ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

Energy Efficiency and Renewable Energy Impacts on Emission Reductions

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Bahman Yazdani, P.E.

CATEE 2015
Clean Air Through Energy Efficiency Conference
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Galveston, Texas

ACKNOWLEDGEMENTS

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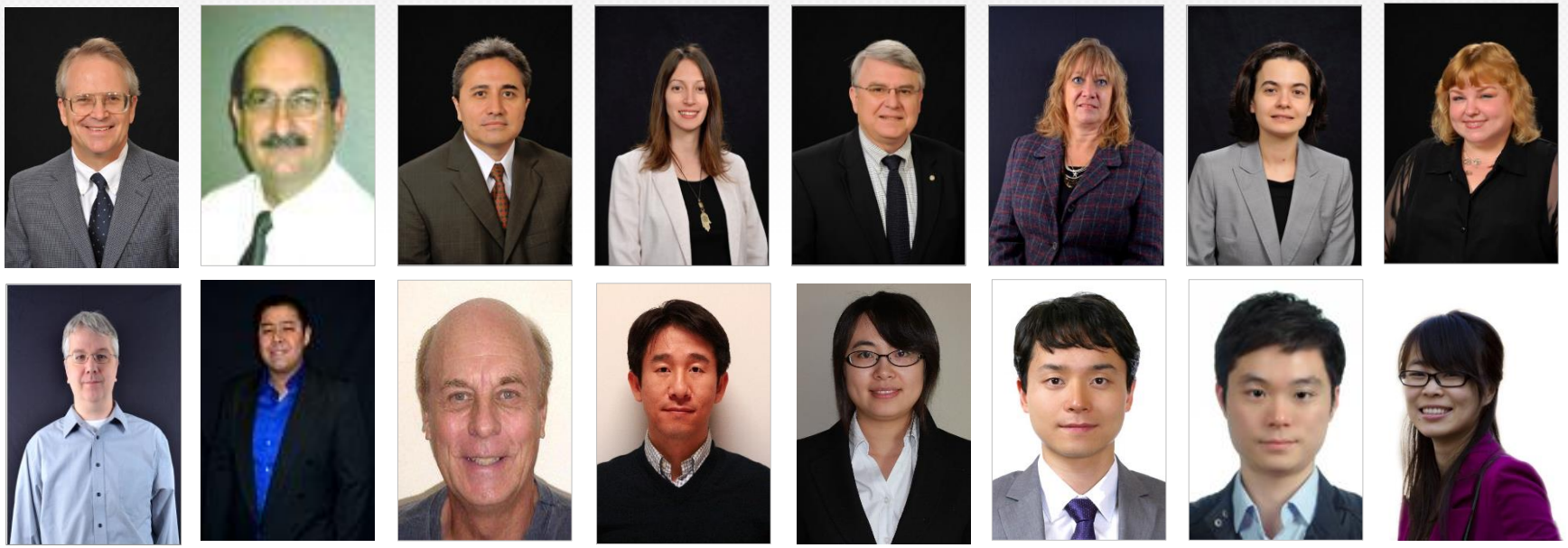

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PUCT: Katie Rich, Therese Harris
SECO: Dub Taylor, Stephen Ross
ERCOT: Paul Wattles, Kevin Hanson, Warren Lasher
USEPA: James Yarborough, Art Diem, Julie Rosenberg

LEGISLATIVE RESPONSE

Legislation to reduce energy/emissions 2001 to Present

Senate Bill 5 (77th Legislature, 2001)

Ch. 386. Texas Emissions Reduction Plan

- Sec. 386.205. Evaluation Of State Energy Efficiency Programs (with PUC)

Ch. 388. Texas Building Energy Performance Standards

- 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.

TERP Amended (78th Legislature, 2003)

Ch. 388. Texas Building Energy Performance Standards

- (HB 1365) Sec. 388.004. Enforcement Of Energy Standards Outside Of Municipality.
- (HB 1365) Sec. 388.009. Energy-Efficient Building Program.

Ch. 388. Texas Building Energy Performance Standards

- (HB 3235) Sec. 388.009. Certification of Municipal Inspectors.

TERP Amended (79th Legislature, 2005)

Ch. 382. Health and Safety Code

- (HB 2129) Sec. 386.056 Development of Creditable Statewide emissions from wind and other renewables.
- (HB 965) Sec. 382.0275 Commission Action Relating to Water Heaters

TERP Amended (80th Legislature, 2007)

Ch. 382. Health and Safety Code

- (HB 3693) Sec. 388.003 added subsection (b-1), (b-2), (b-3) that allows SECO to adopt new editions of the IECC based on written recommendations from the Laboratory.
- (HB 3693) Sec. 388.008 Development of Standardized report formats for newly constructed residences.

Ch. 386.252 Health and and Safety Code

- (SB 12) Section 388.03 added subsection (b-1), (b-2) allows SECO to adopt new editions of the IECC based on written recommendations from the Laboratory.

TERP Amended (81st Legislature, 2009)

Ch. 382. Health and Safety Code

- (HB 1796) Section 23 amends Sec. 386.252 (a) and (b) extends date of TERP to 2019 and requires Commission to contract with Laboratory for creditable EE/RE emissions reductions.

TERP Amended (82nd Legislature, 2011)

Ch. 477.004 Health and Safety Code

- HB 51 Section 2, b-2, establishes advisory committee, which including the Laboratory
- Section 3 & 4 amends review of municipal's amendments.

Ch. 388.003e & 388.007c,d Health and Safety Code

- HB 51 Section 3 & 4 amends review of municipal's amendments.

Ch. 388.006 Health and Safety Code

- SB 898 Section 2, requires the Laboratory to calculate energy savings and emissions reductions for political subdivisions reporting to SECO.

Ch. 39.9051 Utilities Code

- SB 924 Section 1g,h and Section 2c,d requires the Laboratory to calculate energy savings and emissions reductions for political subdivisions reporting to SECO.

NO new amendments were passed (83rd Legislature, 2013)

TERP Amended (84th Legislature, 2015)

Section 388.003, Health and Safety Code

- HB 1736 Section 1 Establishes the 2015 energy codes as the TBEPS effective Sept 1, 2016. The state may adopt new codes no sooner than every 6 years. The section also adds Energy Rating Index as a voluntary compliance alternative.

EPA CRITERIA FOR SIP CREDITS (2004)

Quantifiable: The emission reductions generated by measures to reduce emissions must be quantifiable and include procedures to evaluate and verify over time the level of emission reductions actually achieved.

Surplus: Emission reductions are surplus as long as they are not otherwise relied on to meet air quality attainment requirements in air quality programs related to your SIP.

Enforceability: Measures that reduce emissions from electricity generation may be: (1) Enforceable directly against a source; (2) Enforceable against another party responsible for the energy efficiency or renewable energy activity; or (3) Included under our *voluntary measures* policy.

Record Keeping: The measure should be permanent throughout the term for which the credit is granted unless it is replaced by another measure or the State demonstrates in a SIP revision that the emission reductions from the measure are no longer needed to meet applicable requirements.

ENERGY SAVINGS & NOx EMISSIONS REDUCTION

ESL Calculates NOx Emissions Reductions for:

1. Code-Compliant Construction: Energy savings from new constructions
- ESL Single-family construction
- ESL Multi-family construction
- ESL Commercial construction

2. Green Power Production: Wind and other renewables

3. PUC SB7: Energy efficiency programs implemented by electric utilities under the Public Utility Regulatory Act § 39.905

4. SECO: Energy-efficiency programs towards school districts, government agencies, city and county governments, private industries and residential energy consumers

5. A/C Retrofits: Installation of SEER 13/14 *replacement* air conditioners in existing residences

IC3 International CODE COMPLIANCE CALCULATOR

PUBLIC UTILITY COMMISSION OF TEXAS

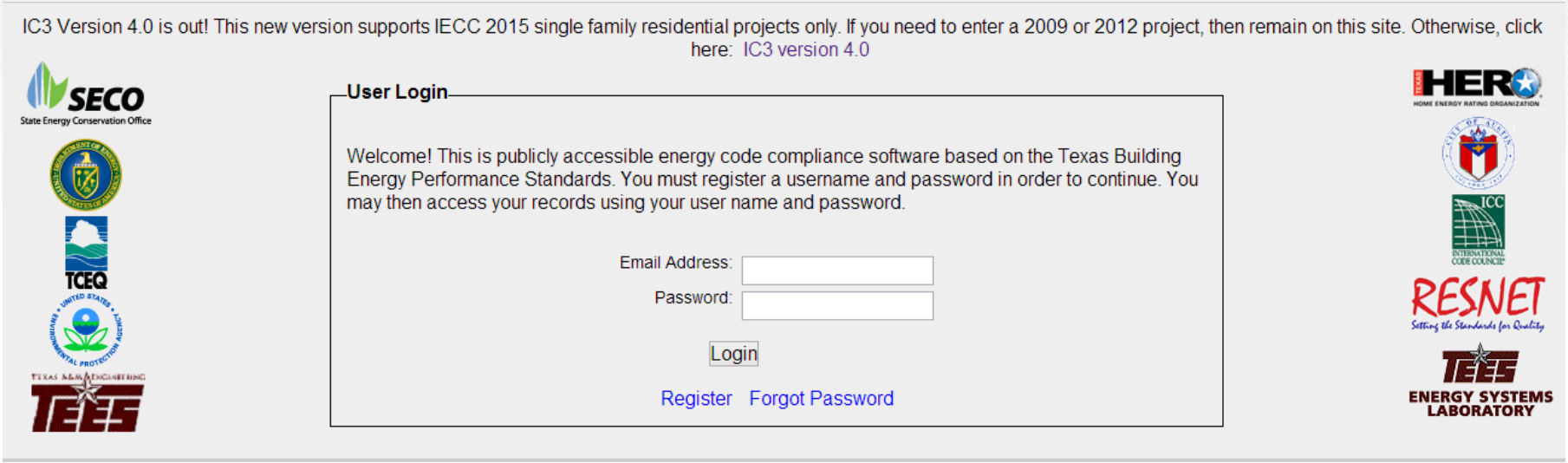
SECO State Energy Conservation Office

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

IC3 International CODE COMPLIANCE CALCULATOR

IC3v. 3.14.4

Current 2009 Version



Login Screen

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

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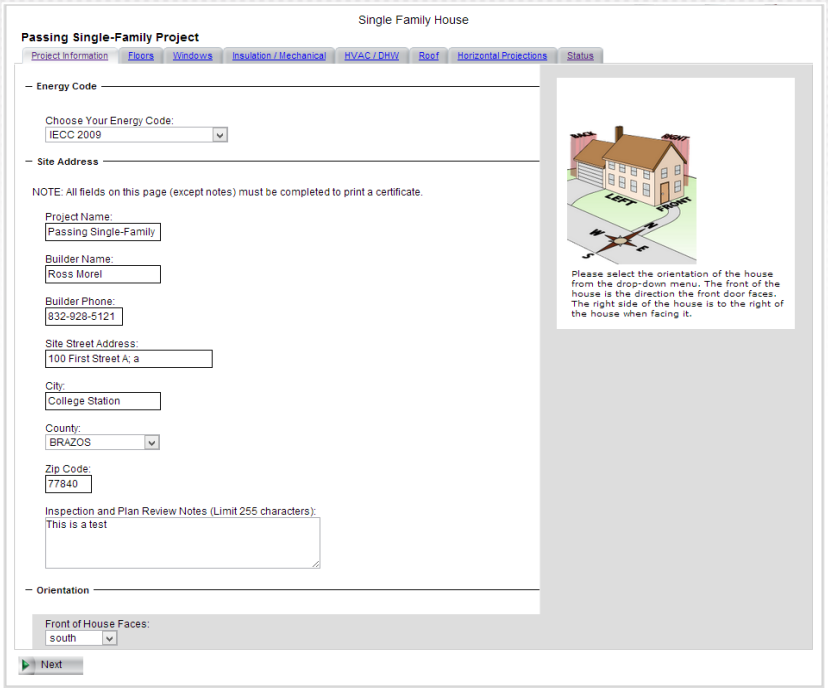

Energy Code/Site Address/Project Details

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

IC3 International CODE COMPLIANCE CALCULATOR

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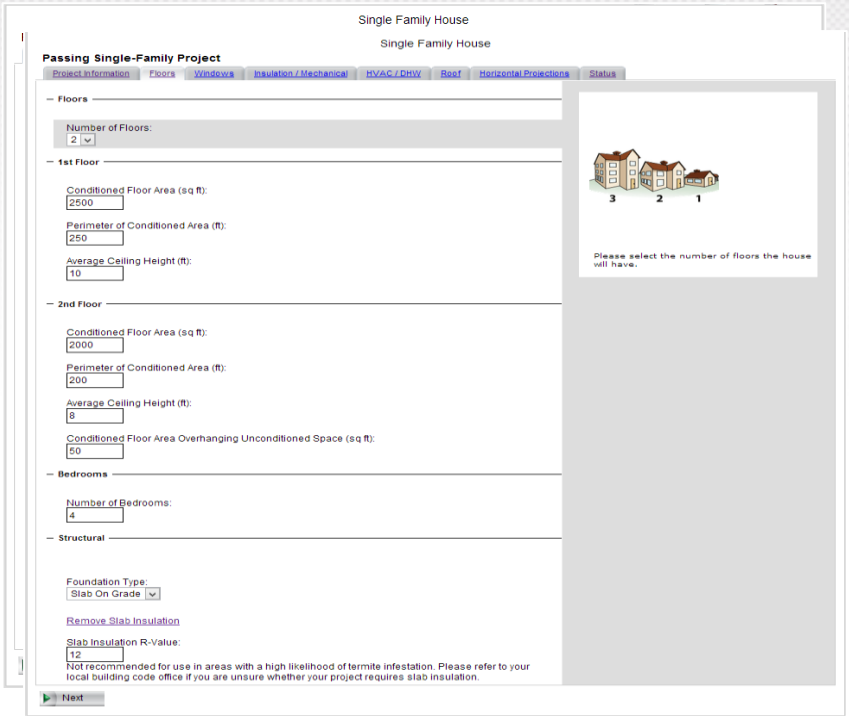
Current 2009 Version



Floors/BedRooms/Foundation

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

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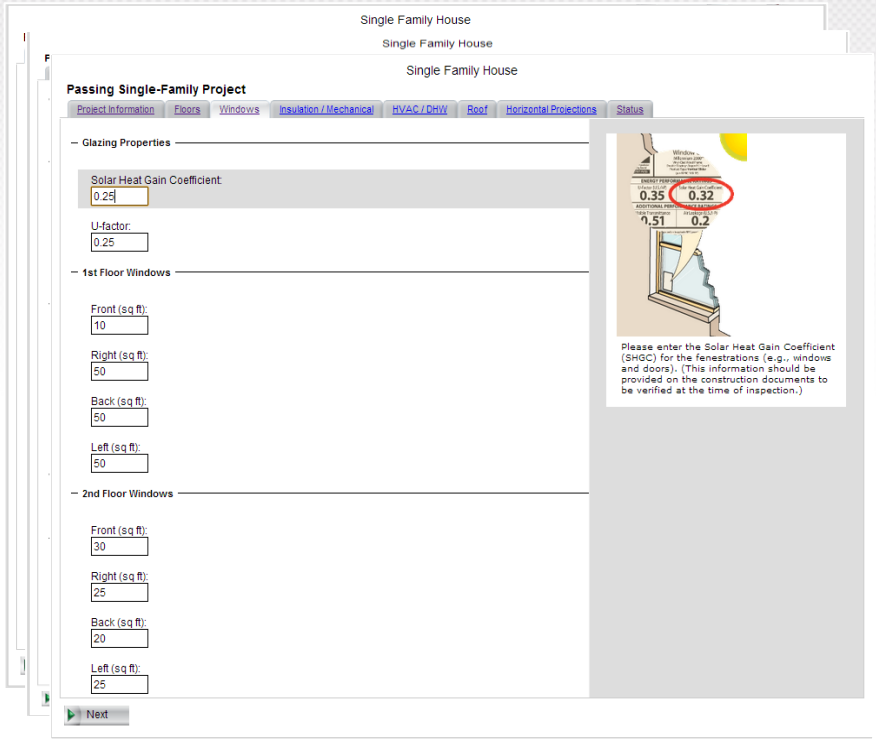

Windows

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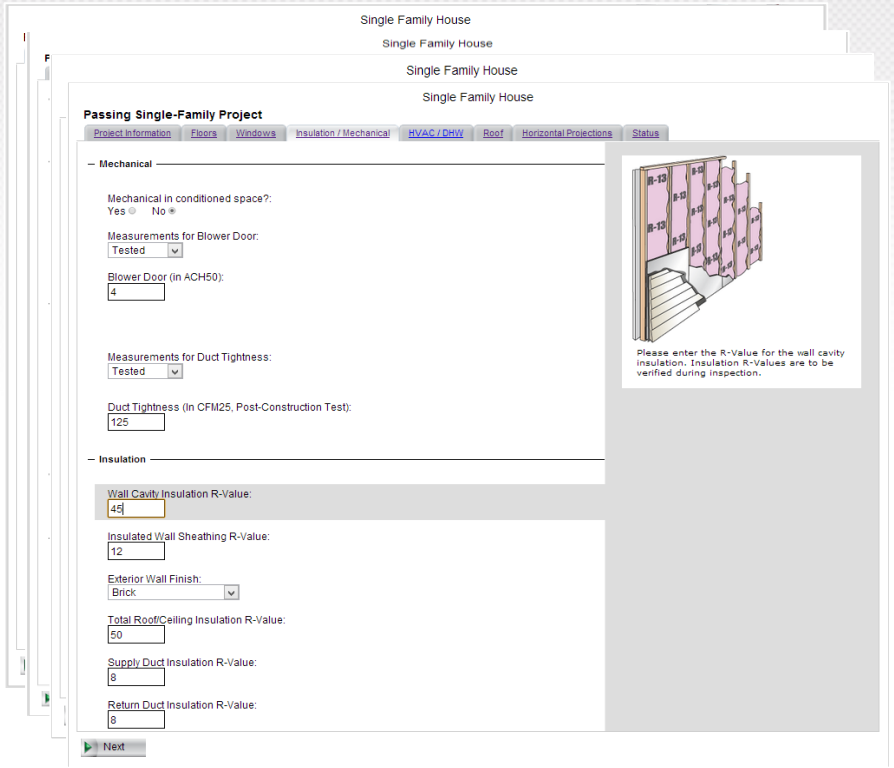

Mechanical System/Insulation

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

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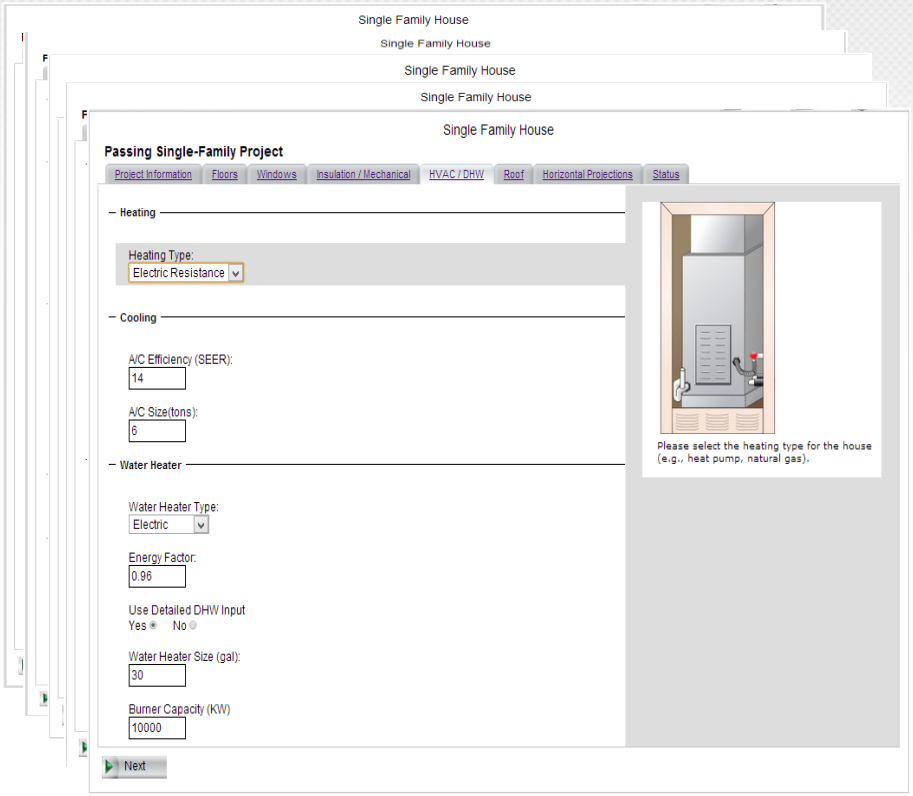

HVAC/DHW

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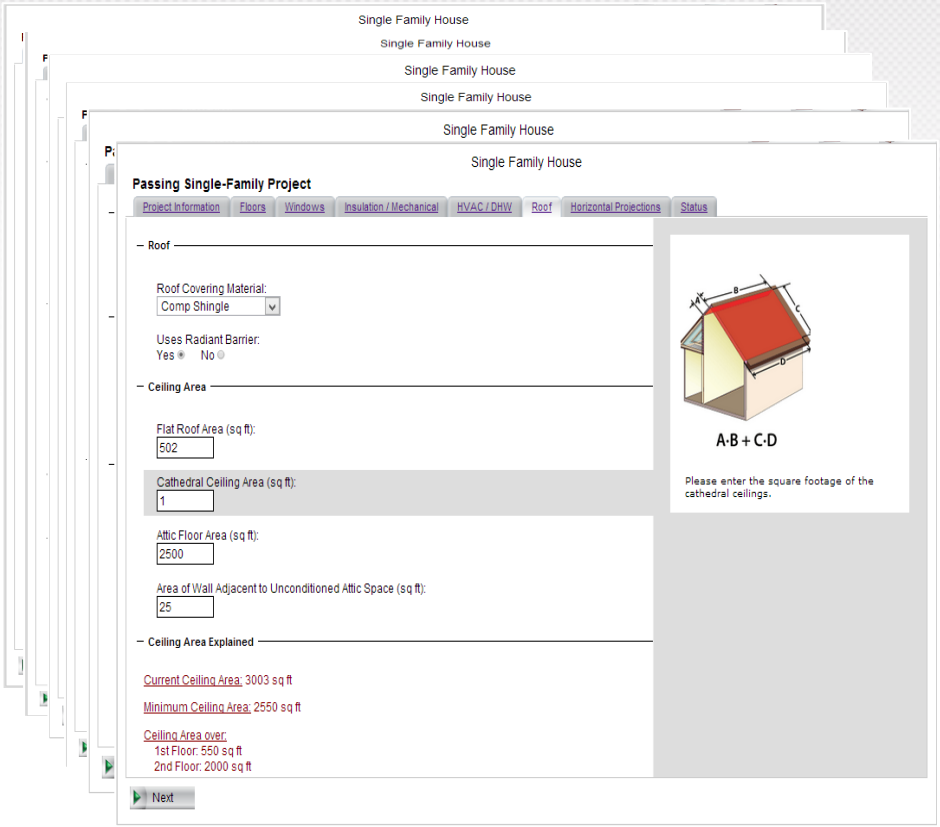

Roof/Ceiling

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

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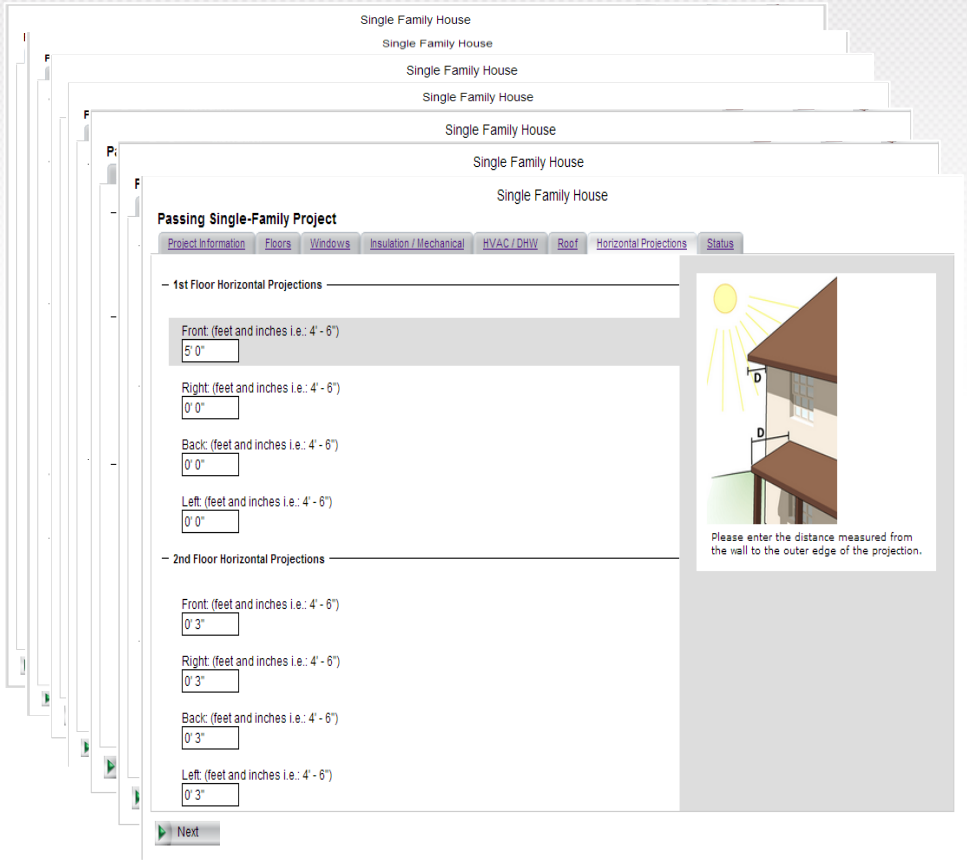

Shading

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

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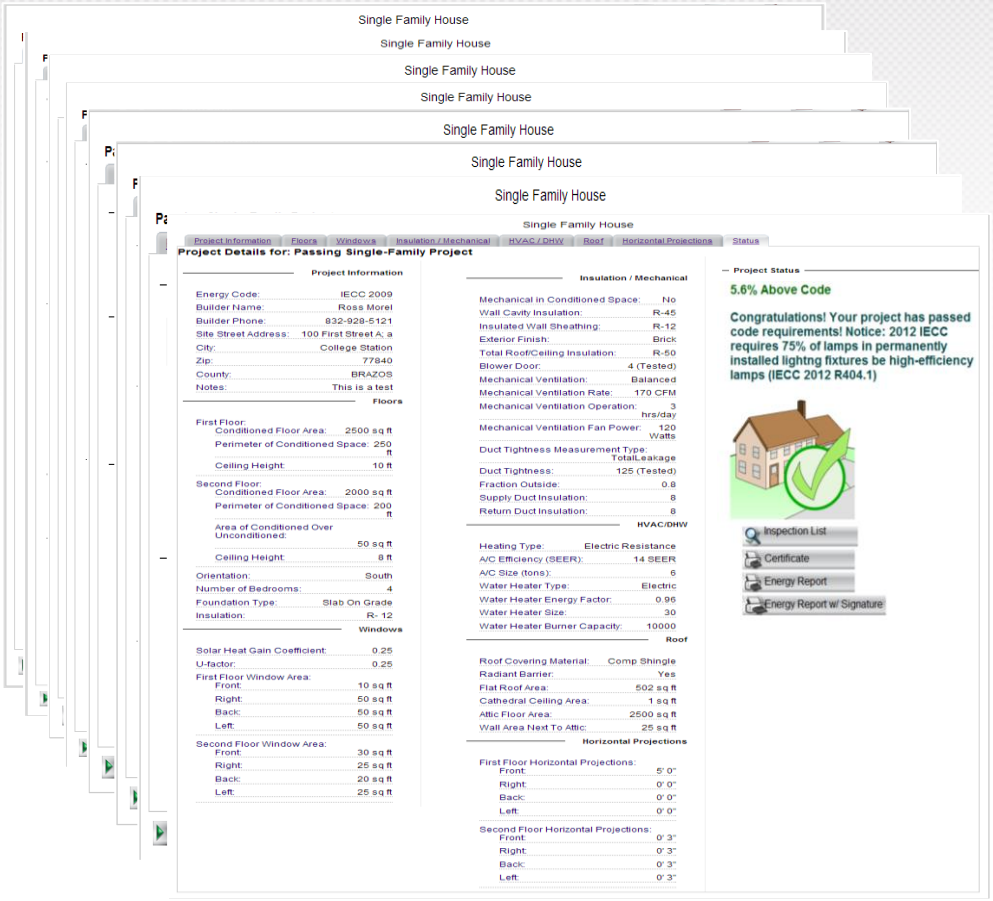

Energy Report

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

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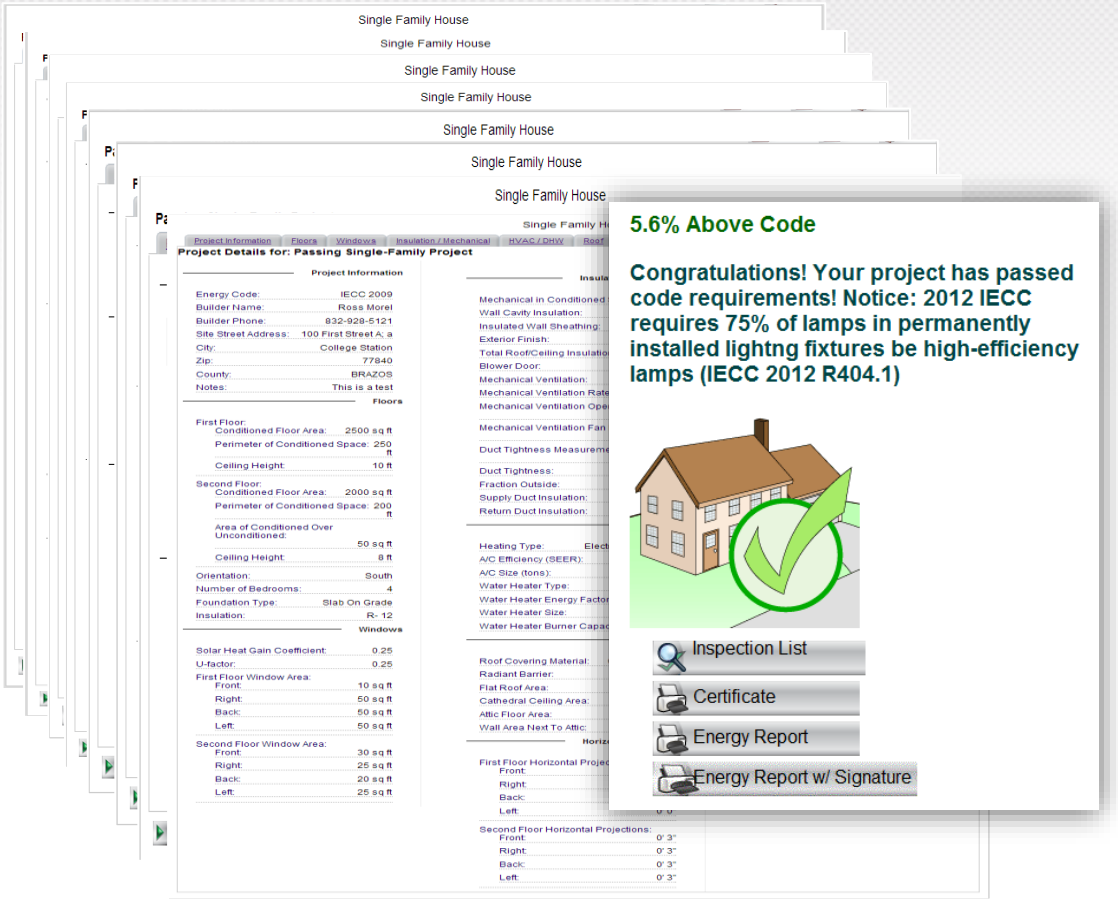

Energy Report

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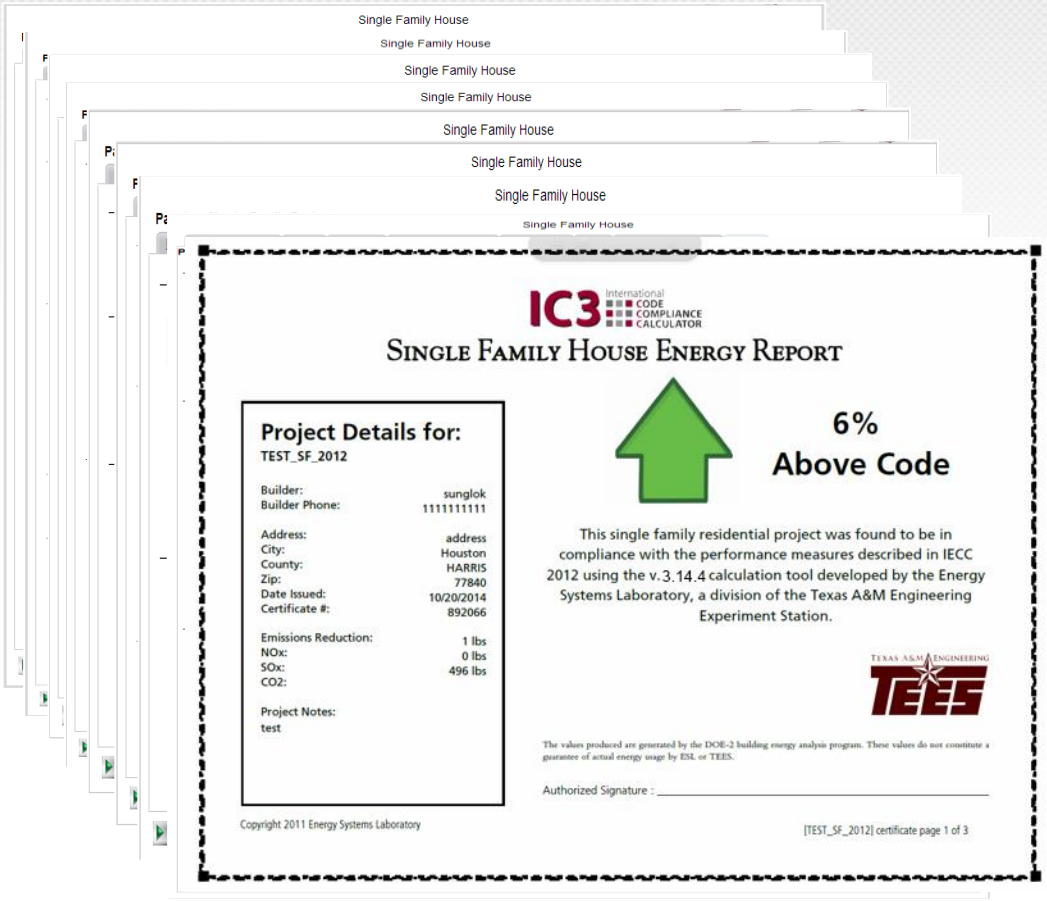

Certificate

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

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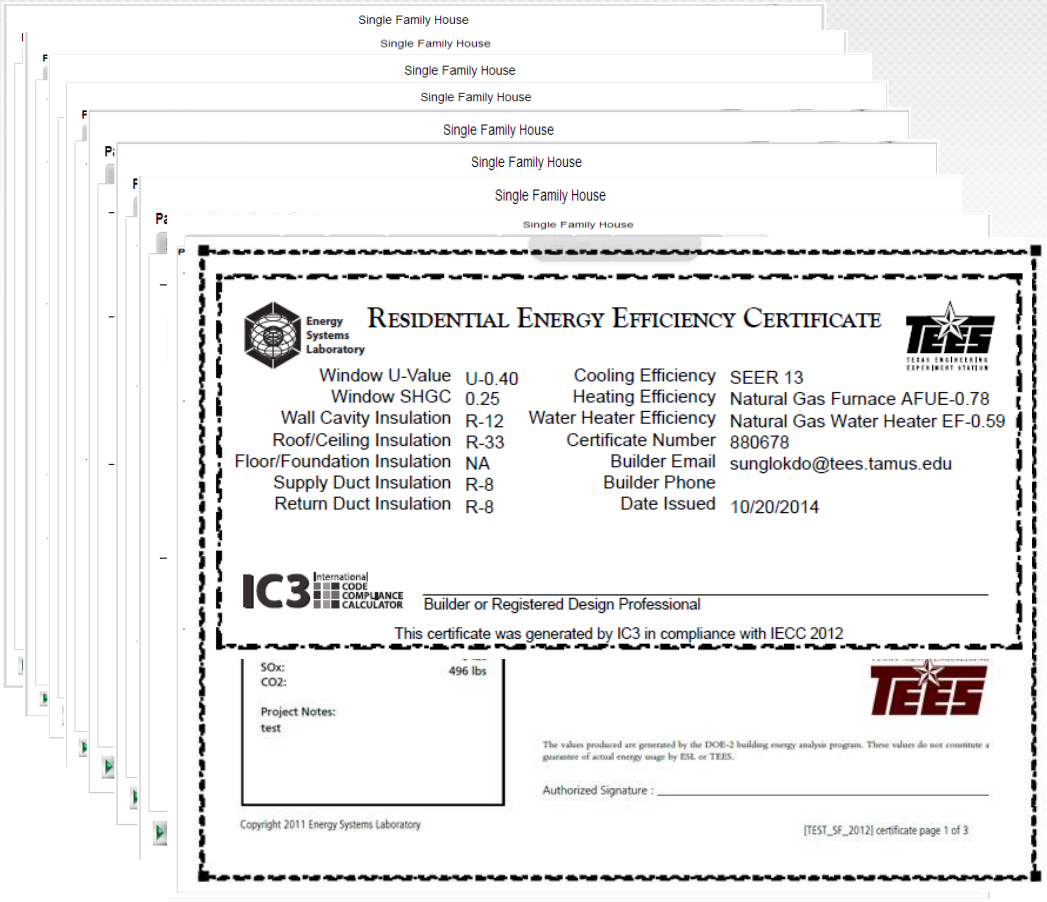
Current 2009 Version



Certificate

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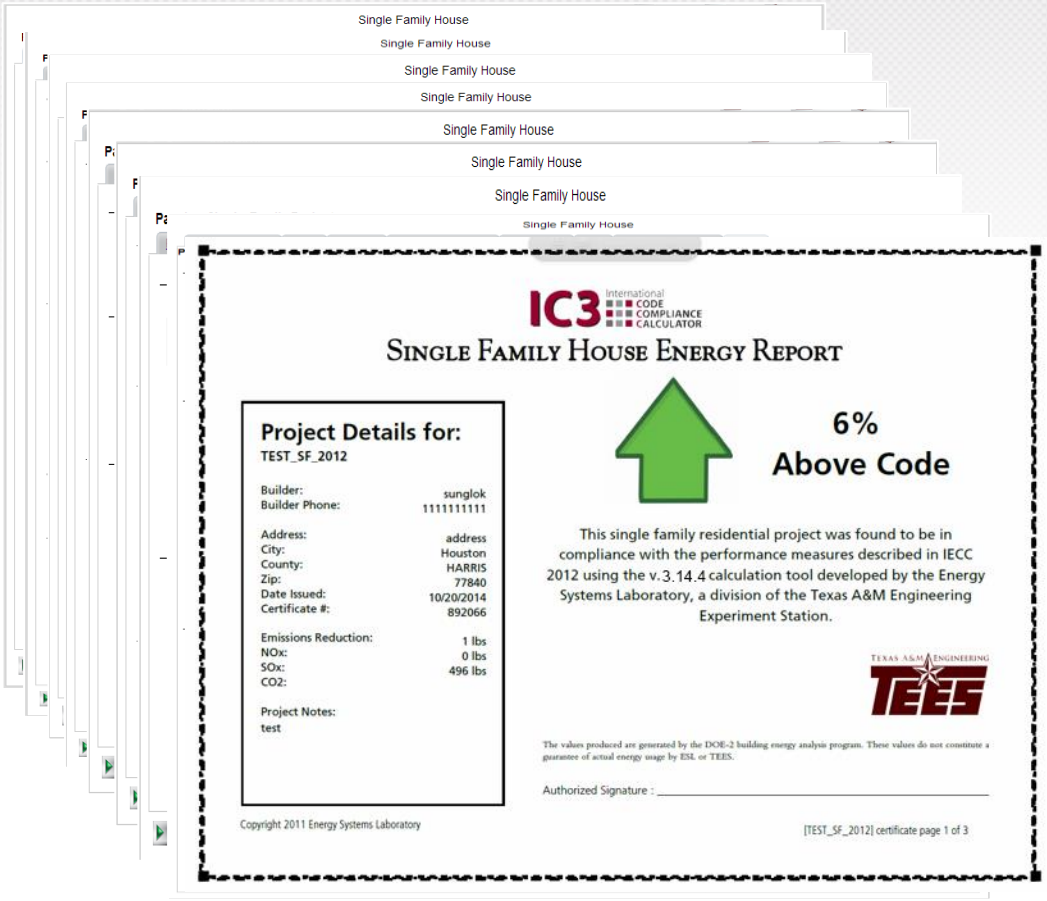
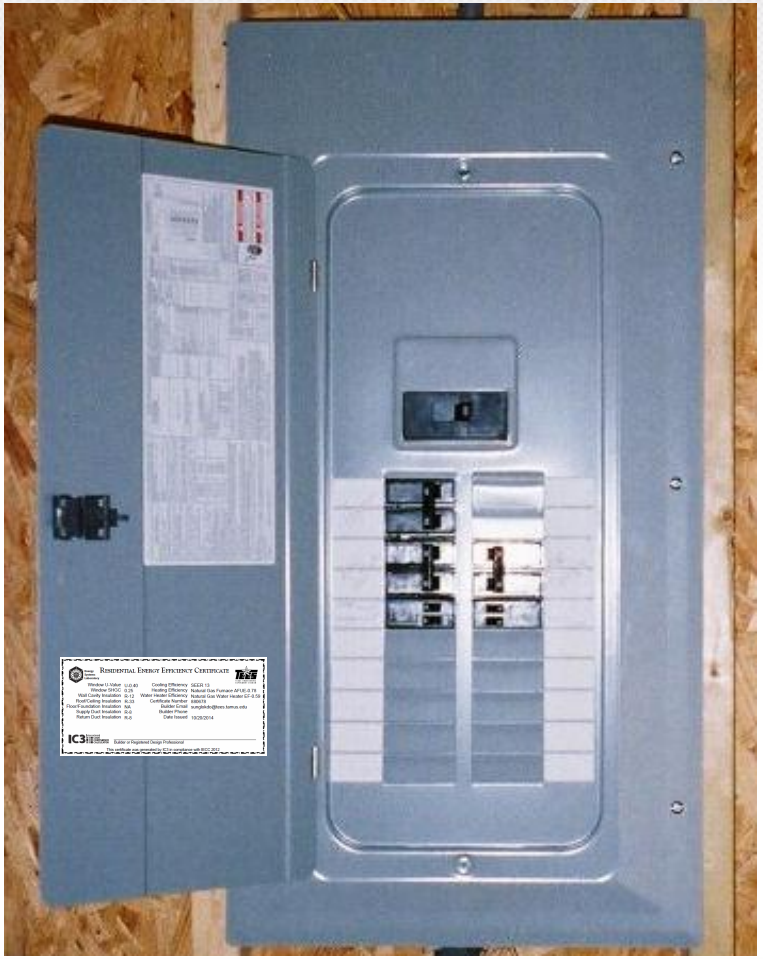


Certificate on Electrical Panel



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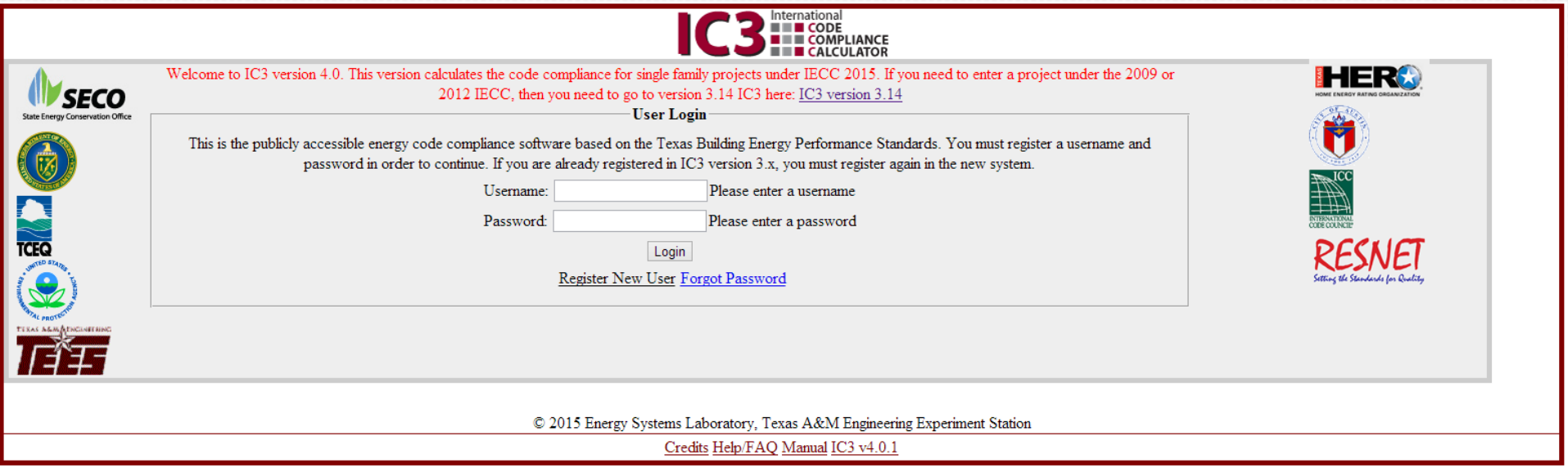
New 2015 Version

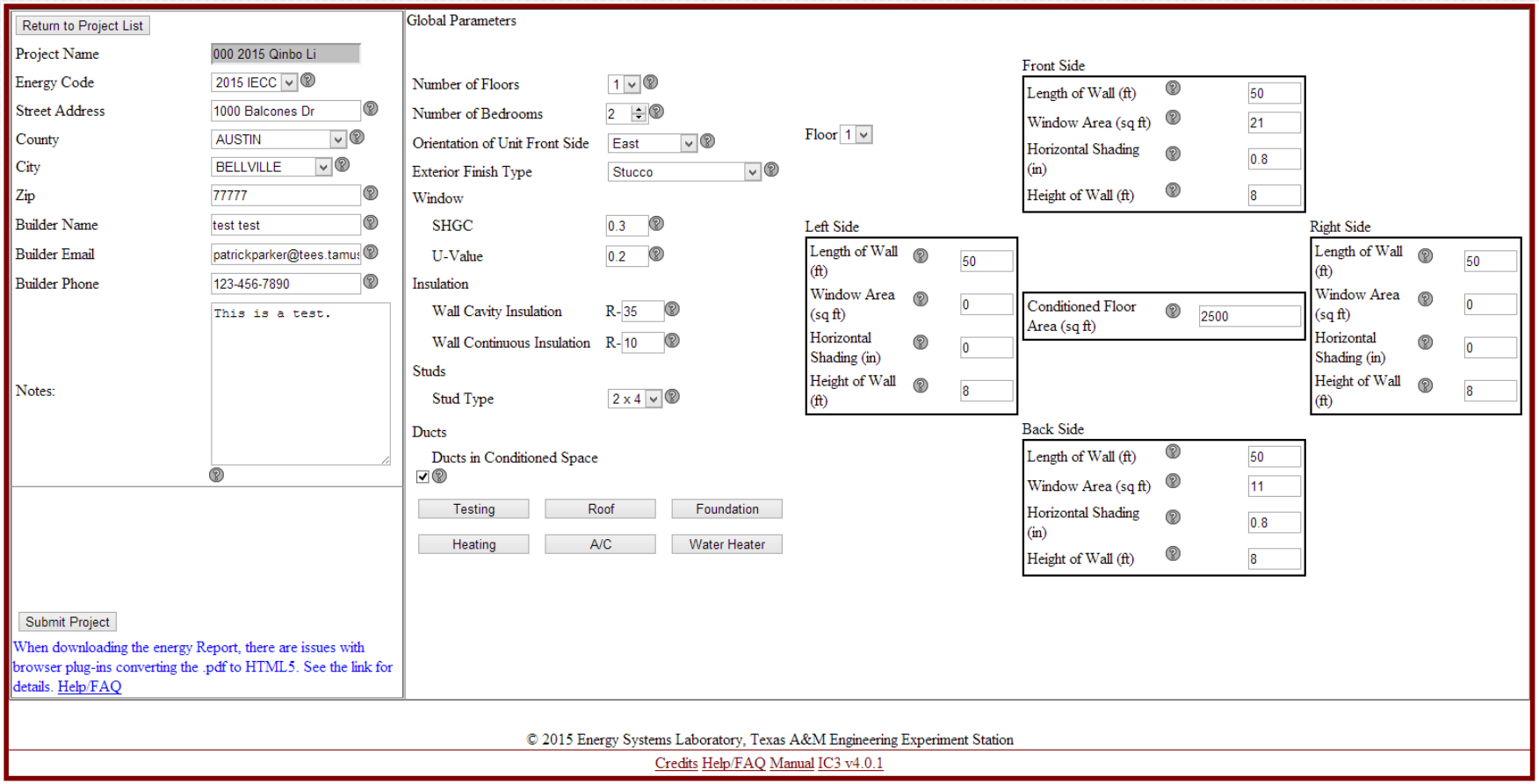


Login Screen

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

IC3 International CODE COMPLIANCE CALCULATOR

New 2015 Version

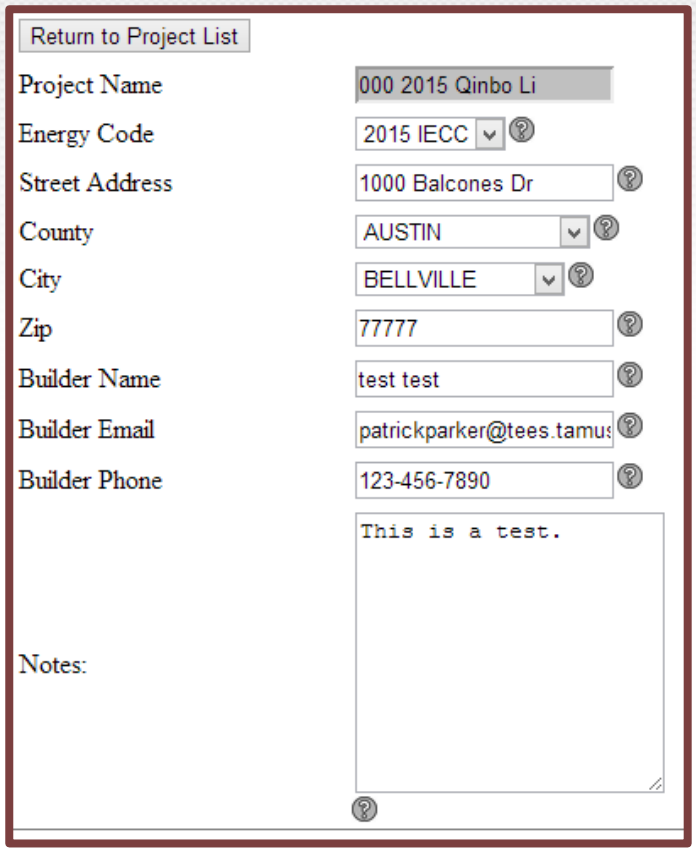


Main Page

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

IC3 International CODE COMPLIANCE CALCULATOR

New 2015 Version



Energy Code/Site Address/Project Details

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

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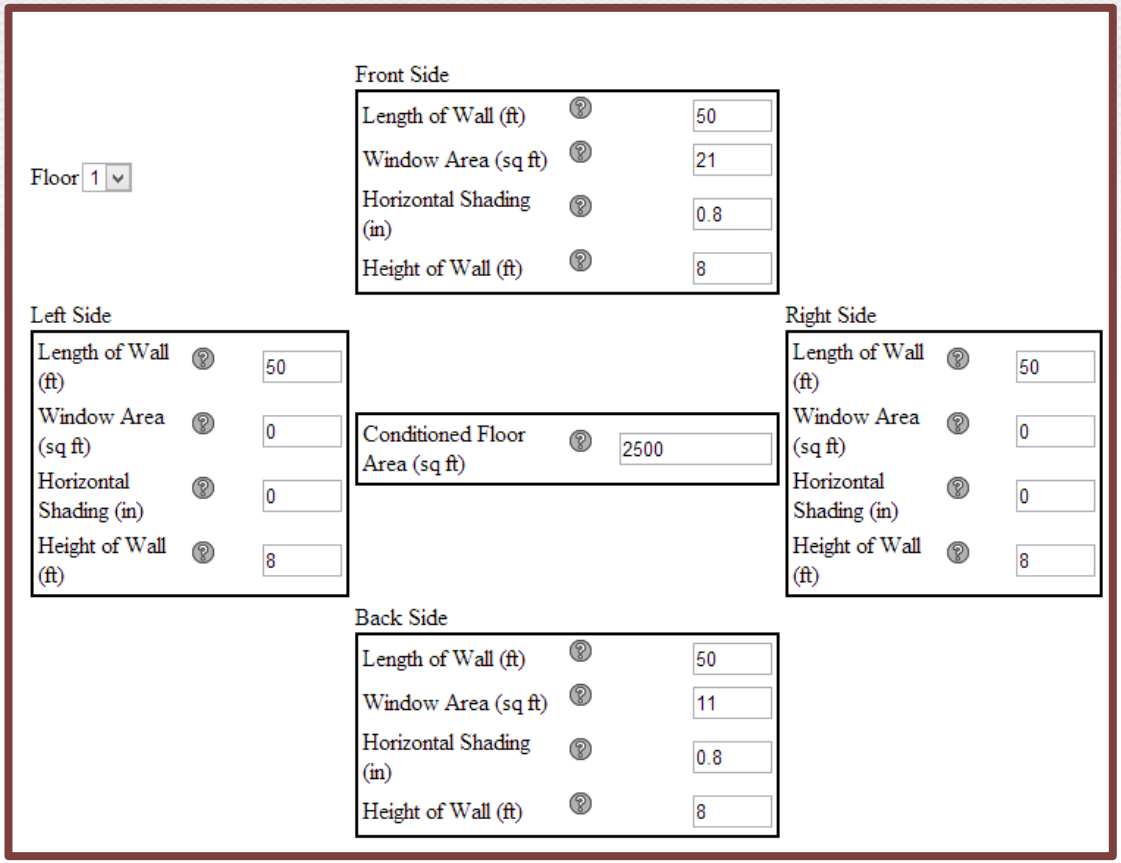
New 2015 Version

