR	49	20 or 13+5[h]	15/19	30[g]	15/19	10, 4 ft	10/13
7 and 8	0.35	0.60	NR	49	21	19/21	38[g]	15/19	10, 4 ft	10/13

For SI: 1 foot = 304.8 mm.

a. [illegible]
b. The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
c. [illegible]
d. [illegible]
e. There are no SHGC requirements in the Marine Zone.
f. Basement wall insulation is not required in warm-humid locations as defined by Figure 301.1 and Table 301.1.
g. Or insulation sufficient to fill the framing cavity, R-19 minimum.
h. [illegible]
i. The second R-value applies when more than half the insulation is on the interior of the mass wall.
j. [illegible]

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[d]	CRAWL SPACE WALL U-FACTOR[c]
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	0.059	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 a maximum of 0.17 in Zone 1, 0.14 in Zone 2, 0.12 in Zone 3, 0.10 in Zone 4 except Marine, and the same as the frame wall U-factor in Marine Zone 4 and Zones 5 through 8.
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 shown in Table 402.1.3 include wall construction and interior air films but exclude soil conductivity and exterior air films. U-factors for determining code compliance in accordance with Section 402.1.4 (total UA alternative) of Section 405 (Simulated Performance Alternative) shall be modified to include soil conductivity and exterior air films.

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.

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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

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SAMPLE CALCULATION—WALLS

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

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

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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

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402.2.1 – CEILINGS WITH ATTIC SPACES
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EXAMPLES OF WALL INSULATION
Blown-in, Loose-fill insulation
Unfaced-batt insulation
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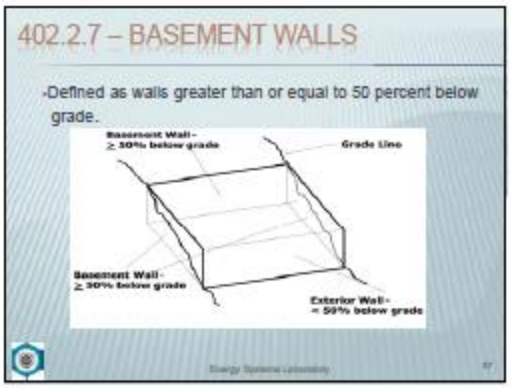
402.2.7 – BASEMENT WALLS
-Defined as walls greater than or equal to 50 percent below grade.
Basement Wall-
≥ 50% below grade
Grade Line
Basement Wall-
≥ 50% below grade
Exterior Wall-
< 50% below grade
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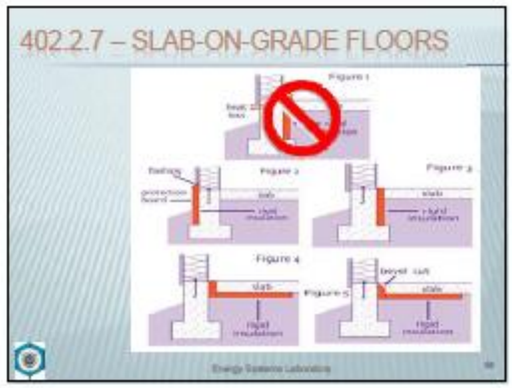
402.2.7 – SLAB-ON-GRADE FLOORS
Figure 1
Figure 2
Figure 3
Figure 4
Figure 5
slab
rigid insulation
bevel cut
Energy Systems Laboratory


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
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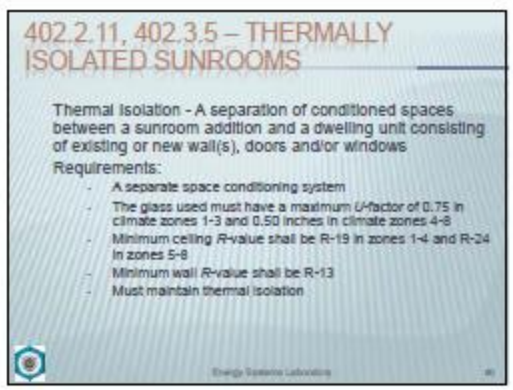
402.2.11, 402.3.5 – THERMALLY ISOLATED SUNROOMS
Thermal Isolation - A separation of conditioned spaces between a sunroom addition and a dwelling unit consisting of existing or new wall(s), doors and/or windows
Requirements:
- A separate space conditioning system
- The glass used must have a maximum U-factor 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
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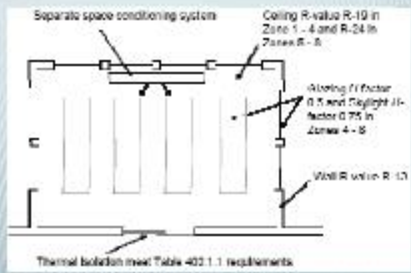
THERMALLY ISOLATED SUNROOMS