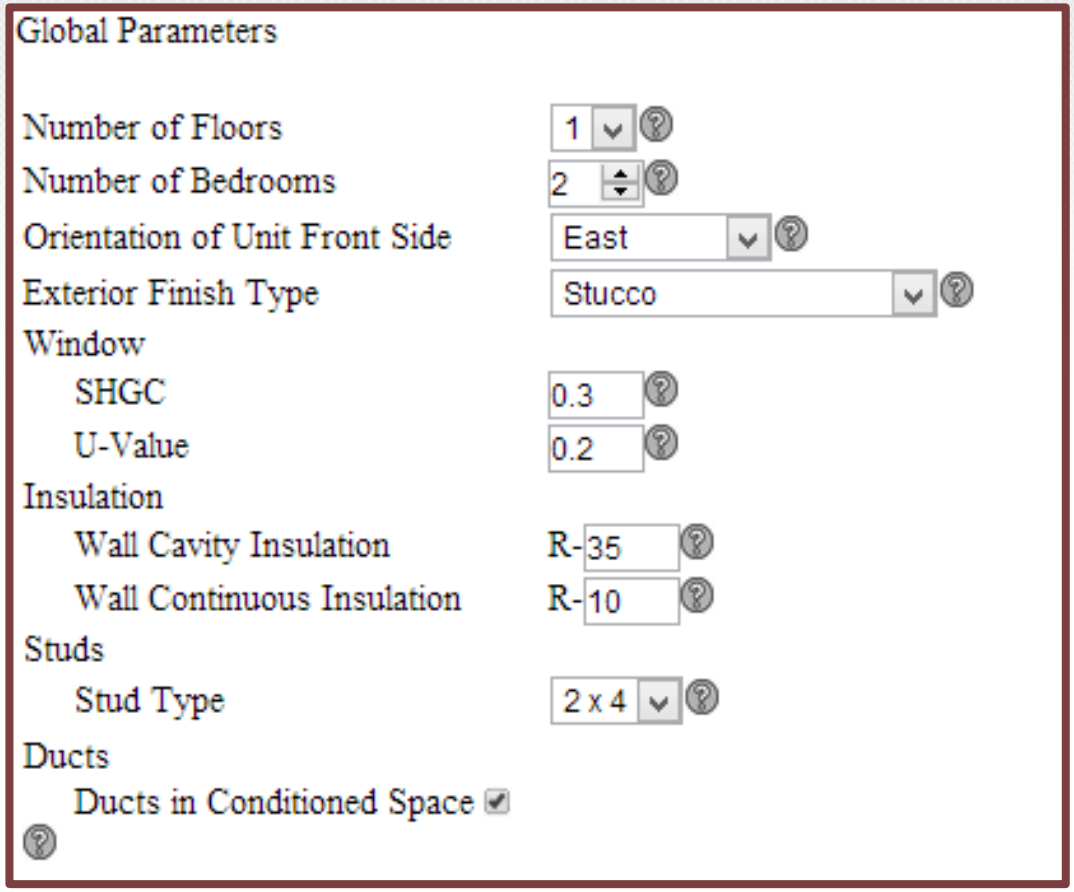


Floors/BedRooms/Foundation

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

IC3 International CODE COMPLIANCE CALCULATOR

New 2015 Version



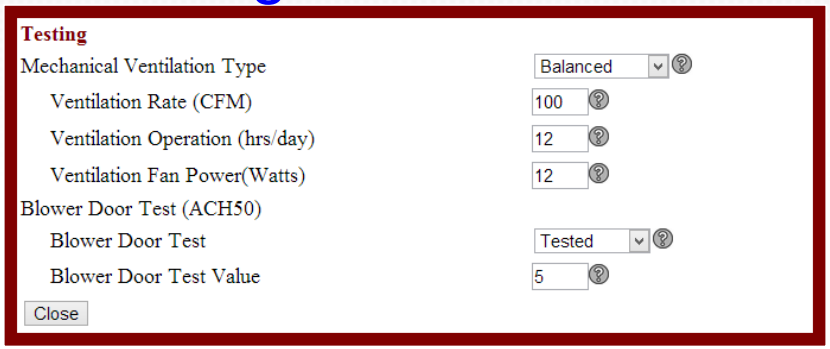
Global Parameters

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

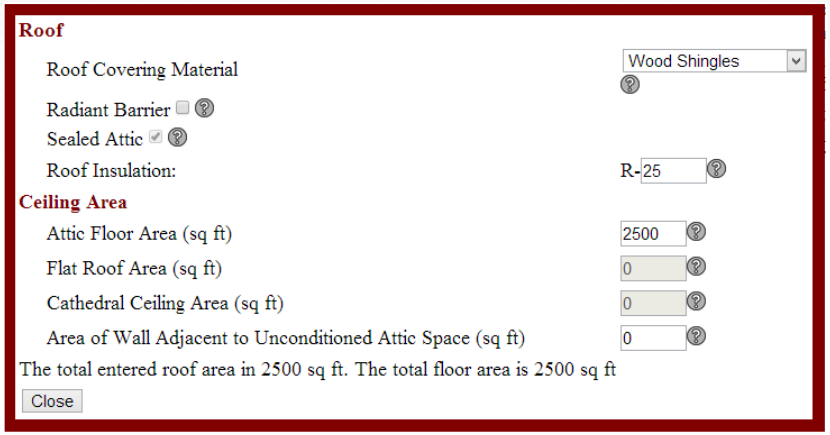
IC3 International CODE COMPLIANCE CALCULATOR

New 2015 Version

Testing



Roof



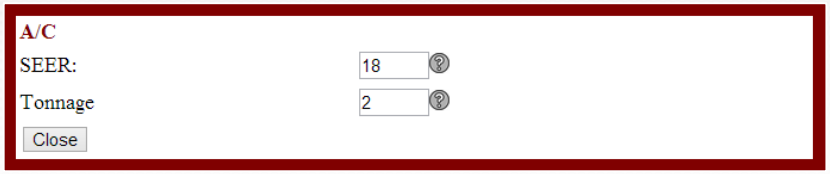
SAVINGS FROM CODE COMPLIANT CONSTRUCTION

IC3 International CODE COMPLIANCE CALCULATOR

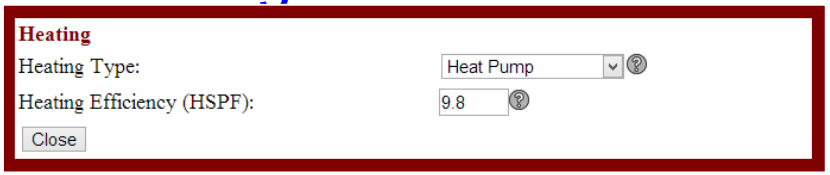
New 2015 Version

Foundation

A/C



Heating

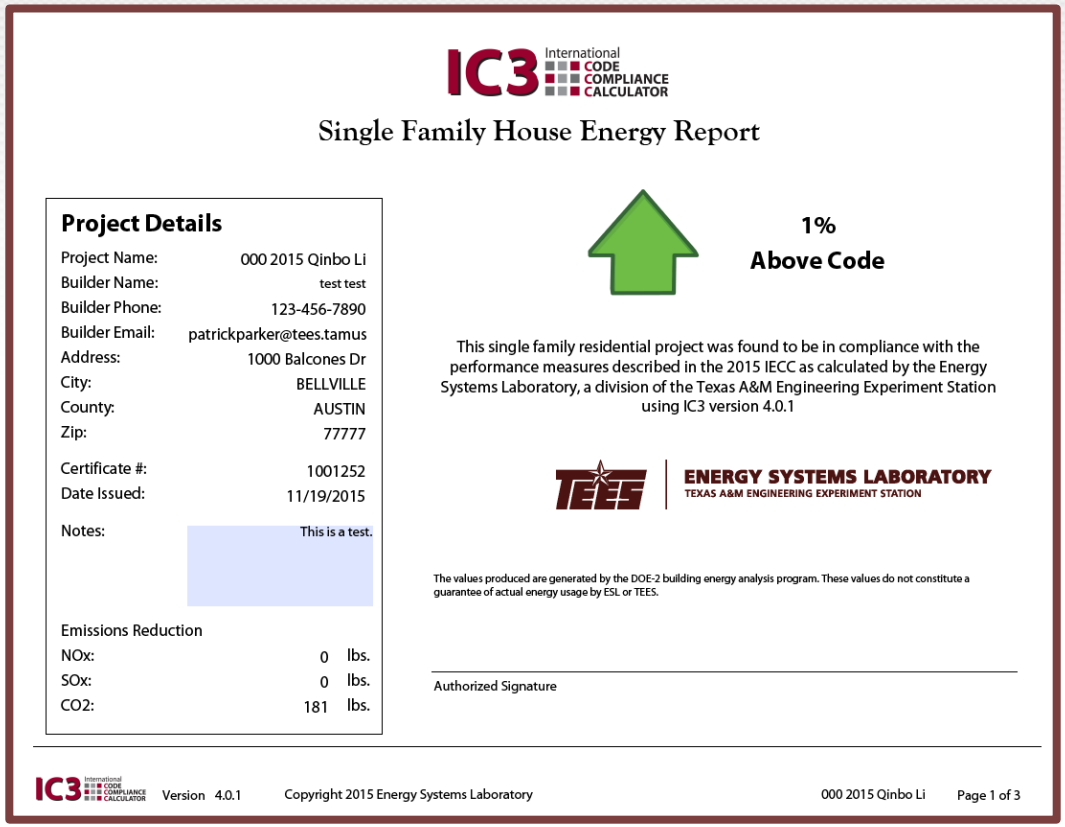


Water Heater

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

IC3 International CODE COMPLIANCE CALCULATOR

New 2015 Version



IC3 International CODE COMPLIANCE CALCULATOR

Single Family House Energy Report

Project Details

Project Name:	000 2015 Qinbo Li
Builder Name:	test test
Builder Phone:	123-456-7890
Builder Email:	patrickparker@tees.tamus
Address:	1000 Balcones Dr
City:	BELLVILLE
County:	AUSTIN
Zip:	77777
Certificate #:	1001252
Date Issued:	11/19/2015
Notes:	This is a test.

Emissions Reduction

NOx:	0	lbs.
SOx:	0	lbs.
CO2:	181	lbs.

1%
Above Code

This single family residential project was found to be in compliance with the performance measures described in the 2015 IECC as calculated by the Energy Systems Laboratory, a division of the Texas A&M Engineering Experiment Station using IC3 version 4.0.1

ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

The values produced are generated by the DOE-2 building energy analysis program. These values do not constitute a guarantee of actual energy usage by ESL or TEES.

Authorized Signature

IC3 Version 4.0.1 Copyright 2015 Energy Systems Laboratory 000 2015 Qinbo Li Page 1 of 3

Certificate

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

IC3 International CODE COMPLIANCE CALCULATOR

New 2015 Version

Residential Energy Efficiency Certificate

ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

Window U-Value	U- 0.2	Duct Tightness (in CFM25)	0
Window SHGC	0.3	Cooling Efficiency	SEER 18
Wall Cavity Insulation	R - 35	Heating Efficiency	Heat Pump HSPF-9.80
Roof/Ceiling Insulation	R - 25	Water Heater Efficiency	Heat Pump EF-2.10
Floor/Foundation Insulation	R - 0	Builder Email	patrickparker@tees.tamus.edu
Supply Duct Insulation	R - 0	Builder Phone	123-456-7890
Return Duct Insulation	R - 0	Date Issued	11/19/2015
Blower Door (in ACH50)	5	Certificate Number	1,001,252

IC3 International CODE COMPLIANCE CALCULATOR

Builder or Registered Design Professional _____

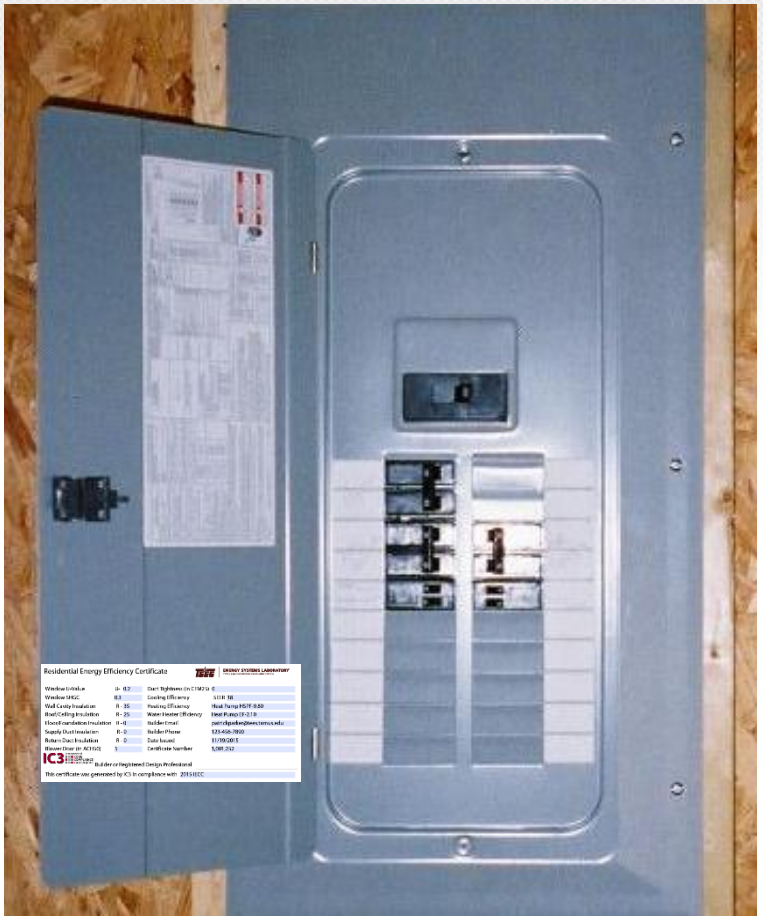
This certificate was generated by IC3 in compliance with 2015 IECC

Certificate on Electrical Panel

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

IC3 International CODE COMPLIANCE CALCULATOR

New 2015 Version



Certificate on Electrical Panel

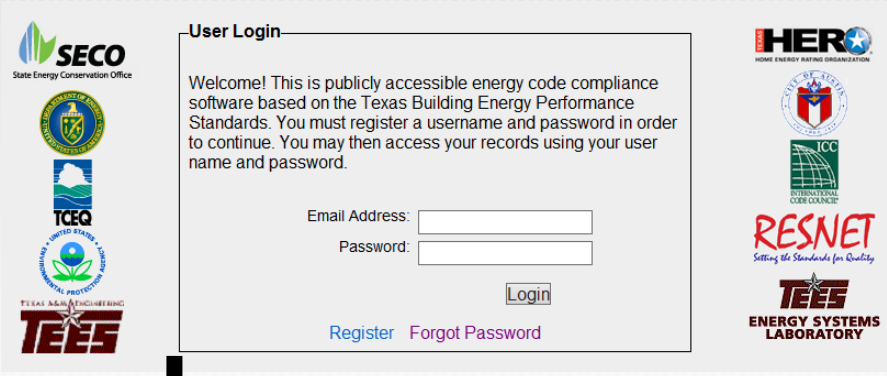
IC3 REGISTRY

IC3 International CODE COMPLIANCE CALCULATOR

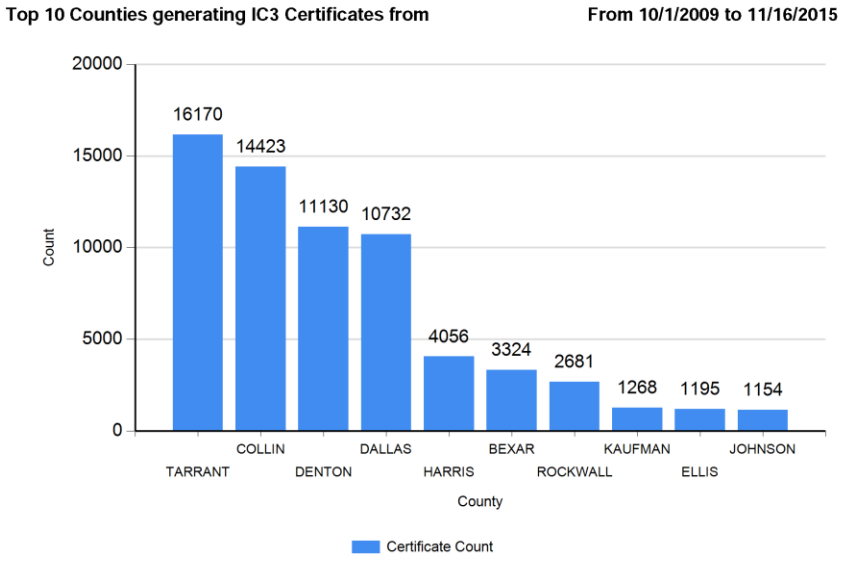
Certificates

Jan. 2015 to Date: 23,728

Total to Date: 116,763



Top 10 Counties for 2009 to 2015



Average SEER Across Counties

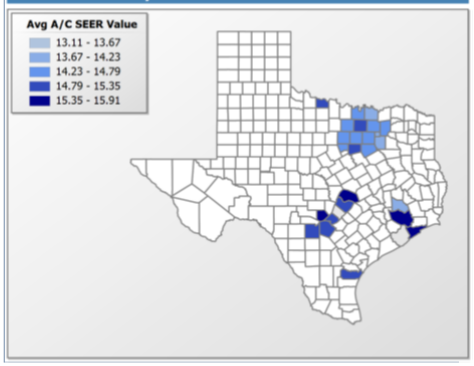
Average A/C SEER across Counties for 2015

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

	Average	Standard Deviation
Single Family	**14.68**	**1.09**
Multi Family	**14.92**	**1.25**

Single Family

County	Avg SEER Value	House Count
Brazoria	15.91	35
Fort bend	15.77	39
Kendall	15.75	16
Galveston	15.58	31
Williamson	15.43	84
Harris	15.37	778
Travis	15.35	806
Bexar	15.33	727
Nueces	15.32	159
San patricio	15.30	33
Wichita	15.22	18
Medina	14.93	14
Comal	14.91	109
Johnson	14.88	335
Denton	14.84	2189
Dallas	14.78	1941
Ellis	14.60	470
Collin	14.55	3103
Parker	14.41	219
Hunt	14.40	45
Hood	14.39	38
Tarrant	14.36	3998



IC3 REGISTRY

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Certificates

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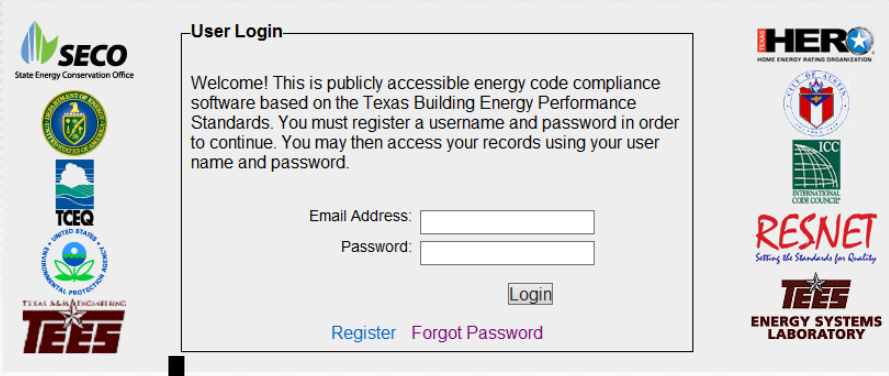
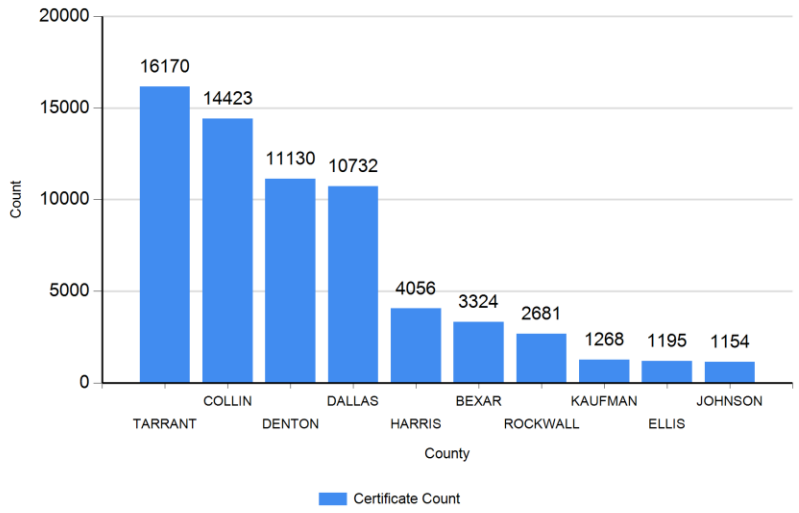


Top 10 Counties for 2009 to 2015

Top 10 Counties generating IC3 Certificates from From 10/1/2009 to 11/16/2015



Average SEER Across Counties

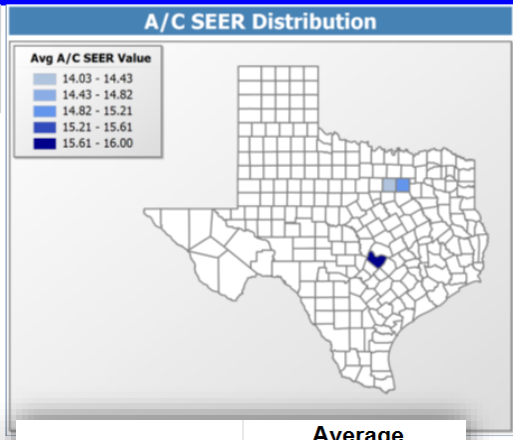
Average A/C SEER across Counties for 2015

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

	Average	Standard Deviation
Single Family	14.68	1.09
Multi Family	14.92	1.25

Multi Family

County	Avg SEER Value	Unit Count
Travis	16.00	41
Dallas	15.03	109
Tarrant	14.03	62



	Average
Single Family	14.68
Multi Family	14.92

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

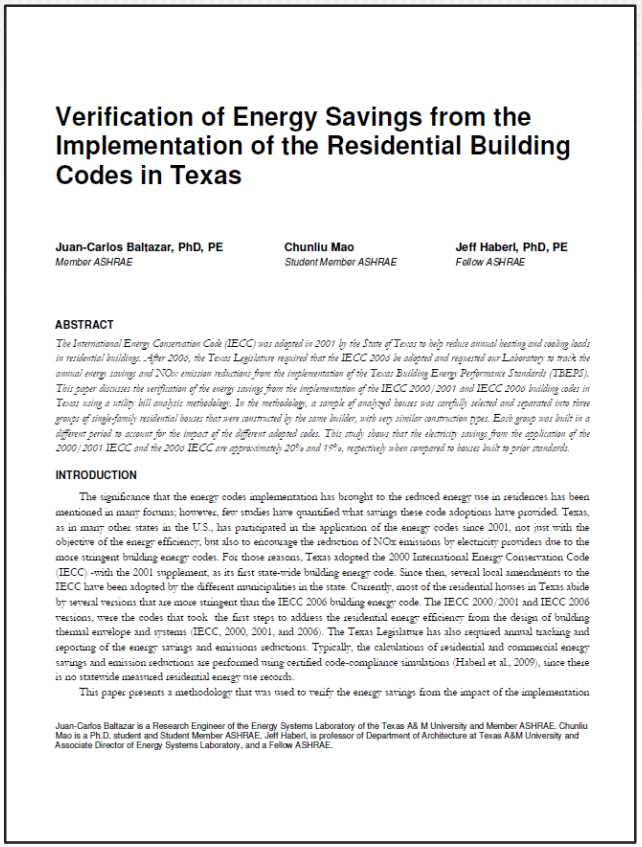
IC3 International CODE COMPLIANCE CALCULATOR

Has an analysis been performed to determine actual measured energy savings (i.e., real utility bills)?

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

Juan-Carlos Baltazar, PhD, PE
Member ASHRAE

Chunliu Mao
Student Member ASHRAE

Jeff Haberl, PhD, PE
Fellow ASHRAE

ABSTRACT

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 saving 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-family residential houses that were constructed by the same builder, with very similar construction types. Each group was built in a different period to account for the impact of the different adopted codes. This study shows that the electricity savings from the application of the 2000/2001 IECC and the 2006 IECC are approximately 20% and 19%, respectively when compared to houses built to prior standards.

INTRODUCTION

The significance that the energy codes implementation has brought to the reduced energy use in residences has been mentioned in many forums; however, few studies have quantified what savings these code adoptions have provided. Texas, as in many other states in the U.S., has participated in the application of the energy codes since 2001, not just with the objective of the energy efficiency, but also to encourage the reduction of NOx emissions by electricity providers due to the more stringent building energy codes. For those reasons, Texas adopted the 2000 International Energy Conservation Code (IECC) -with the 2001 supplement, as its first state-wide building energy code. Since then, several local amendments to the IECC have been adopted by the different municipalities in the state. Currently, most of the residential houses in Texas abide by several versions that are more stringent than the IECC 2006 building energy code. The IECC 2000/2001 and IECC 2006 versions, were the codes that took the first steps to address the residential energy efficiency from the design of building thermal envelope and systems (IECC, 2000, 2001, and 2006). The Texas Legislature has also required annual tracking and reporting of the energy savings and emissions reductions. Typically, the calculations of residential and commercial energy savings and emission reductions are performed using certified code-compliance simulations (Haberl et al., 2009), since there is no statewide measured residential energy use records.

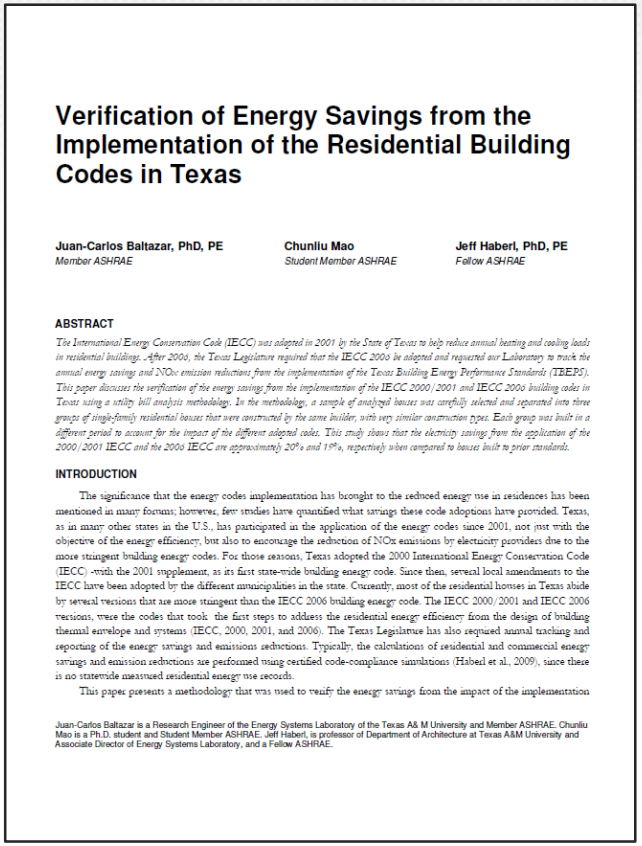
This paper presents a methodology that was used to verify the energy savings from the impact of the implementation

Juan-Carlos Baltazar is a Research Engineer of the Energy Systems Laboratory of the Texas A& M University and Member ASHRAE. Chunliu Mao is a Ph.D. student and Student Member ASHRAE. Jeff Haberl, is professor of Department of Architecture at Texas A&M University and Associate Director of Energy Systems Laboratory, and a Fellow ASHRAE.

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

Juan-Carlos Baltazar, PhD, PE
Member ASHRAE

Chunliu Mao
Student Member ASHRAE

Jeff Haberl, PhD, PE
Fellow ASHRAE

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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 saving 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-family residential houses that were constructed by the same builder, with very similar construction types. Each group was built in a different period to account for the impact of the different adopted codes. This study shows that the electricity savings from the application of the 2000/2001 IECC and the 2006 IECC are approximately 20% and 15%, respectively when compared to houses built to prior standards.

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*Results published in the 2014 ASHRAE Transactions.

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

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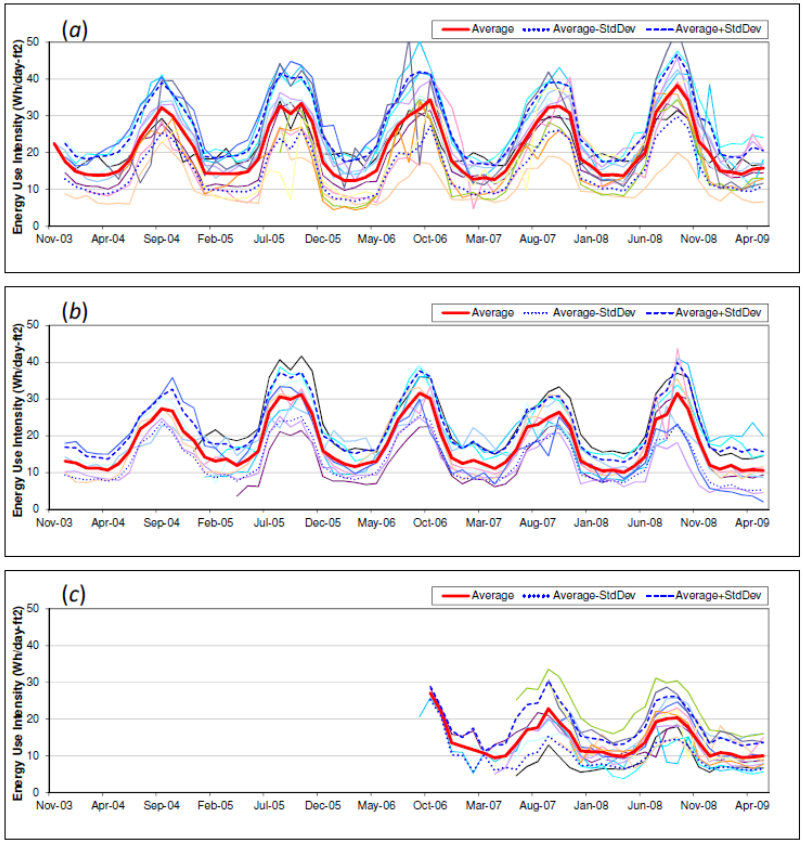

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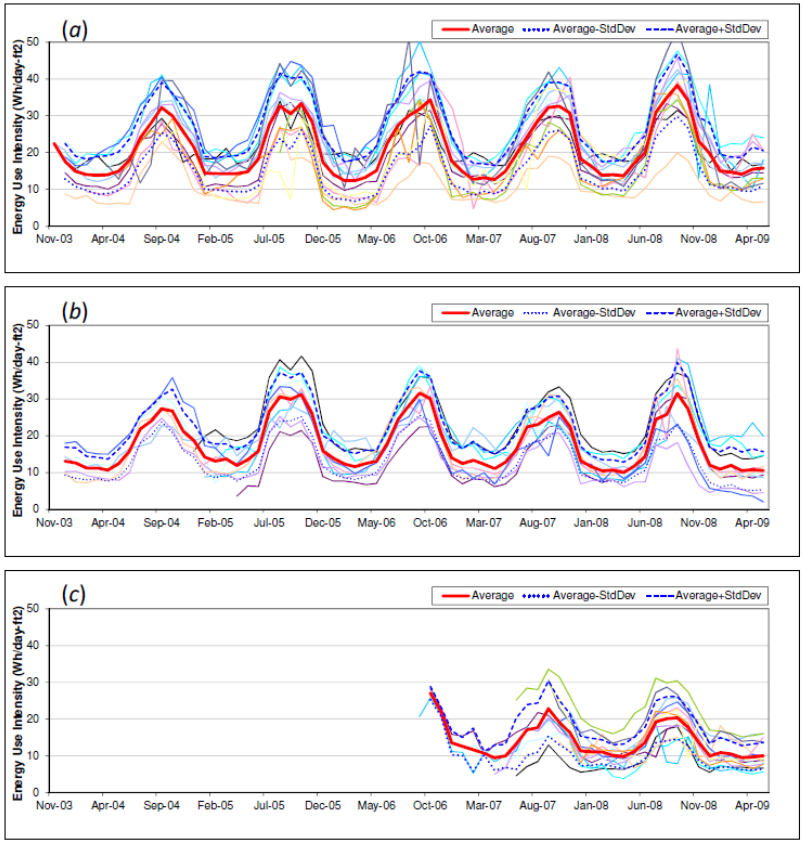

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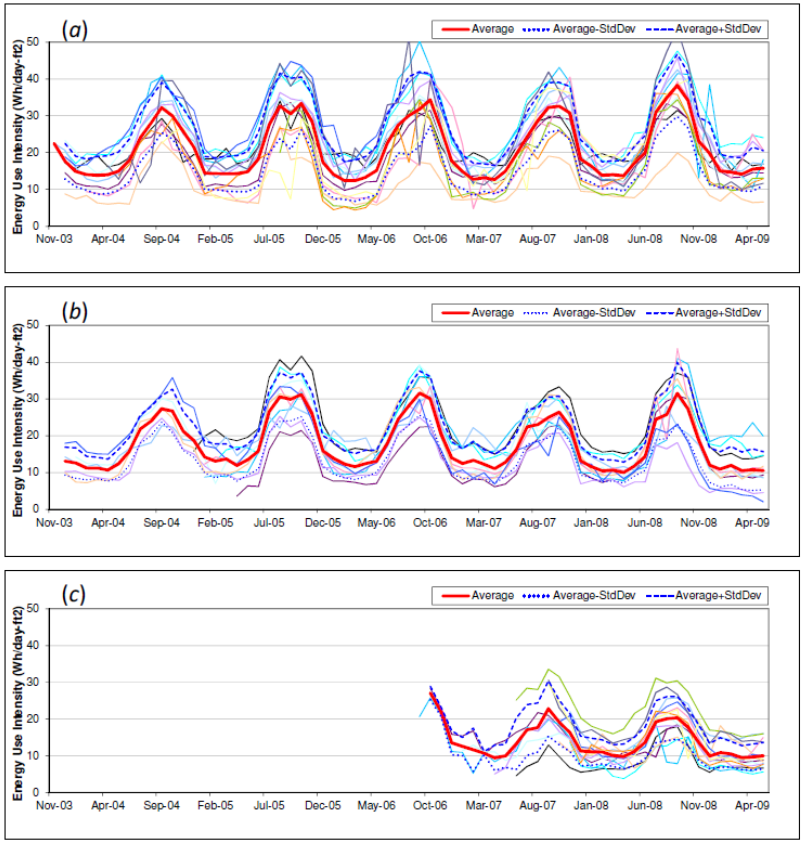
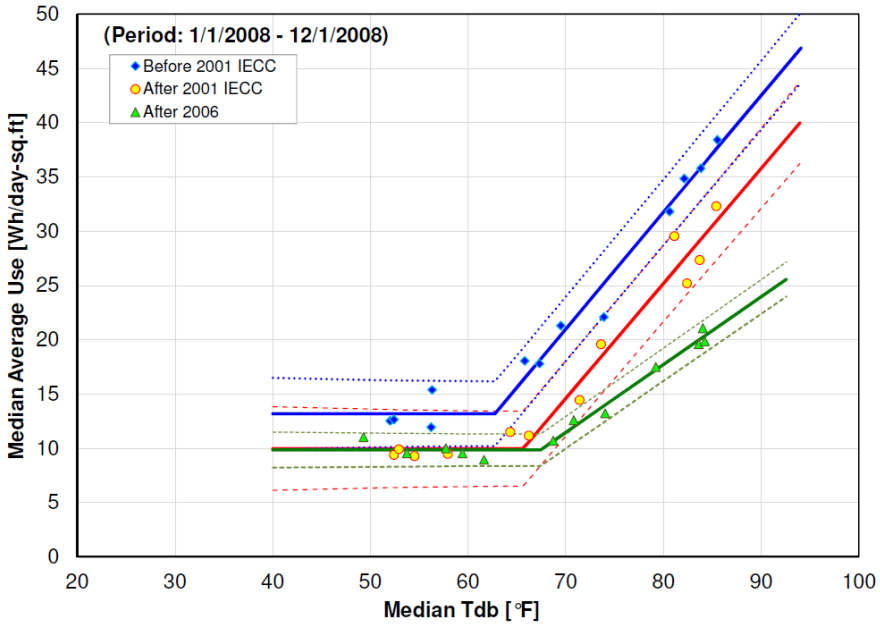


This analysis looked at houses built:

- before 2001
- after the 2001 IECC and
- after the 2006 IECC (SEER 13)

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

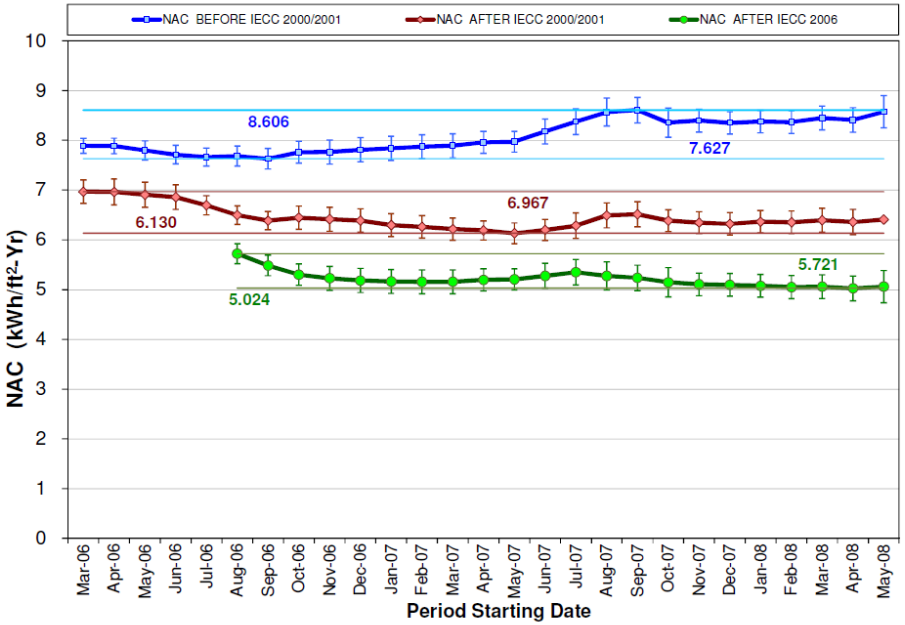
IC3 International CODE COMPLIANCE CALCULATOR



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.

SAVINGS FROM CODE COMPLIANT CONSTRUCTION

IC3 International CODE COMPLIANCE CALCULATOR



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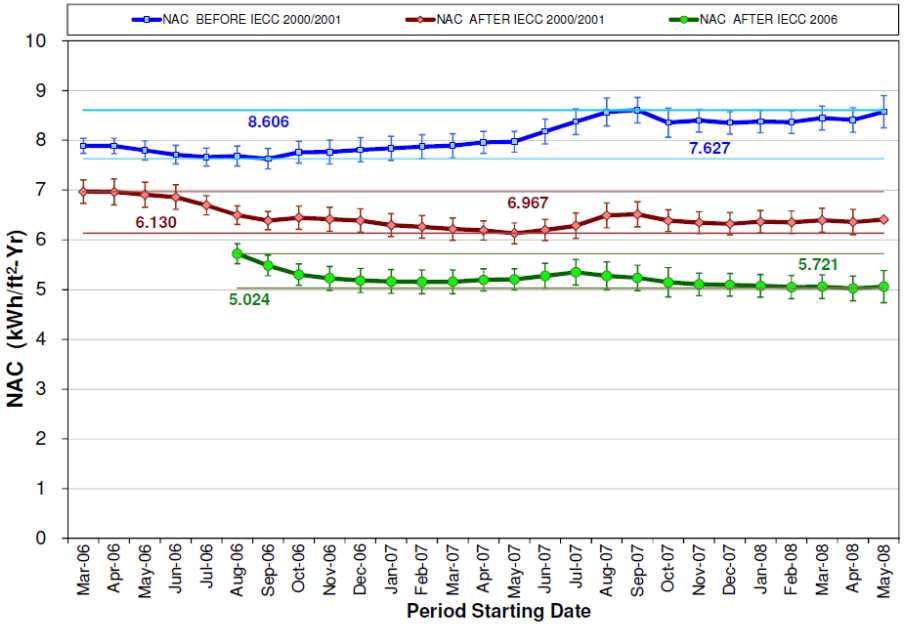
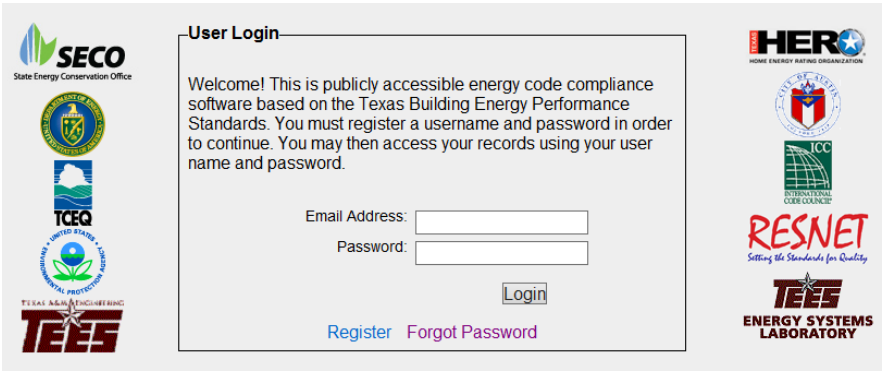


These results match simulations performed with IC3 simulations.



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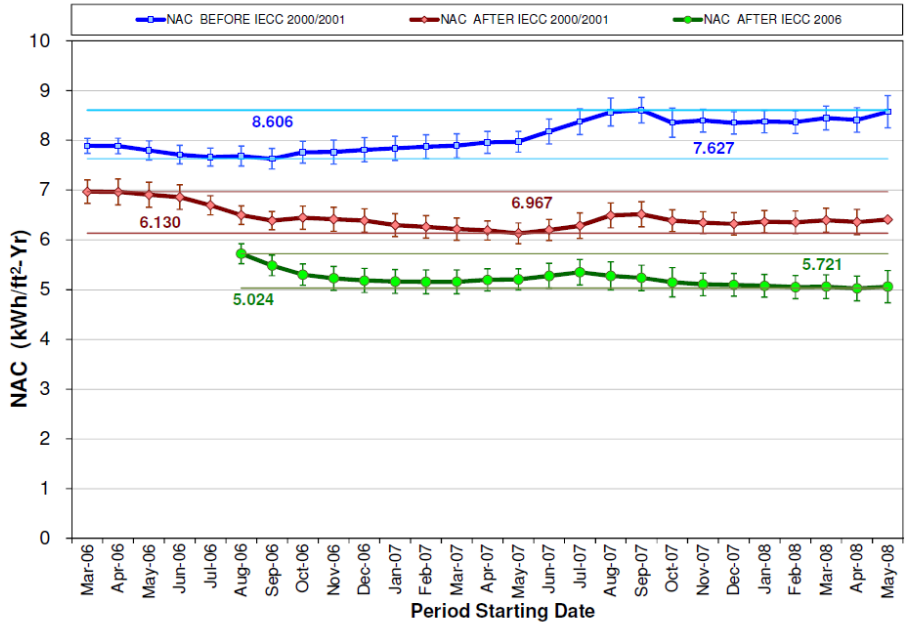
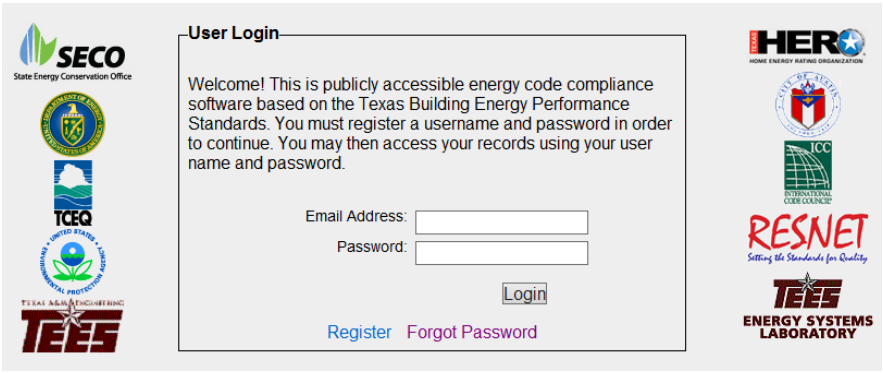


Results for the 2009 IECC are currently underway.



New API for IC3

IC3 International CODE COMPLIANCE CALCULATOR

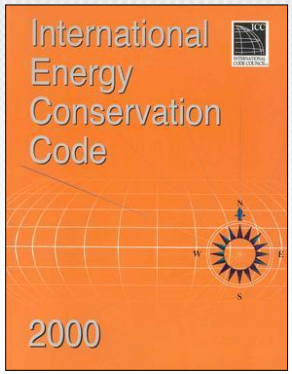
IC3 Web:
http://ic3-2015.tamu.edu

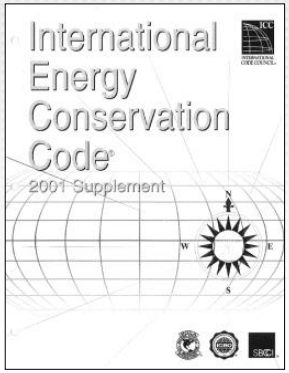
Benefits from API:

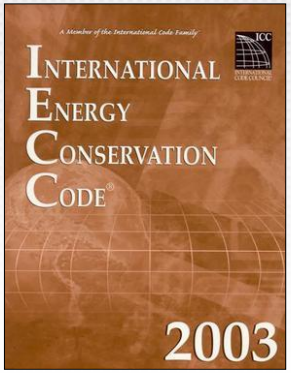
- Single screen allowing access to the same DOE-2 model used by the IC3 webpage
- Tablet/iPad/iPhone friendly
- XML input/output
- Easily integrated into existing third party software

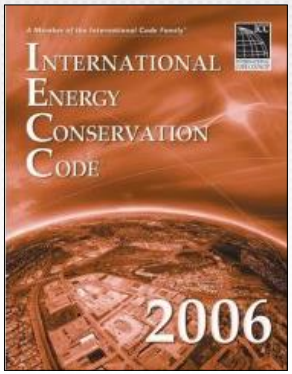
STATEWIDE SAVINGS FROM CODE COMPLIANCE (2000 – 2014)

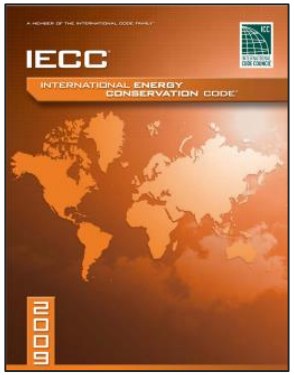
How much electricity has been saved from residential code compliance for all single-family housing 2000-2014?

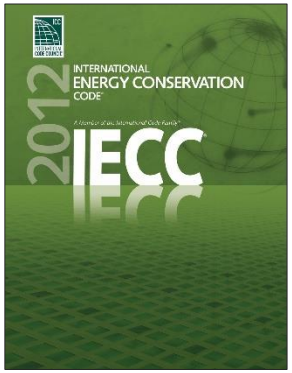


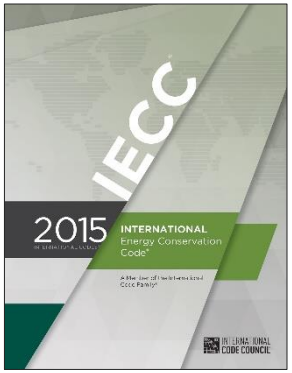






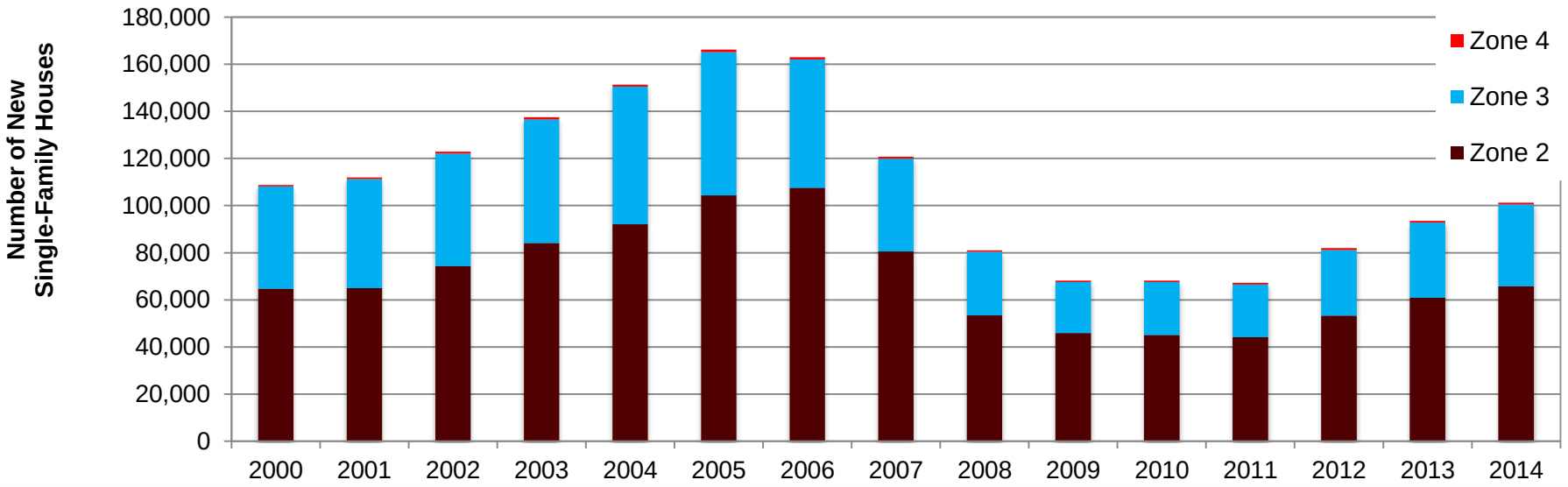






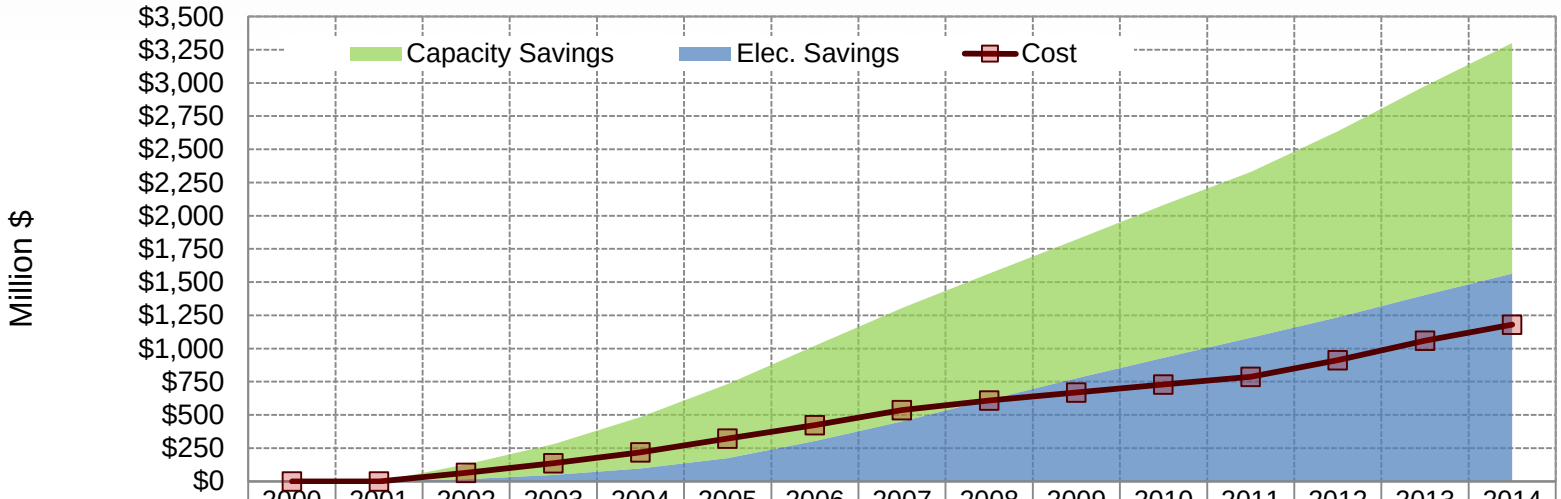
STATEWIDE SAVINGS FROM CODE COMPLIANCE (2000 – 2014)

How much electricity has been saved from residential code compliance for all single-family housing 2000-2014?



STATEWIDE SAVINGS FROM CODE COMPLIANCE 2000 – 2014 (ESTIMATED)

Savings (2002 to 2014)

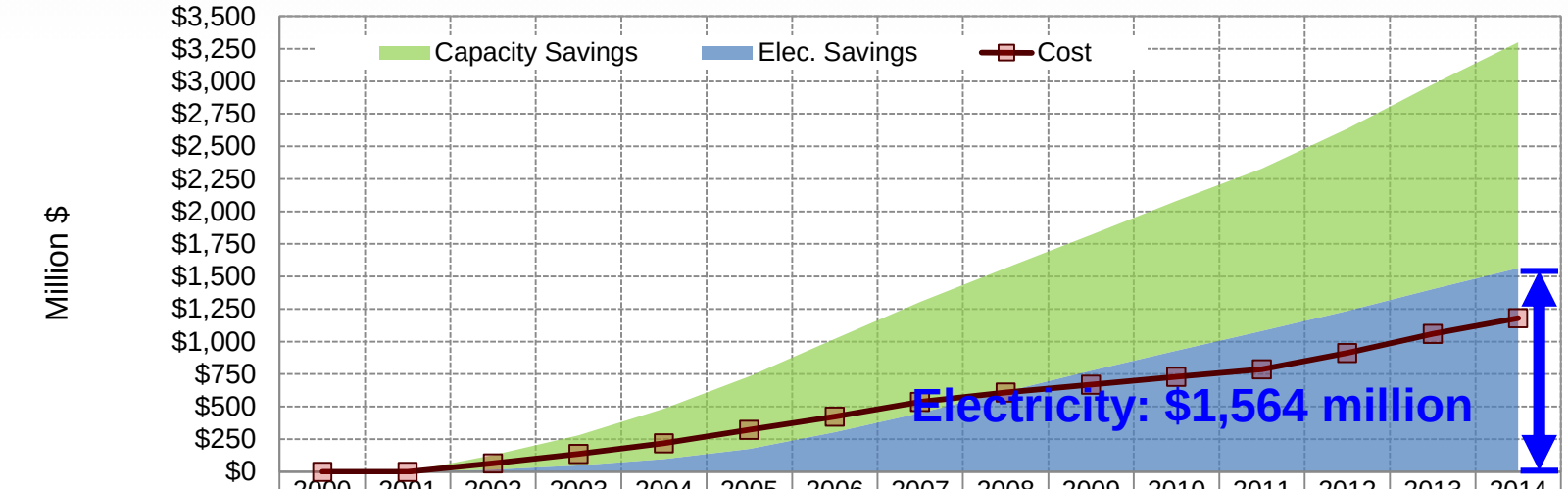


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Capacity Savings	-	-	$111	$232	$387	$558	$717	$854	$949	$1,044	$1,151	$1,248	$1,400	$1,574	$1,736
Elec. Savings	-	-	$16	$48	$97	$175	$304	$451	$615	$776	$930	$1,082	$1,236	$1,403	$1,564
Cost	-	-	$64	$136	$218	$321	$422	$536	$610	$669	$729	$788	$914	$1,060	$1,179

STATEWIDE SAVINGS FROM CODE COMPLIANCE 2000 – 2014 (ESTIMATED)

Savings (2002 to 2014)

Electricity - $1,564 million



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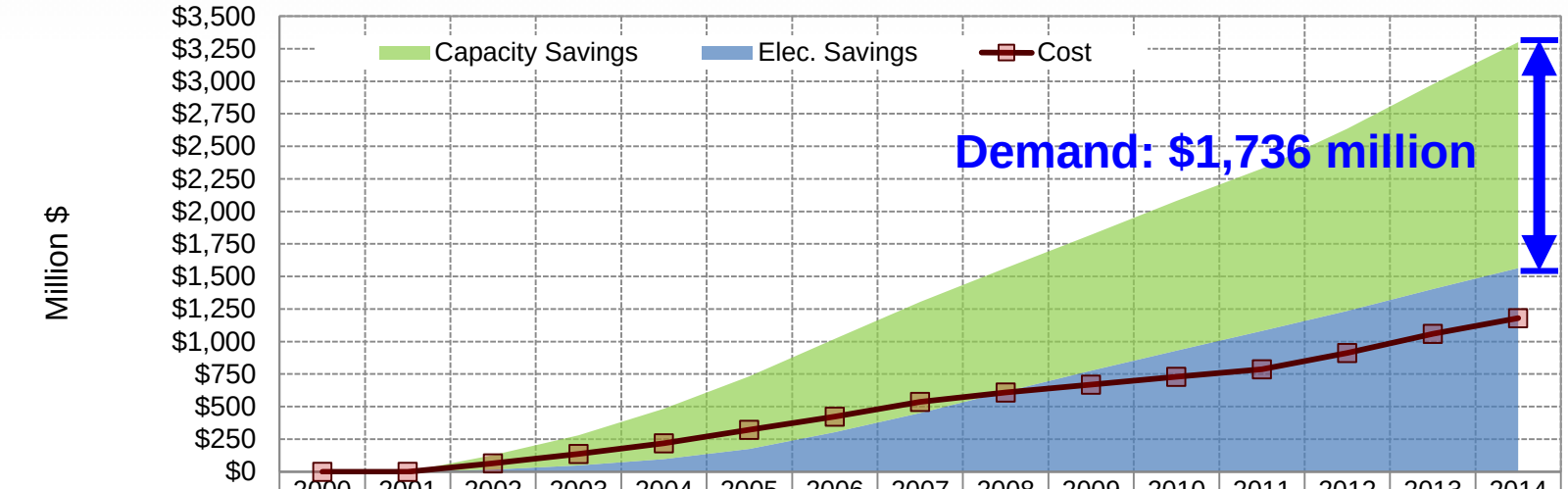
STATEWIDE SAVINGS FROM CODE COMPLIANCE 2000 – 2014 (ESTIMATED)

Savings (2002 to 2014)

Electricity - $1,564 million

Demand - $1,736 million



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STATEWIDE SAVINGS FROM CODE COMPLIANCE 2000 – 2014 (ESTIMATED)

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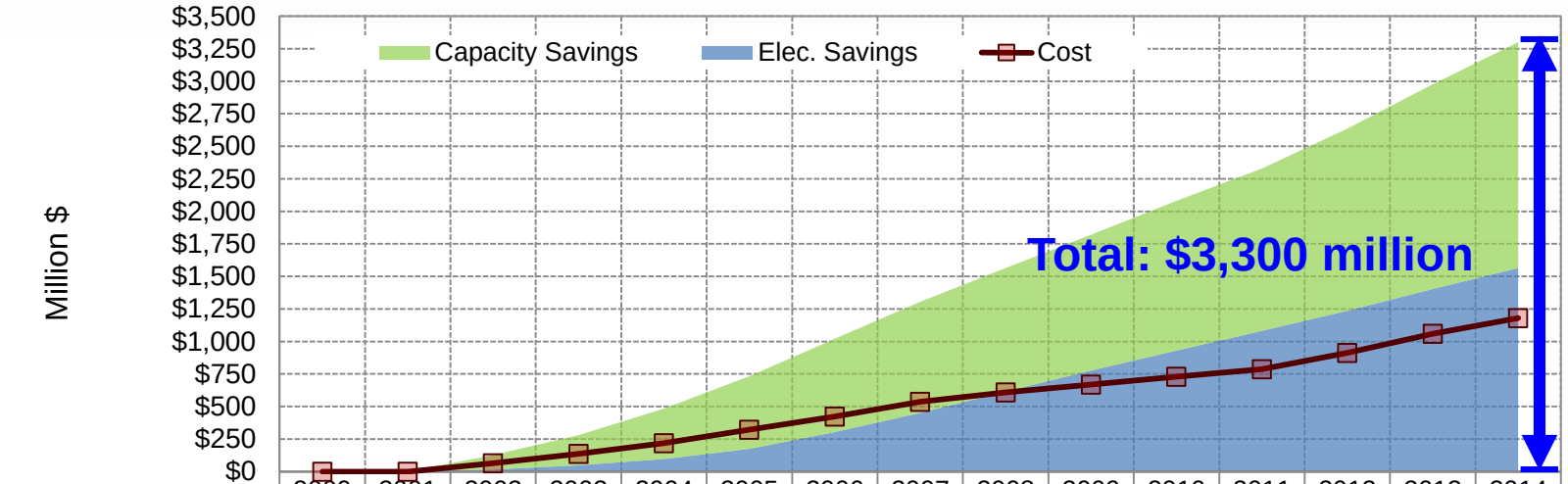
Total - $3,300 million



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Increased Costs (2002 to 2014)

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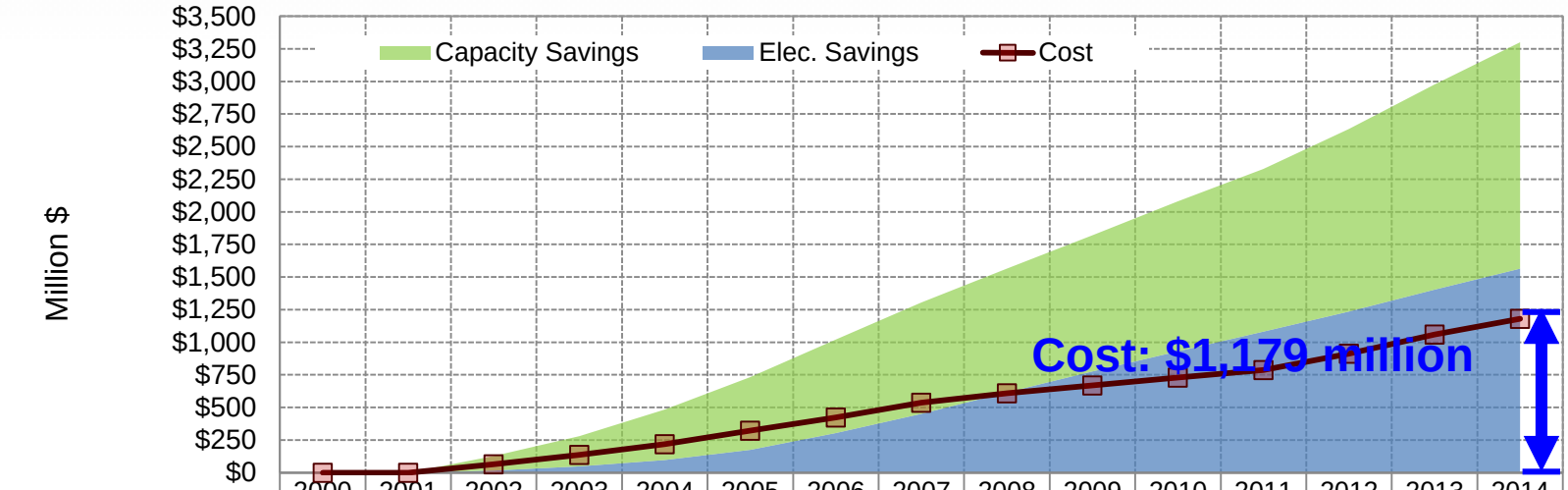

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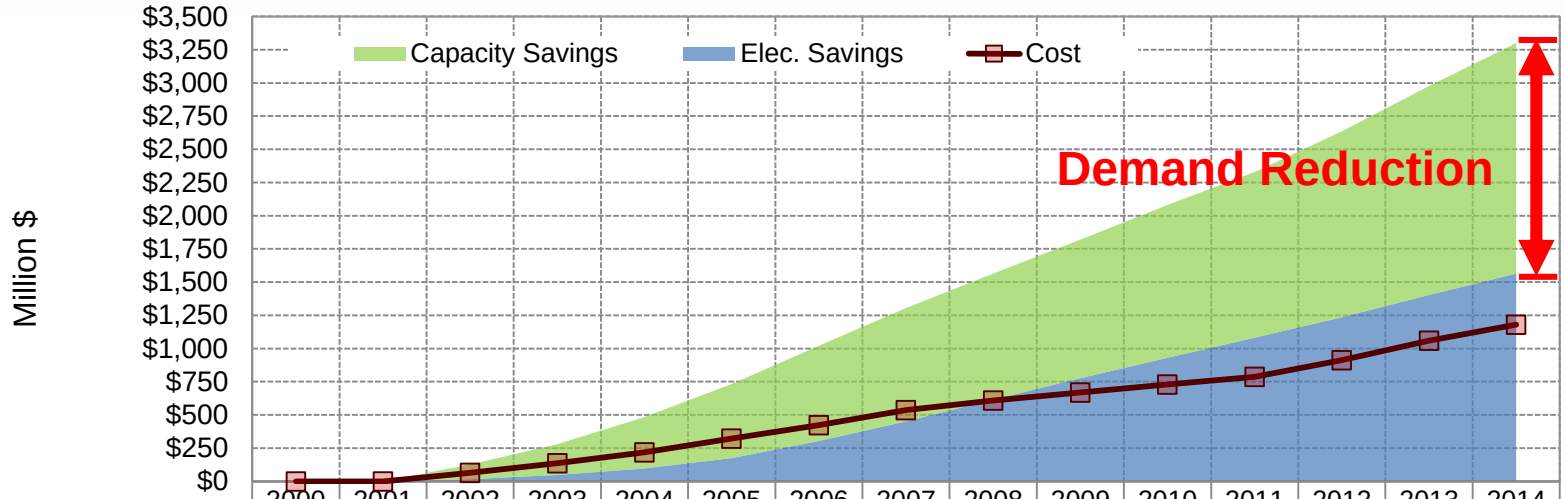
Demand Reduction in 2014

1,265.8 MW

More than one power plant

Increased Costs (2002 to 2014)

Costs - $ 1,179 million



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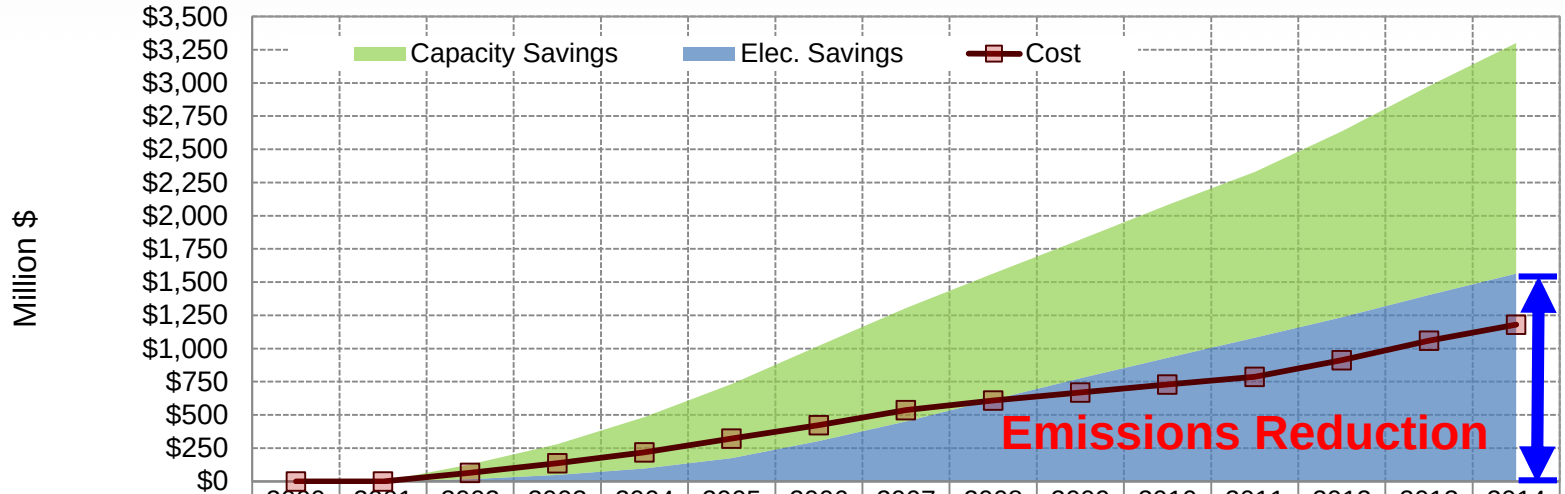
STATEWIDE SAVINGS FROM CODE COMPLIANCE 2000 – 2014 (ESTIMATED)

Savings (2002 to 2014)
- Electricity - $1,564 million
- Demand - $1,736 million
- Total - $3,300 million

Increased Costs (2002 to 2014)
- Costs - $ 1,179 million

Demand Reduction in 2014
- 1,265.8 MW
- More than one power plant

Emissions Reduction in 2014
- 190 tons-NOx/year,
- (About 20,742 cars)



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STATEWIDE WATER SAVINGS AT POWER PLANTS 2002~2014

Electricity/Water Savings from SF (Code Compliance)

STATEWIDE WATER SAVINGS AT POWER PLANTS 2002~2014

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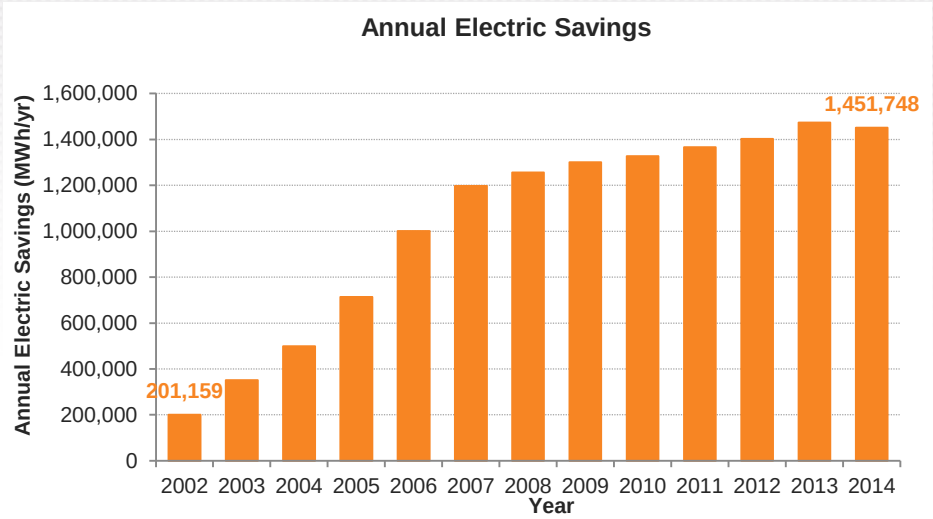
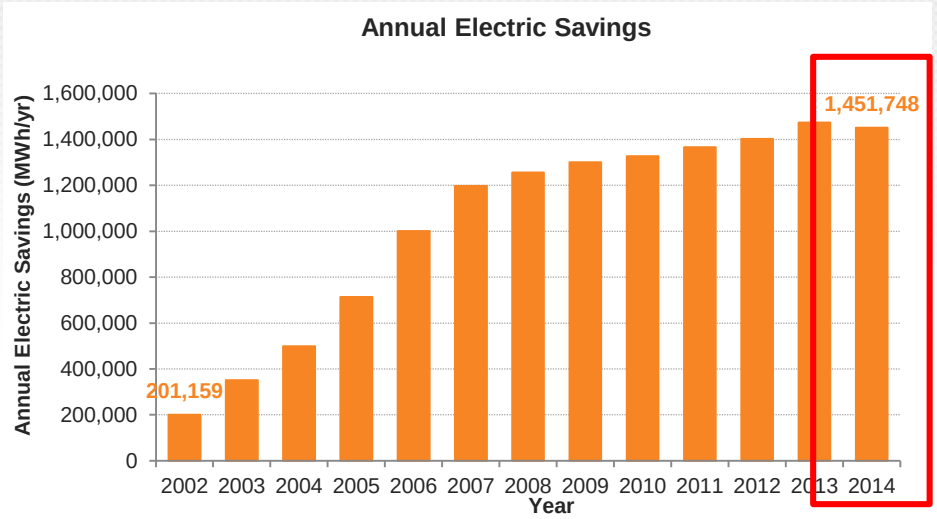


2014 Total Electricity Savings (MWh/yr)
1,451,784

STATEWIDE WATER SAVINGS AT POWER PLANTS 2002~2014

Electricity/Water Savings from SF (Code Compliance)



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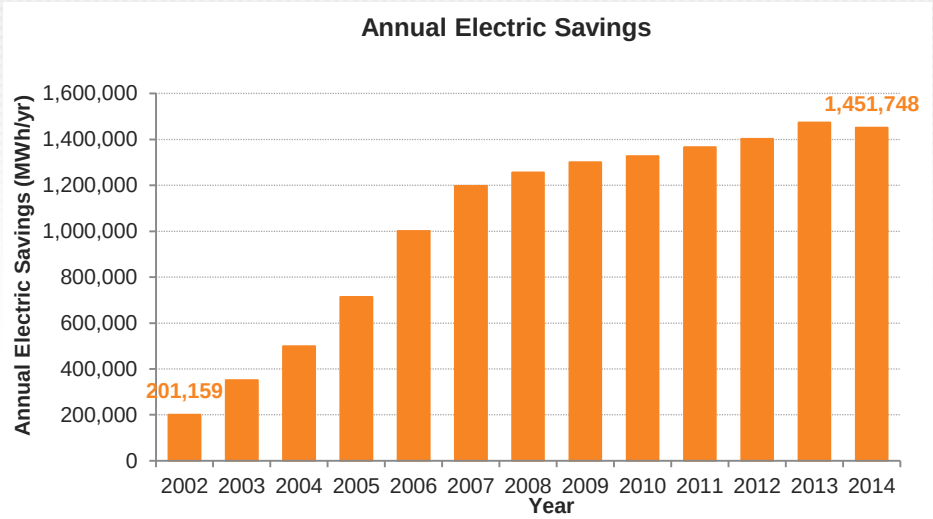
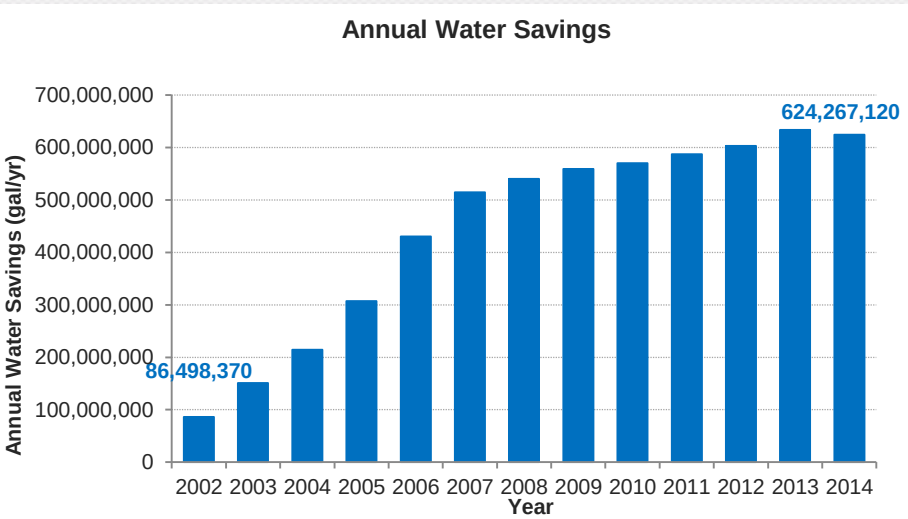
STATEWIDE WATER SAVINGS AT POWER PLANTS 2002~2014

Electricity/Water Savings from SF (Code Compliance)





2014 Total Electricity Savings	2014 Total Water Savings	
(MWh/yr)	(gal/yr)	(acre-ft/yr)
1,451,784	624,267,120	1,916

Conversion Factors: 430 *gal/MWh*
325,851 *gal/acre-ft*

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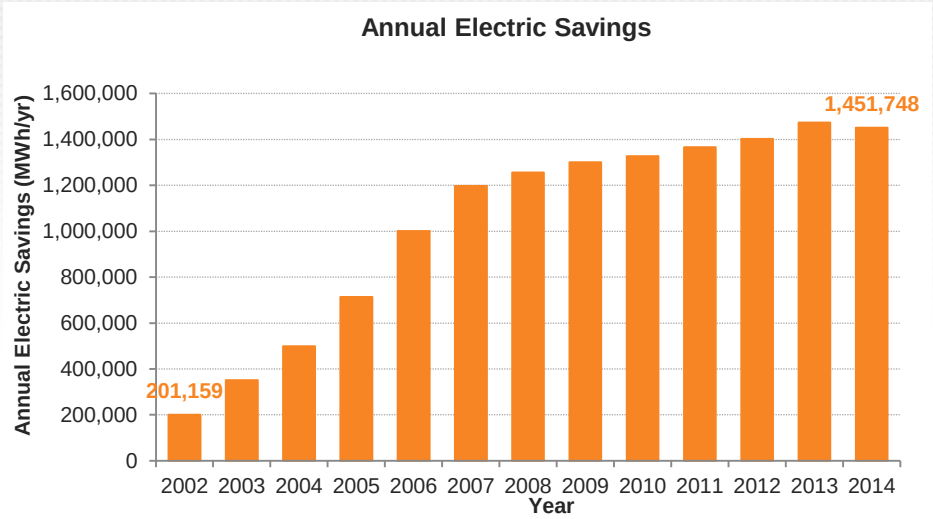

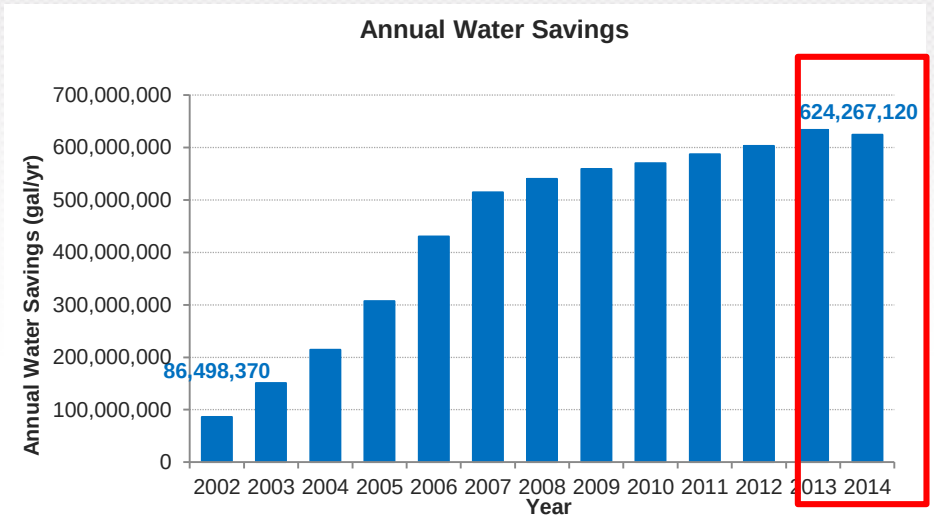

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SAVINGS FROM RENEWABLES

420 Panel Solar PV Array In Waco, TX

Solar PV

Army Residence Community, San Antonio

Solar Thermal

Dam at Elephant Butte, El Paso, TX

Hydro

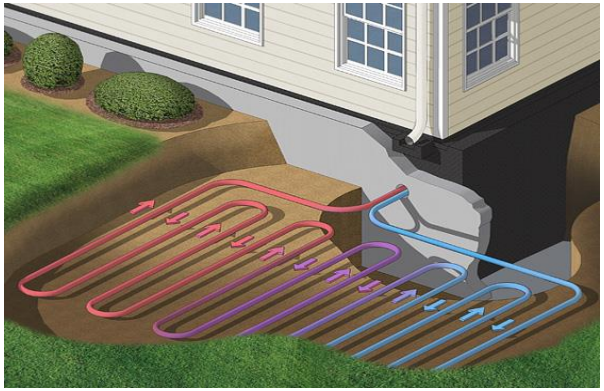
2.5 Miles Southwest of Woodville, TX

Biomass

Aspen Power plant in Lufkin, TX

Landfill Gas

Ground Source Heat Pump



Geothermal

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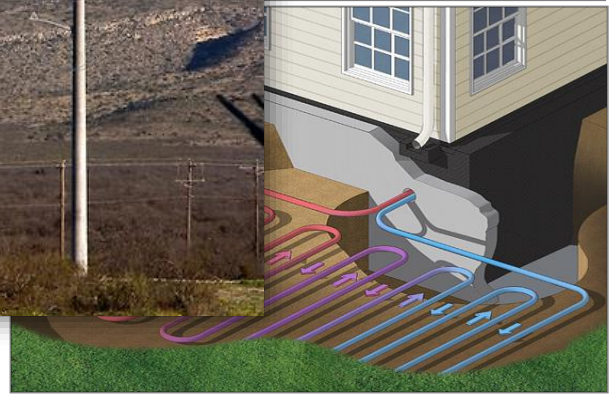


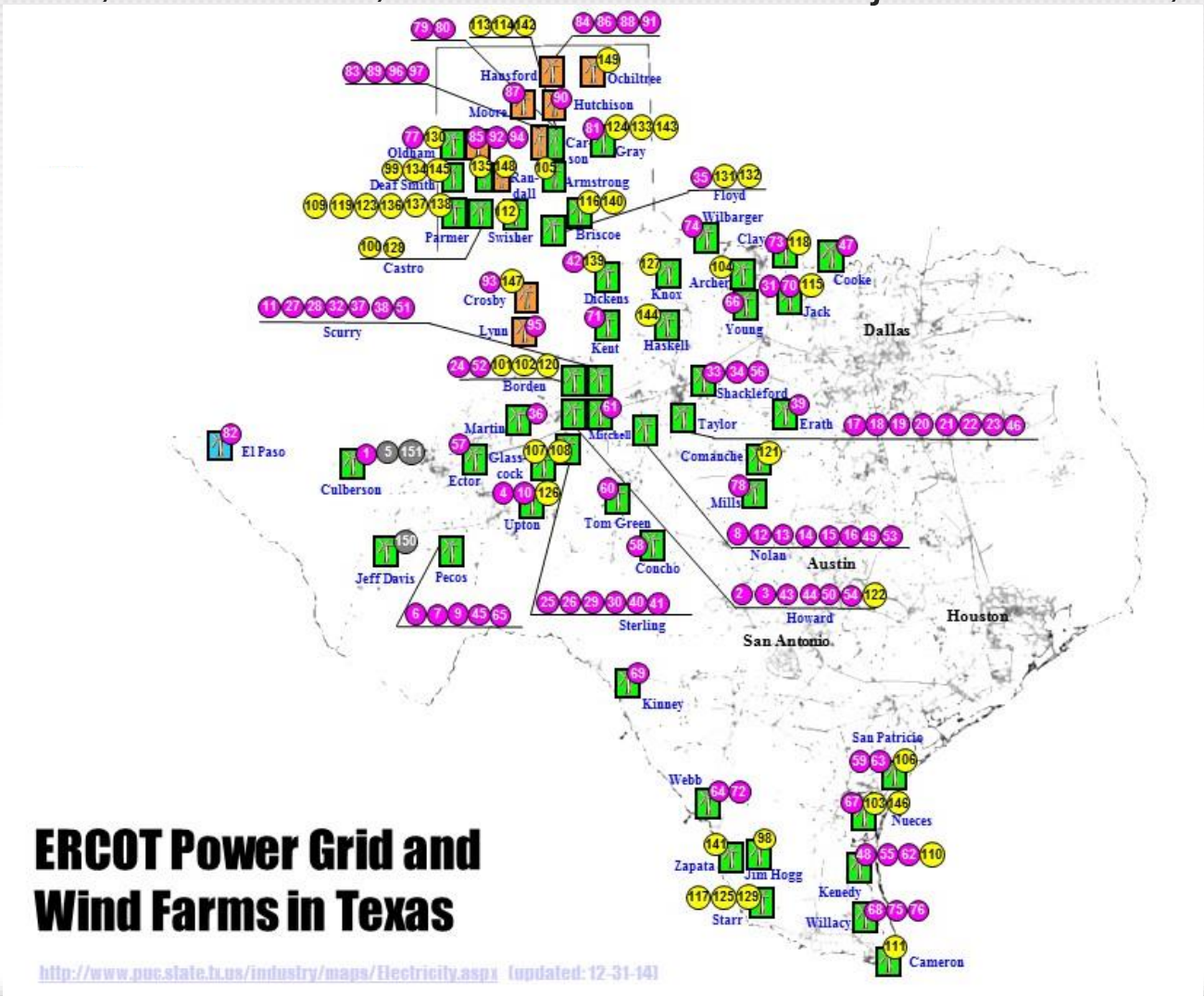
Geothermal

Wind

Forest Creek Wind Farm, TX.

WIND PROJECTS IN TEXAS (2014)

Completed, Announced, and Retired Wind Projects in Texas, as of Dec. 2014



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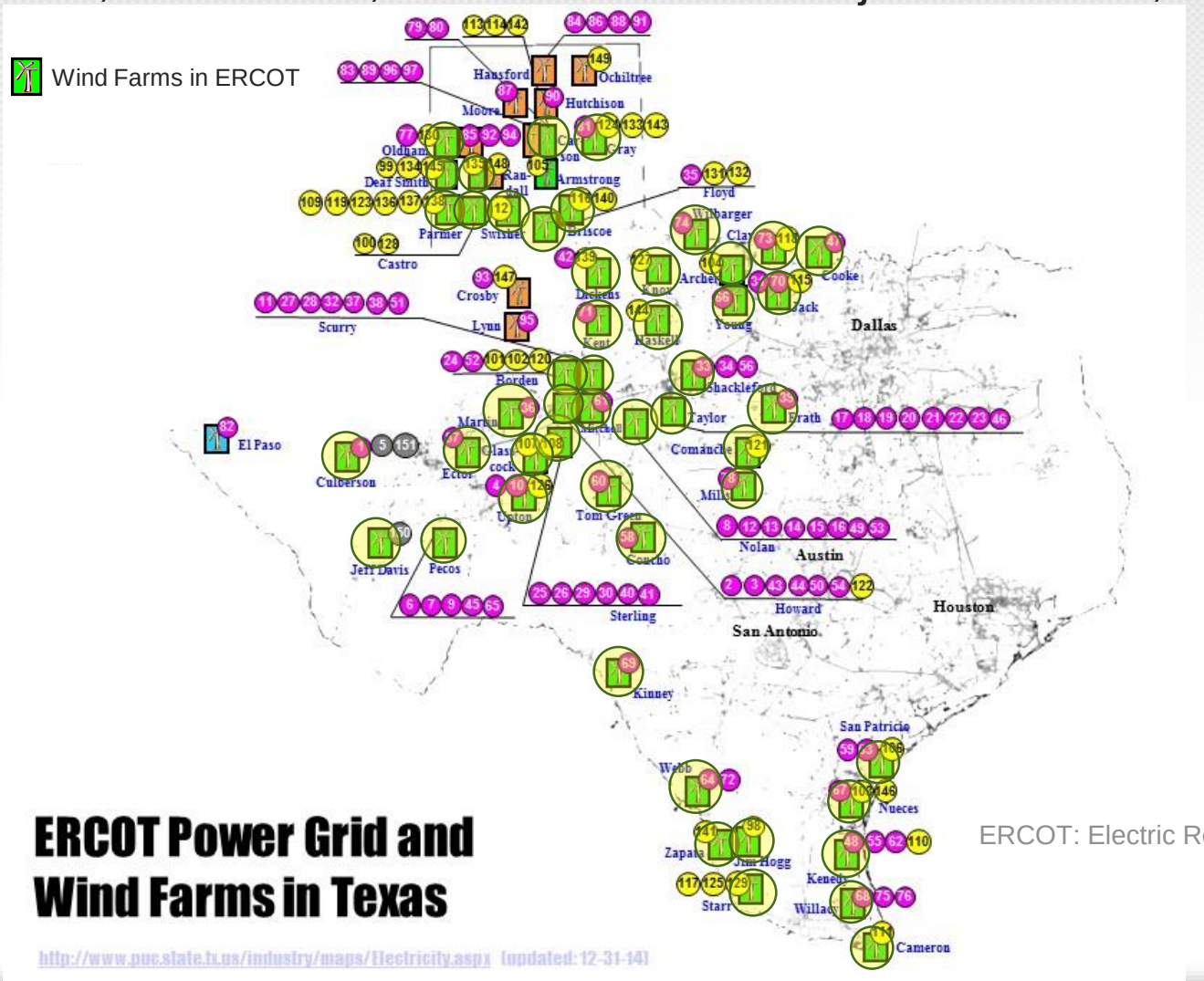

ERCOT: Electric Reliability Council of Texas

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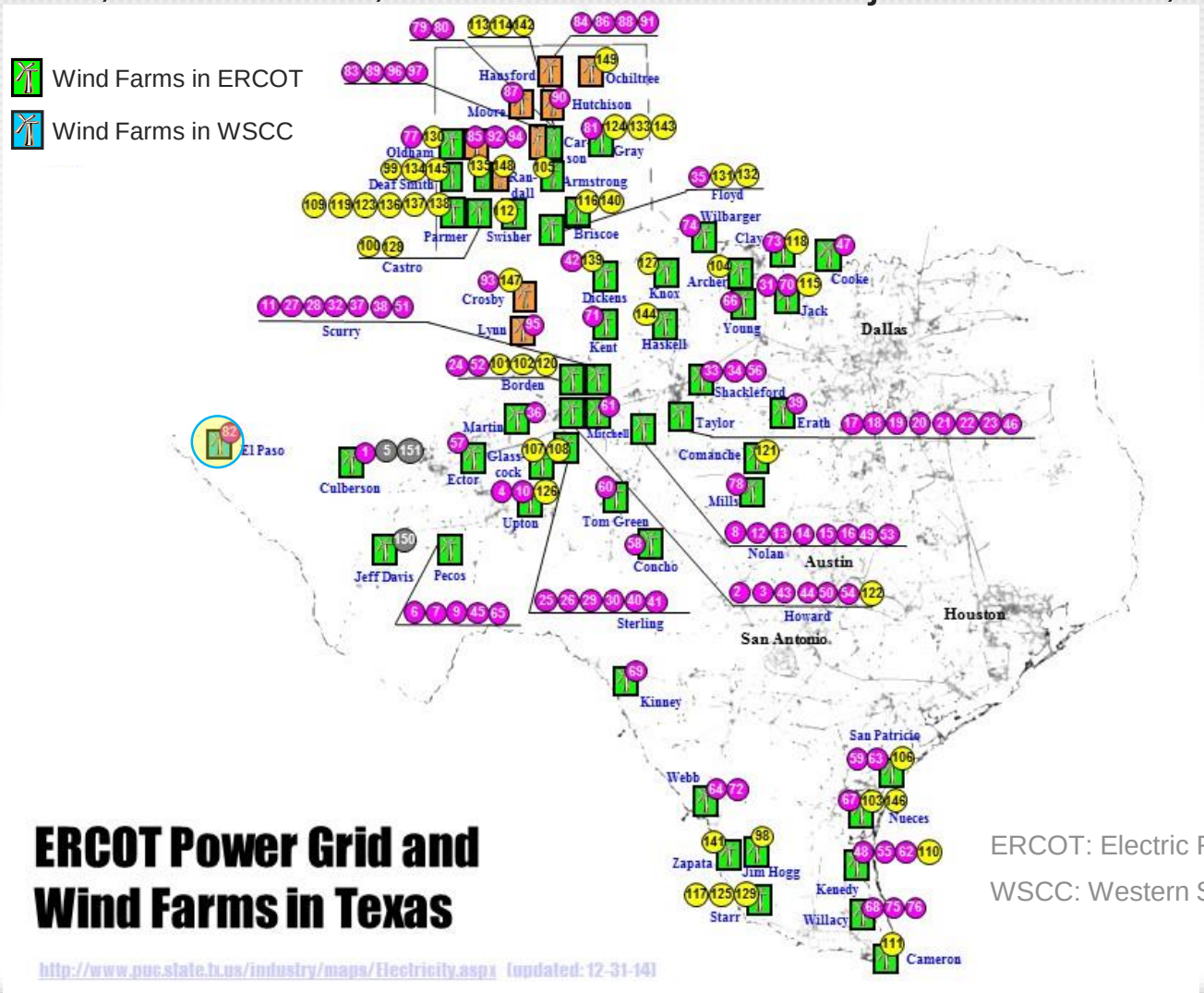

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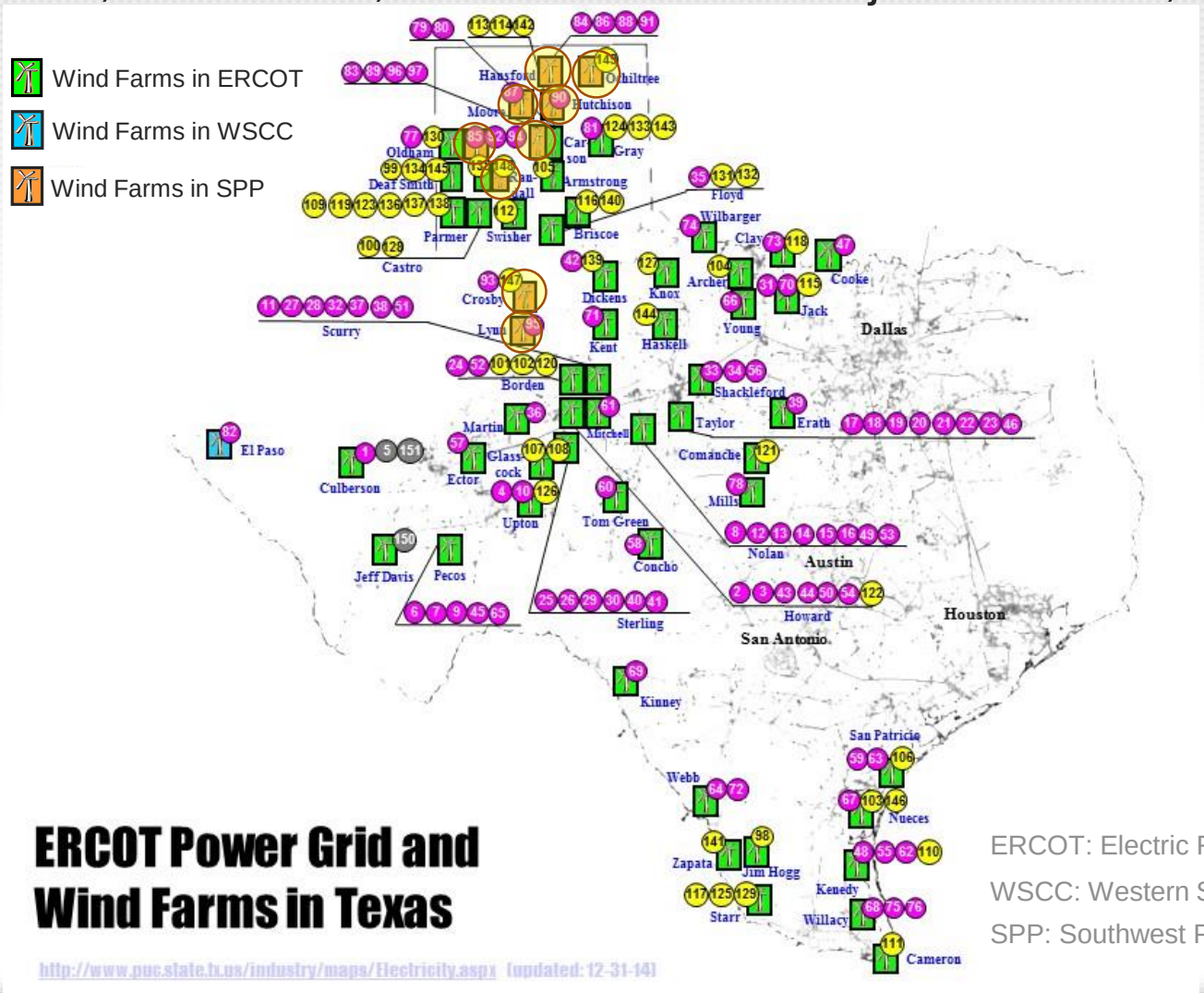

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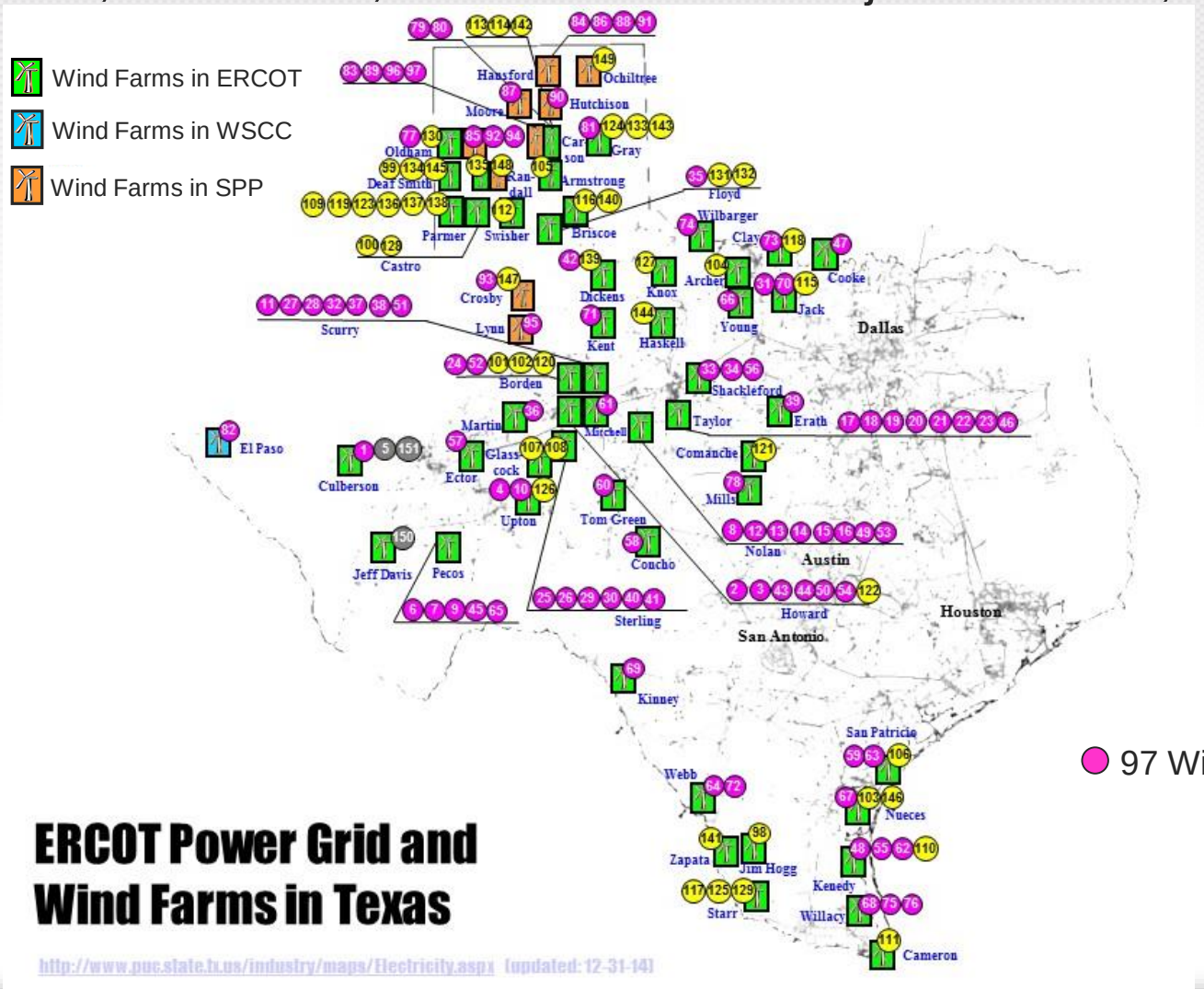
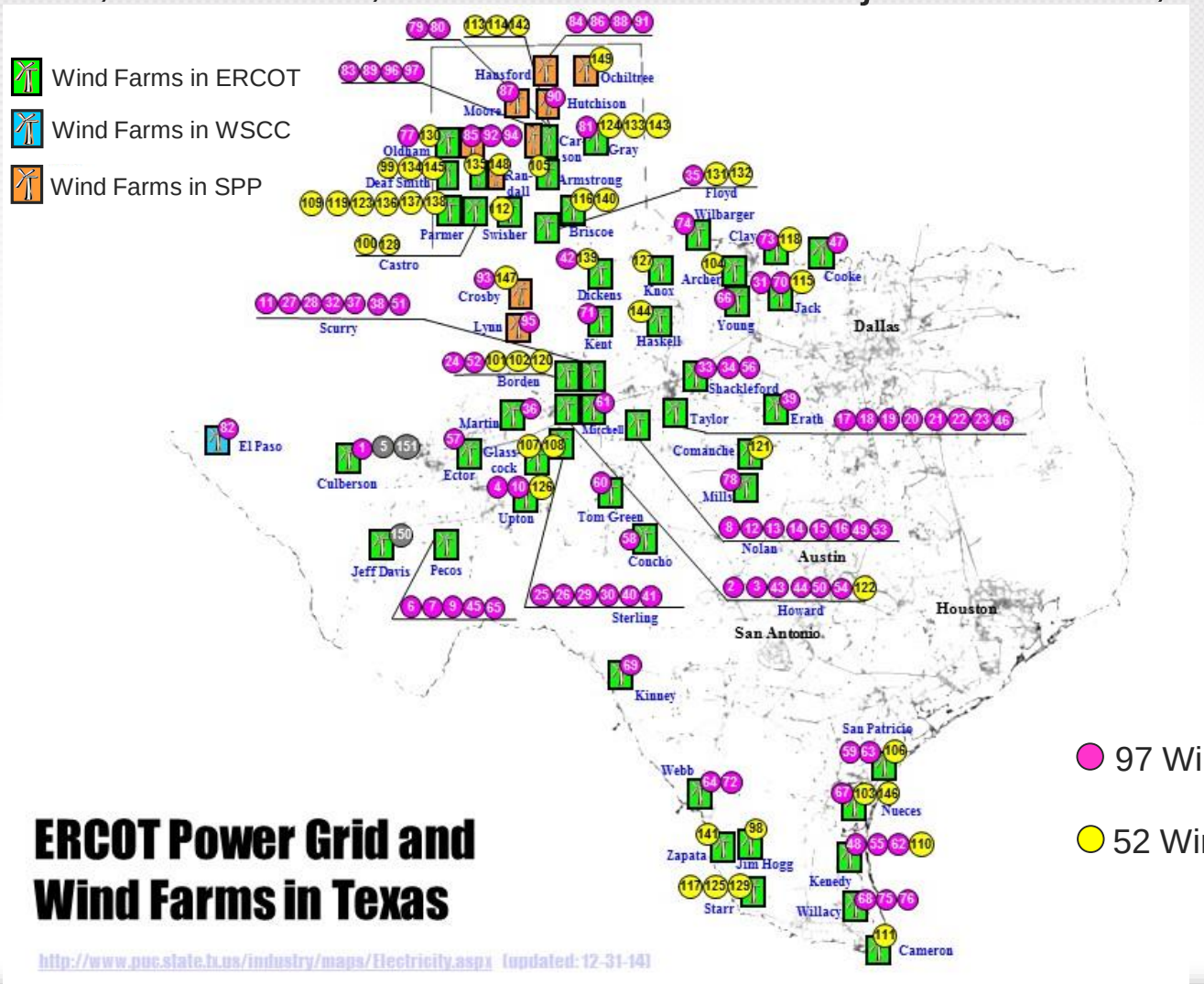


97 Wind Projects Completed

WIND PROJECTS IN TEXAS (2014)

Completed, Announced, and Retired Wind Projects in Texas, as of Dec. 2014



- 97 Wind Projects Completed
- 52 Wind Projects Announced

WIND PROJECTS IN TEXAS (2014)

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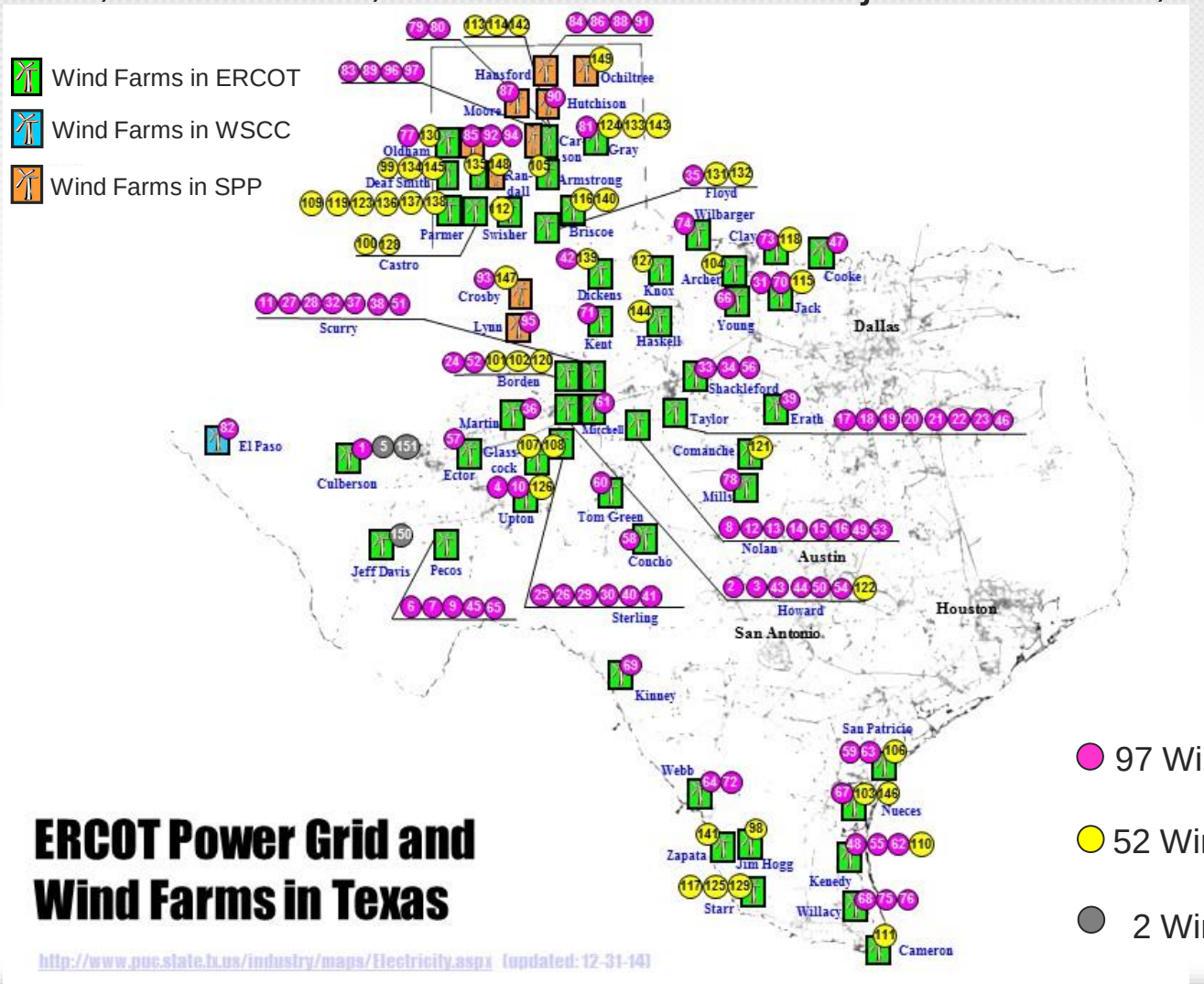

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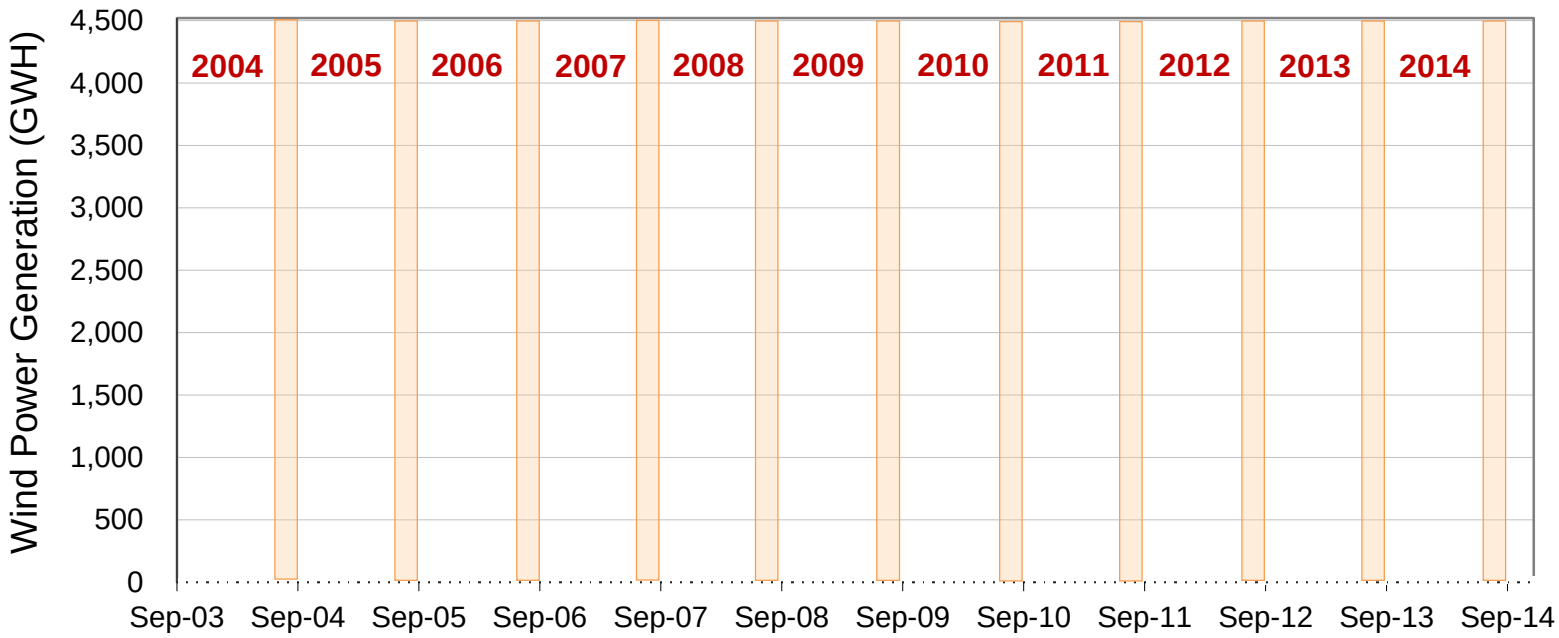