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

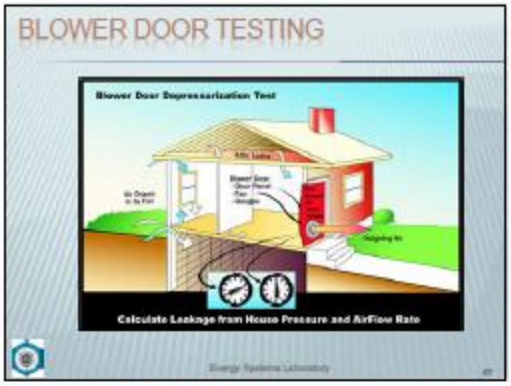
- Building envelope air tightness and insulation shall be demonstrated in one of two ways.

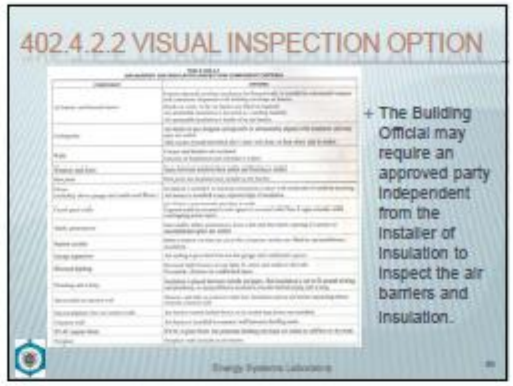
402.4.2.1 TESTING OPTION

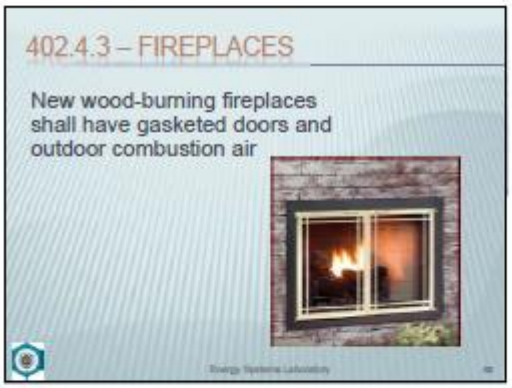
Requires testing at specific air changes per hour at a specific air pressure

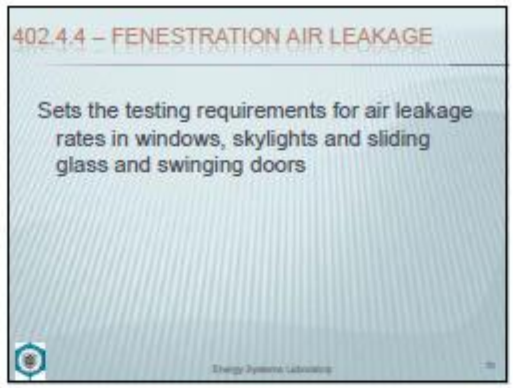
There are seven requirements

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.

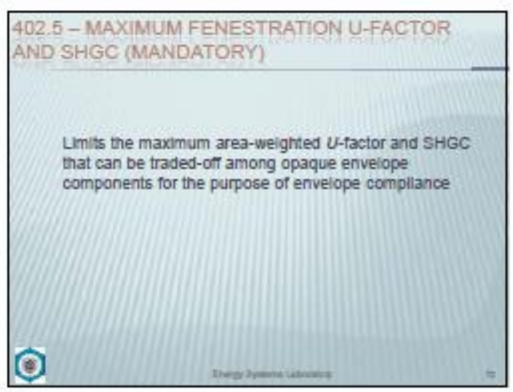

BLOWER DOOR TESTING
Blower Door Depressurization Test
Calculate Leakage from House Pressure and AirFlow Rate
Energy Systems Laboratory


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.
Energy Systems Laboratory


402.4.3 – FIREPLACES
New wood-burning fireplaces shall have gasketed doors and outdoor combustion air
Energy Systems Laboratory