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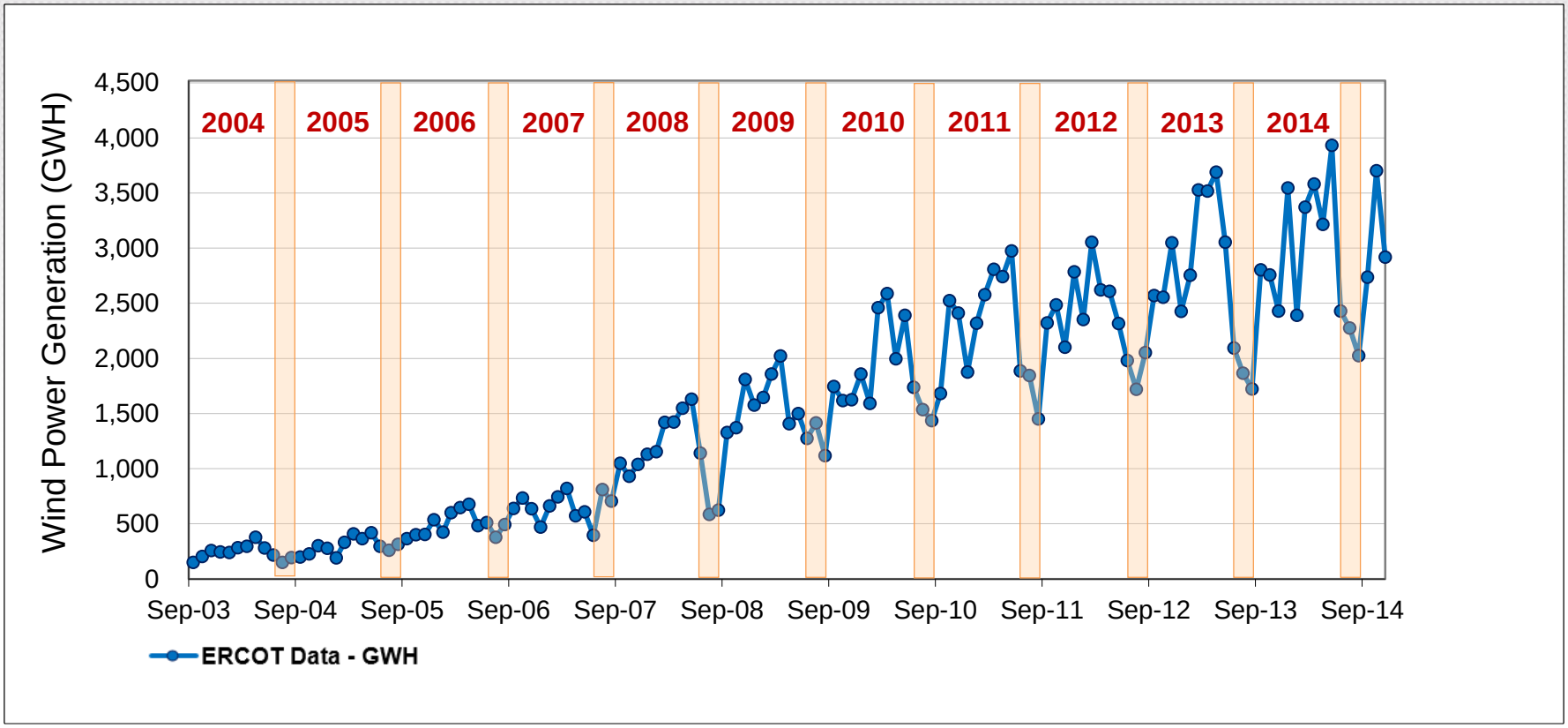

Substantial increases in measured electricity from wind energy

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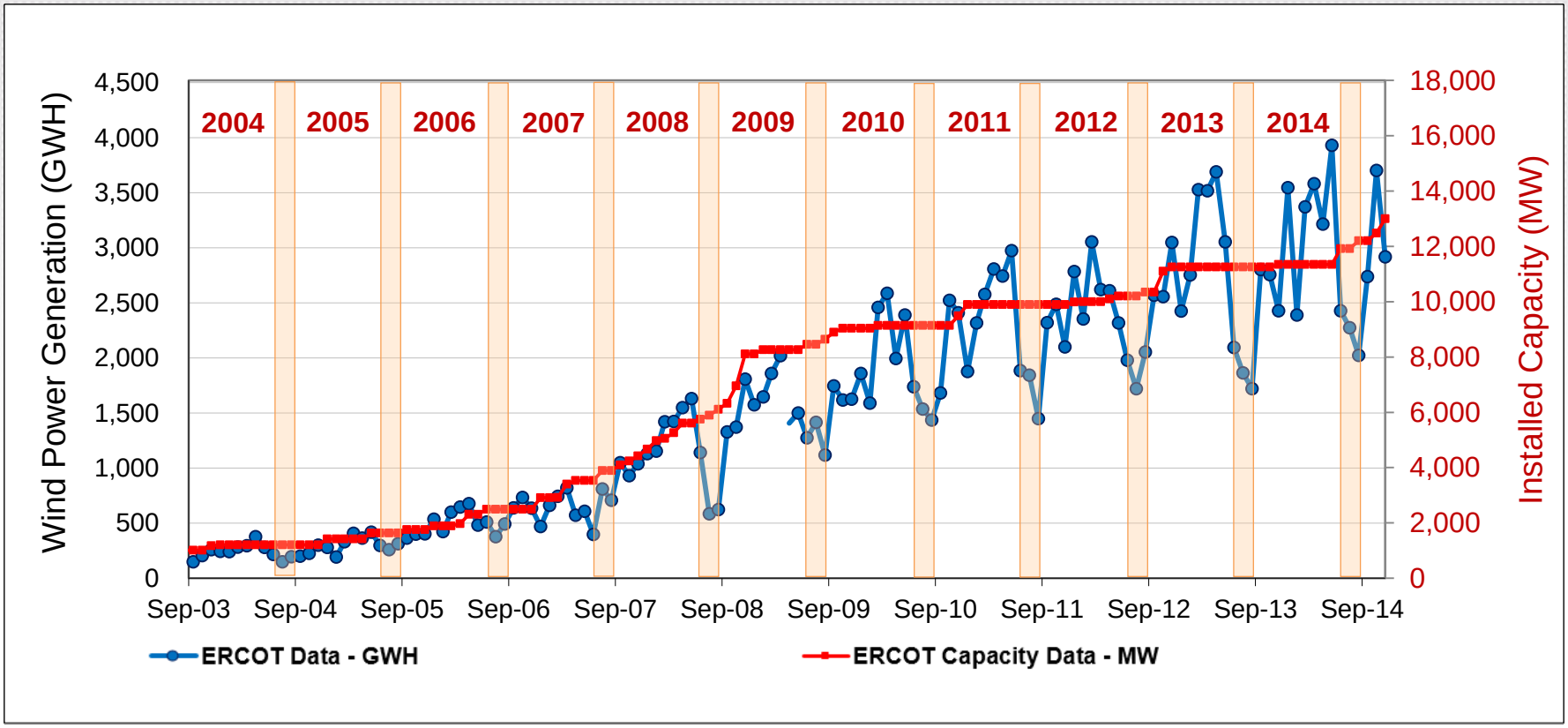

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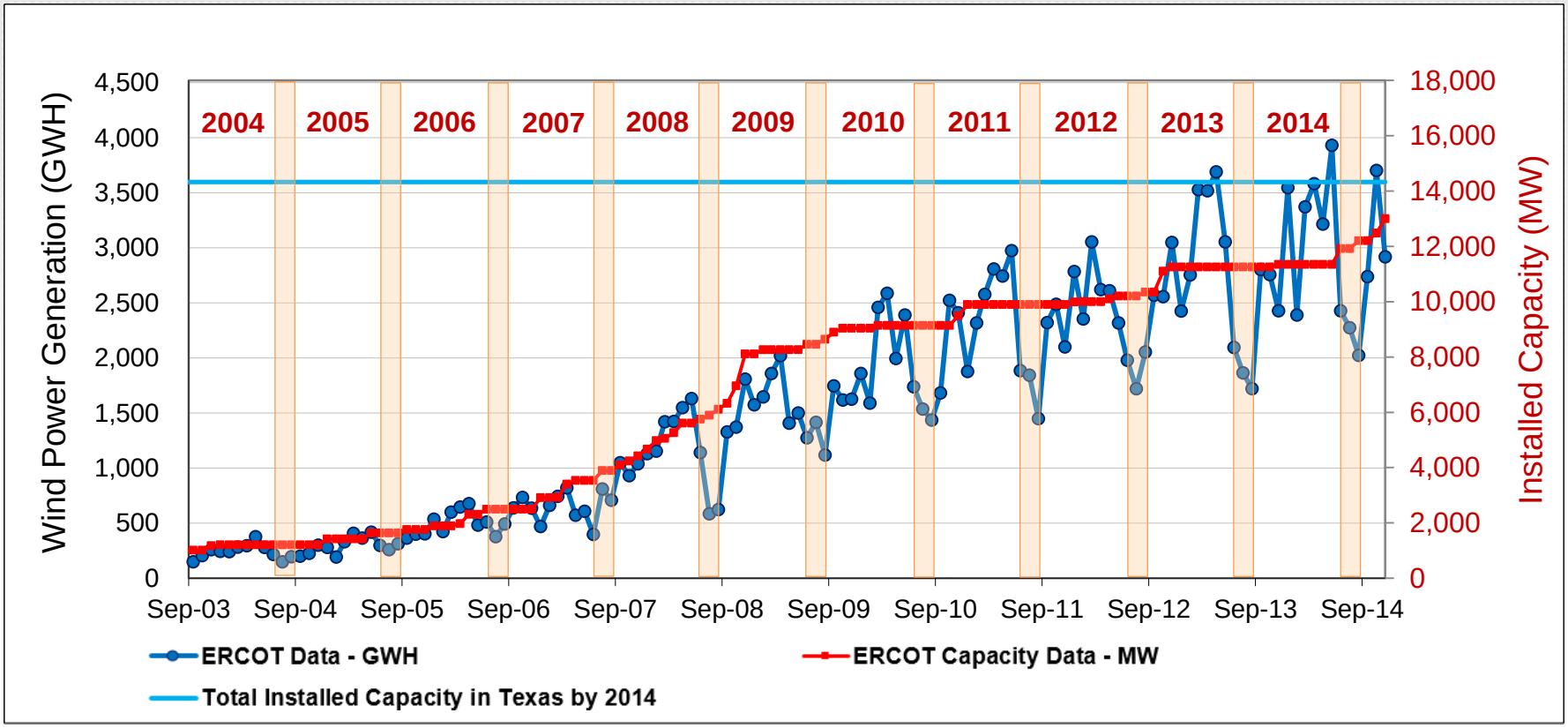

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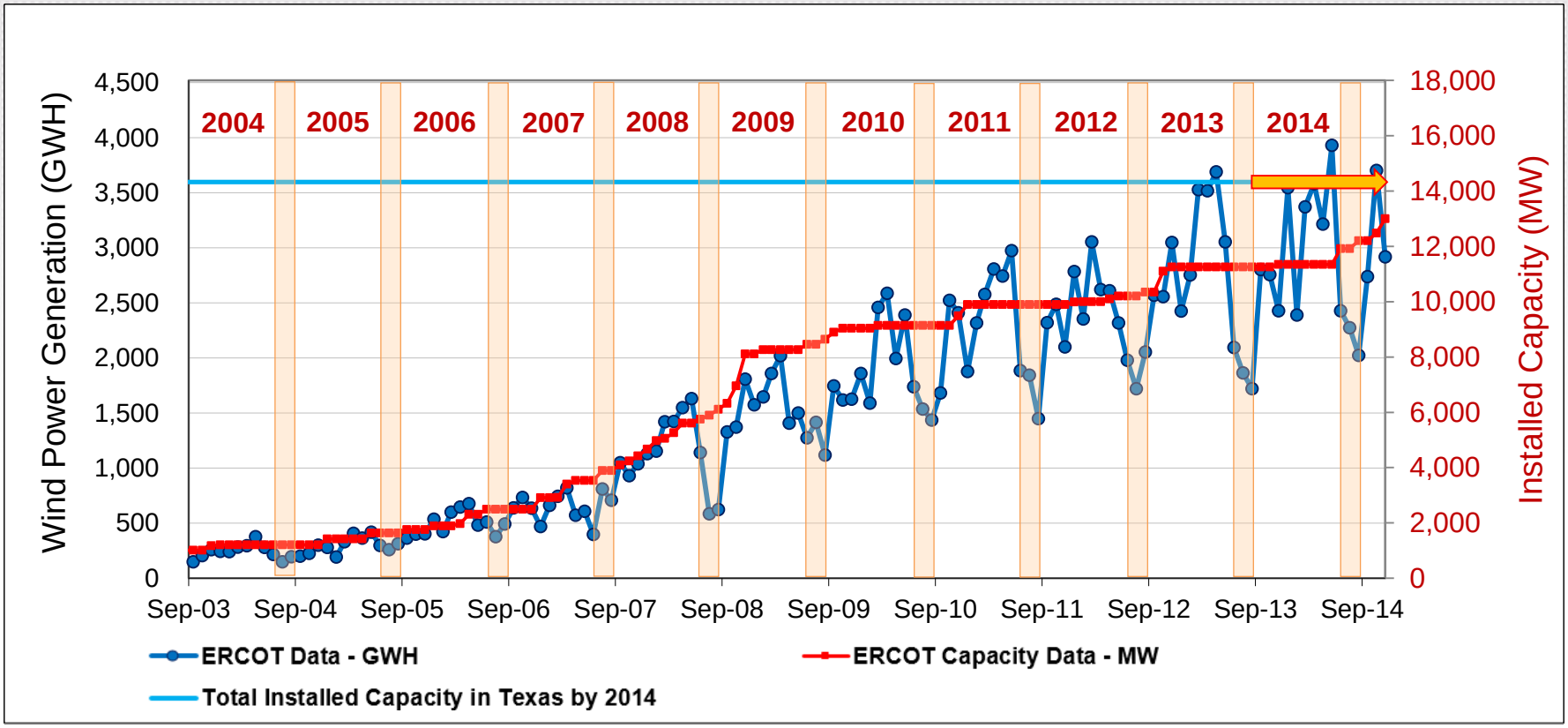

Substantial increases in measured electricity from wind energy

Total capacity: 14,327 MW in Texas

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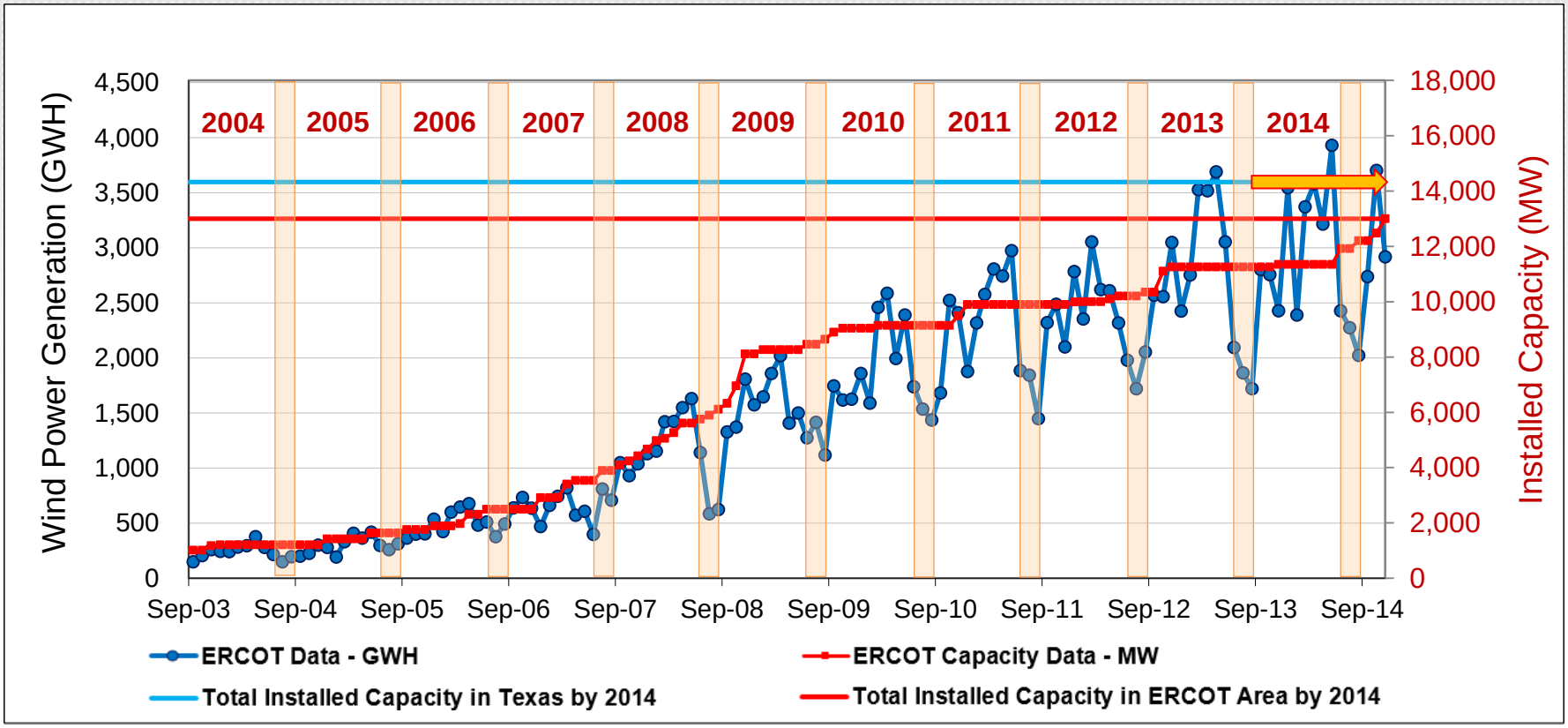

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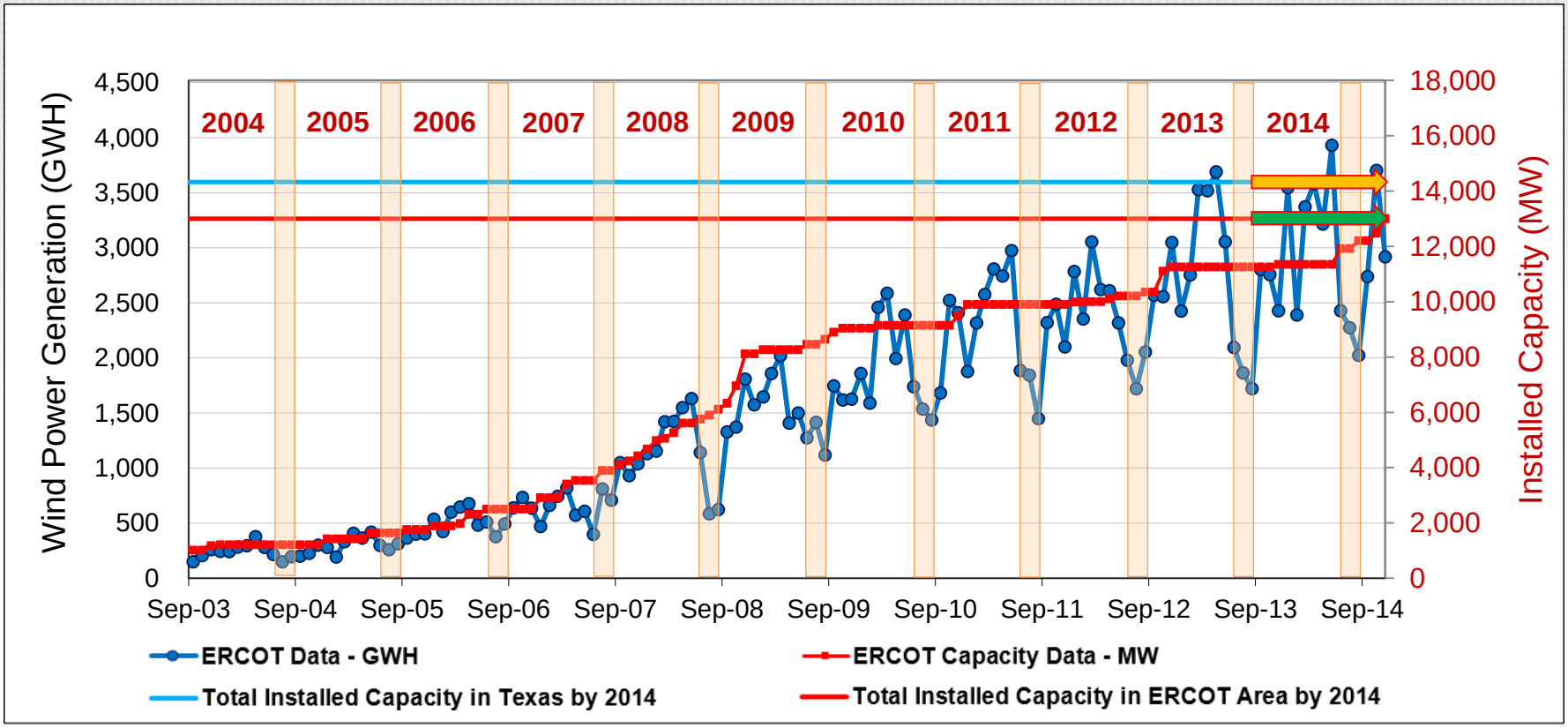

Substantial increases in measured electricity from wind energy
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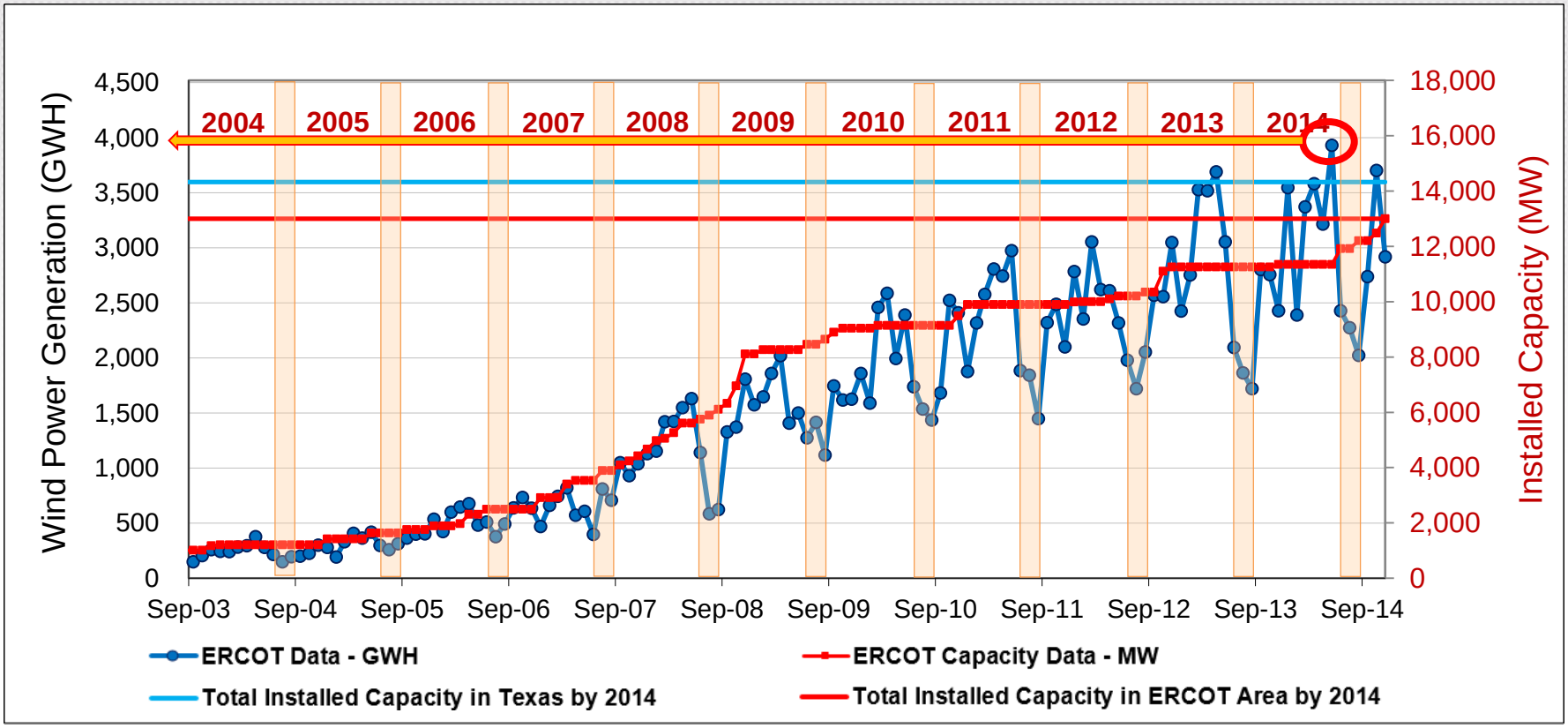

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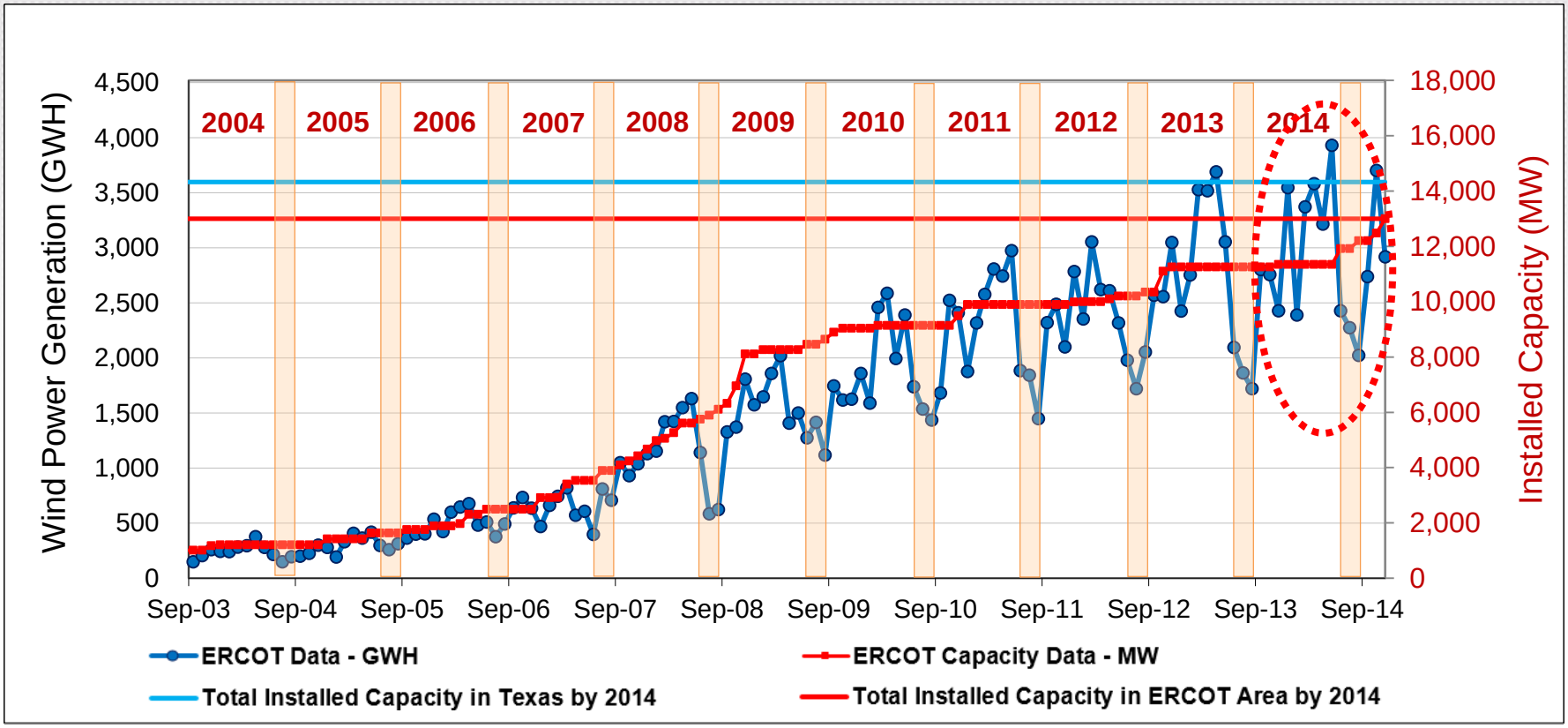

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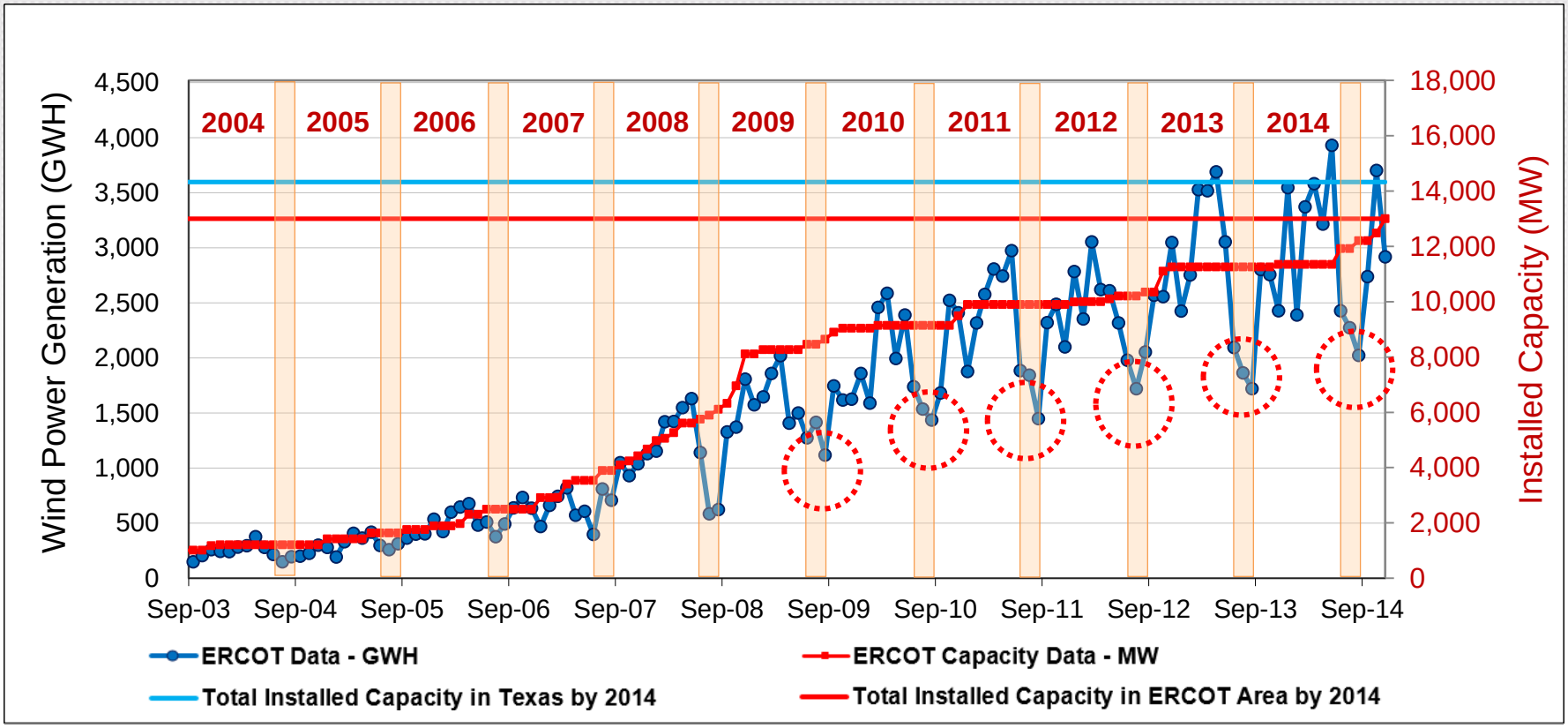

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New peak wind power generation in 2014: **3,932** GWH/month
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Average Ozone Season Period (OSP) power generation increasing

TRACKING WIND POWER GENERATION (2014)

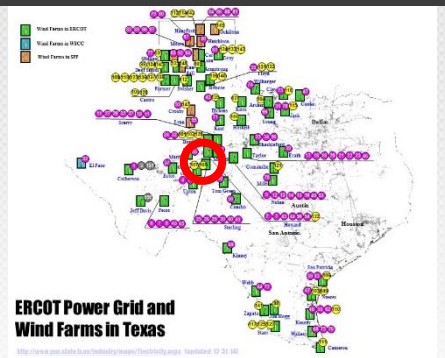
Example: Forest Creek (124.2 MW Capacity)

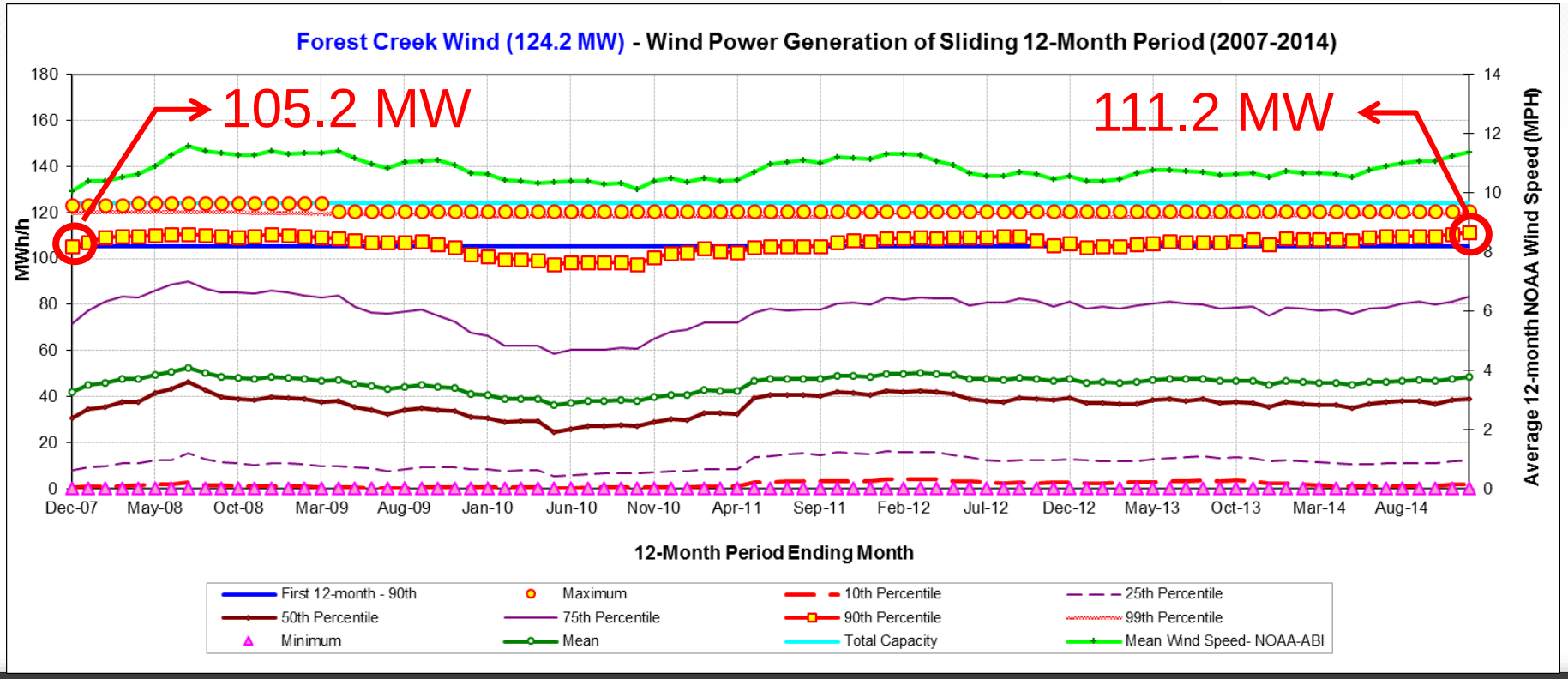
Is There Degradation?

December 2007: 105.2 MW

December 2014: 111.2 MW

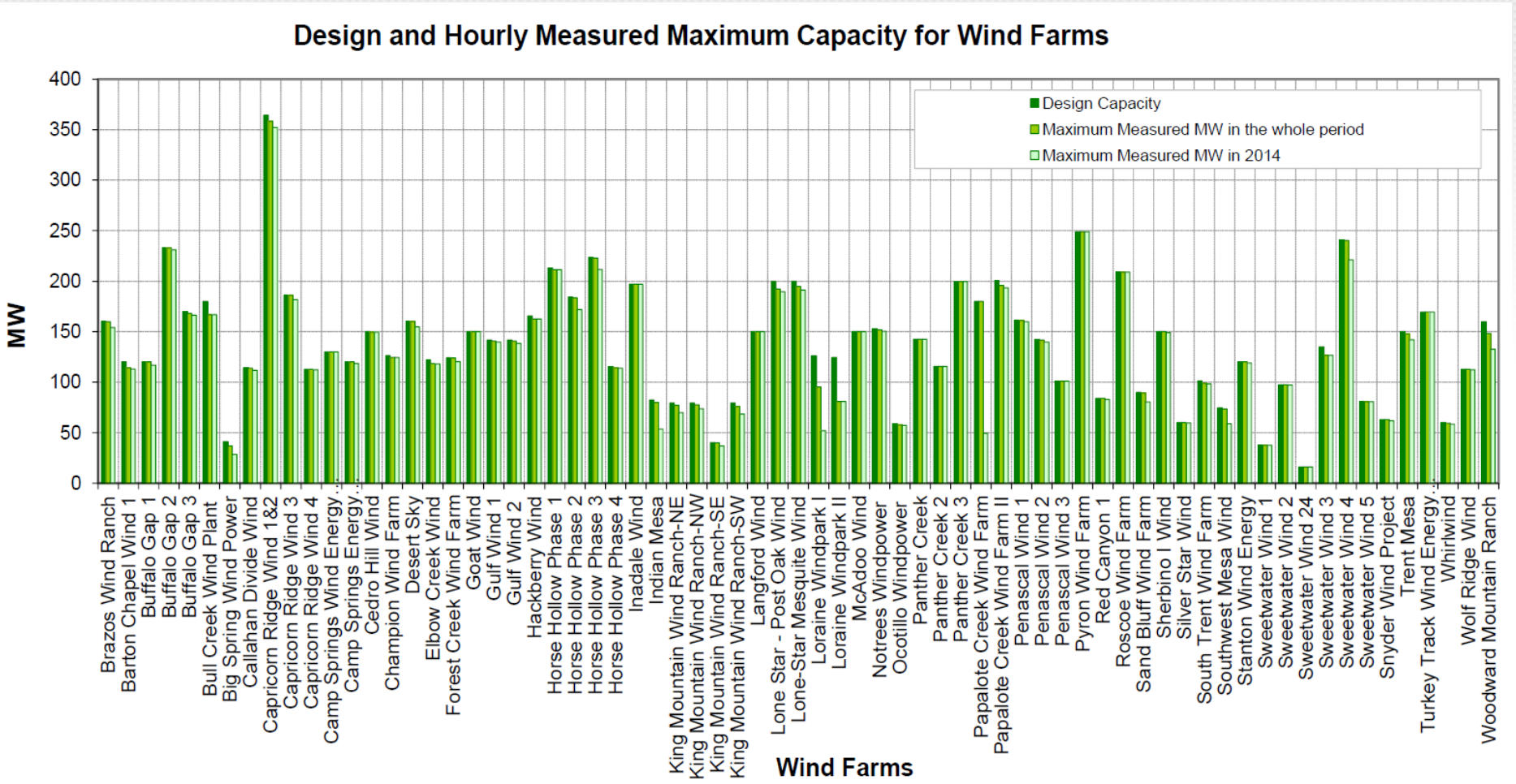
No Degradation Observed (22.5% above)





WIND FARMS CAPACITY/PRODUCTION

Are Wind farms operating to the design capacity?



Design and Measured Maximum Capacity

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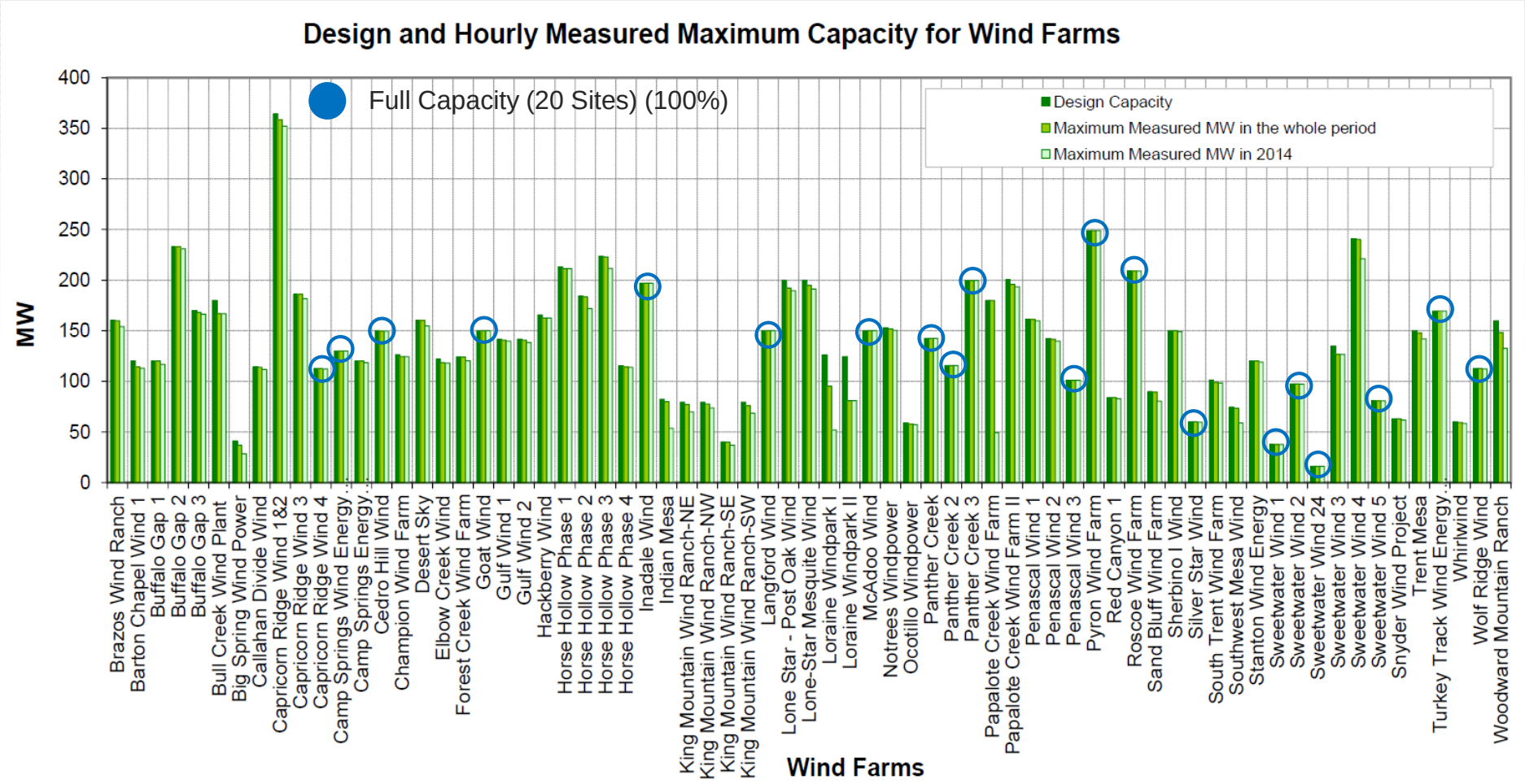

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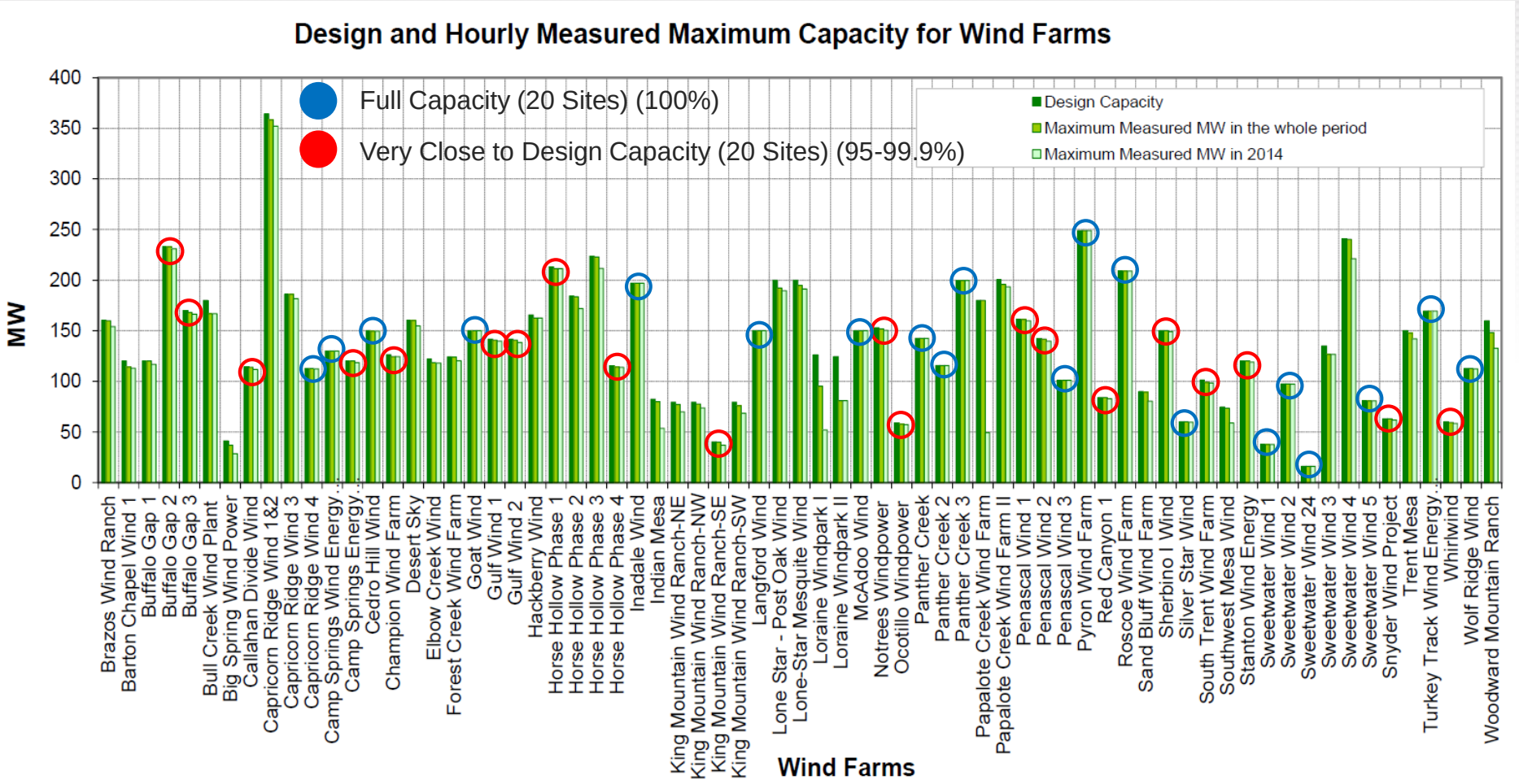

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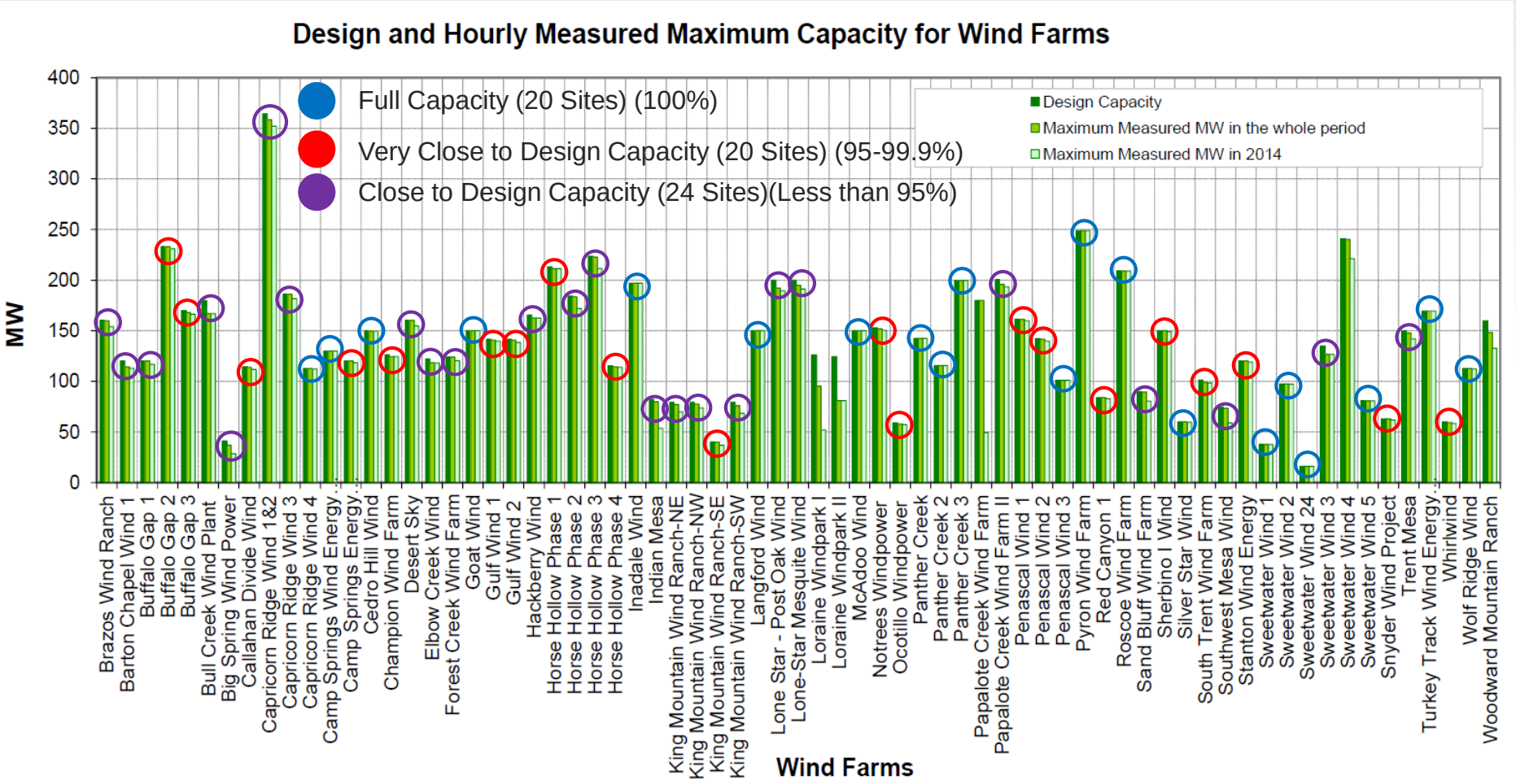

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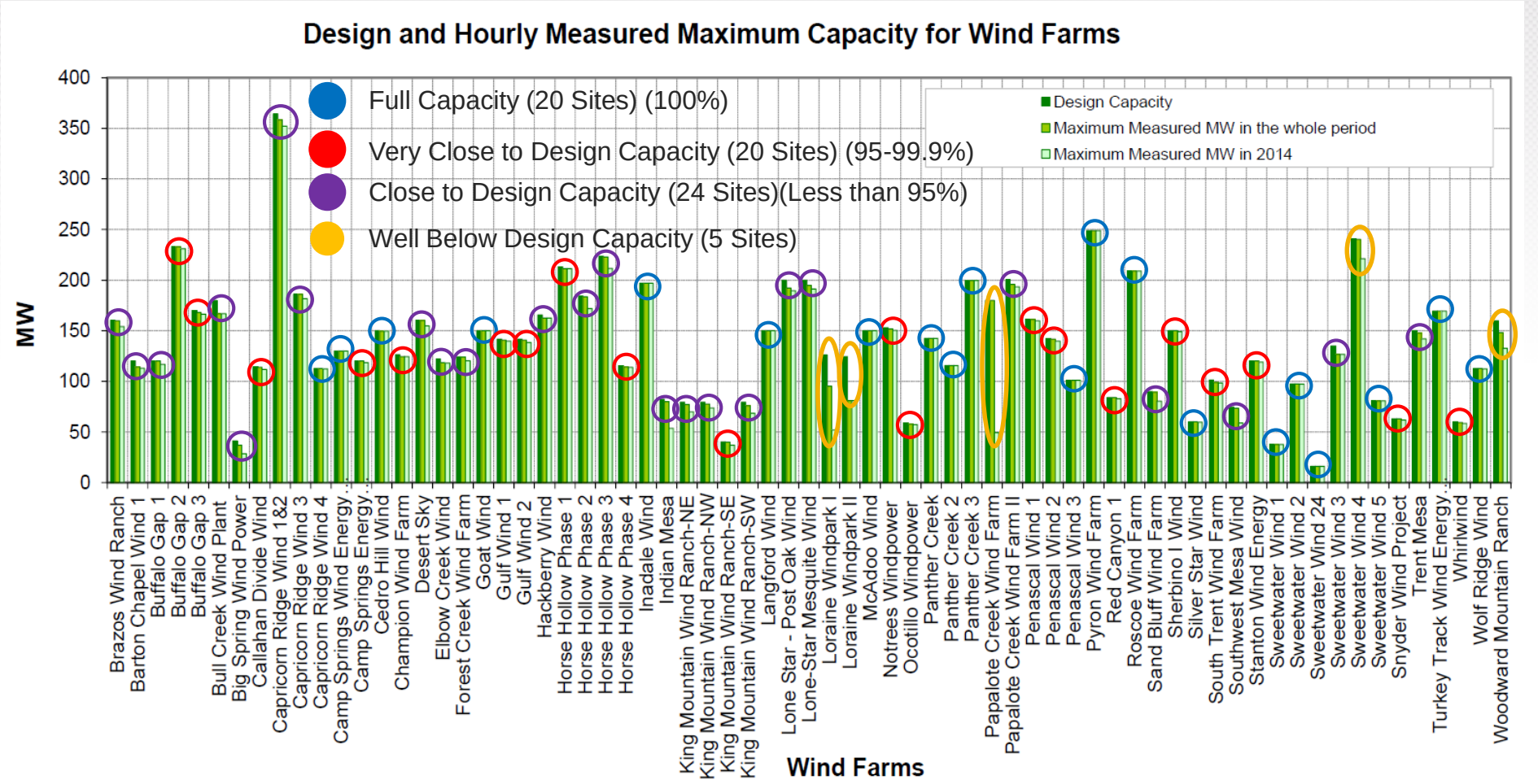

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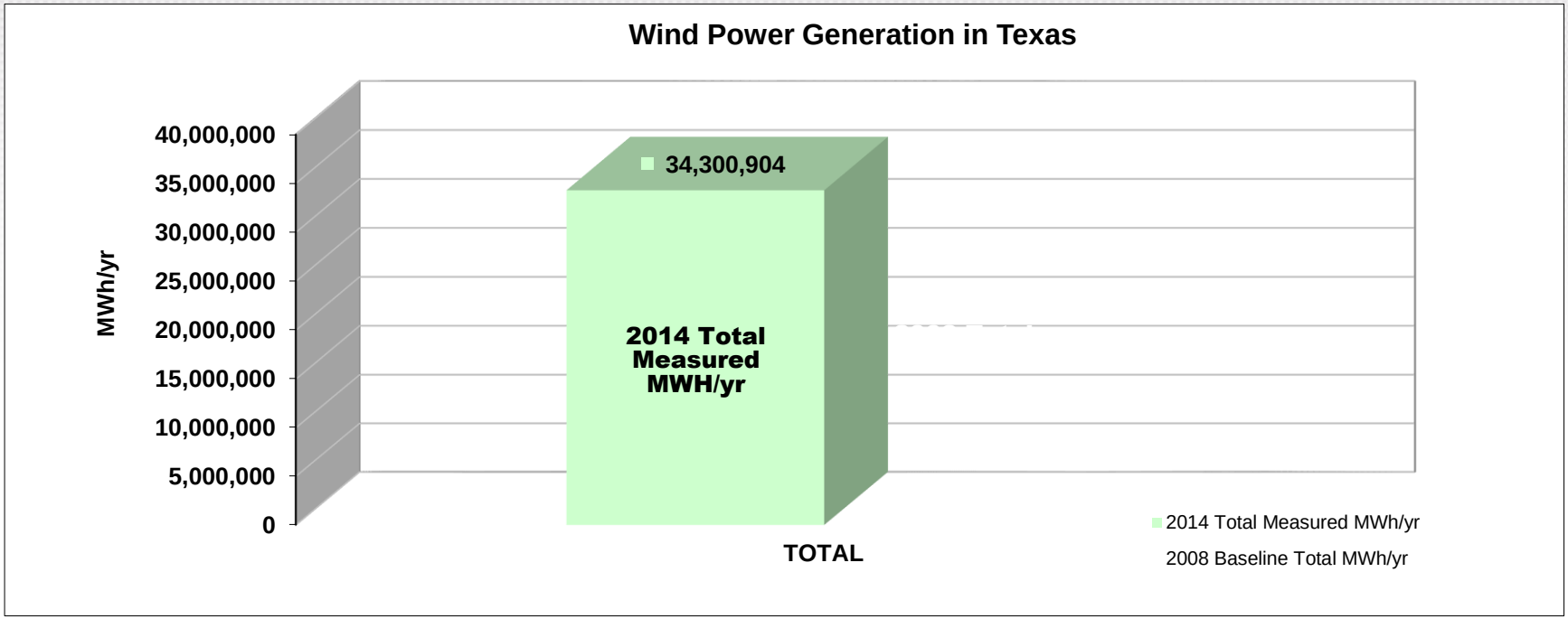
WIND FARMS CAPACITY/PRODUCTION

2008 Annual/OSP Baseline vs. 2014 Annual/OSP Measured



2008 Calculated from 2014 Measured Annual Power Production

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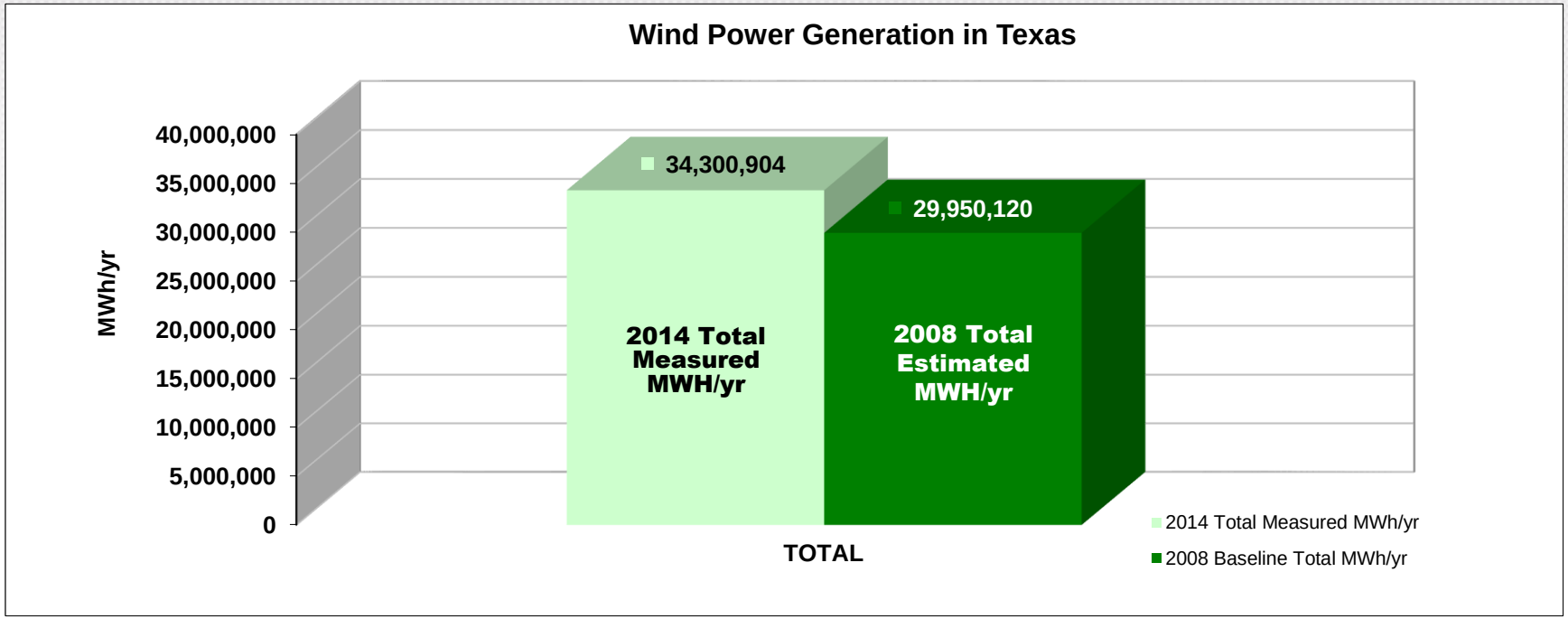

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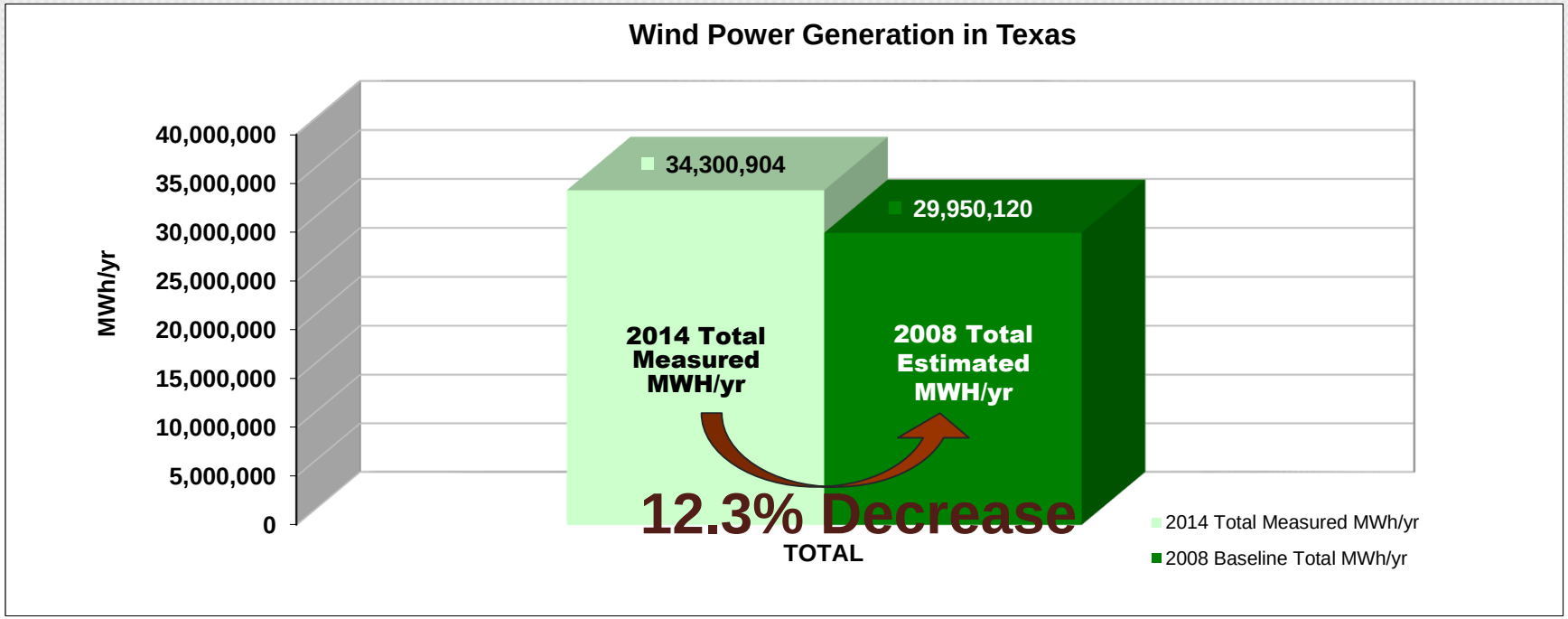

(Due to wind normalized weather condition)

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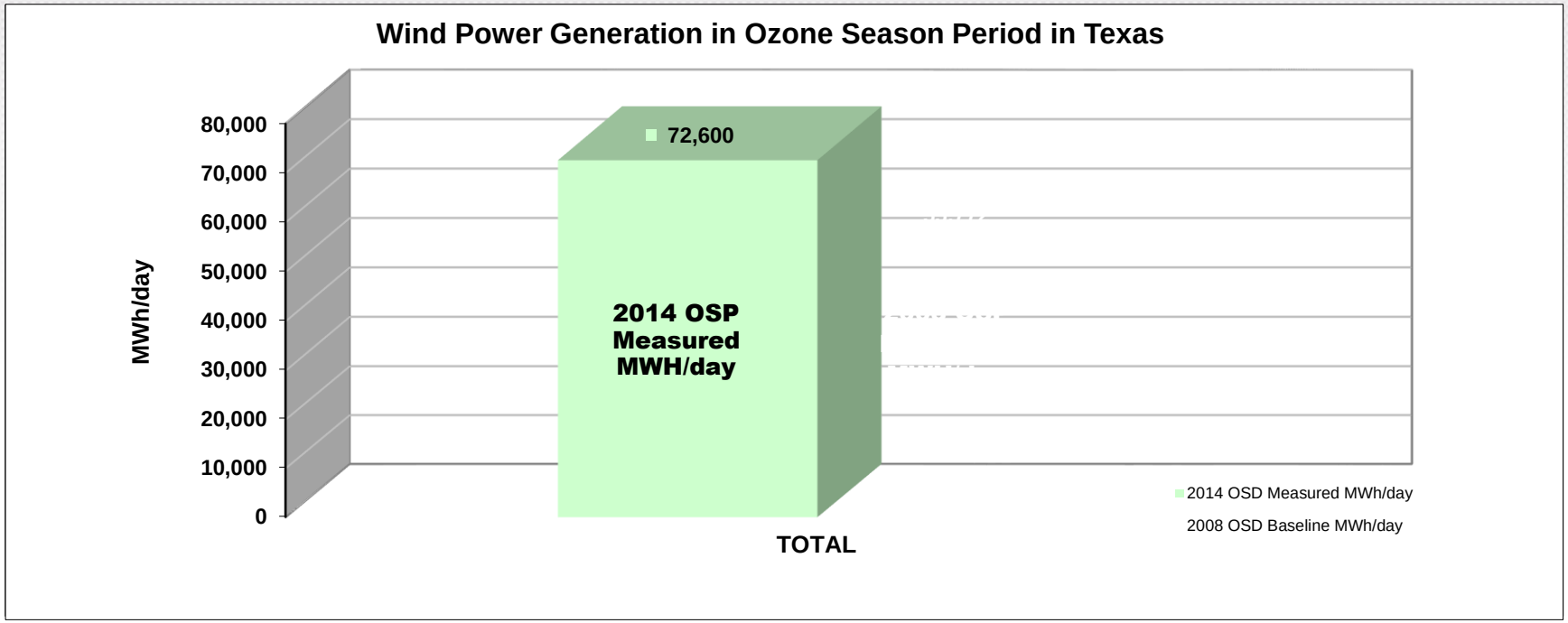

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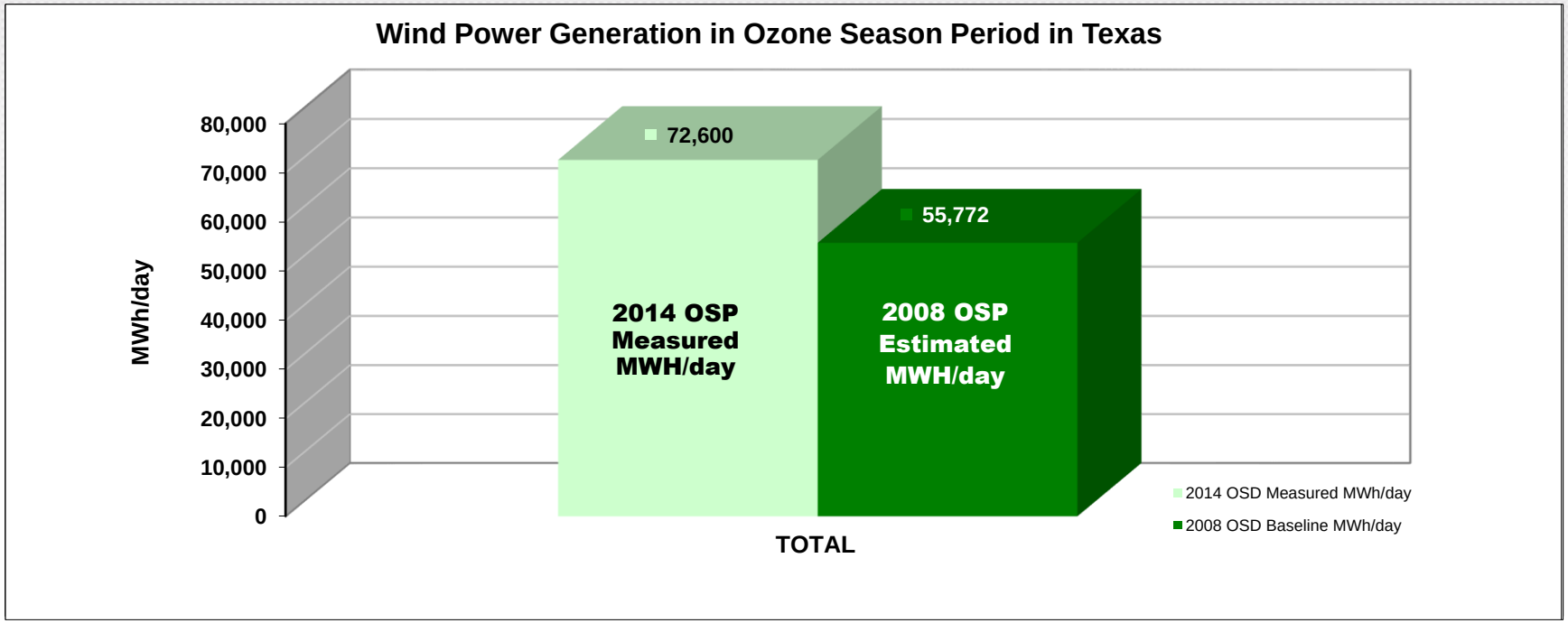

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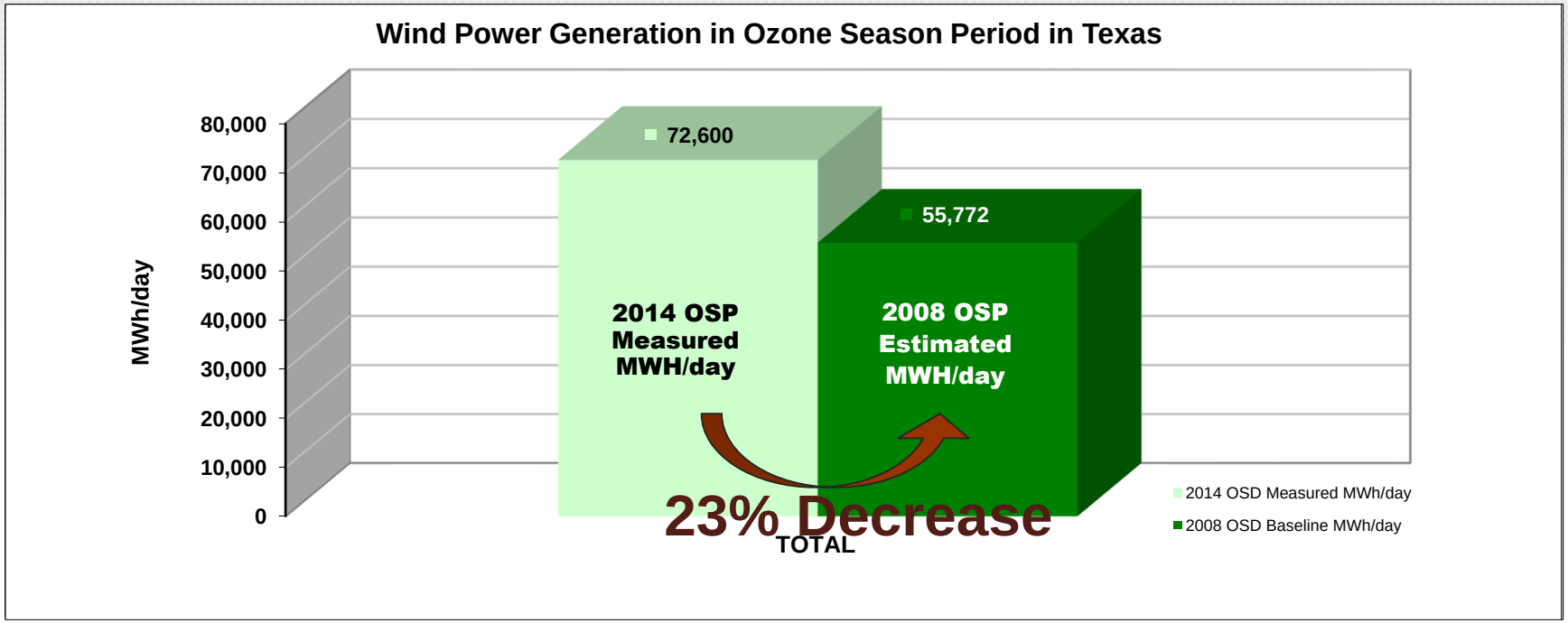

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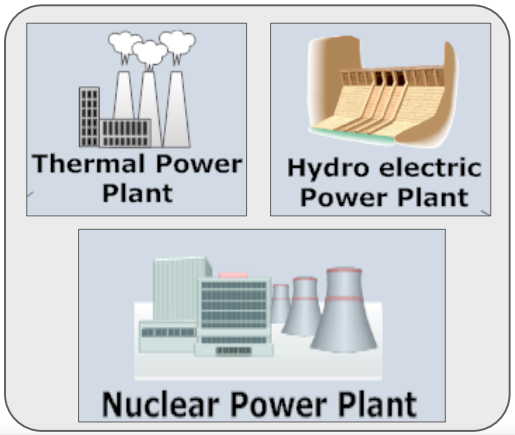
NOx REDUCTIONS USING eGRID

NOx emissions reductions calculation from electricity savings

GENERATION

- Conventional



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GENERATION

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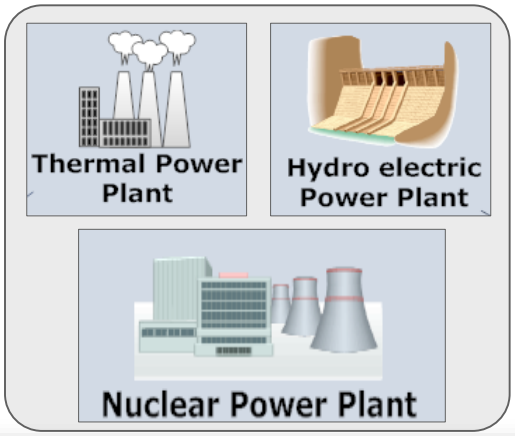

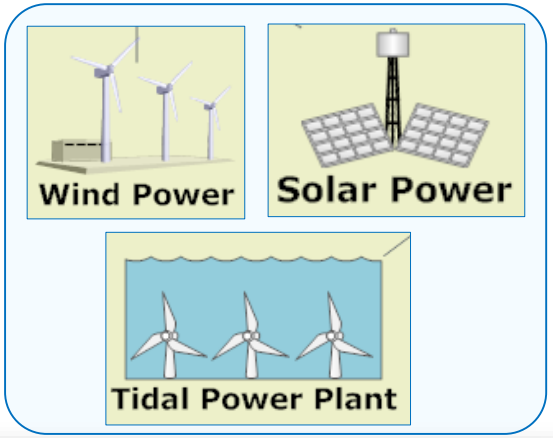

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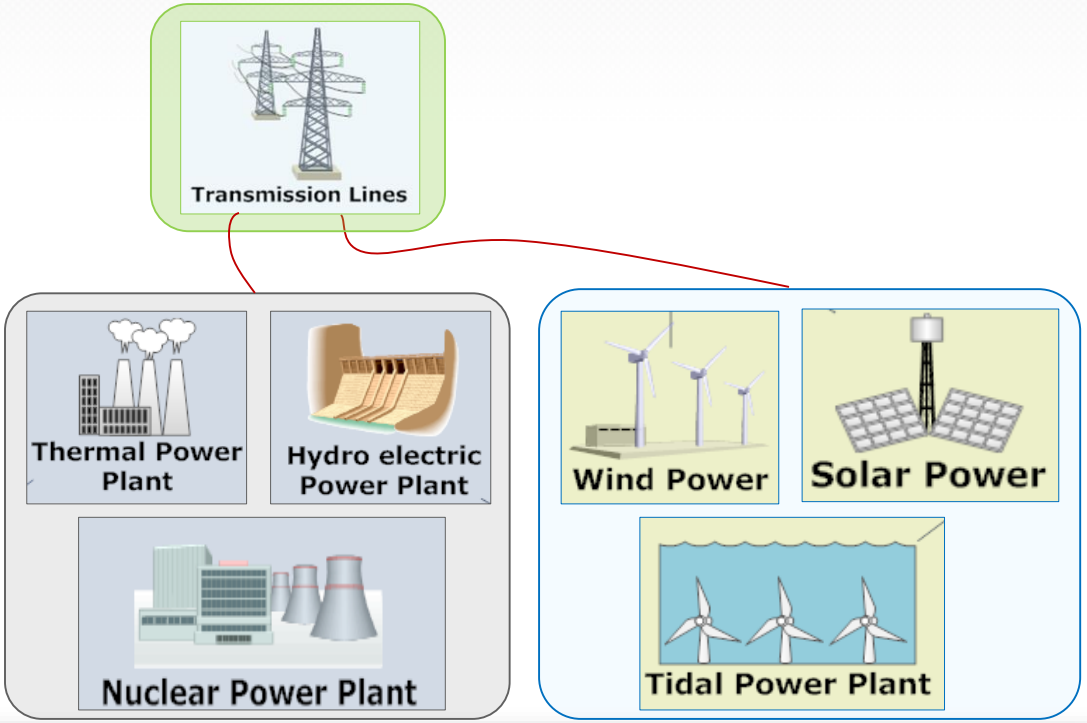
TRANSMISSION & DISTRIBUTION

- Transmission Lines

GENERATION

- Conventional
- Renewable



NOx REDUCTIONS USING eGRID

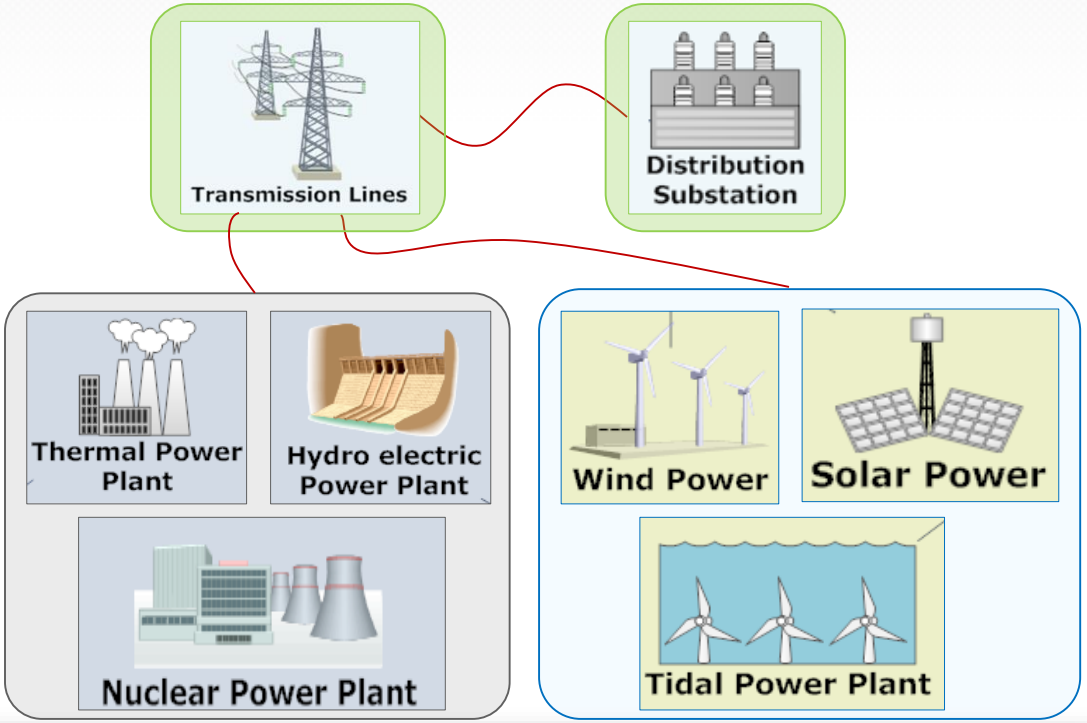
NOx emissions reductions calculation from electricity savings

TRANSMISSION & DISTRIBUTION

- Transmission Lines
- Sub-Station

GENERATION

- Conventional
- Renewable



NOx REDUCTIONS USING eGRID

NOx emissions reductions calculation from electricity savings

CONSUMPTION
- Residential

TRANSMISSION & DISTRIBUTION
- Transmission Lines
- Sub-Station

GENERATION
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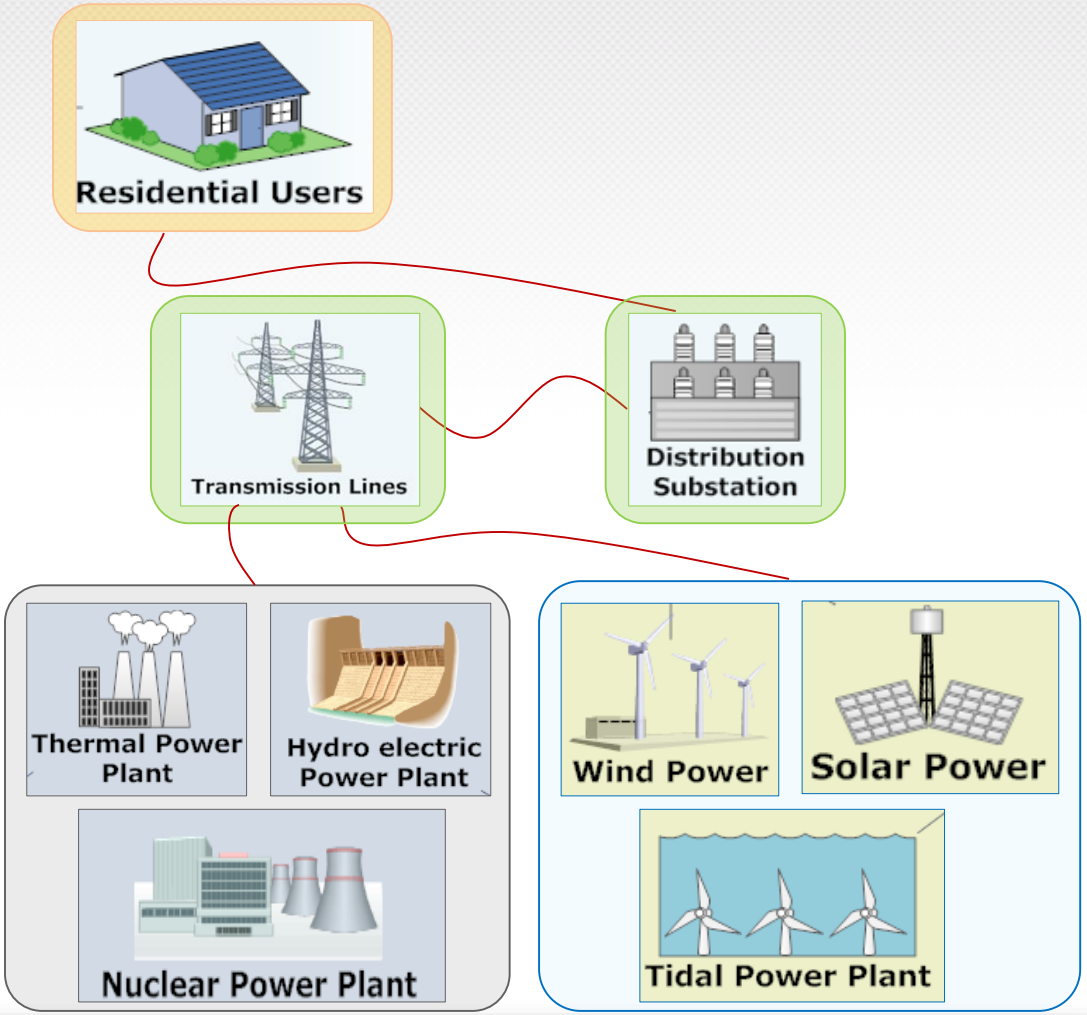


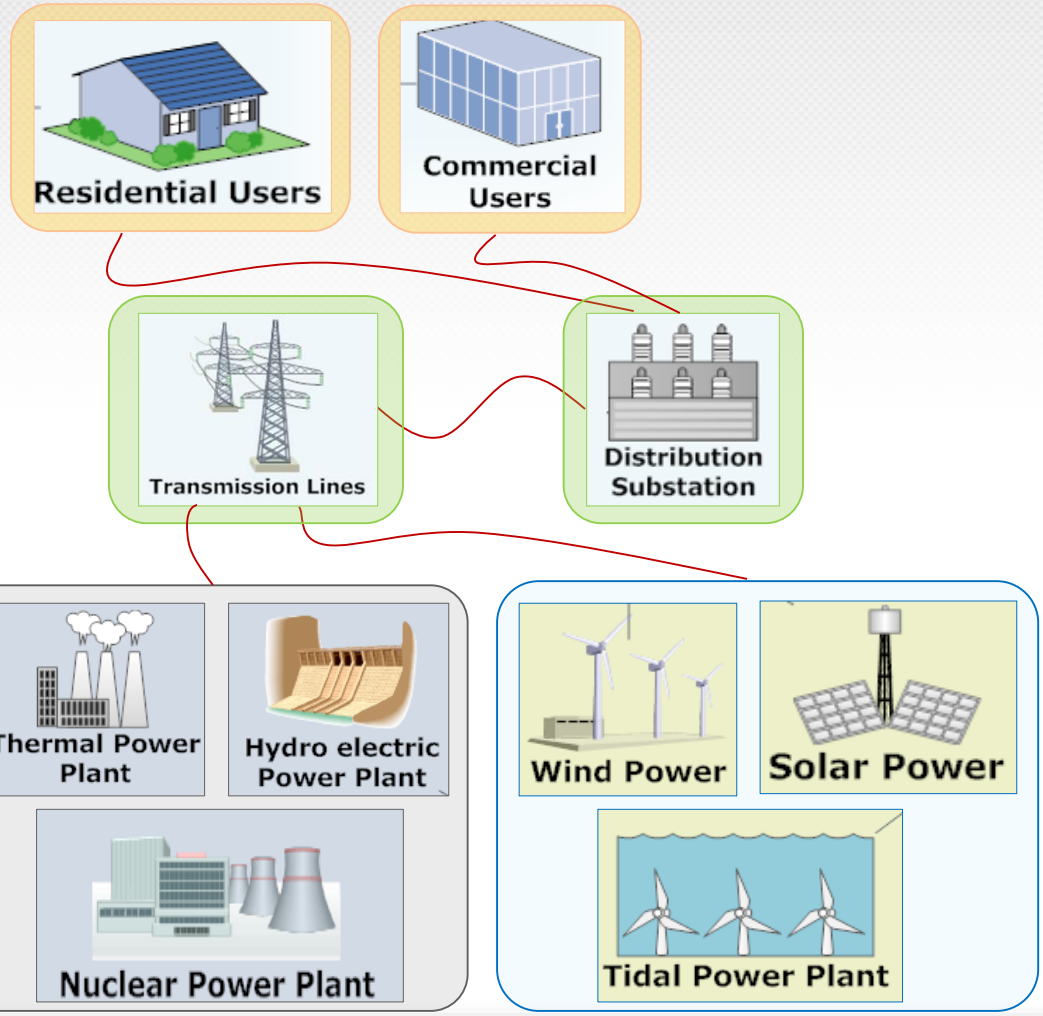
NOx REDUCTIONS USING eGRID

NOx emissions reductions calculation from electricity savings

CONSUMPTION
- Residential
- Commercial

TRANSMISSION & DISTRIBUTION
- Transmission Lines
- Sub-Station

GENERATION
- Conventional
- Renewable



NOx REDUCTIONS USING eGRID

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CONSUMPTION
- Residential
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- Industrial

TRANSMISSION & DISTRIBUTION
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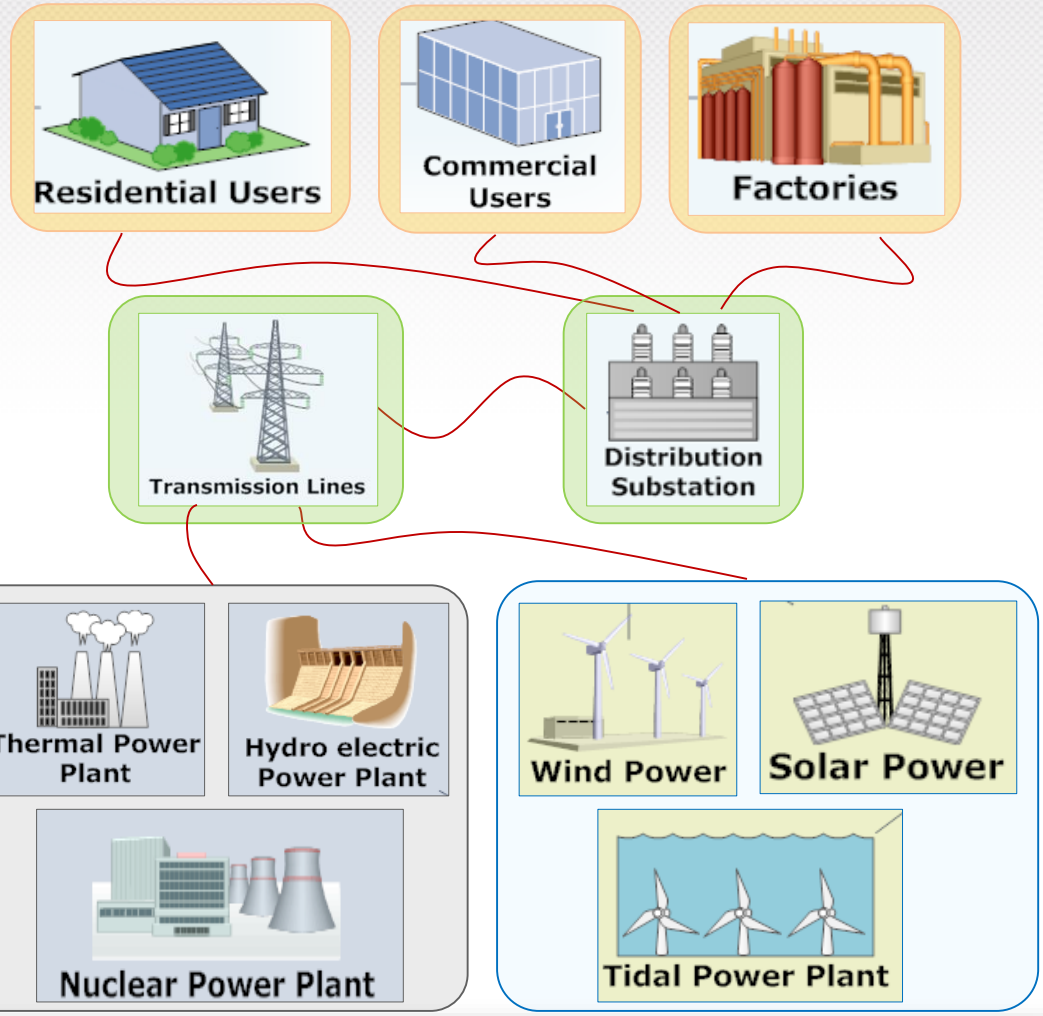

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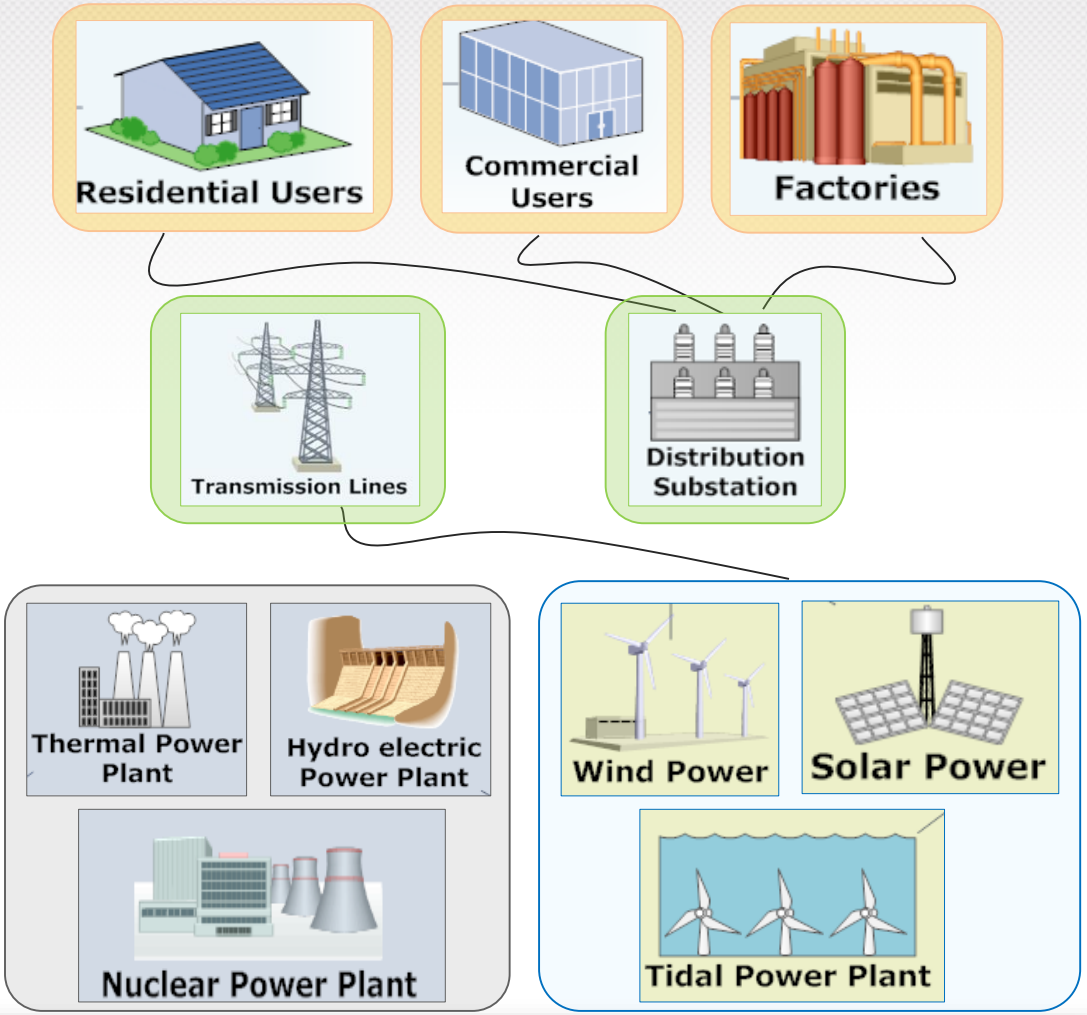
Energy Savings from EE/RE Programs



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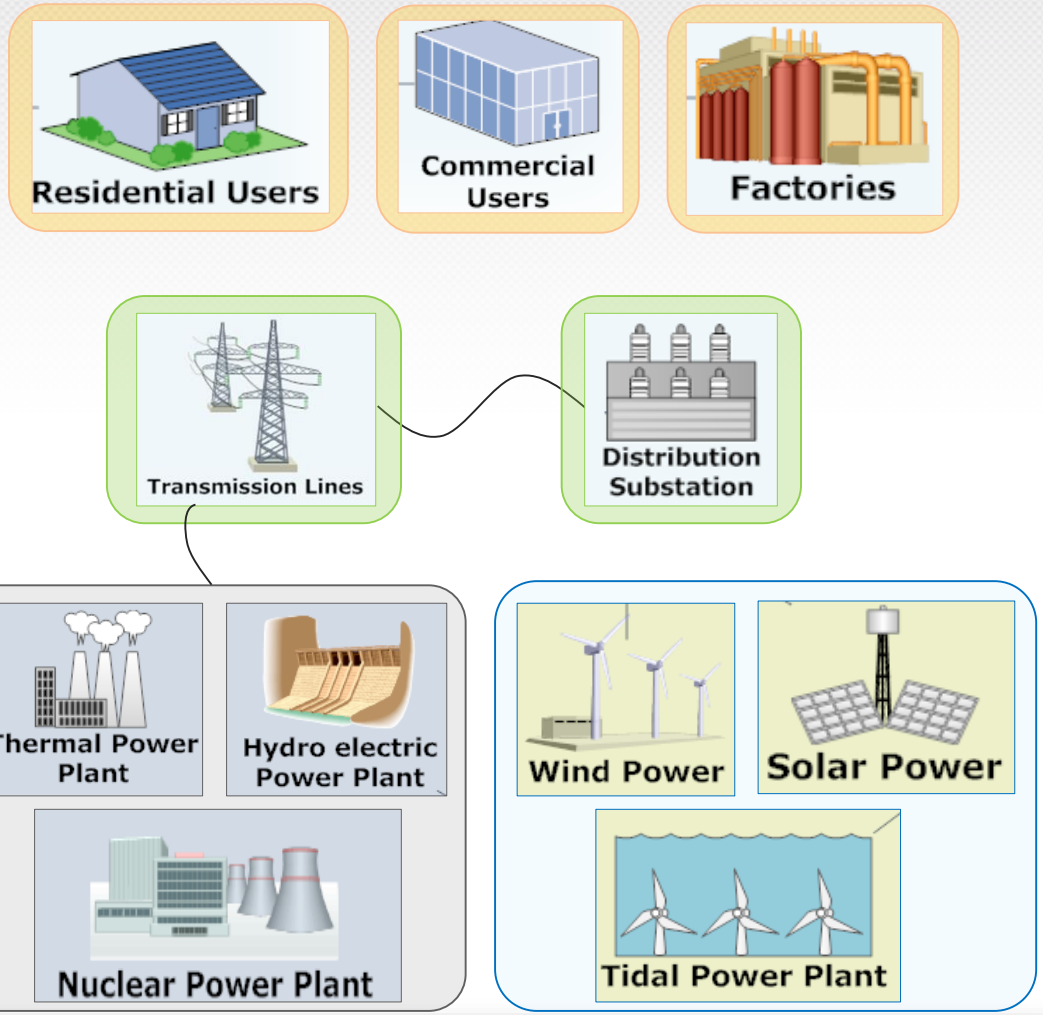
Energy Production & **Emissions Reductions**

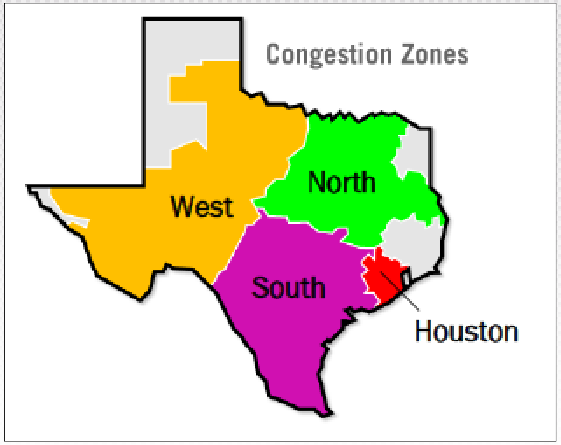


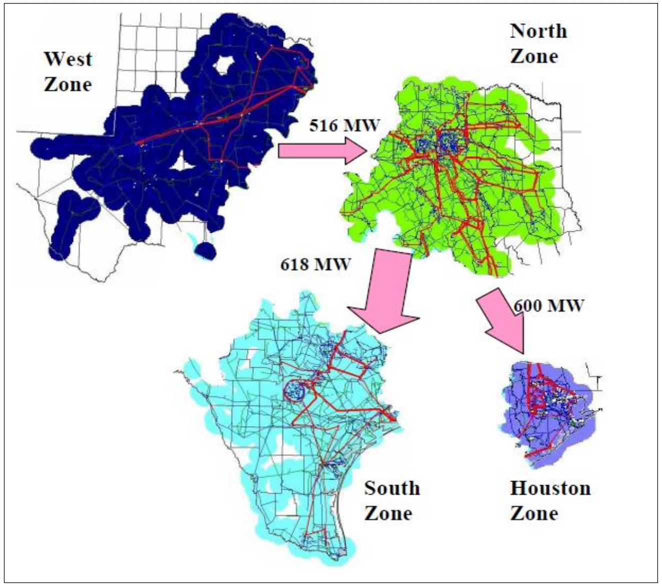
NOx REDUCTIONS USING eGRID

New 2010 eGrid

4 Congestion Management (CM) Zones

Area	County	CM Zones H		N		W		S		Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
Houston-Galveston Area	Brazoria	0.0562032	0.0000	0.0000071	0.0000	0.0000003	0.0000	0.0005265	0.0000	0.00	0.00
	Chambers	0.0204500	0.0000	0.0000026	0.0000	0.0000001	0.0000	0.0001916	0.0000	0.00	0.00
	Fort Bend	0.0313463	0.0000	0.0000040	0.0000	0.0000002	0.0000	0.0002937	0.0000	0.00	0.00
	Galveston	0.0226620	0.0000	0.0000029	0.0000	0.0000001	0.0000	0.0002123	0.0000	0.00	0.00
	Harris	0.1486911	0.0000	0.0000189	0.0000	0.0000009	0.0000	0.0013930	0.0000	0.00	0.00
	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
	[illegible]	0.0000000	0.0000	[illegible]	0.0000	[illegible]	0.0000	[illegible]	0.0000	0.00	0.00
Beaumont/ Port Arthur Area	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0000	[illegible]	[illegible]	0.00	0.00
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	0.00
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	0.00
Dallas/ Fort Worth Area	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	0.00
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	0.00
	Denton	0.0001267	0.0000	0.0007770	0.0000	0.0000375	0.0000	0.0000079	0.0000	0.00	0.00
	Tarrant	0.0004742	0.0000	0.0029089	0.0000	0.0001405	0.0000	0.0000297	0.0000	0.00	0.00
	Ellis	0.0029920	0.0000	0.0183544	0.0000	0.0008865	0.0000	0.0001873	0.0000	0.00	0.00
	Johnson	0.0007256	0.0000	0.0044512	0.0000	0.0002150	0.0000	[illegible]	0.0000	0.00	0.00
	Kaufman	[illegible]	[illegible]	[illegible]	0.0000	[illegible]	0.0000	[illegible]	0.0000	0.00	0.00
	Parker	[illegible]	0.0000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	0.00
	Rockwall	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	0.00
	Henderson	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	0.00
	Hood	0.0050771	0.0000	0.0311454	[illegible]	[illegible]	0.0000	0.0003178	0.0000	0.00	0.00
	Hunt	0.0088463	0.0000	0.0047066	0.0000	0.0002273	0.0000	0.0652823	0.0000	0.00	0.00
El Paso Area	[illegible]	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	[illegible]	[illegible]	0.00
San Antonio Area	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00
	[illegible]	[illegible]	[illegible]	[illegible]	0.0000	[illegible]	0.0000	[illegible]	[illegible]	[illegible]	0.00
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00
Austin Area	Bastrop	0.0033782	0.0000	[illegible]	0.0000	0.0000110	0.0000	0.0269798	[illegible]	0.00	0.00
	Caldwell	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Hays	0.0008331	0.0000	[illegible]	[illegible]	0.0000027	0.0000	0.0066537	0.0000	0.00	0.00
	Travis	0.0051785	0.0000	0.0003493	[illegible]	[illegible]	[illegible]	[illegible]	0.0000	0.00	0.00
	Williamson	0.0000000	0.0000	0.0000000	[illegible]	[illegible]	[illegible]	[illegible]	0.0000	0.00	0.00
North East Texas Area	Gregg	0.0000000	0.0000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	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	0.0000	0.0008672	0.0000	0.0000419	0.0000	0.1026870	0.0000	0.00	0.00
	San Patricio	0.0015100	0.0000	0.0001018	0.0000	0.0000049	0.0000	0.0120591	0.0000	0.00	0.00
Victoria Area	Victoria	0.0021192	0.0000	0.0001429	0.0000	0.0000069	0.0000	0.0169244	0.0000	0.00	0.00
Other ERCOT counties	Andrews	0.0000037	0.0000	0.0000230	0.0000	0.0039003	0.0000	0.0000002	0.0000	0.00	0.00
	Angelina	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Bosque	0.0022204	0.0000	0.0136212	0.0000	0.0006579	0.0000	0.0001390	0.0000	0.00	0.00
	Brazos	0.0024089	0.0000	0.0112305	0.0000	0.0005425	0.0000	0.0047829	0.0000	0.00	0.00
	Calhoun	0.0009466	0.0000	0.0000638	0.0000	0.0000031	0.0000	0.0075598	0.0000	0.00	0.00
	Cameron	0.0063536	0.0000	0.0004285	0.0000	0.0000207	0.0000	0.0507425	0.0000	0.00	0.00
	Cherokee	0.0027392	0.0000	0.0168033	0.0000	0.0008116	0.0000	0.0001714	0.0000	0.00	0.00
	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	0.0000	0.0006604	0.0000	0.0911346	0.0000	0.0146527	0.0000	0.00	0.00
	Fannin	0.0000041	0.0000	0.0000249	0.0000	0.0000012	0.0000	0.0000003	0.0000	0.00	0.00
	Fayette	0.0051867	0.0000	0.0103217	0.0000	0.0004986	0.0000	0.0283993	0.0000	0.00	0.00
	Freestone	0.0047643	0.0000	0.0292268	0.0000	0.0014117	0.0000	0.0002982	0.0000	0.00	0.00
	Frio	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Grimes	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Hardeman	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Haskell	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Hidalgo	0.0053716	0.0000	0.0003623	0.0000	0.0000175	0.0000	0.0428994	0.0000	0.00	0.00
	Howard	0.0002411	0.0000	0.0007641	0.0000	0.1283942	0.0000	0.0009490	0.0000	0.00	0.00
	Jack	0.0030783	0.0000	0.0188839	0.0000	0.0009121	0.0000	0.0001927	0.0000	0.00	0.00
	Jones	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Lamar	0.0040001	0.0000	0.0245388	0.0000	0.0011853	0.0000	0.0002504	0.0000	0.00	0.00
	Limestone	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Llano	0.0040314	0.0000	0.0002719	0.0000	0.0000131	0.0000	0.0321966	0.0000	0.00	0.00
	McLennan	0.0056576	0.0000	0.0347066	0.0000	0.0016764	0.0000	0.0003541	0.0000	0.00	0.00
	Milam	0.0012686	0.0000	0.0000856	0.0000	0.0000041	0.0000	0.0101316	0.0000	0.00	0.00
	Mitchell	0.0000311	0.0000	0.0001910	0.0000	0.0324260	0.0000	0.0000019	0.0000	0.00	0.00
	Nolan	0.0000293	0.0000	0.0001795	0.0000	0.0304745	0.0000	0.0000018	0.0000	0.00	0.00
	Palo Pinto	0.0036129	0.0000	0.0221635	0.0000	0.0010705	0.0000	0.0002261	0.0000	0.00	0.00
	Pecos	0.0000020	0.0000	0.0000121	0.0000	0.0020520	0.0000	0.0000001	0.0000	0.00	0.00
	Presidio	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Red River	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Robertson	0.0039506	0.0000	0.0055755	0.0000	0.0002693	0.0000	0.0246170	0.0000	0.00	0.00
	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	0.0000	0.0000156	0.0000	0.0026494	0.0000	0.0000002	0.0000	0.00	0.00
	Ward	0.0001995	0.0000	0.0012239	0.0000	0.2078335	0.0000	0.0000125	0.0000	0.00	0.00
	Webb	0.0042017	0.0000	0.0002834	0.0000	0.0000137	0.0000	0.0335565	0.0000	0.00	0.00
	Wharton	0.0021095	0.0000	0.0001423	0.0000	0.0000069	0.0000	0.0168474	0.0000	0.00	0.00
	Wichita	0.0000121	0.0000	0.0000743	0.0000	0.0126190	0.0000	0.0000008	0.0000	0.00	0.00
	Wilbarger	0.0179710	0.0000	0.1102430	0.0000	0.0053249	0.0000	0.0011247	0.0000	0.00	0.00
	Wise	0.0010202	0.0000	0.0062583	0.0000	0.0003023	0.0000	0.0000638	0.0000	0.00	0.00
	Young	0.0071054	0.0000	0.0435880	0.0000	0.0021054	0.0000	0.0004447	0.0000	0.00	0.00
	Total	**0.4414501**	**0.0000**	**0.4812863**	**0.0000**	**0.5345786**	**0.0000**	**0.6829349**	**0.0000**	0.00	**0.00**
Energy Savings (MWh)		0		0		0		0			





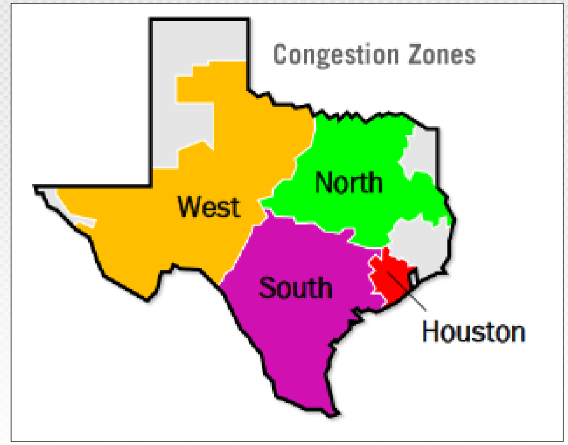
Electricity Flows between CM Zones in ERCOT