402.4.4 – FENESTRATION AIR LEAKAGE
Sets the testing requirements for air leakage rates in windows, skylights and sliding glass and swinging doors
Energy Systems Laboratory


402.4.5 – RECESSED LIGHTING
Air Leakage Through Recessed Can Lights
Energy Systems Laboratory


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
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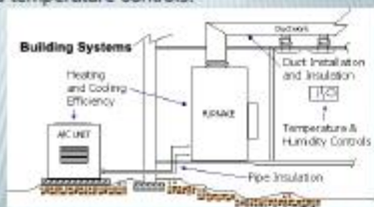
403 – BUILDING SYSTEMS

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



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THERMOSTAT AND CONTROLS

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

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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.

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403.4 – CIRCULATING HOT WATER

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

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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

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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

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403.8 - SNOWMELT SYSTEMS

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

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

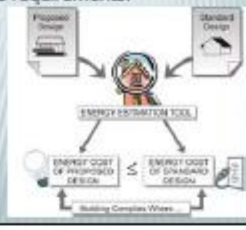
- Heated pools shall have a vapor-retardant pool cover on or at the water surface
- Pools heated to more than 90ºF shall have a R-12 min value pool cover
- Exception
  - Pools deriving over 60 percent of the energy for heating from site-recovered or solar energy source

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.

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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

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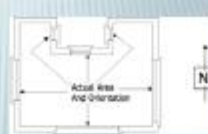
TABLE 405.5.2(1) – GLAZING



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DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES
Proposed Design
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QUESTIONS AND ANSWERS
Q
&
A
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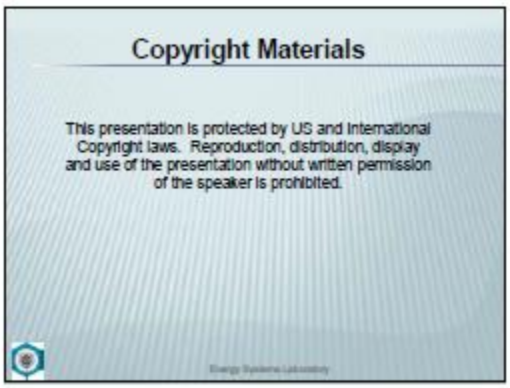
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Conference Paper Session 20 – New Professional Skills, Codes and Ethics

Verification of the Energy Savings from the Implementation of the Residential Building Codes in Texas

2014 ASHRAE Annual Conference Seattle

Learning Objectives

- Describe how the Water Efficiency sections of ASHRAE Standard 189.1 and the IGCC impact the design of evaporative cooling towers.
- Understand the importance of cycles of concentration and its control as the single best method to conserve water.
- Become familiar with the Codes of Ethics published by ASHRAE and state engineering license boards.
- Give real-world examples of conflicts of interest and reasons why engineers must avoid them.
- Know a methodology that help to verify residential energy savings from the implementation of energy codes.
- Learn how to apply inverse methodologies to characterize the residential energy use..

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2

Outline/Agenda

- Background
- Methodology
  - Sample of houses
    - Climate Zones
  - Energy Modeling
    - Data Driven Techniques
- Results
- Summary

3

Background

- Texas Emission Reduction Program - NOx
  - Verify the savings that are obtained by the application of residential energy codes.

4

Methodology - Sample

- Three groups of at least two dozens of houses built
  - Before 2000/2001
  - Before 2006 /After 2000/2001
  - After 2006

5

Sample - Main Characteristics

- Three groups of residential houses located in the same city in nearby neighborhoods; each one corresponding to a period when the codes were adopted in the city
- Houses were built by the same builder to reduce the impact of different construction practices, and to maintain same quality in the material selection

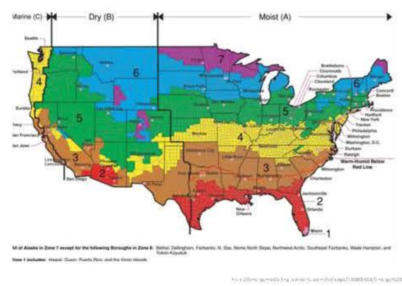
6

1

Sample - Main Characteristics

- Each group originally include at least twenty-four houses
- At least one coincident year (12 monthly utility bills) of energy data for each house in each group
- All houses used electricity for the air-conditioning and natural gas for heating and domestic hot water (DHW)

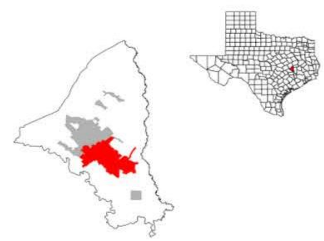
Sample – Climate Zones



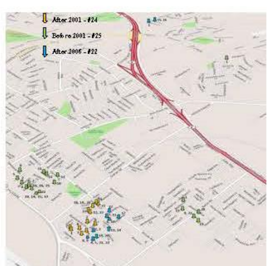
Sample – Climate Zones

https://energycode.pnl.gov/EnergyCodeReqs/?state=Texas

Sample - Locations



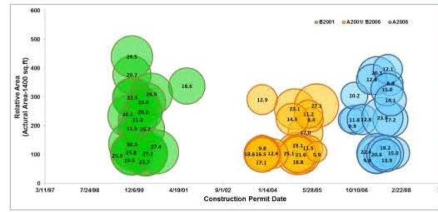
Sample - Locations



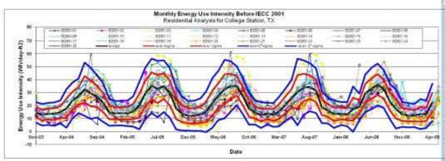
Sample - Residential Style

Sample - Residential Style

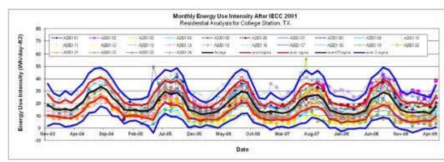
Sample - Description



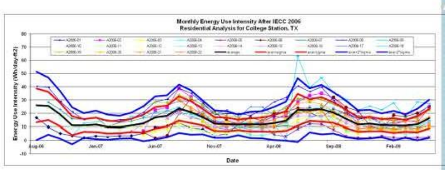
Sample - Before IECC 2000/2001



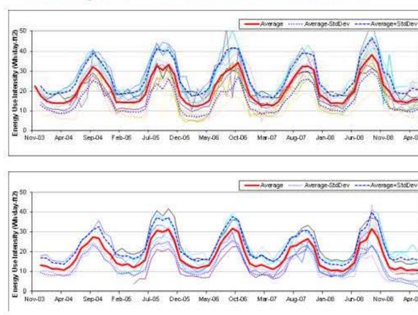
Sample - After IECC 2000/2001



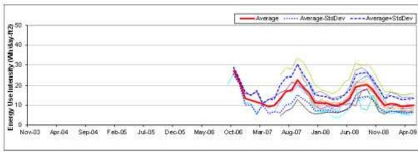
Sample - After IECC 2006



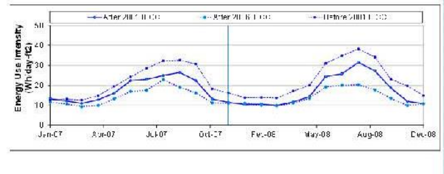
Sample – Clean Patterns



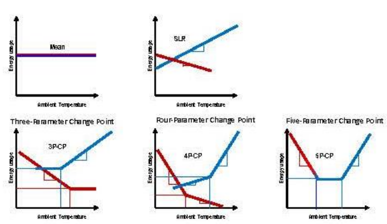
Content Slides



Content Slides

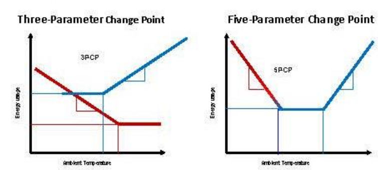


Energy Models



Residential Energy Modeling

Energy Use Normalized Model



$$E = a + b(T - T_{cp})^{+} + c\left(T_{cp2} - T\right)^{+}$$

Residential Energy Modeling

Variable-based Degree-day Model

Normalized Annual Consumption (NAC)

$$NAC = 365\alpha + \beta H_o(\tau) + \varepsilon_I$$

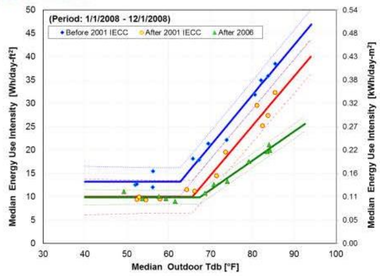
where, $H_o(\tau)$ are the degree-days for the average weather data period at base temperature τ;

α and β are the base-level and the cooling (or heating) slope parameters; and ε_I is the random error term.