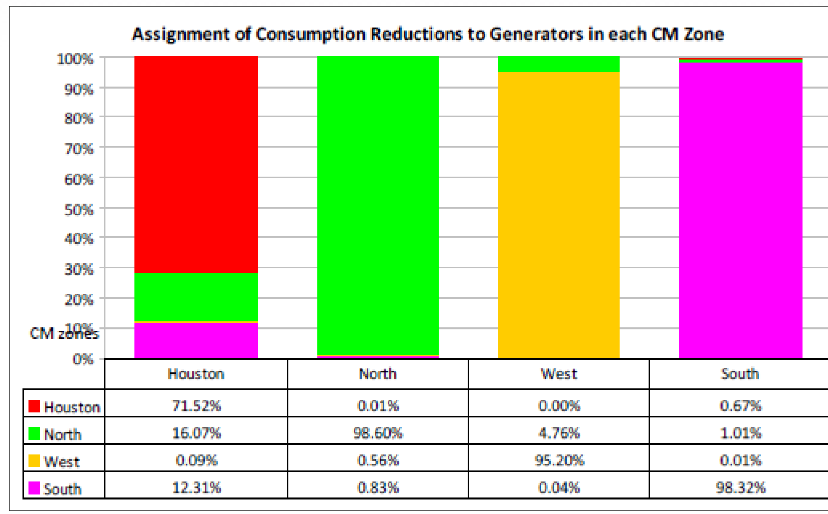
NOx REDUCTIONS USING eGRID

New 2010 eGrid

4 Congestion Management (CM) Zones

Area	County	CM Zones								Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
		H		N		W		S			
Houston-Galveston Area	Brazoria	0.0562032	0.0000	0.0000071	0.0000	0.0000003	0.0000	0.0005265	0.0000	0.00	0.00
	Chambers	0.0204500	0.0000	0.0000026	0.0000	0.0000001	0.0000	0.0001916	0.0000	0.00	0.00
	Fort Bend	0.0313463	0.0000	0.0000040	0.0000	0.0000002	0.0000	0.0002937	0.0000	0.00	0.00
	Galveston	0.0226620	0.0000	0.0000029	0.0000	0.0000001	0.0000	0.0002123	0.0000	0.00	0.00
	Harris	0.1486911	0.0000	0.0000189	0.0000	0.0000009	0.0000	0.0013930	0.0000	0.00	0.00
	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	[illegible]	[illegible]	0.0000	[illegible]	[illegible]	[illegible]	0.0000	[illegible]	0.0000	0.00	0.00
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	0.00
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	0.00
Dallas/ Fort Worth Area	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	0.00
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	0.00
	Denton	0.0001267	0.0000	0.0007770	0.0000	0.0000375	0.0000	0.0000079	0.0000	0.00	0.00
	Tarrant	0.0004742	0.0000	0.0029089	0.0000	0.0001405	0.0000	0.0000297	0.0000	0.00	0.00
	Ellis	0.0029920	0.0000	0.0183544	0.0000	0.0008865	0.0000	0.0001873	0.0000	0.00	0.00
	Johnson	0.0007256	0.0000	0.0044512	0.0000	0.0002150	0.0000	[illegible]	0.0000	0.00	0.00
	Kaufman	[illegible]	[illegible]	0.0366343	0.0000	0.0017695	0.0000	0.0003738	0.0000	0.00	0.00
	Parker	[illegible]	0.0000	[illegible]	[illegible]	[illegible]	0.0000	[illegible]	[illegible]	0.00	0.00
	Rockwall	[illegible]	0.0000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	0.00
	Henderson	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	0.00
	Hood	0.0050771	0.0000	0.0311454	[illegible]	0.0015044	0.0000	0.0003178	0.0000	0.00	0.00
	Hunt	0.0088463	0.0000	0.0047066	0.0000	0.0002273	0.0000	0.0652823	0.0000	0.00	0.00
El Paso Area	[illegible]	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	[illegible]	[illegible]	0.00
San Antonio Area	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00
	[illegible]	[illegible]	[illegible]	[illegible]	0.0000	[illegible]	0.0000	[illegible]	[illegible]	[illegible]	0.00
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00
Austin Area	Bastrop	0.0033782	0.0000	[illegible]	0.0000	0.0000110	0.0000	0.0269798	[illegible]	0.00	0.00
	Caldwell	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Hays	0.0008331	0.0000	[illegible]	[illegible]	0.0000027	0.0000	0.0066537	0.0000	0.00	0.00
	Travis	0.0051785	0.0000	0.0003493	[illegible]	[illegible]	[illegible]	[illegible]	0.0000	0.00	0.00
	Williamson	0.0000000	0.0000	0.0000000	[illegible]	[illegible]	[illegible]	[illegible]	0.0000	0.00	0.00
North East Texas Area	Gregg	0.0000000	0.0000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	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	0.0000	0.0008672	0.0000	0.0000419	0.0000	0.1026870	0.0000	0.00	0.00
	San Patricio	0.0015100	0.0000	0.0001018	0.0000	0.0000049	0.0000	0.0120591	0.0000	0.00	0.00
Victoria Area	Victoria	0.0021192	0.0000	0.0001429	0.0000	0.0000069	0.0000	0.0169244	0.0000	0.00	0.00
Other ERCOT counties	Andrews	0.0000037	0.0000	0.0000230	0.0000	0.0039003	0.0000	0.0000002	0.0000	0.00	0.00
	Angelina	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Bosque	0.0022204	0.0000	0.0136212	0.0000	0.0006579	0.0000	0.0001390	0.0000	0.00	0.00
	Brazos	0.0024089	0.0000	0.0112305	0.0000	0.0005425	0.0000	0.0047829	0.0000	0.00	0.00
	Calhoun	0.0009466	0.0000	0.0000638	0.0000	0.0000031	0.0000	0.0075598	0.0000	0.00	0.00
	Cameron	0.0063536	0.0000	0.0004285	0.0000	0.0000207	0.0000	0.0507425	0.0000	0.00	0.00
	Cherokee	0.0027392	0.0000	0.0168033	0.0000	0.0008116	0.0000	0.0001714	0.0000	0.00	0.00
	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	0.0000	0.0006604	0.0000	0.0911346	0.0000	0.0146527	0.0000	0.00	0.00
	Fannin	0.0000041	0.0000	0.0000249	0.0000	0.0000012	0.0000	0.0000003	0.0000	0.00	0.00
	Fayette	0.0051867	0.0000	0.0103217	0.0000	0.0004986	0.0000	0.0283993	0.0000	0.00	0.00
	Freestone	0.0047643	0.0000	0.0292268	0.0000	0.0014117	0.0000	0.0002982	0.0000	0.00	0.00
	Frio	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Grimes	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Hardeman	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Haskell	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Hidalgo	0.0053716	0.0000	0.0003623	0.0000	0.0000175	0.0000	0.0428994	0.0000	0.00	0.00
	Howard	0.0002411	0.0000	0.0007641	0.0000	0.1283942	0.0000	0.0009490	0.0000	0.00	0.00
	Jack	0.0030783	0.0000	0.0188839	0.0000	0.0009121	0.0000	0.0001927	0.0000	0.00	0.00
	Jones	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Lamar	0.0040001	0.0000	0.0245388	0.0000	0.0011853	0.0000	0.0002504	0.0000	0.00	0.00
	Limestone	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Llano	0.0040314	0.0000	0.0002719	0.0000	0.0000131	0.0000	0.0321966	0.0000	0.00	0.00
	McLennan	0.0056576	0.0000	0.0347066	0.0000	0.0016764	0.0000	0.0003541	0.0000	0.00	0.00
	Milam	0.0012686	0.0000	0.0000856	0.0000	0.0000041	0.0000	0.0101316	0.0000	0.00	0.00
	Mitchell	0.0000311	0.0000	0.0001910	0.0000	0.0324260	0.0000	0.0000019	0.0000	0.00	0.00
	Nolan	0.0000293	0.0000	0.0001795	0.0000	0.0304745	0.0000	0.0000018	0.0000	0.00	0.00
	Palo Pinto	0.0036129	0.0000	0.0221635	0.0000	0.0010705	0.0000	0.0002261	0.0000	0.00	0.00
	Pecos	0.0000020	0.0000	0.0000121	0.0000	0.0020520	0.0000	0.0000001	0.0000	0.00	0.00
	Presidio	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Red River	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Robertson	0.0039506	0.0000	0.0055755	0.0000	0.0002693	0.0000	0.0246170	0.0000	0.00	0.00
	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	0.0000	0.0000156	0.0000	0.0026494	0.0000	0.0000002	0.0000	0.00	0.00
	Ward	0.0001995	0.0000	0.0012239	0.0000	0.2078335	0.0000	0.0000125	0.0000	0.00	0.00
	Webb	0.0042017	0.0000	0.0002834	0.0000	0.0000137	0.0000	0.0335565	0.0000	0.00	0.00
	Wharton	0.0021095	0.0000	0.0001423	0.0000	0.0000069	0.0000	0.0168474	0.0000	0.00	0.00
	Wichita	0.0000121	0.0000	0.0000743	0.0000	0.0126190	0.0000	0.0000008	0.0000	0.00	0.00
	Wilbarger	0.0179710	0.0000	0.1102430	0.0000	0.0053249	0.0000	0.0011247	0.0000	0.00	0.00
	Wise	0.0010202	0.0000	0.0062583	0.0000	0.0003023	0.0000	0.0000638	0.0000	0.00	0.00
	Young	0.0071054	0.0000	0.0435880	0.0000	0.0021054	0.0000	0.0004447	0.0000	0.00	0.00
	Total	**0.4414501**	**0.0000**	**0.4812863**	**0.0000**	**0.5345786**	**0.0000**	**0.6829349**	**0.0000**	0.00	**0.00**
Energy Savings (MWh)		0		0		0		0			





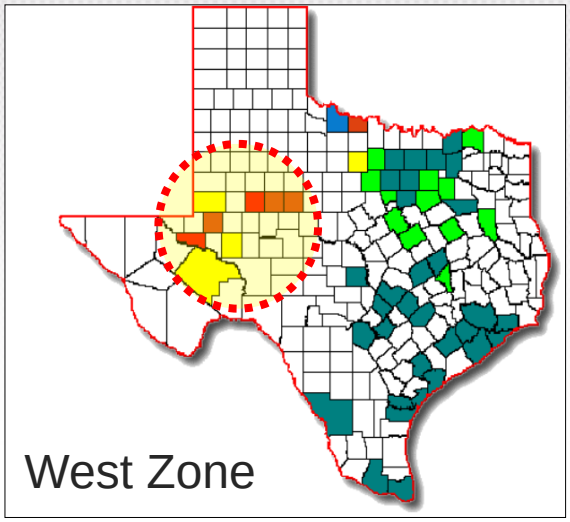
Assignment of Consumption Reductions to Generators in Each CM Zone

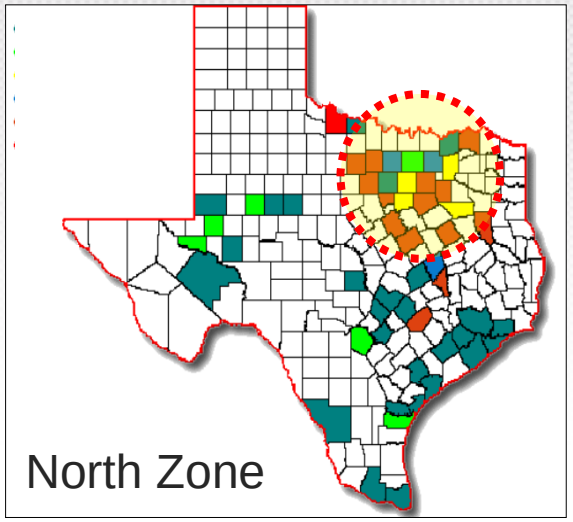
NOx REDUCTIONS USING eGRID

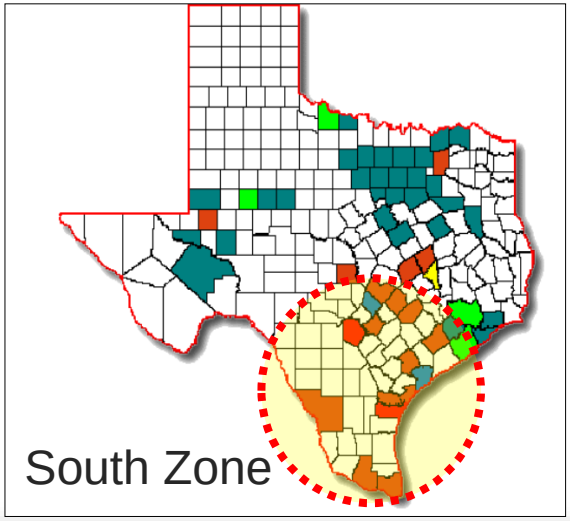
2010 **Annual** eGrid for NOx Emissions

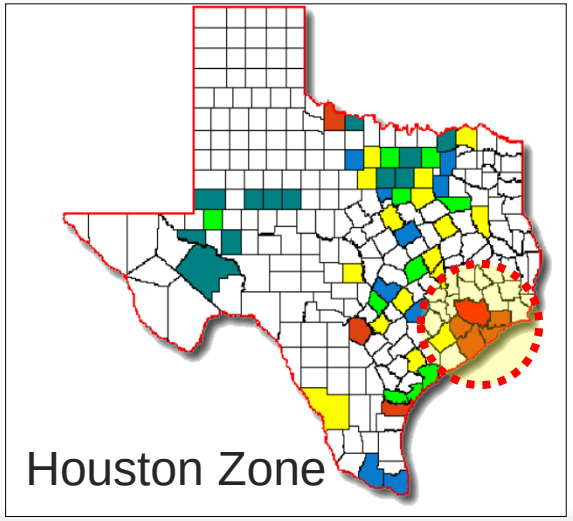
- < 0.0005
- 0.0005 - 0.002
- 0.002 - 0.005
- 0.005 - 0.01
- 0.01 - 0.1
- > 0.1

Unit: lbs of NOx/MWh



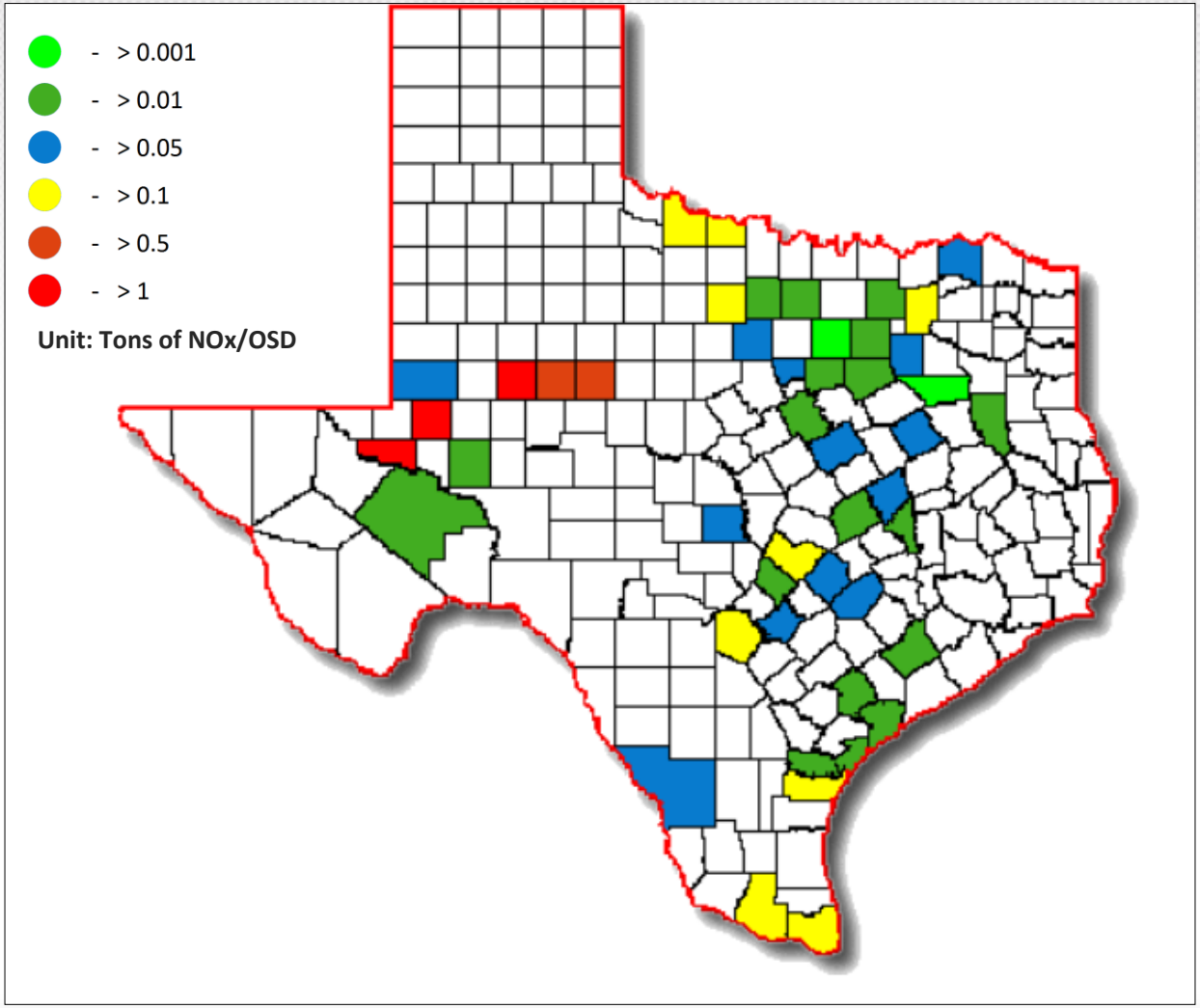






NOx REDUCTIONS USING eGRID

2010 OSD eGrid for NOx Emissions

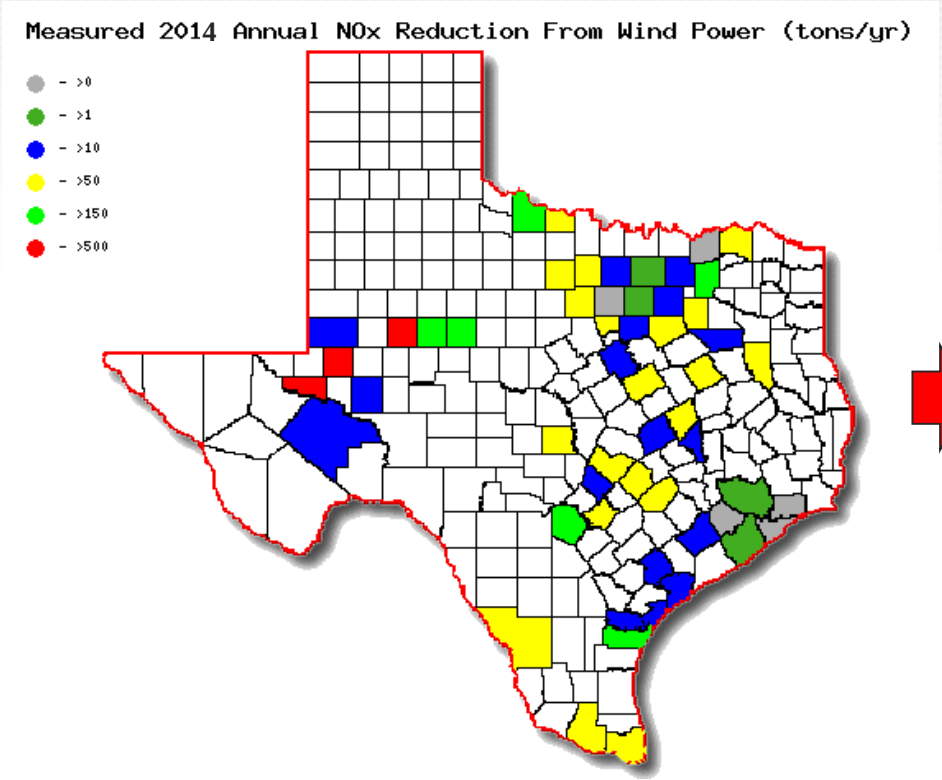


NOx REDUCTIONS USING eGRID

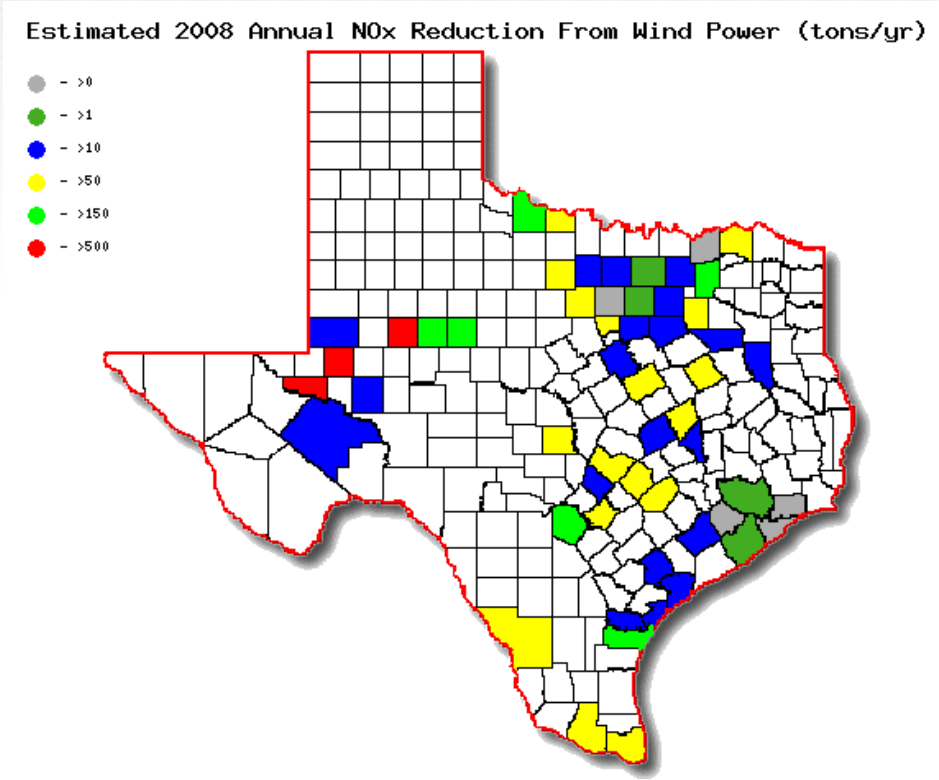
Calculation of NOx Emissions from **Wind Power** Using 2010 eGRID

Annual NOx Reductions

2014 Measured (Wind Power only)



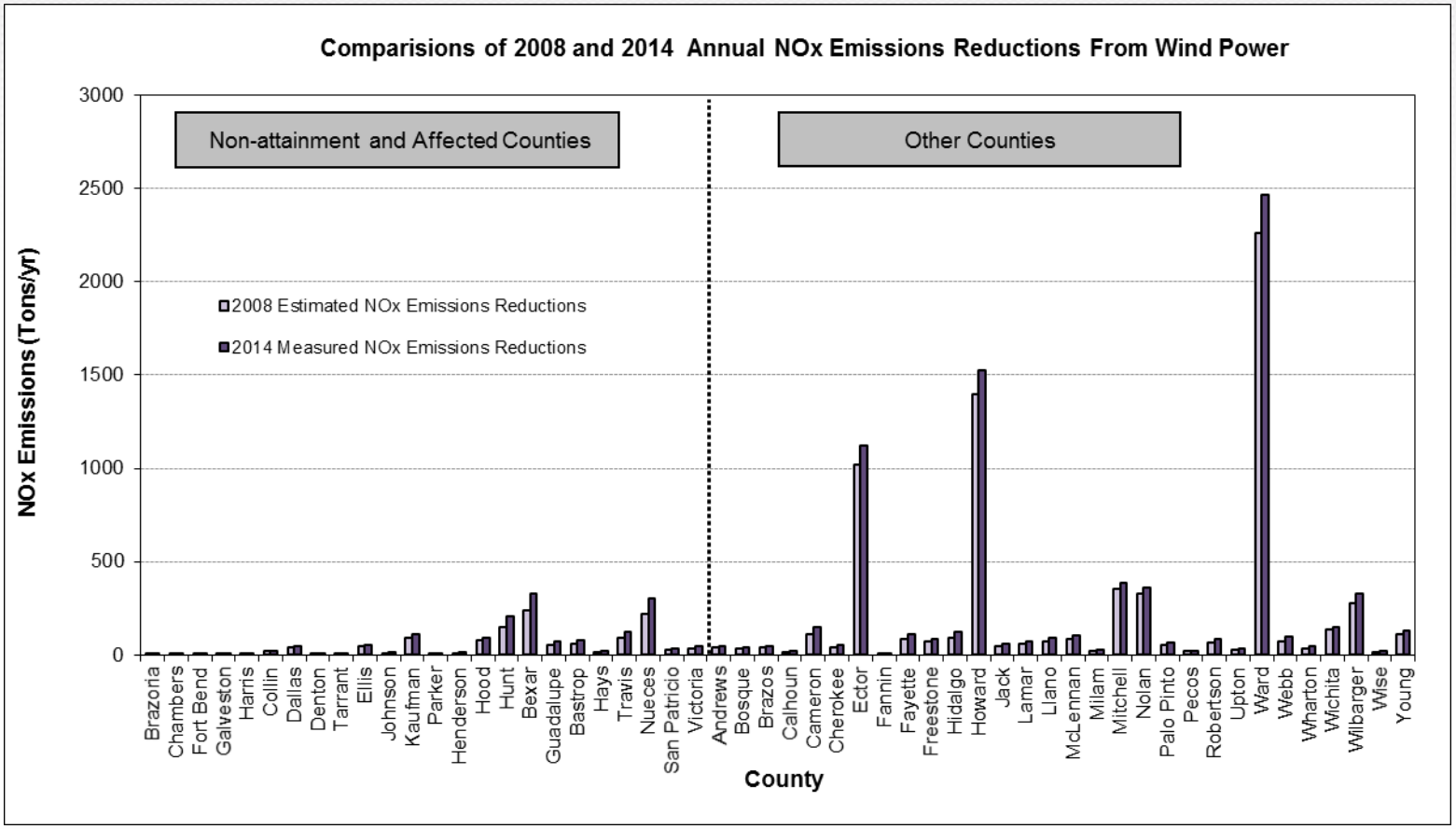
2008 Baseline (Wind Power only)



NOx REDUCTIONS USING eGRID

Calculation of NOx Emissions from **Wind Power** Using 2010 eGRID

Annual NOx Reductions
Comarisions of 2008 and 2014 Annual NOx Emissions

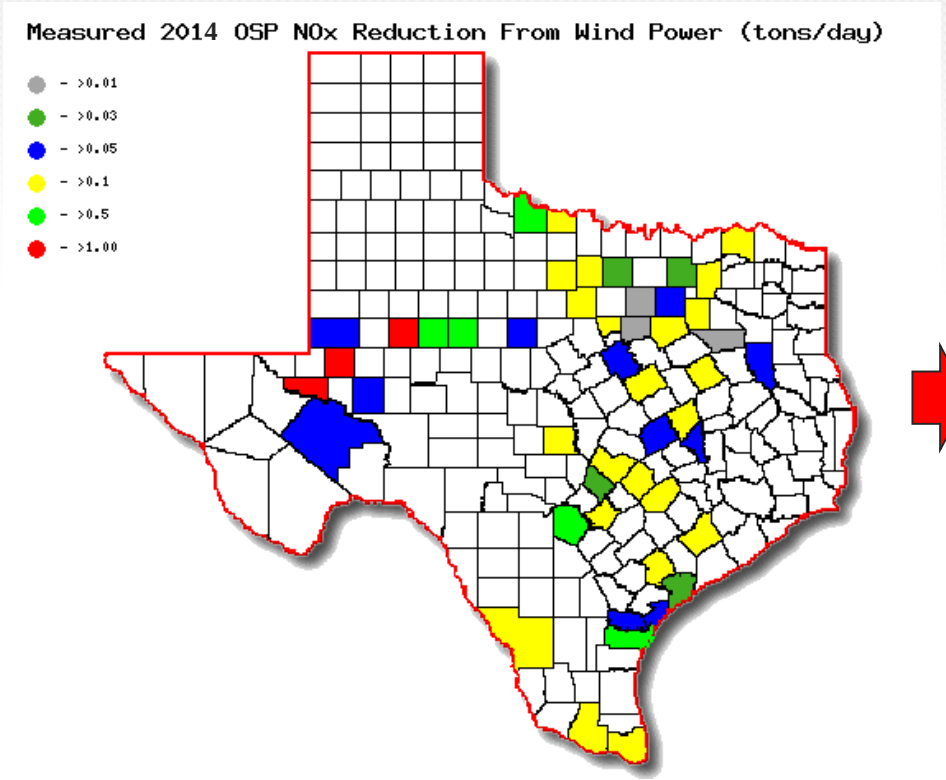


NOx REDUCTIONS USING eGRID

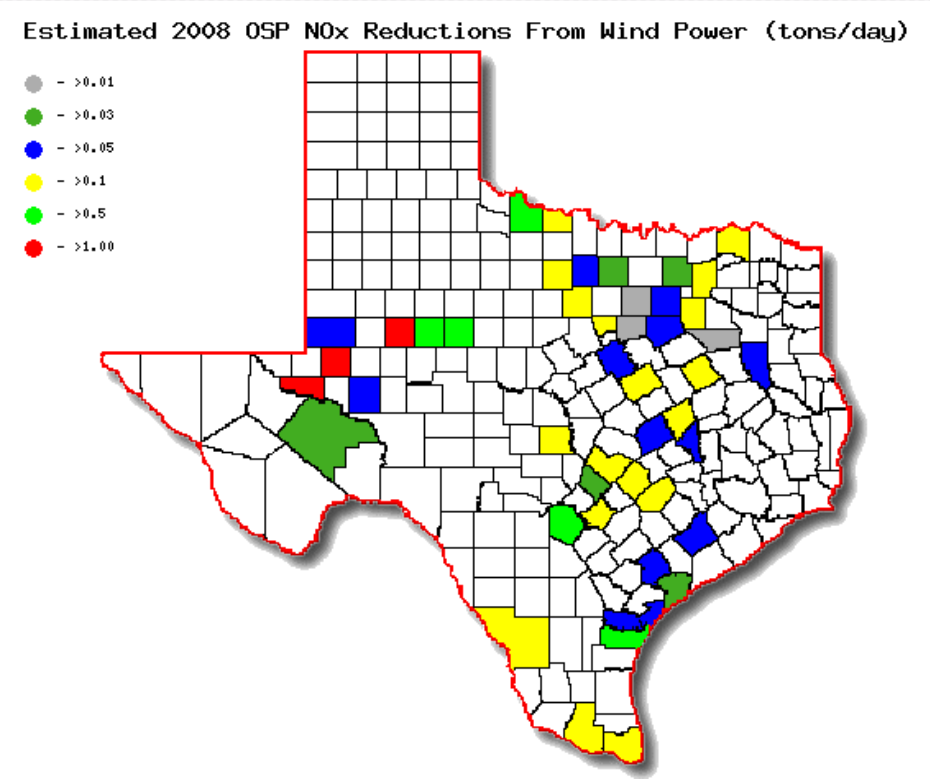
Calculation of NOx Emissions from **Wind Power** Using 2010 eGRID

OSP NOx Reductions

2014 Measured (Wind Power only)



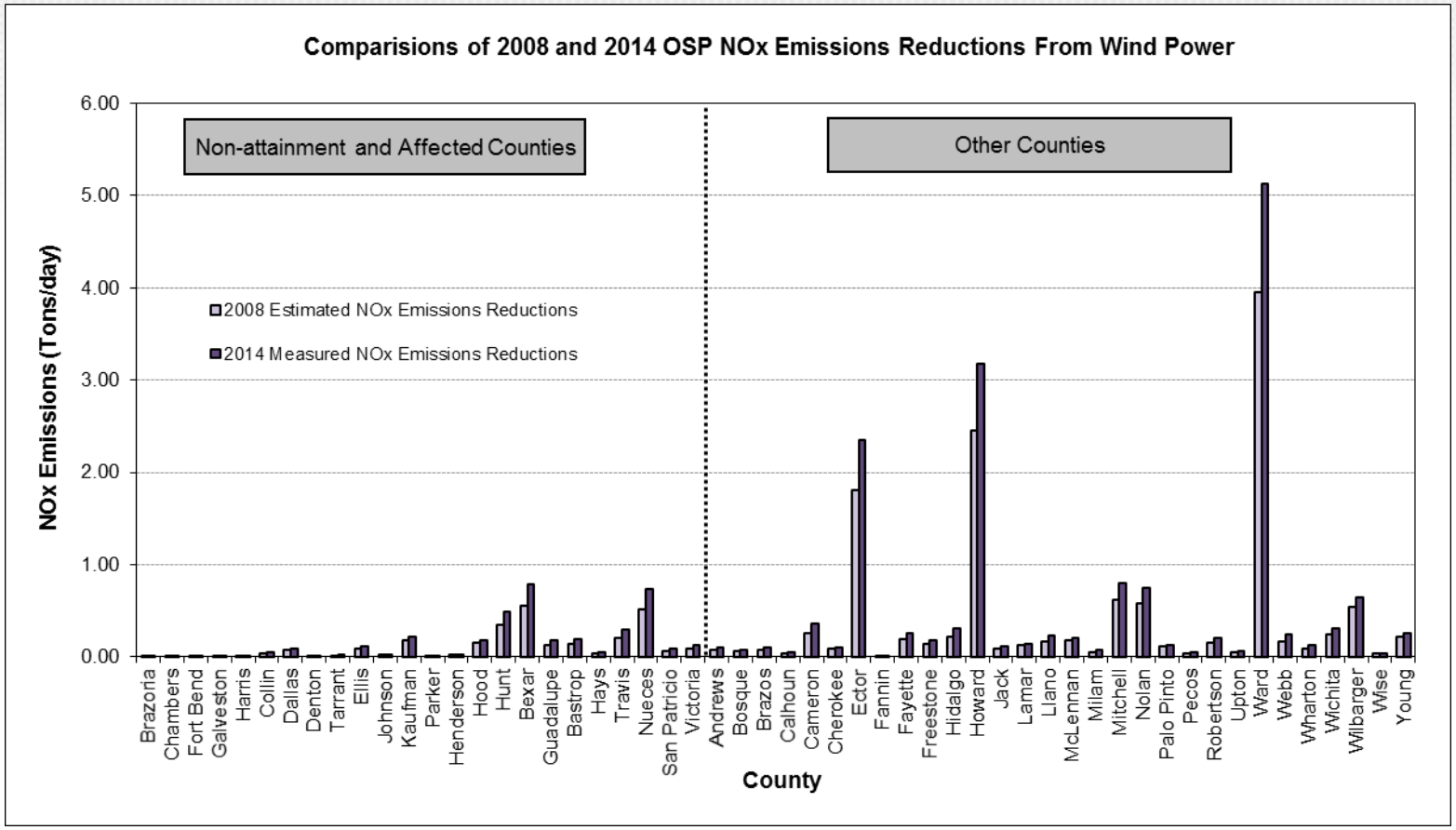
2008 Baseline (Wind Power only)



NOx REDUCTIONS USING eGRID

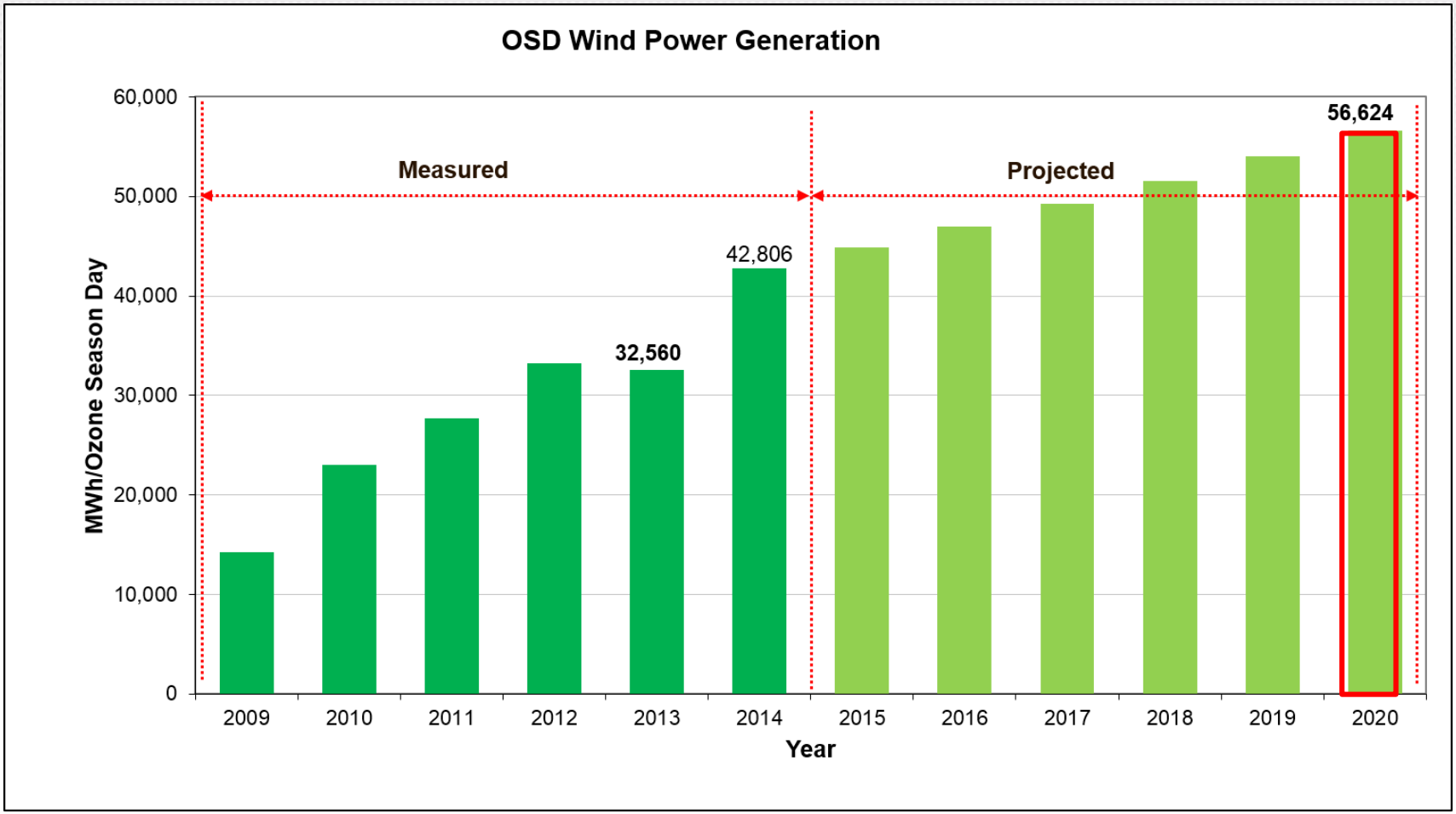
Calculation of NOx Emissions from **Wind Power** Using 2010 eGRID

Comarisions of 2008 and 2014 OSP NOx Emissions



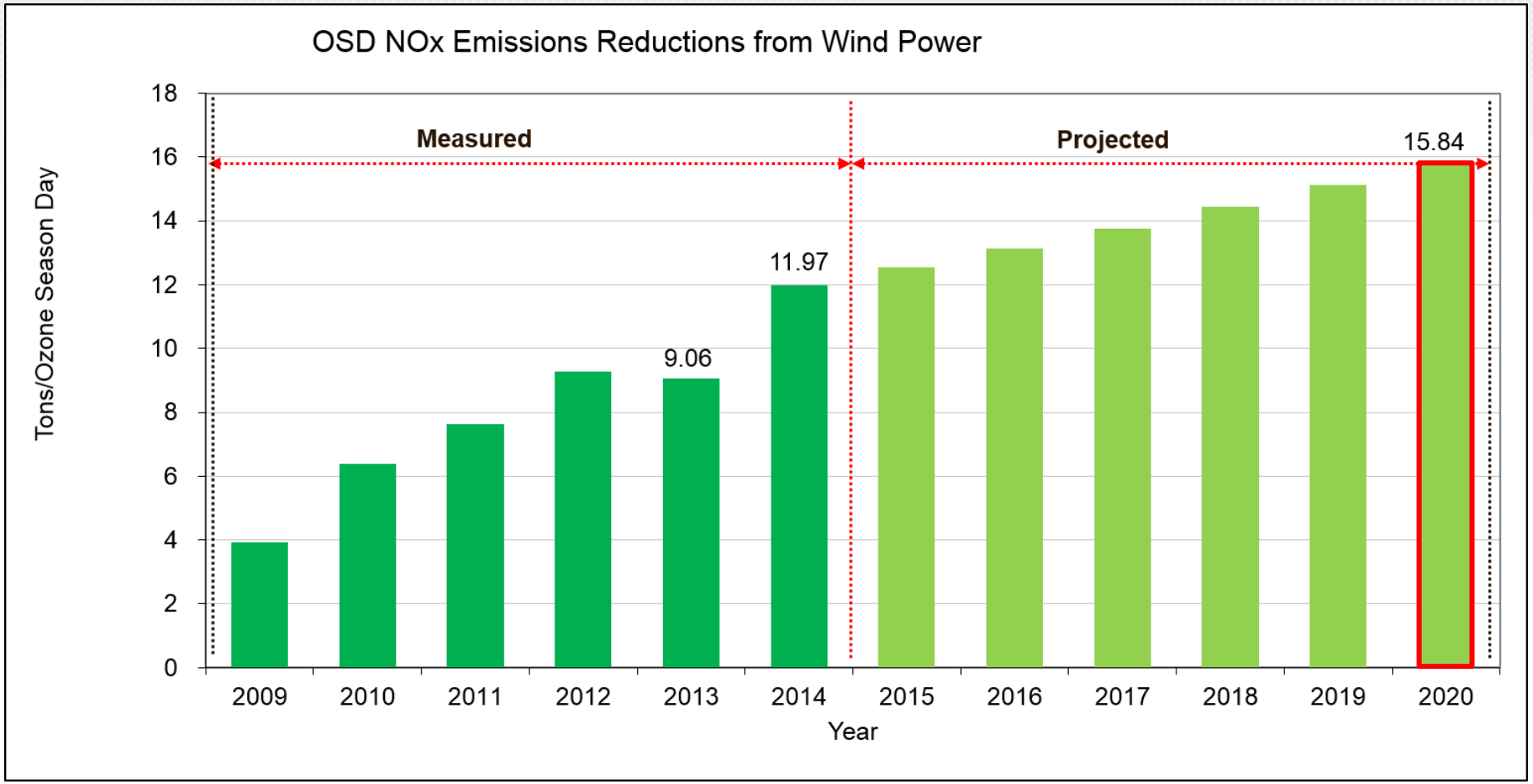
NOx REDUCTIONS FROM WIND POWER

OSD Power Generation and NOx Emissions Reductions (2008 base year)



NOx REDUCTIONS FROM WIND POWER

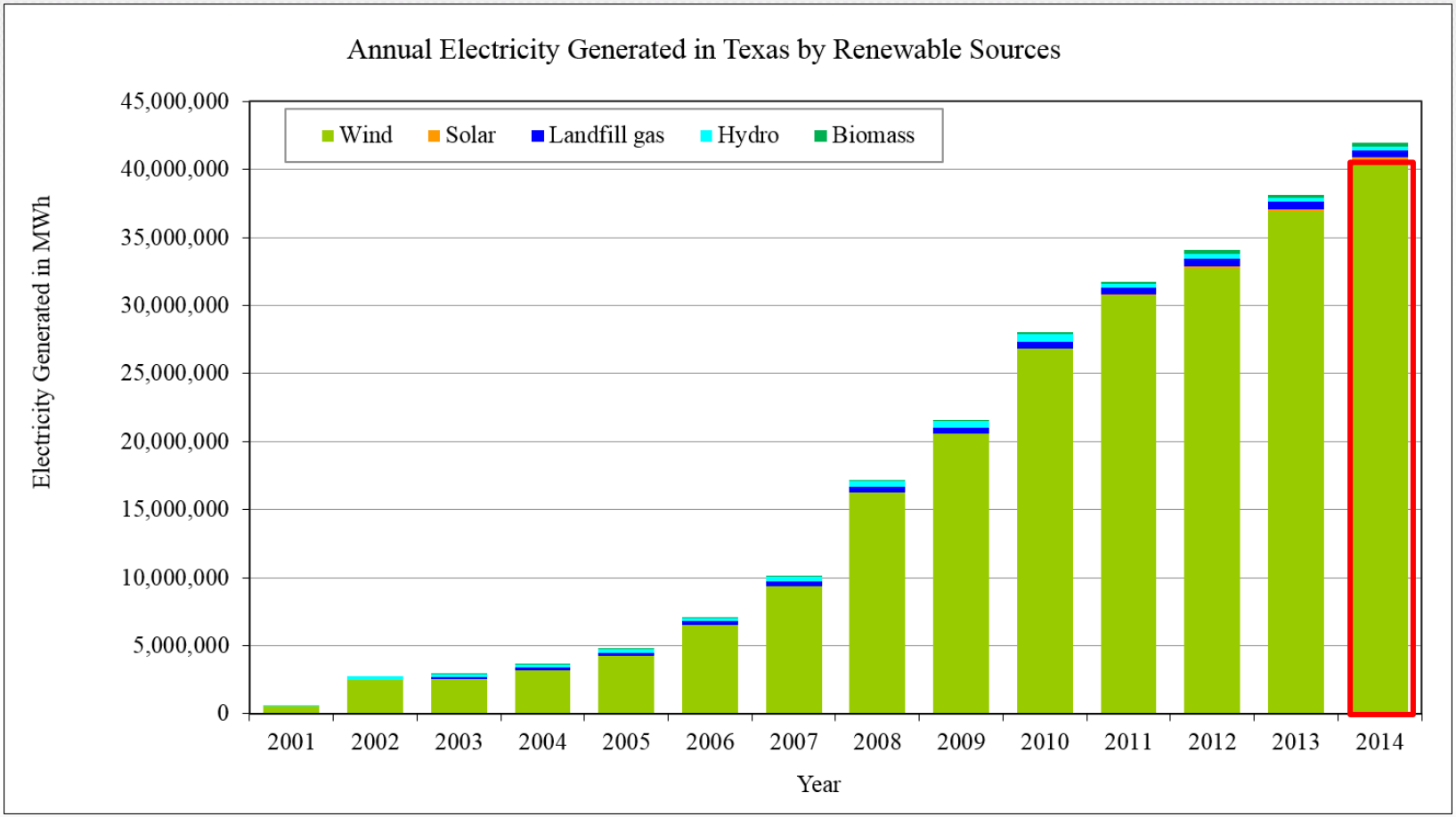
OSD Power Generation and NOx Emissions Reductions (2008 base year)



SAVINGS FROM OTHER RENEWABLES (2001-2014)

Renewables: Biomass, Hydro, Landfill Gas, Solar, Wind

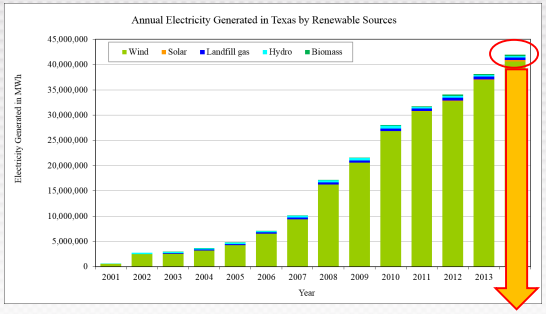
✓ Wind energy is the largest portion



SAVINGS FROM OTHER RENEWABLES (2001-2014)

Renewables: Biomass, Hydro, Landfill Gas, Solar, Wind

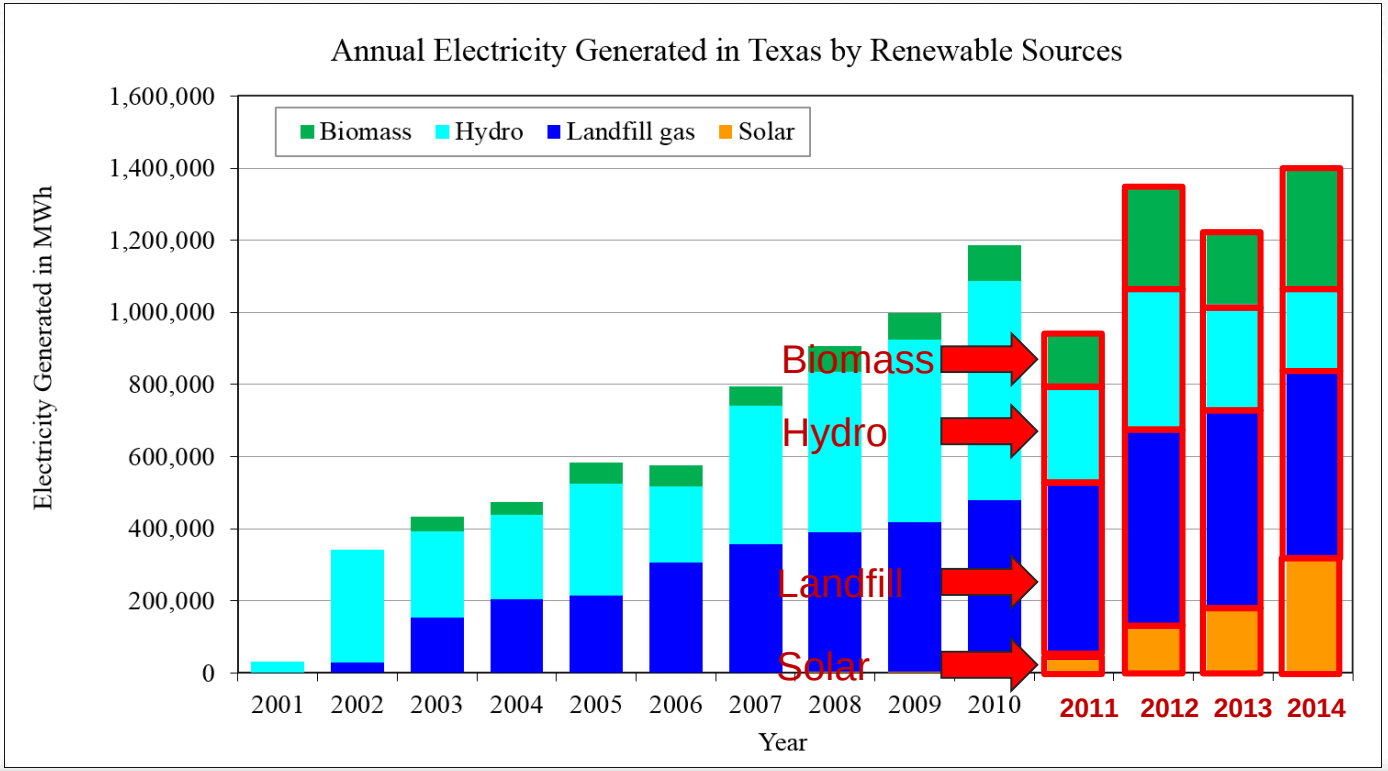
- ✓ Wind energy is the largest portion



Excluding Wind

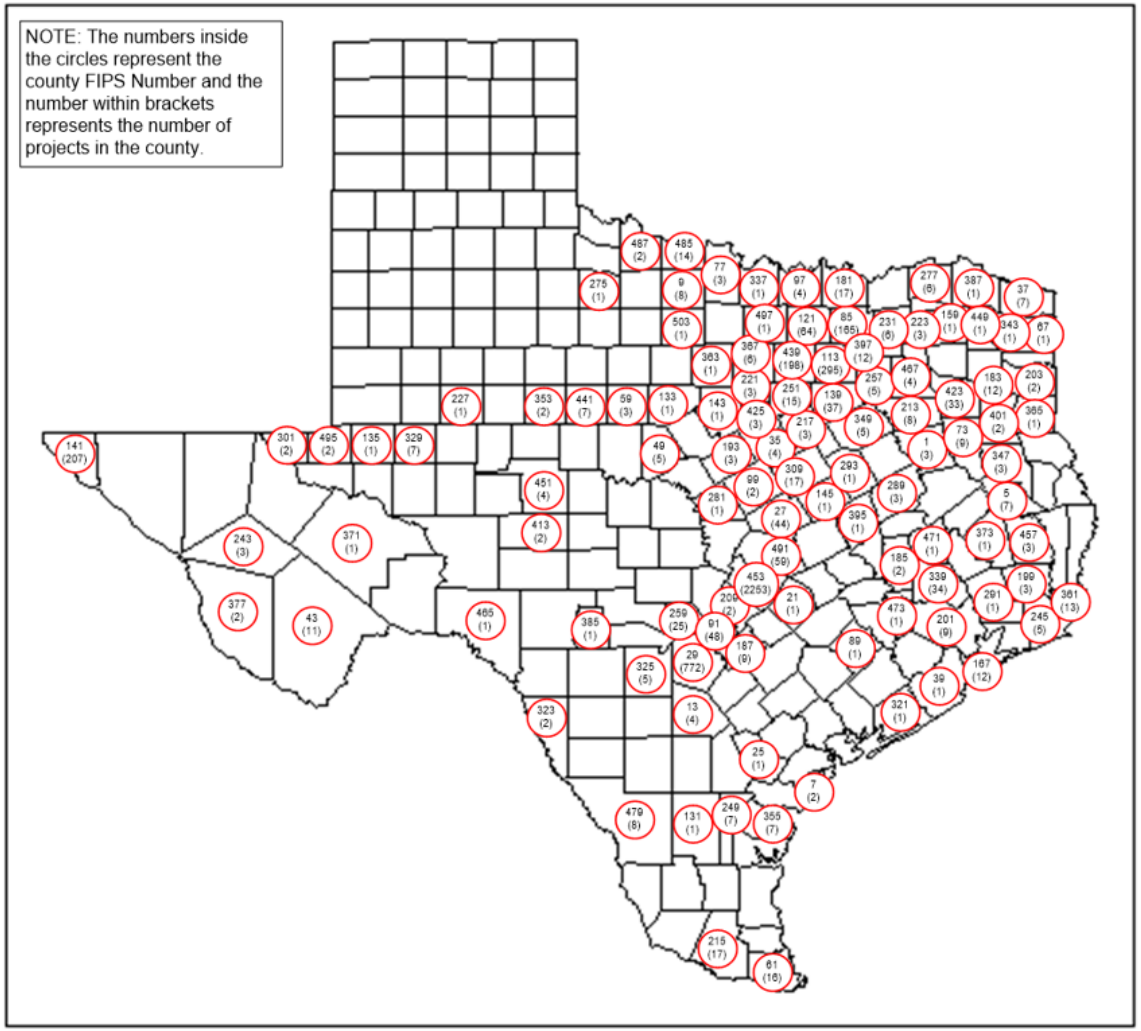
For the last 4 years

- ✓ Solar has increased considerably
- ✓ Landfill has been steady
- ✓ Hydro has increased/decreased
- ✓ Biomass has increased/decreased



RENEWABLE PROJECTS IN TEXAS (2014)

Solar PV



https://openpv.nrel.gov

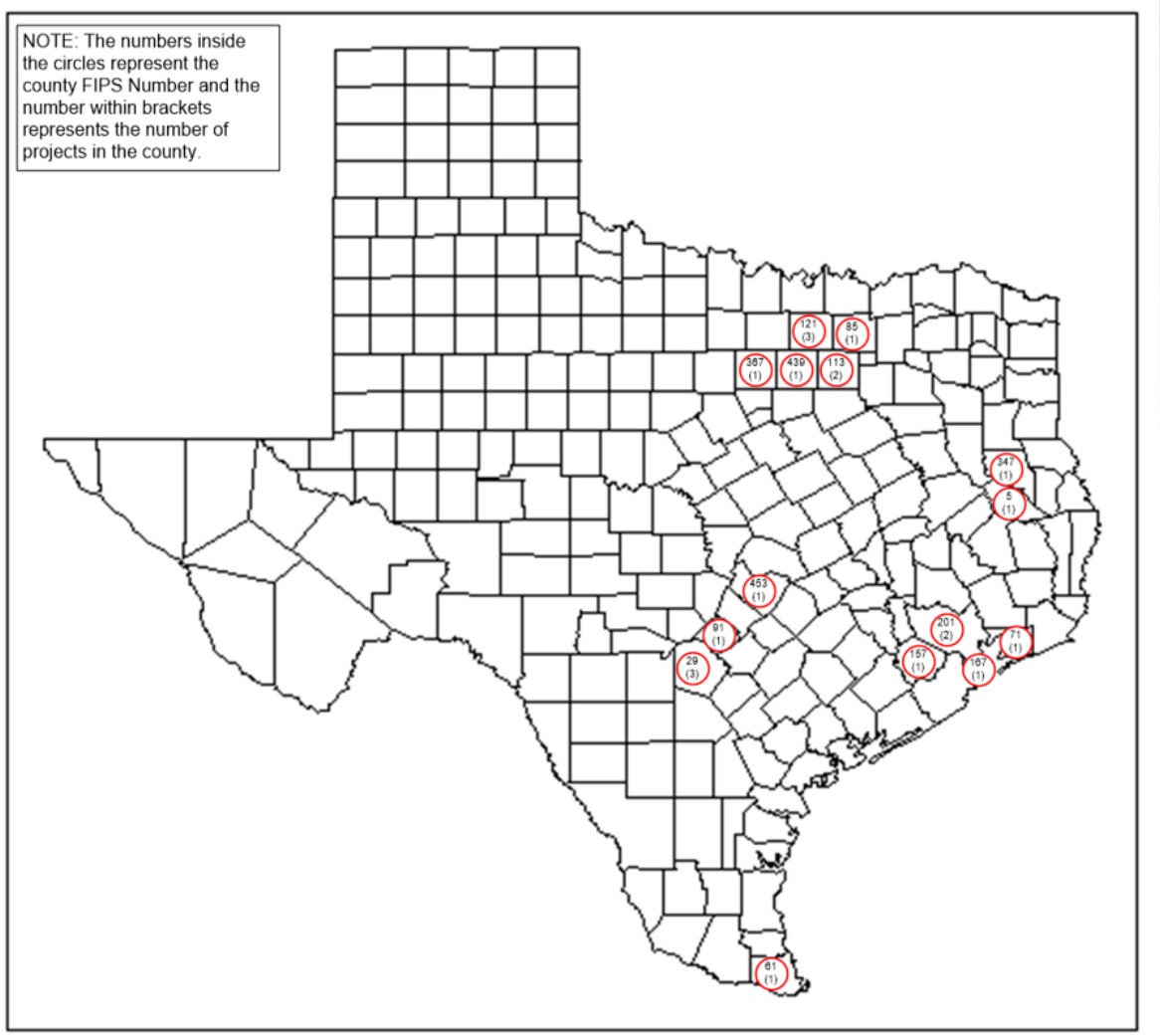
Renewables*:

Solar PV (4,647 projects)

* Included renewable projects if their information/data are available

RENEWABLE PROJECTS IN TEXAS (2014)

Biomass



* Included renewable projects if their information/data are available

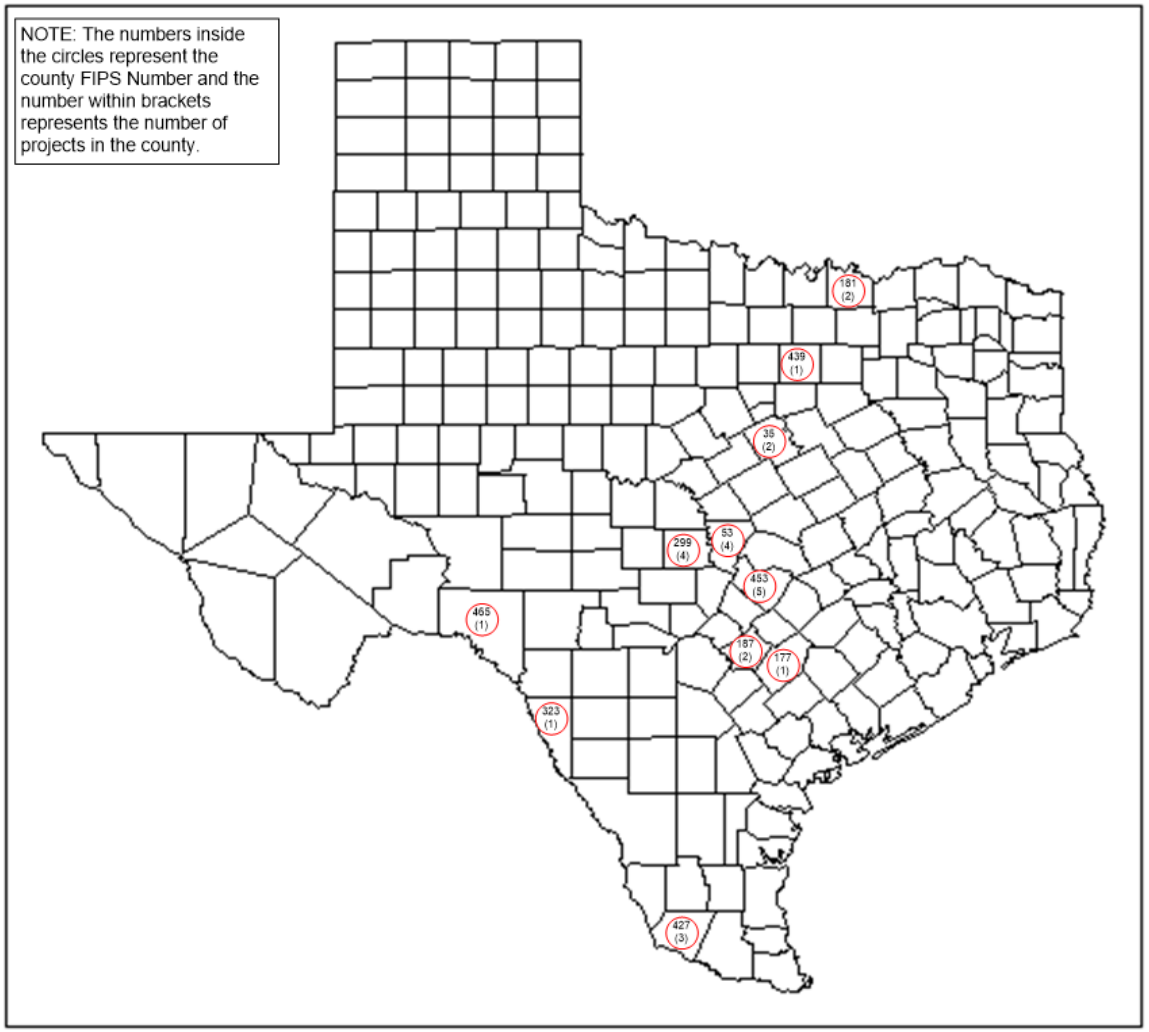
Renewables*:

Solar PV (4,647 projects)

Biomass (20 projects)

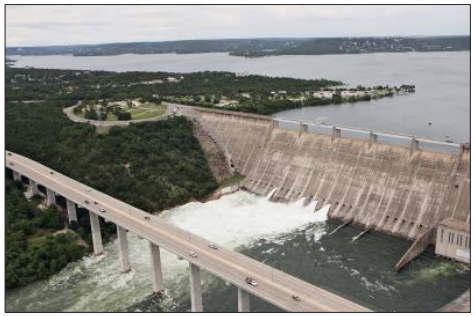
RENEWABLE PROJECTS IN TEXAS (2014)

Hydro



Renewables*:

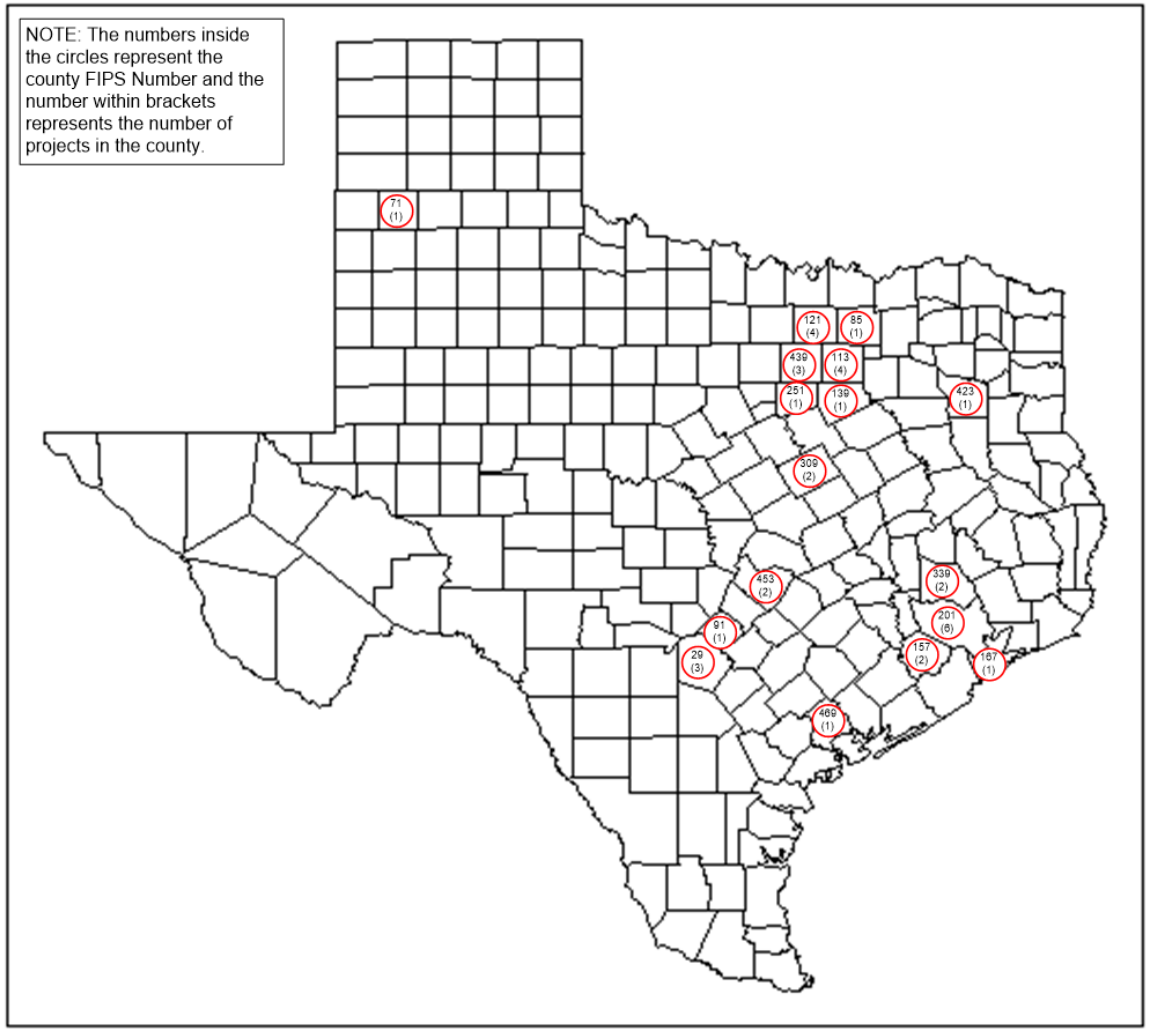
- Solar PV (4,647 projects)
- Biomass (20 projects)
- Hydro (27 projects)



* Included renewable projects if their information/data are available

RENEWABLE PROJECTS IN TEXAS (2014)

Landfill Gas



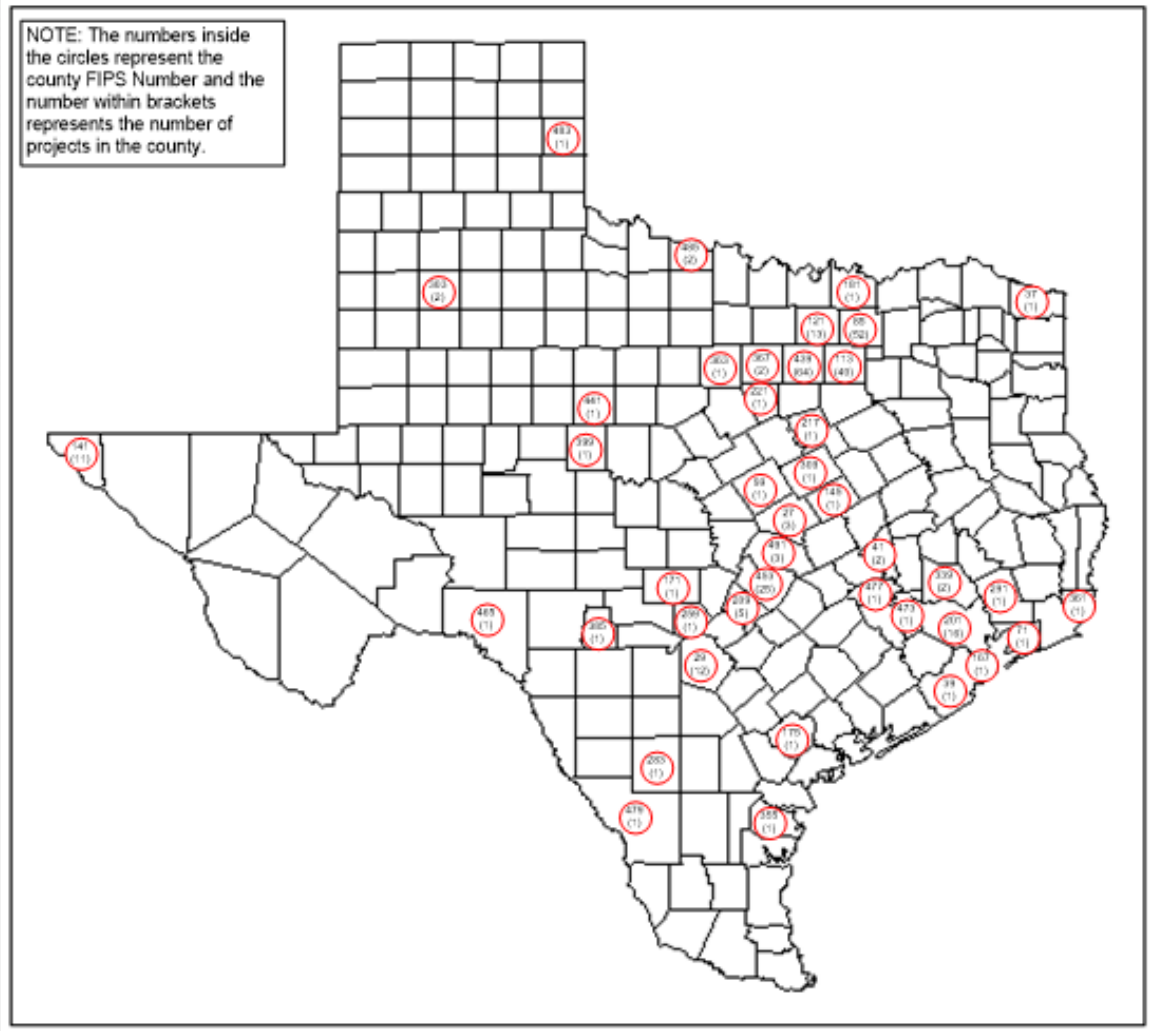
* Included renewable projects if their information/data are available

Renewables*:

- Solar PV (4,647 projects)
- Biomass (20 projects)
- Hydro (27 projects)
- Landfill Gas (34 projects)

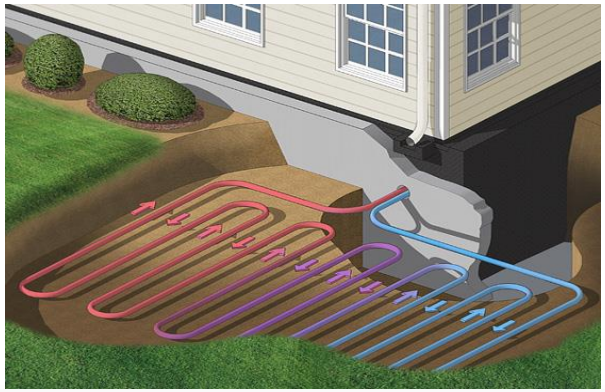
RENEWABLE PROJECTS IN TEXAS (2014)

Geothermal



Renewables*:

- Solar PV (4,647 projects)
- Biomass (20 projects)
- Hydro (27 projects)
- Landfill Gas (34 projects)
- Geothermal (286 projects)

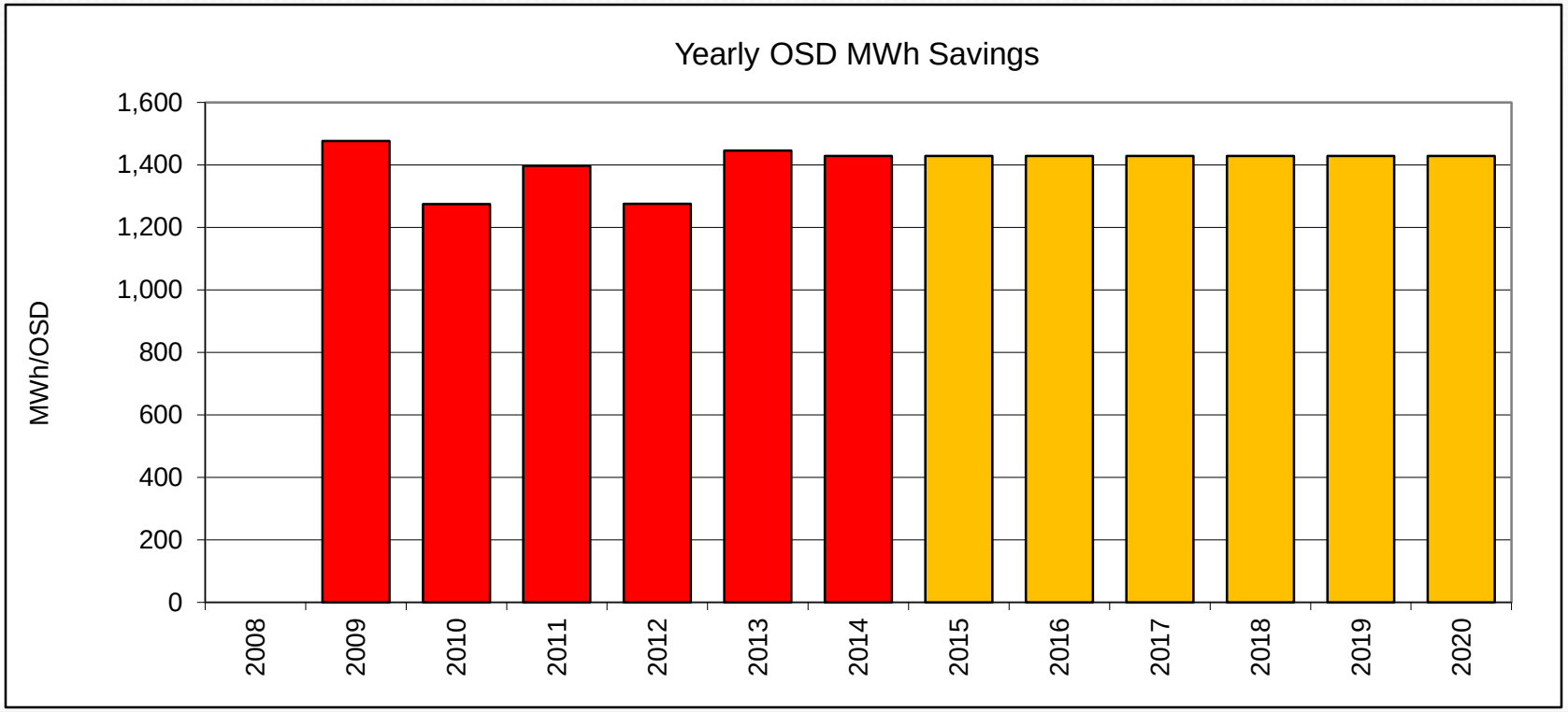


* Included renewable projects if their information/data are available

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.

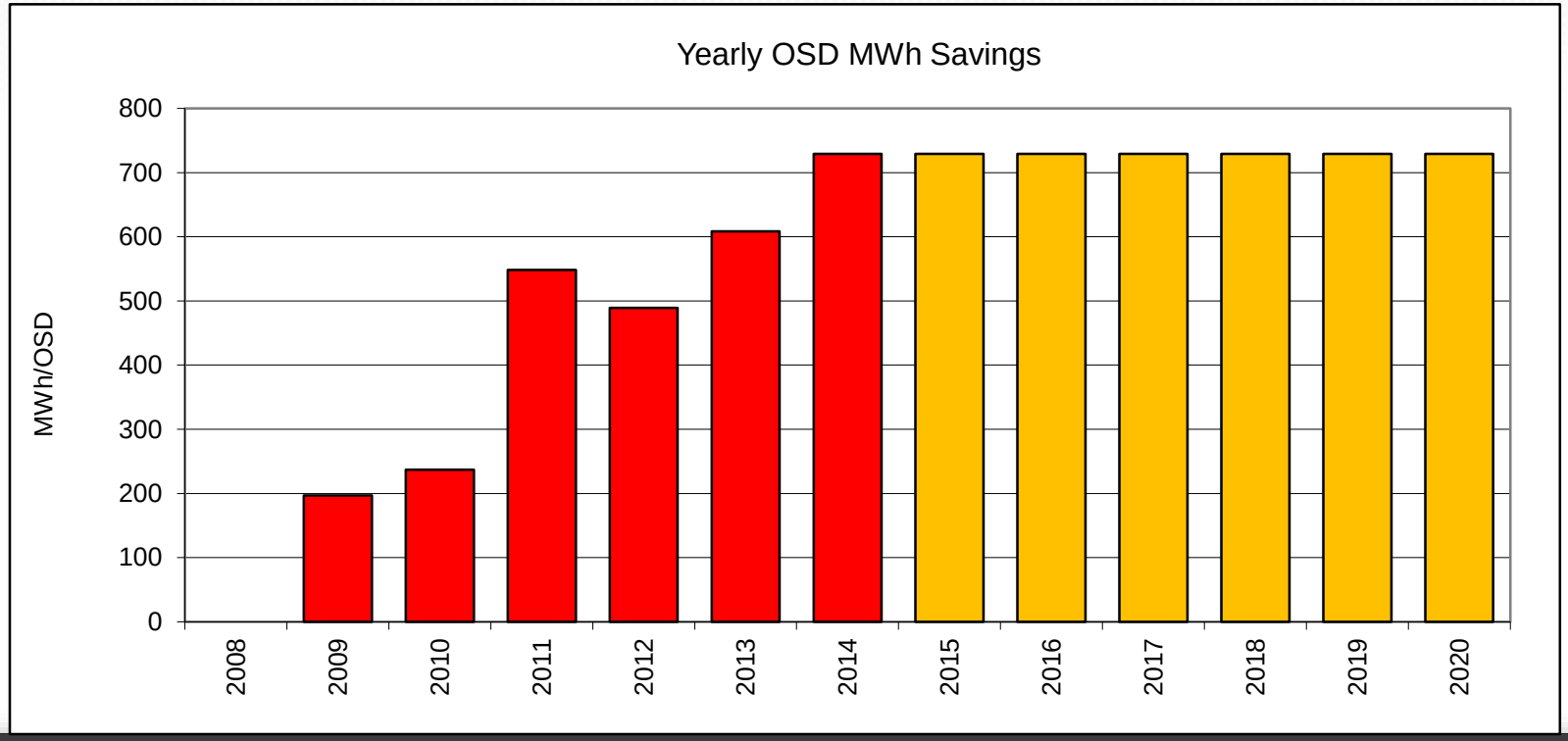


ENERGY SAVINGS FROM SECO

SECO Savings and Projections

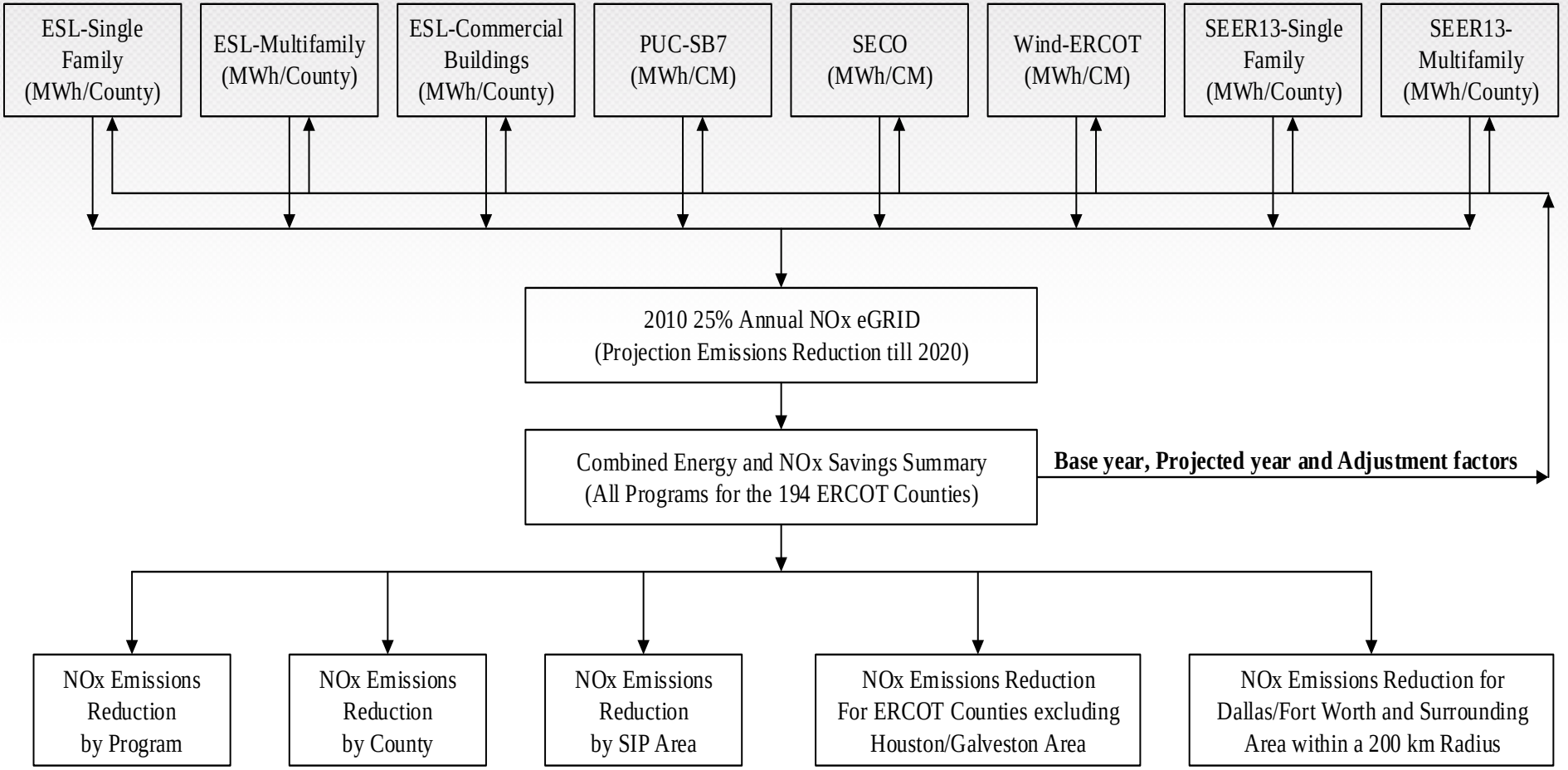
- The Texas State Energy Conservation Office (SECO) funds energy-efficiency programs directed towards school districts, government agencies, city and county governments, private industries and residential energy consumers.
- The annual electricity savings are obtained from SECO's energy conservation projects reported by political subdivisions for 47 counties.

SECO
State Energy Conservation Office



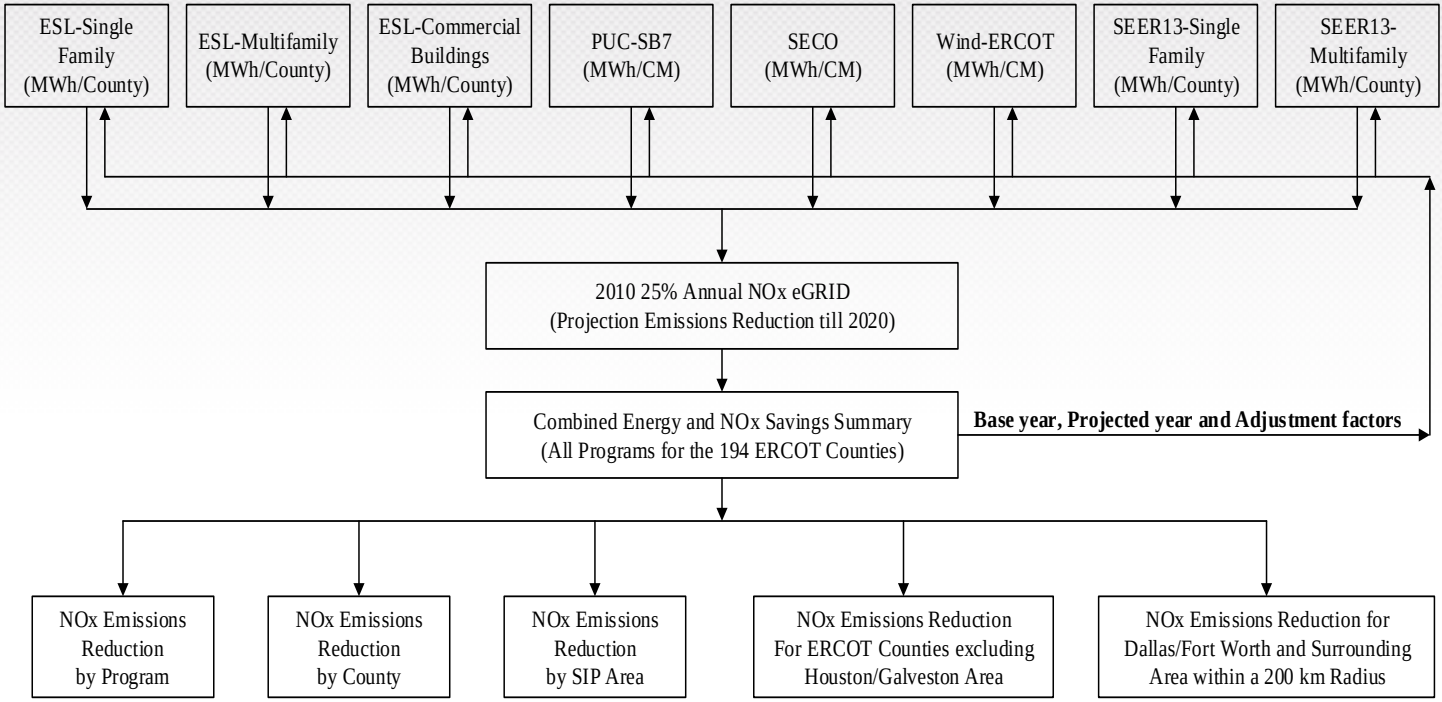
INTEGRATED NOx EMISSIONS REDUCTION

Integrated Emissions Savings Across Agencies To Report Savings To TCEQ and EPA



INTEGRATED NOx EMISSIONS REDUCTION

Integrated Emissions Savings Across Agencies To Report Savings To TCEQ and EPA



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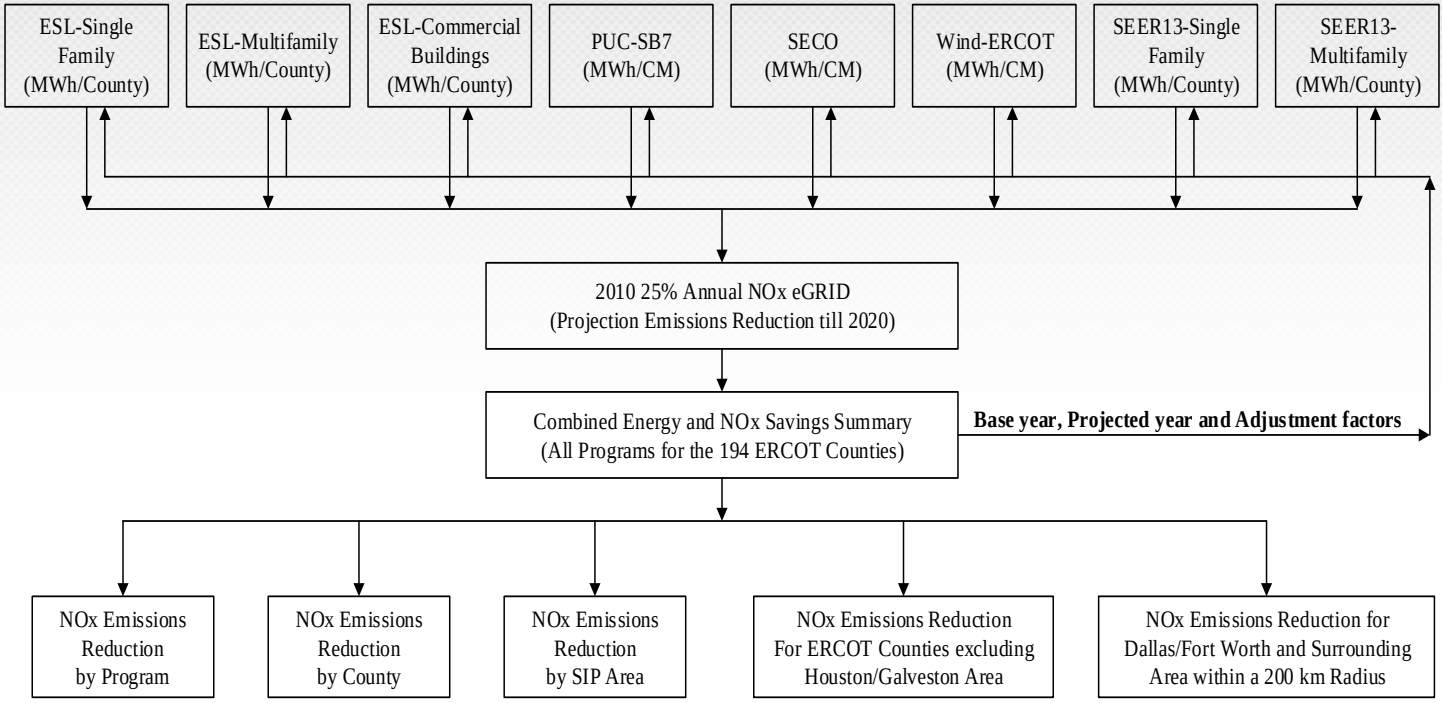
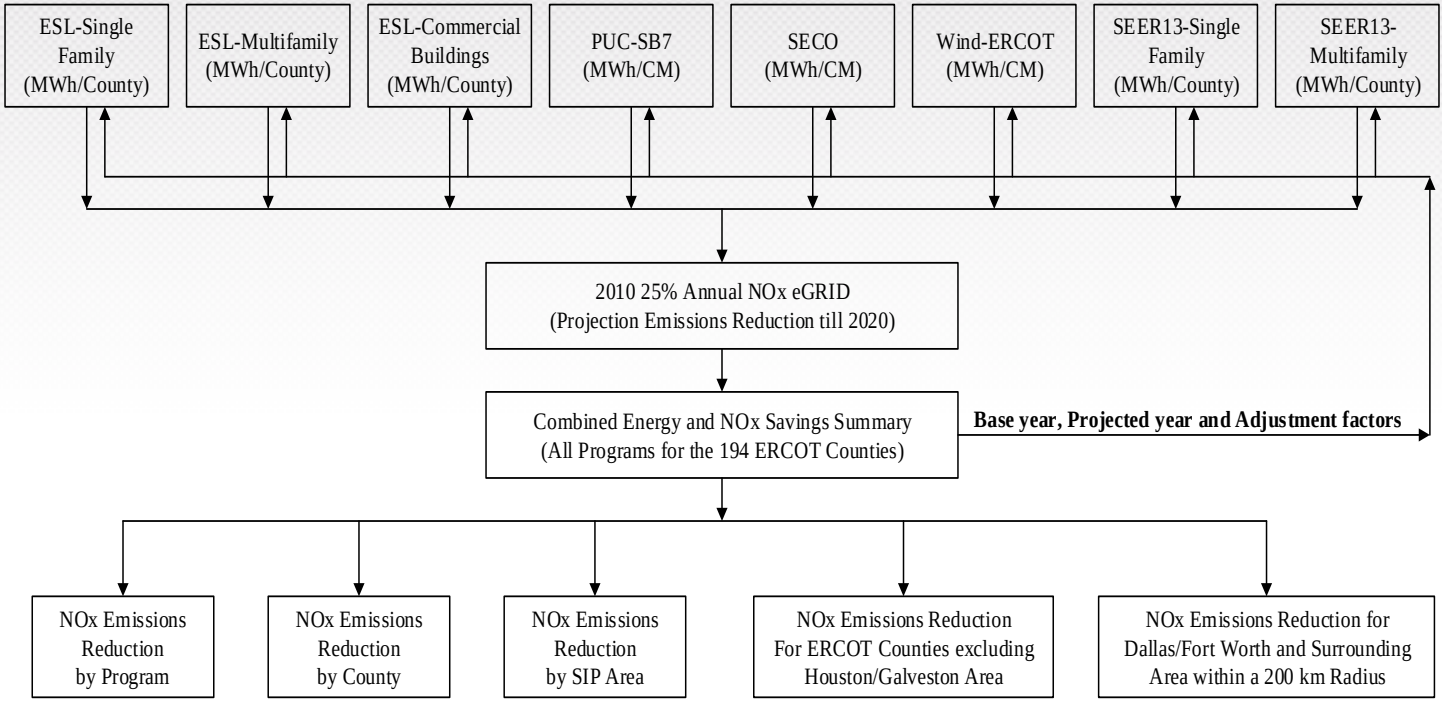


TCEQ
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
PUBLIC UTILITY COMMISSION OF TEXAS
SECO State Energy Conservation Office
ERCOT

INTEGRATED NOx EMISSIONS REDUCTION

Integrated Emissions Savings Across Agencies To Report Savings To TCEQ and EPA

State agencies included:



TCEQ

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PUBLIC UTILITY COMMISSION OF TEXAS

SECO
State Energy Conservation Office

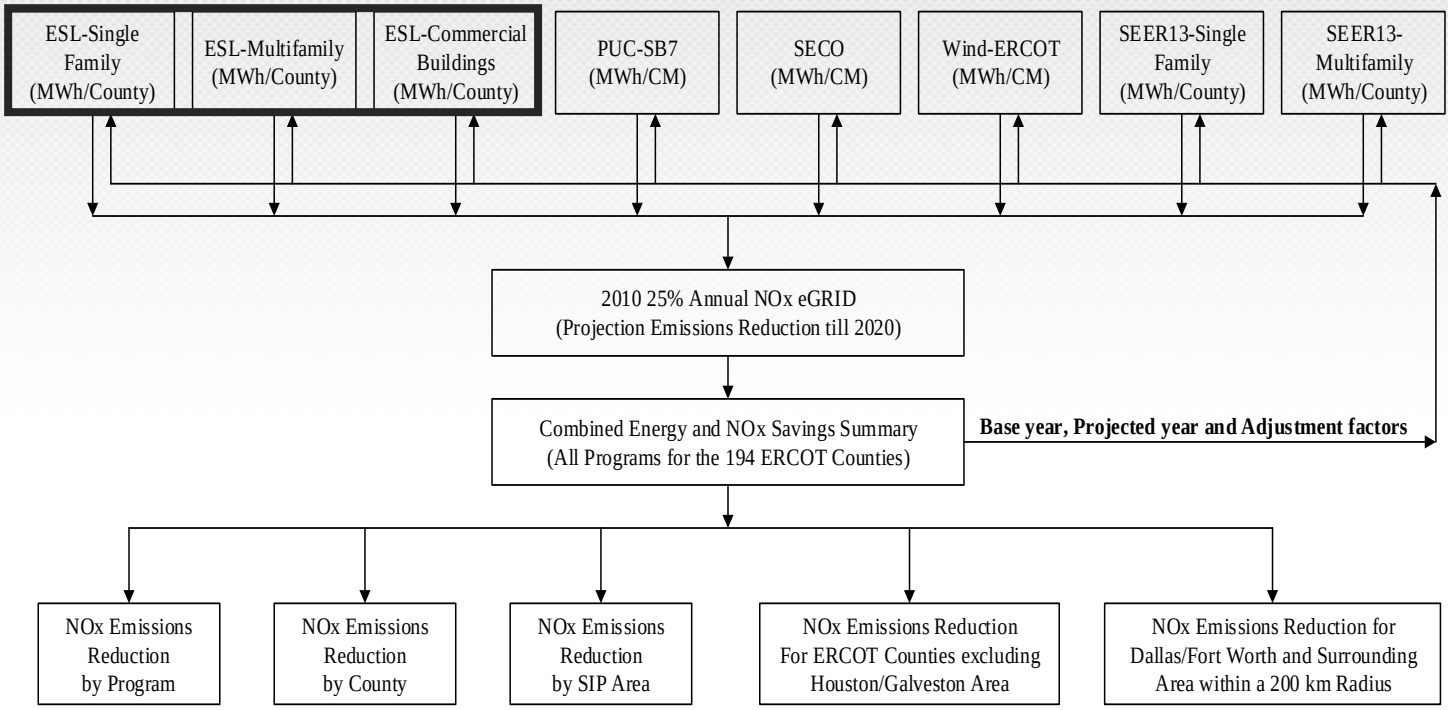
ERCOT

INTEGRATED NOx EMISSIONS REDUCTION

Integrated Emissions Savings Across Agencies To Report Savings To TCEQ and EPA

State agencies included:

- **TEES/ESL**



TCEQ

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PUBLIC UTILITY COMMISSION OF TEXAS

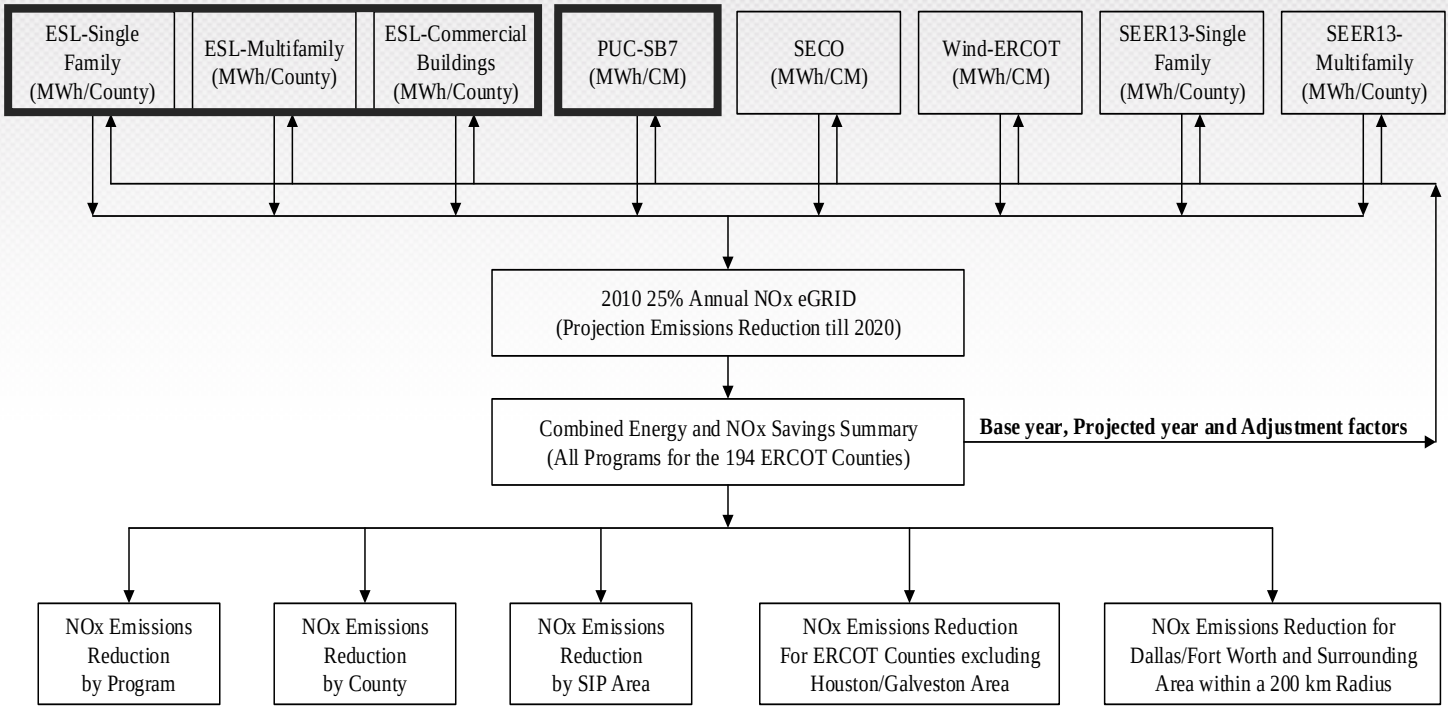
SECO
State Energy Conservation Office

ERCOT

INTEGRATED NOx EMISSIONS REDUCTION

Integrated Emissions Savings Across Agencies To Report Savings To TCEQ and EPA

State agencies included:
- **TEES/ESL**
- **PUC**



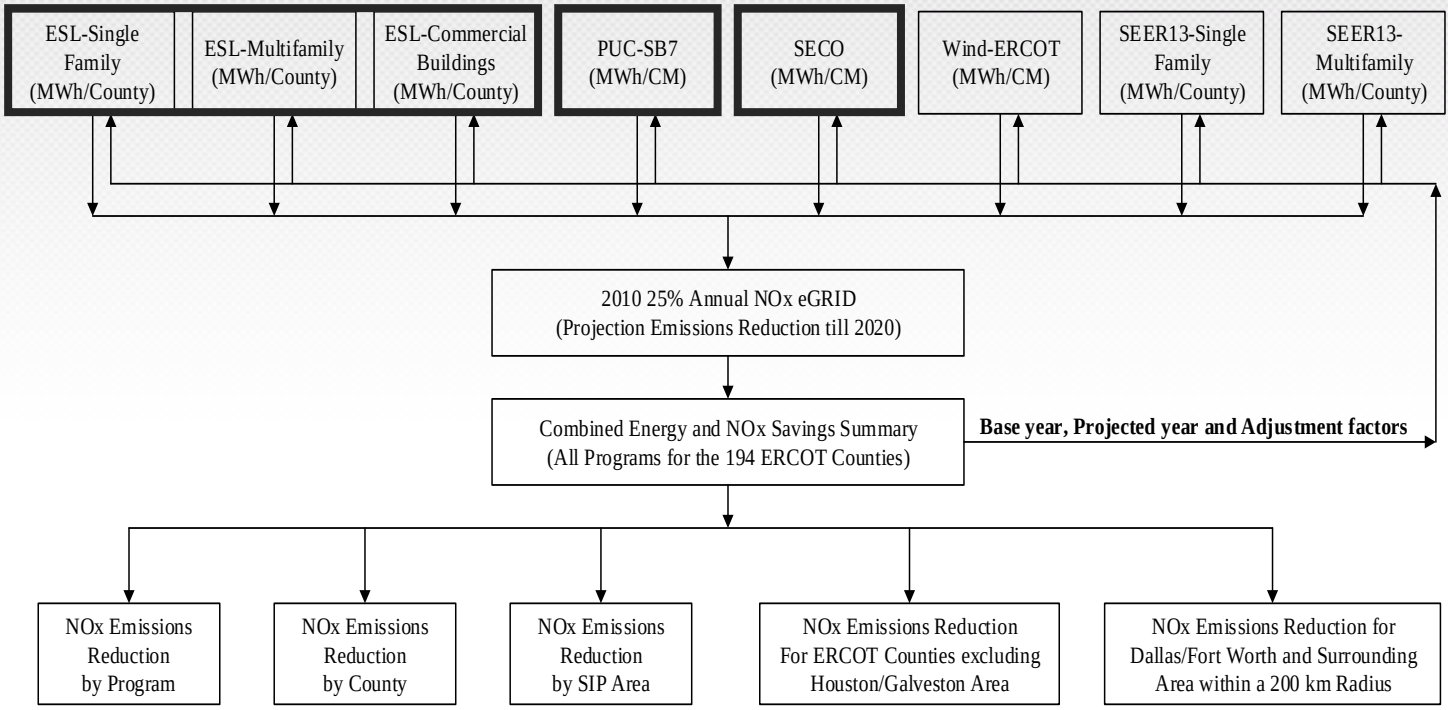
TCEQ
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
PUBLIC UTILITY COMMISSION OF TEXAS
SECO State Energy Conservation Office
ERCOT

INTEGRATED NOx EMISSIONS REDUCTION

Integrated Emissions Savings Across Agencies To Report Savings To TCEQ and EPA

State agencies included:

- **TEES/ESL**
- **PUC**
- **SECO**



TCEQ

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PUBLIC UTILITY COMMISSION OF TEXAS

SECO
State Energy Conservation Office

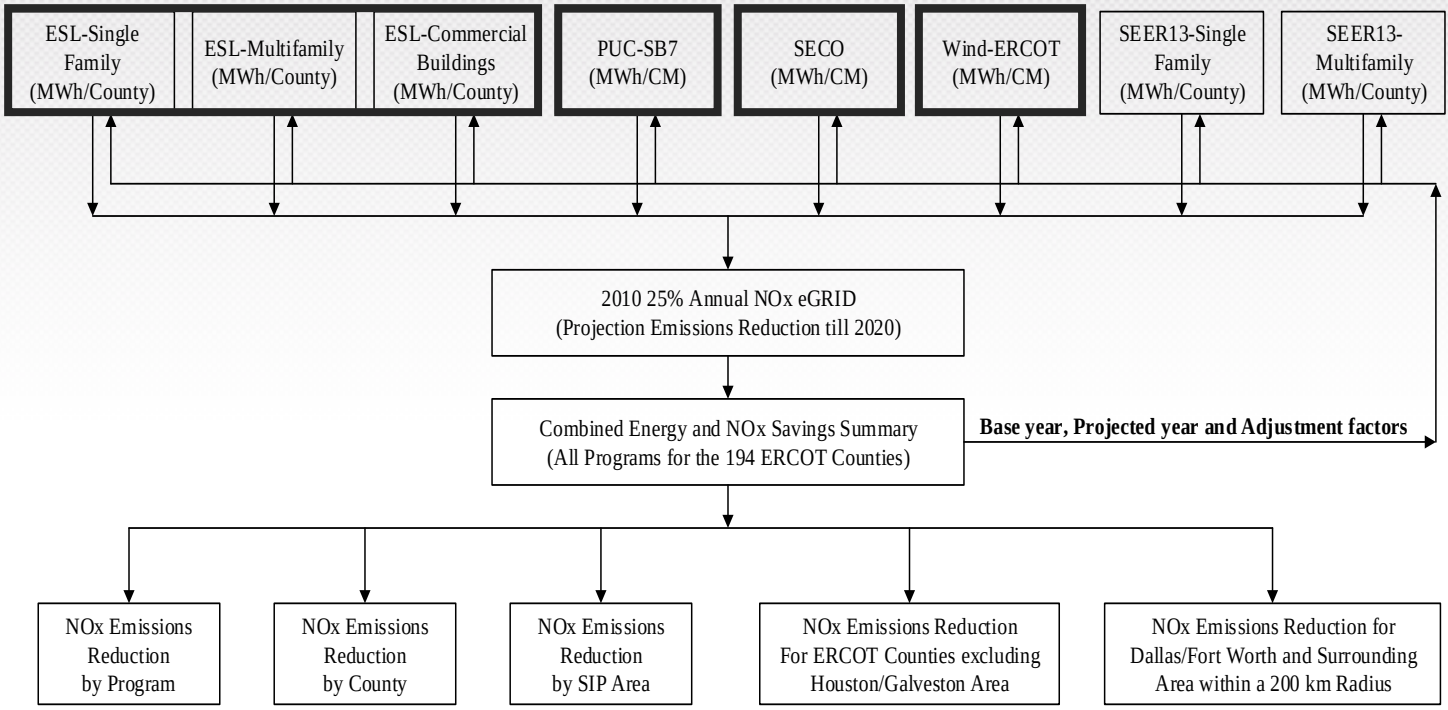
ERCOT

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**



TCEQ

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PUBLIC UTILITY COMMISSION OF TEXAS

SECO
State Energy Conservation Office

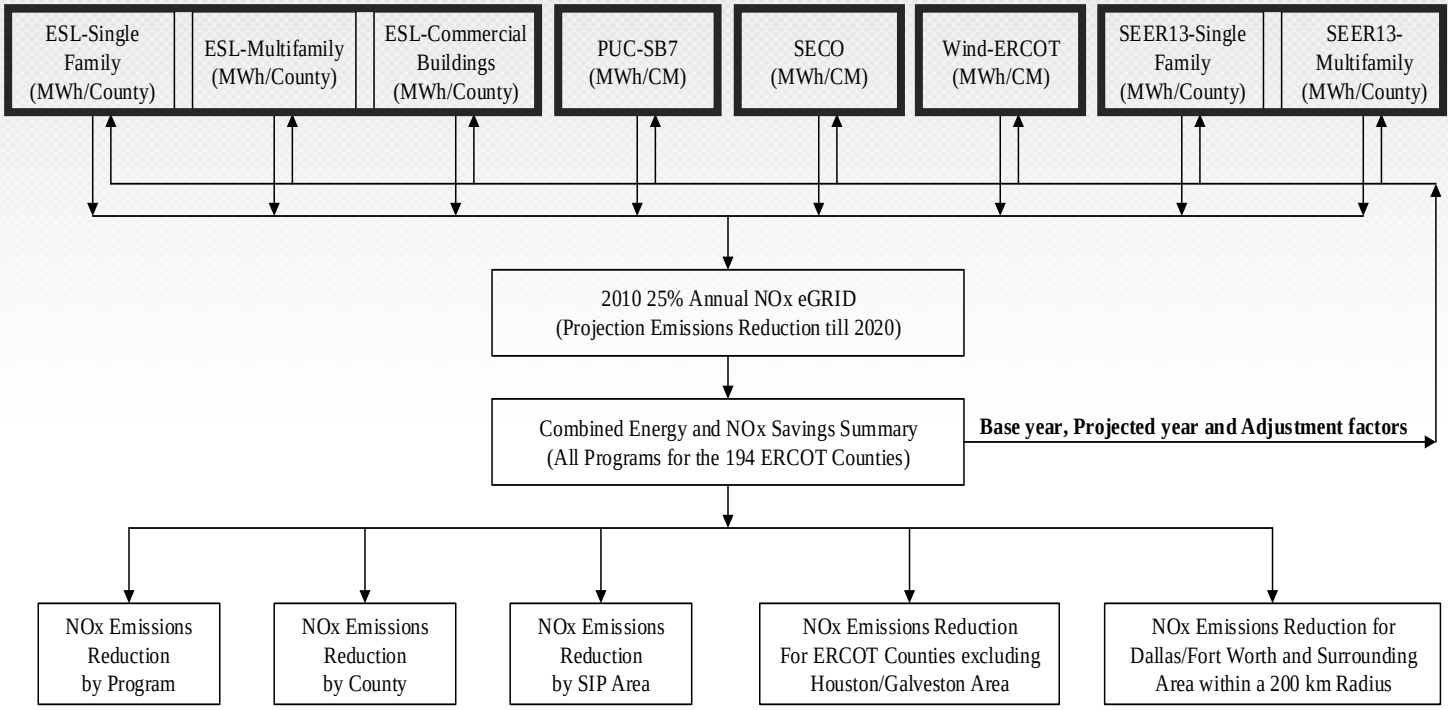
ERCOT

INTEGRATED NOx EMISSIONS REDUCTION

Integrated Emissions Savings Across Agencies To Report Savings To TCEQ and EPA

State agencies included:

- **TEES/ESL**
- **PUC**
- **SECO**
- **ERCOT/Wind**
- **SEER 13/14 Single/Multifamily**



TCEQ

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PUBLIC UTILITY COMMISSION OF TEXAS