Residential Energy Modeling

	2001 IECC			2006 IECC		
	CZ 2	CZ 3	CZ 4	CZ 2	CZ 3	CZ 4
	Harris	Tarrant	Potter	Harris	Tarrant	Potter
Ceiling Insulation (hr-sq.ft.-°F/Btu)	R-30	R-38		R-27.84		R-32.51
Wall Insulation (hr-sq.ft.-°F/Btu)	R-11		R-12/3.125 c.i.	R-11.8		
Slab Perimeter Insulation	None		R-6	None		R-10
U-Factor of Glazing (Btu/hr-sq.ft.-°F)	0.47		0.41	0.75	0.65	0.40
Solar Heat Gain Coefficient (SHGC)	0.40		0.68	0.40		
HVAC System Efficiency	(a) Electric/Gas House: SEER 10 AC, 0.78 AFUE furnace			(a) Electric/Gas House: SEER 13 AC, 0.78 AFUE furnace		
	(b) Heat Pump House: SEER 10 AC, 6.8 HSPF heat pump			(b) Heat Pump House: SEER 13 AC, 7.7 HSPF heat pump		
DHW Heater Energy Factor	(a) Electric/Gas House: 0.544 (b) Heat Pump House: 0.864			(a) Electric/Gas House: 0.594 (b) Heat Pump House: 0.904		
Duct Distribution System Efficiency (DSE)	0.80			0.88		
Infiltration Rate (SG)	SLA= 0.00057			SLA= 0.00036		

Results



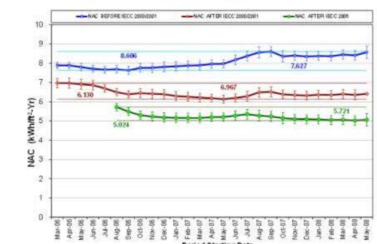
Results – Energy Normalized Patterns

	Before IECC 2000/2001	After IECC 2000/2001	After IECC 2006
a	14.0456	10.8119	10.3621
b	0.9835	0.9717	0.5612
Tcp	62.4644	66.2052	66.8500
R^2	0.9667	0.9703	0.9839
AdjR^2	0.9633	0.9673	0.9823
RMSE	1.7633	1.4224	0.5602
CV-RMSE	7.7%	8.2%	4.0%

Results – Variable Base Degree-day

	Before IECC 2000/2001		After IECC 2000/2001		After IECC 2006	
	Estimates	Std. Errors	Estimates	Std. Errors	Estimates	Std. Errors
Reference Temperature	63.1600	4.0600	66.4500	3.7200	65.5500	7.3900
Cooling Slope	0.0010	0.0002	0.0010	0.0002	0.0005	0.0002
Base Level	0.0128	0.0017	0.0098	0.0013	0.0100	0.0013
NAC	8.3312	0.2347	6.3282	0.2180	5.0873	0.2042
R-Square	0.9522		0.9430		0.8289	
Cooling Part of NAC	3.6653	0.5589	2.7618	0.4290	1.4463	0.4467
Numbers of Obs.	12		12		12	

Results – Sliding NAC



Results

$$Energy\ Savings = NAC_{before} - NAC_{after}$$

	Before IECC 2000/2001	After IECC 2000/2001	Savings	After IECC 2006	Savings
NAC	7.958	6.383	1,575	5.172	1.211
Std Error	± 0.110	± 0.036	± 0.116	± 0.036	± 0.051
% Savings			19.8%		19.0%

Summary

- A procedure to verify the energy savings of groups of residential houses in Texas through three-parameter, linear regression change point models, variable based degree-day analysis, and sliding NAC analysis.
- The three-parameter, change point regression model yielded a 23.9% and 15.1 % energy savings after implementation of IECC 2000/2001 and IECC 2006, respectively.

Summary

- The variable based degree-day analysis provided a similar match, and showed that the IECC building codes helped residential houses achieve 24% and 19.6% energy savings due to the adoption of IECC 2000/2001 and IECC 2006, respectively.
- By minimizing the impacts of equipment degradation and operation changes, a sliding NAC analysis stated a 19.8% and 19% energy savings achieved by the implementation of IECC building codes.

Acknowledgements

- The authors want to thank Mr. Brian Henry of City of College Station Utilities for providing the residential utility bills that are used for the analysis in this paper

Questions?

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