SECO
State Energy Conservation Office

ERCOT

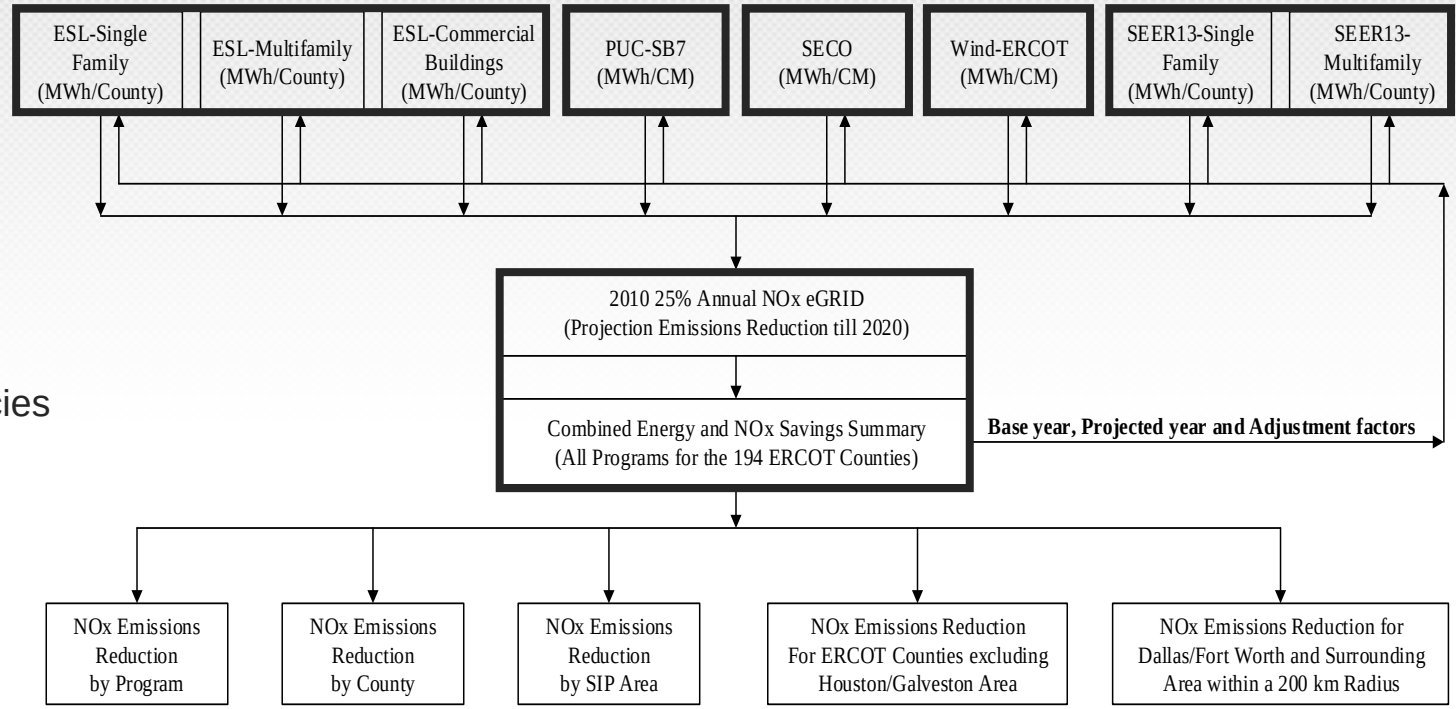
INTEGRATED NOx EMISSIONS REDUCTION

Integrated Emissions Savings Across Agencies To Report Savings To TCEQ and EPA

State agencies included:

- **TEES/ESL**
- **PUC**
- **SECO**
- **ERCOT/Wind**
- **SEER 13/14 Single/Multifamily**

Total savings across agencies



TCEQ

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PUBLIC UTILITY COMMISSION OF TEXAS

SECO State Energy Conservation Office

ERCOT

INTEGRATED NOx EMISSIONS REDUCTION

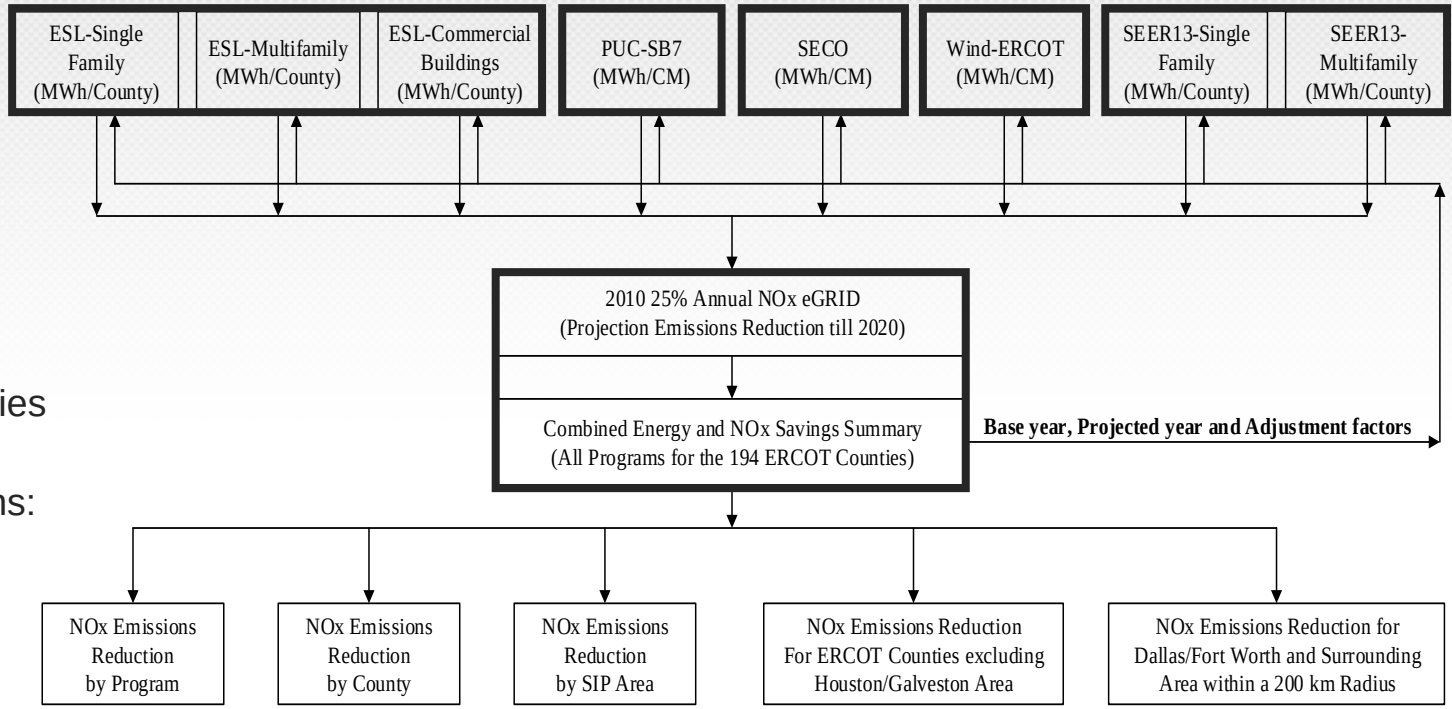
Integrated Emissions Savings Across Agencies To Report Savings To TCEQ and EPA

State agencies included:

- **TEES/ESL**
- **PUC**
- **SECO**
- **ERCOT/Wind**
- **SEER 13/14 Single/Multifamily**

Total savings across agencies

Annual emissions reductions:



TCEQ

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PUBLIC UTILITY COMMISSION OF TEXAS

SECO State Energy Conservation Office

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Total savings across agencies

Annual emissions reductions:
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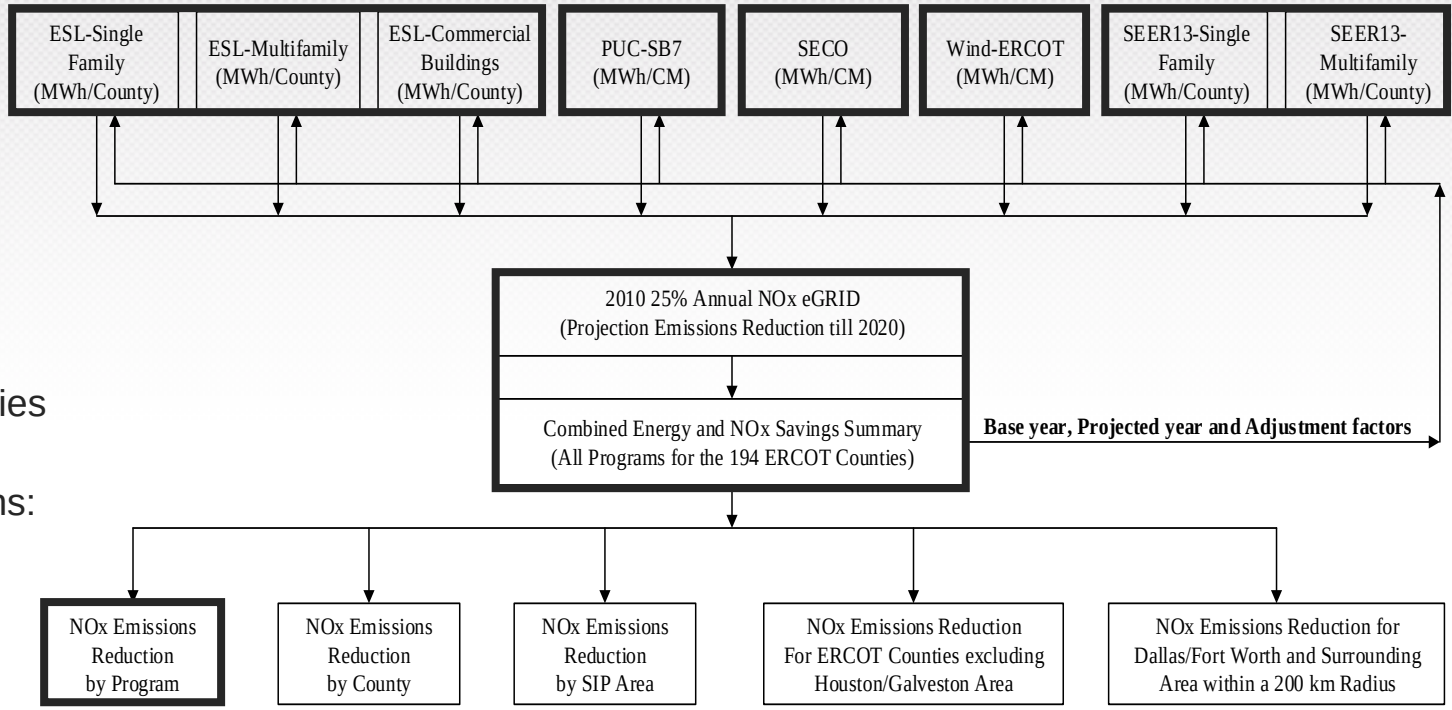

TCEQ · United States Environmental Protection Agency · Public Utility Commission of Texas · SECO State Energy Conservation Office · ERCOT

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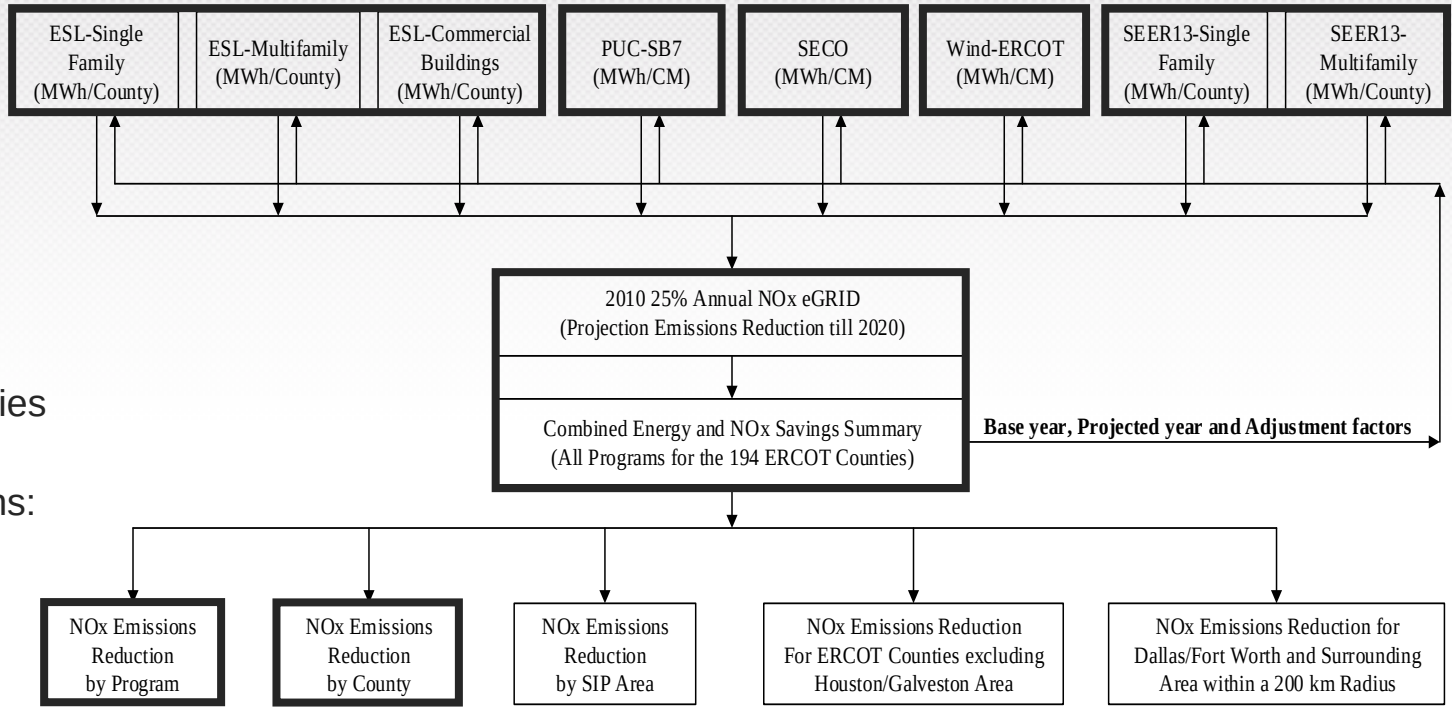
Total savings across agencies

Annual emissions reductions:
- **By program**
- **By county**



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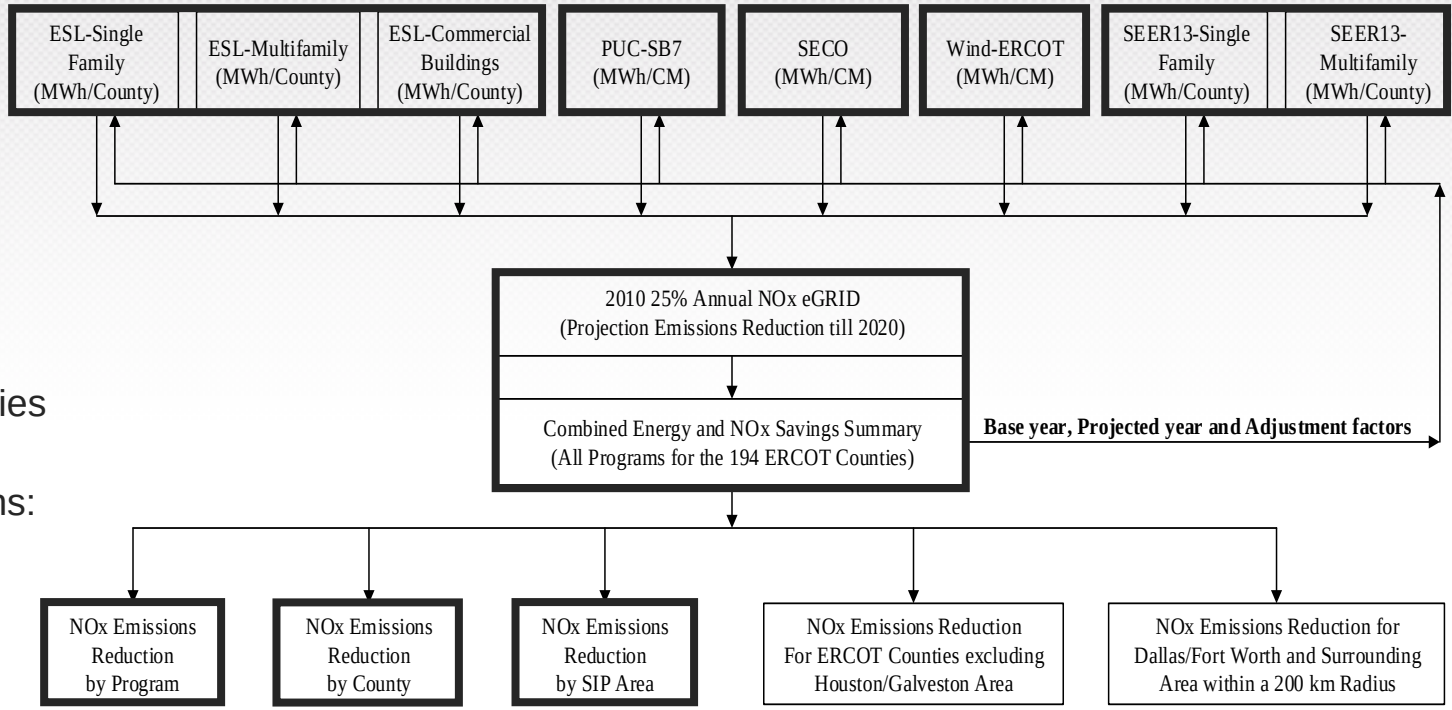
Total savings across agencies

Annual emissions reductions:
- **By program**
- **By county**
- **By SIP area**



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Annual emissions reductions:

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- **By SIP area**
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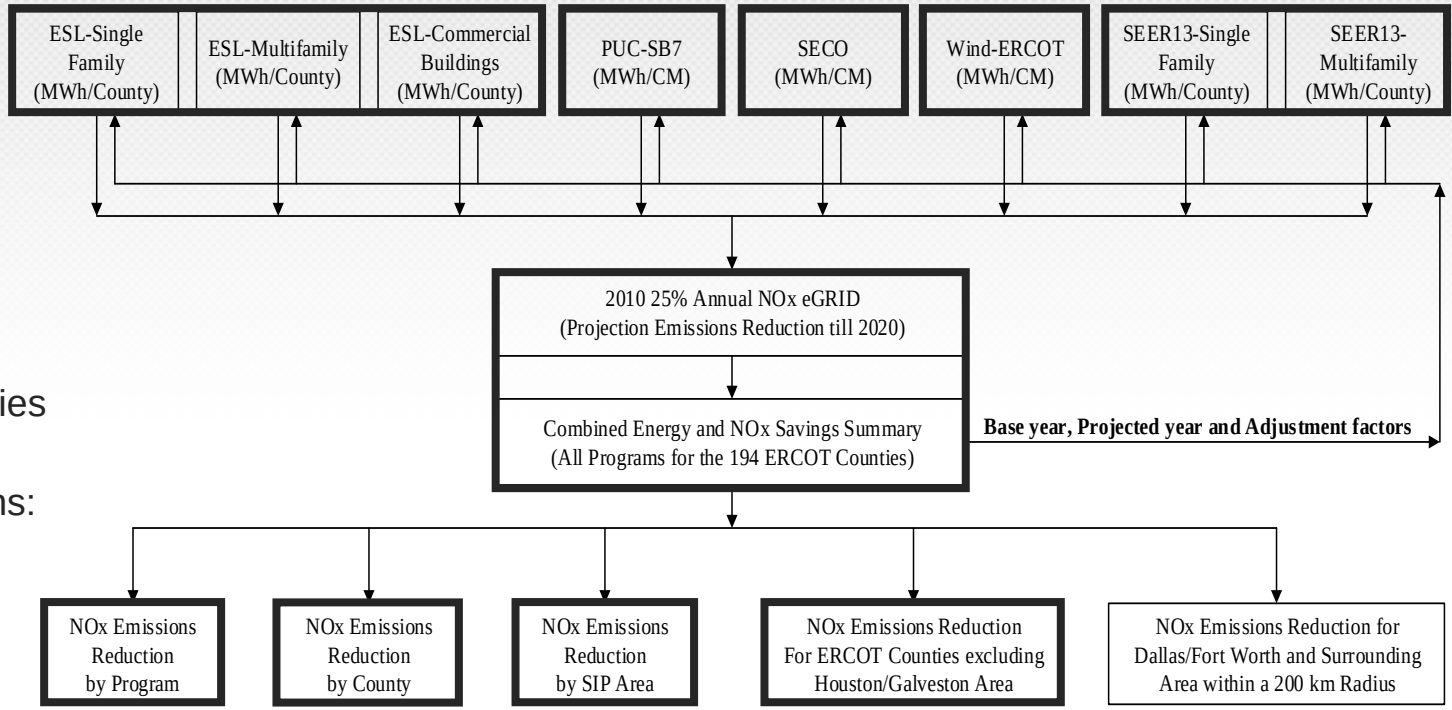

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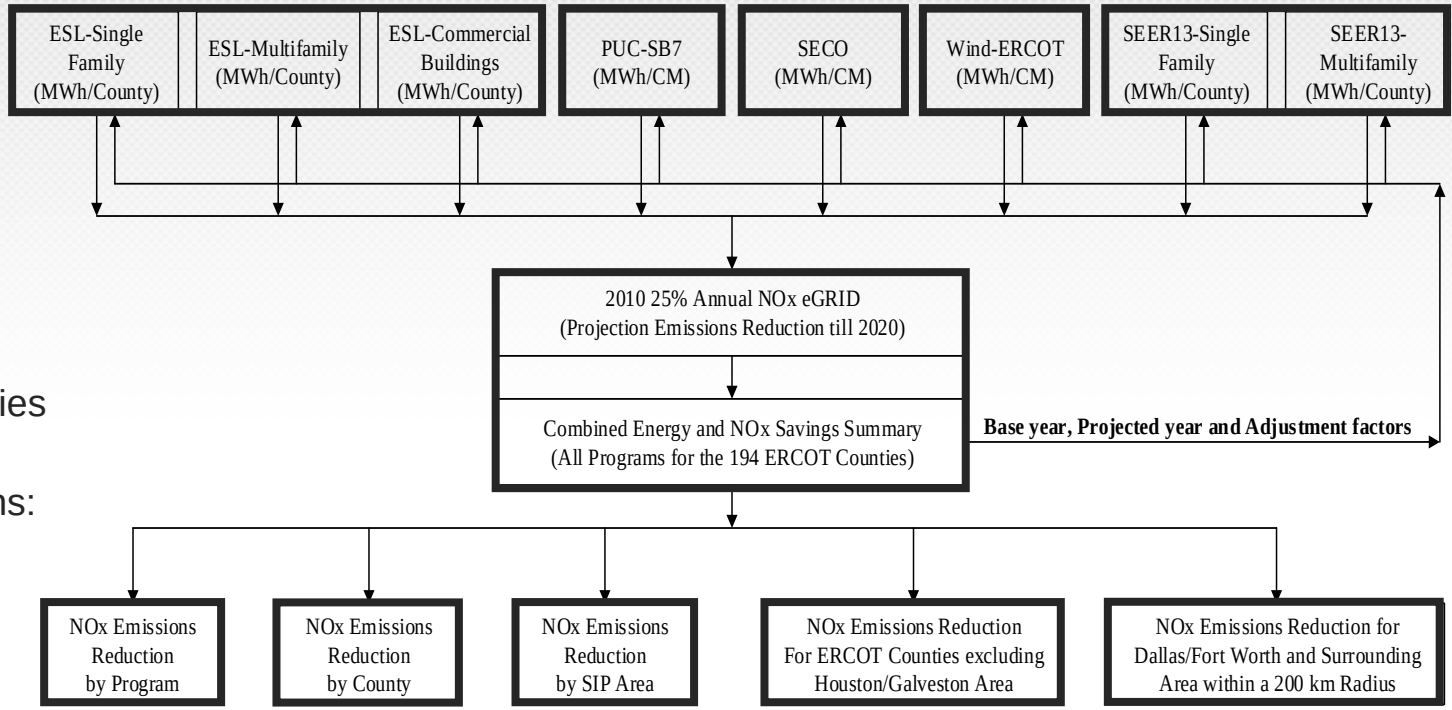
Total savings across agencies

Annual emissions reductions:

- **By program**
- **By county**
- **By SIP area**
- **By ERCOT counties**
- **By City and Surrounding Area within a 200km Radius**



TCEQ

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PUBLIC UTILITY COMMISSION OF TEXAS

SECO State Energy Conservation Office

ERCOT

INTEGRATED NOx EMISSIONS REDUTION (2008 Baseyear)

2014 Integrated OSD NOx Emissions Reduction Using new 2010 eGrid

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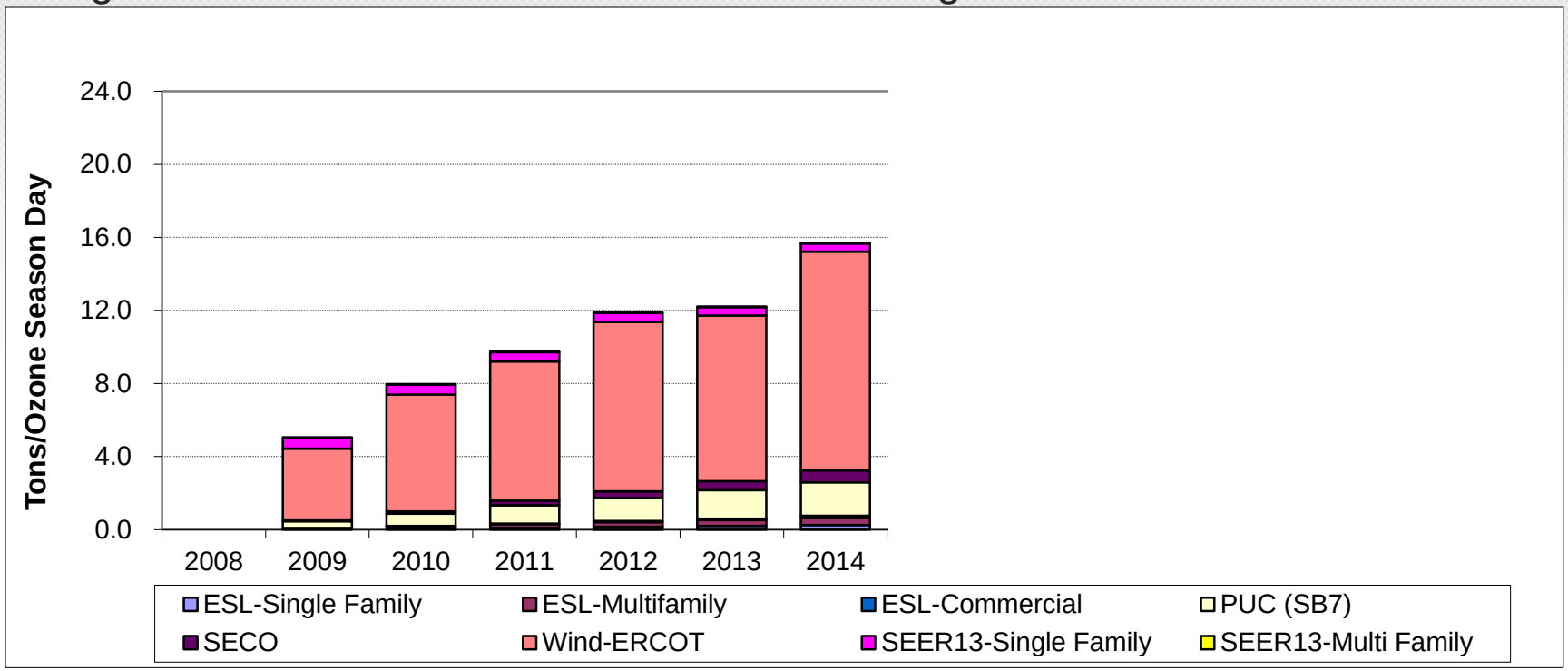

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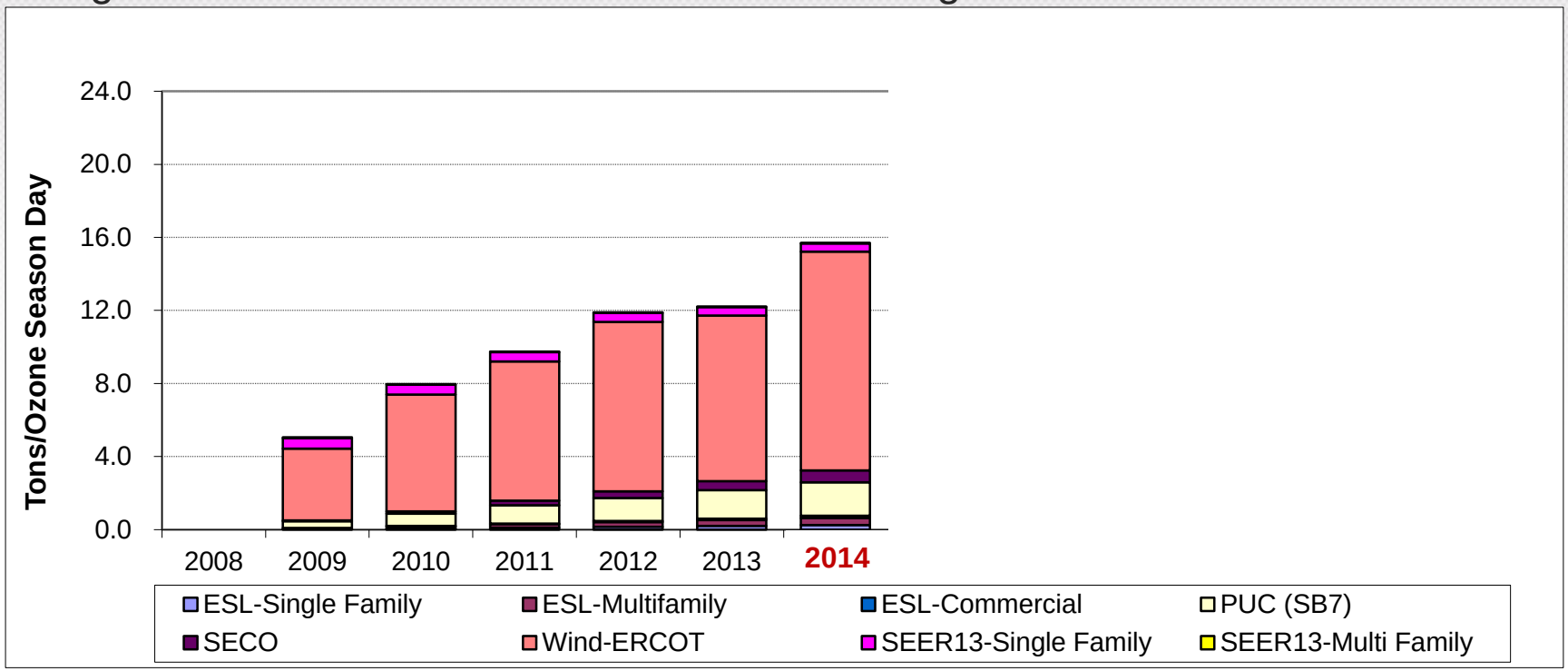

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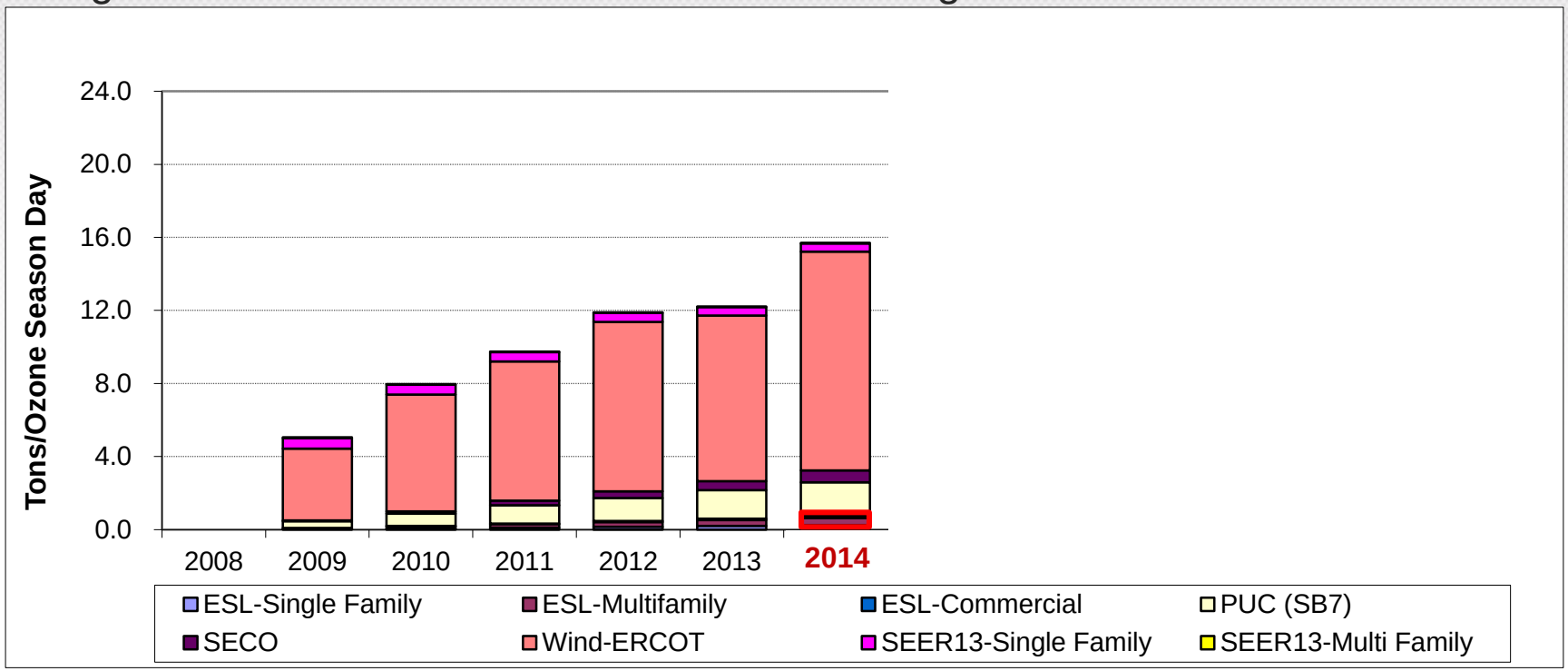

2014 integrated OSD NOx emissions reduction

- ESL Code Compliance (0.76 tons/day)

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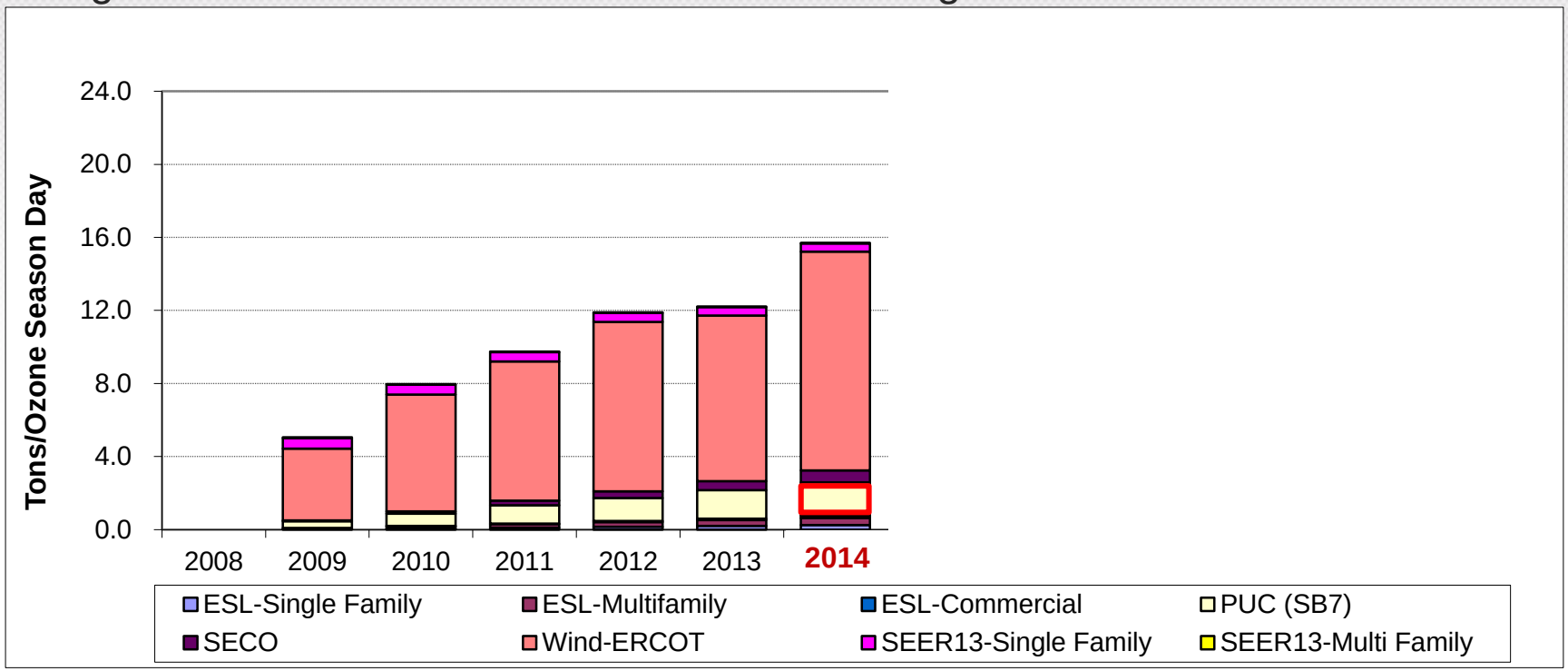
2014 Integrated OSD NOx Emissions Reduction Using new 2010 eGrid

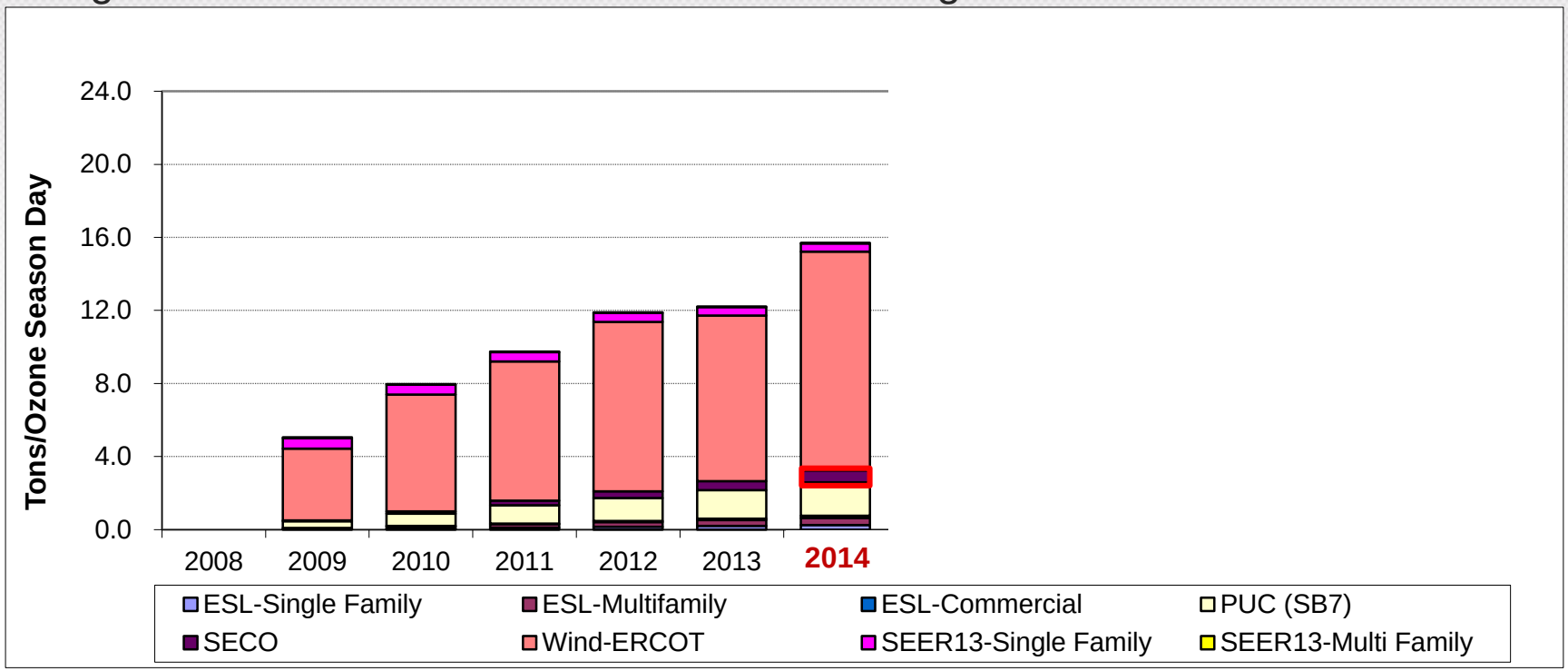


2014 integrated OSD NOx emissions reduction

- ESL Code Compliance (0.76 tons/day)
- PUC SB7 programs (1.83 tons/day)

INTEGRATED NOx EMISSIONS REDUTION (2008 Baseyear)

2014 Integrated OSD NOx Emissions Reduction Using new 2010 eGrid



2014 integrated OSD NOx emissions reduction

- ESL Code Compliance (0.76 tons/day)
- PUC SB7 programs (1.83 tons/day)
- SECO Political Sub. (0.66 tons/day)

INTEGRATED NOx EMISSIONS REDUTION (2008 Baseyear)

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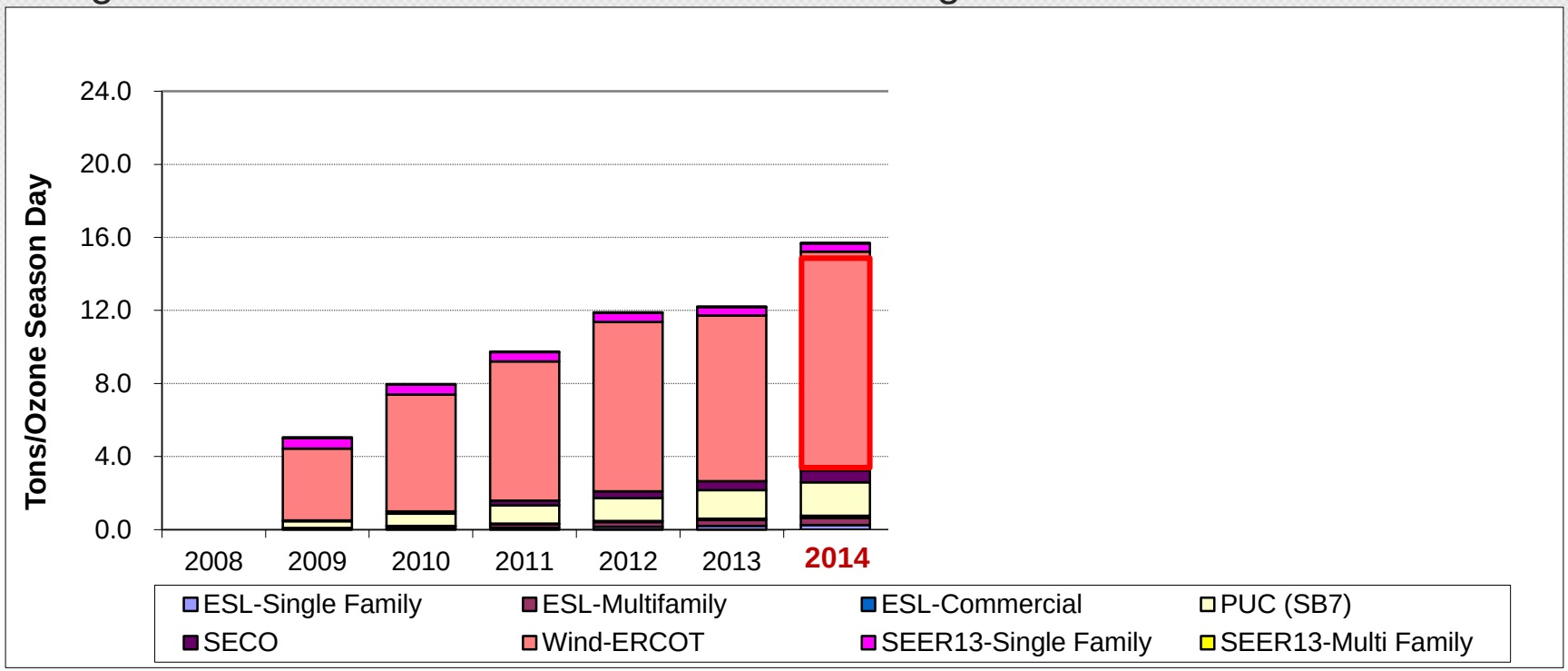

2014 integrated OSD NOx emissions reduction

- ESL Code Compliance (0.76 tons/day)
- PUC SB7 programs (1.83 tons/day)
- SECO Political Sub. (0.66 tons/day)
- Green Power (Wind) (11.97 tons/day)

INTEGRATED NOx EMISSIONS REDUTION (2008 Baseyear)

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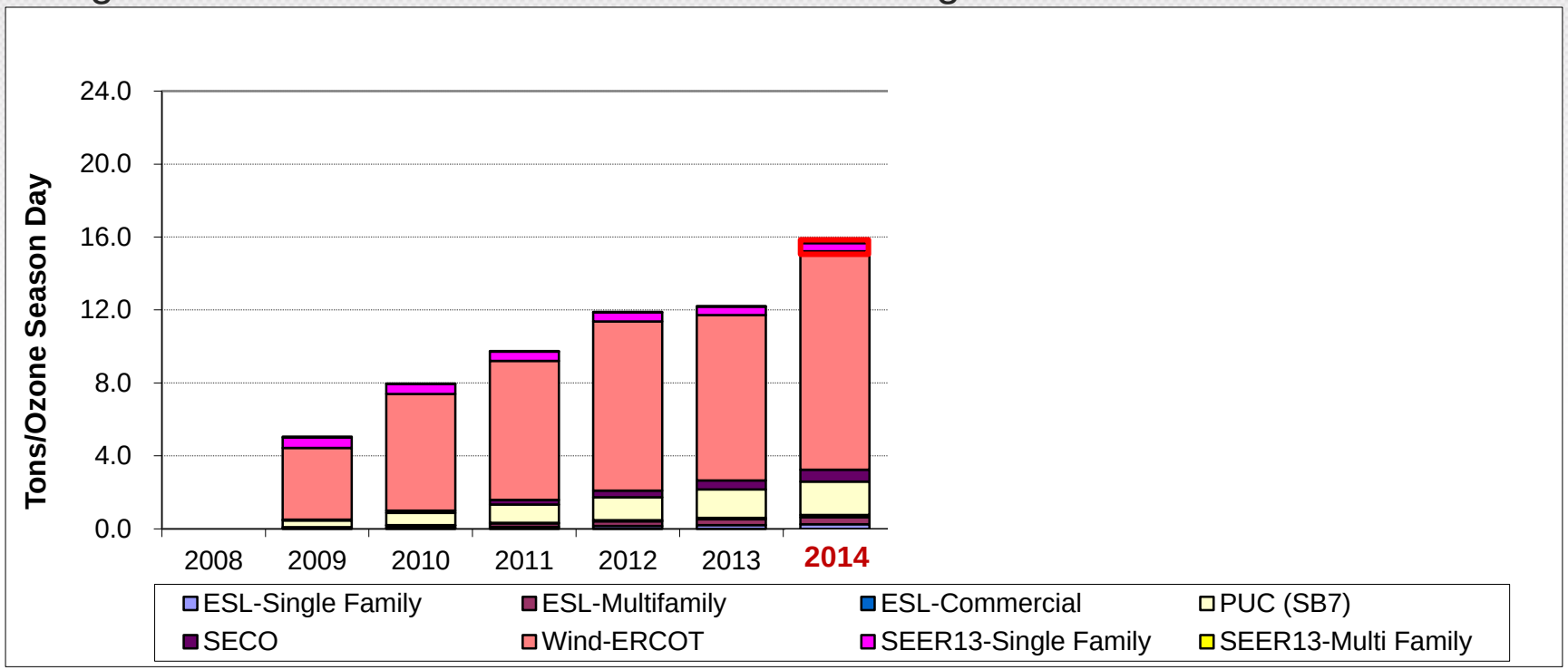

2014 integrated OSD NOx emissions reduction

- ESL Code Compliance (0.76 tons/day)
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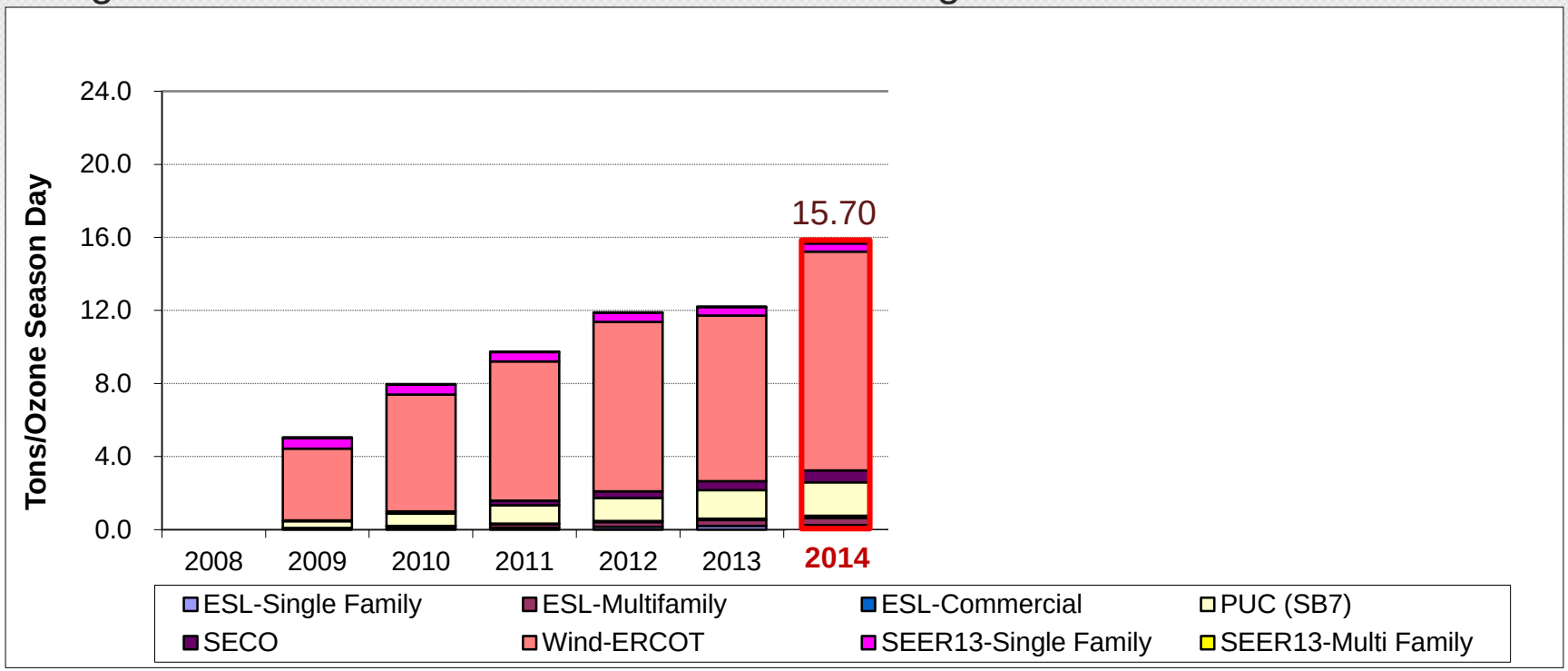
- SECO Political Sub. (0.66 tons/day)
- Green Power (Wind) (11.97 tons/day)
- Residential AC Retrofits (0.48 tons/day)

INTEGRATED NOx EMISSIONS REDUTION (2008 Baseyear)

2014 Integrated OSD NOx Emissions Reduction Using new 2010 eGrid



2014 integrated OSD NOx emissions reduction

- ESL Code Compliance (0.76 tons/day)
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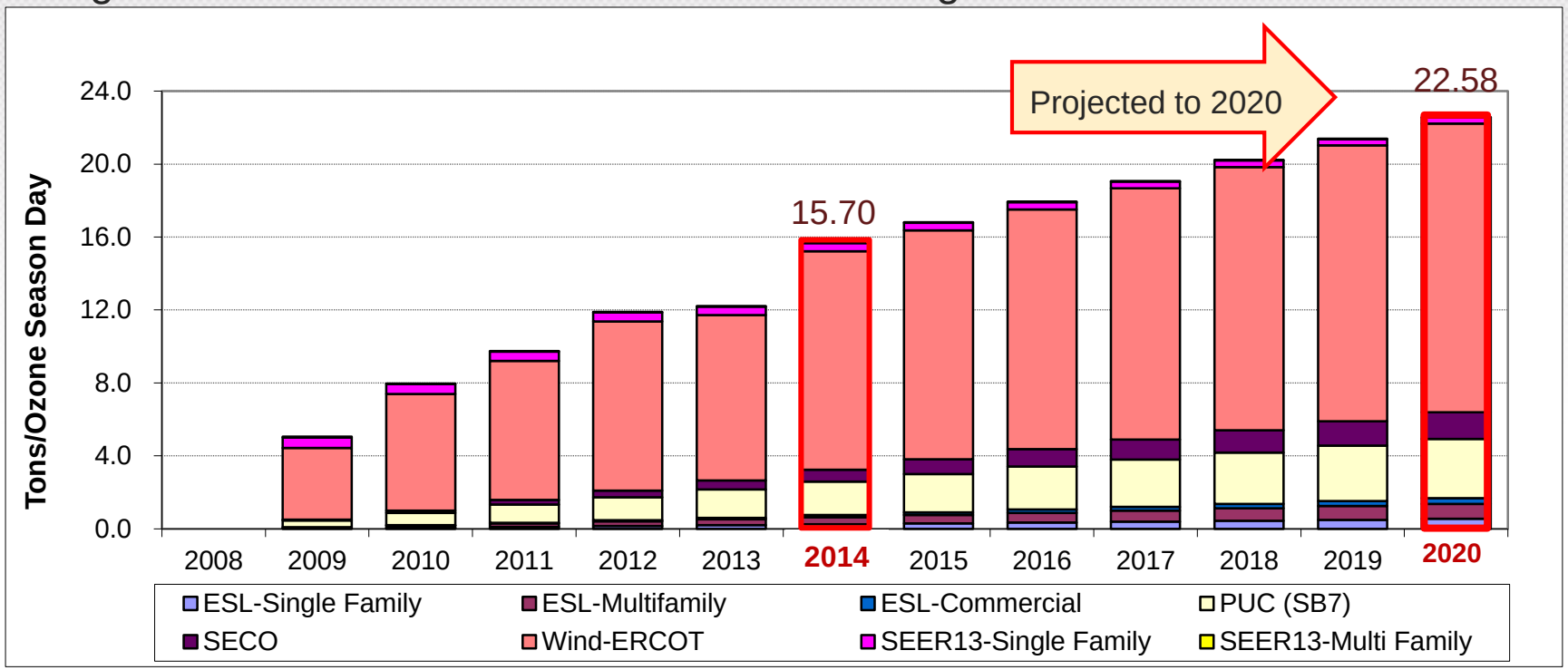
- SECO Political Sub. (0.66 tons/day)
- Green Power (Wind) (11.97 tons/day)
- Residential AC Retrofits (0.48 tons/day)

➢ **Total (2013) (15.70 tons/day)**

INTEGRATED NOx EMISSIONS REDUTION (2008 Baseyear)

2014 Integrated OSD NOx Emissions Reduction Using new 2010 eGrid



2014 integrated OSD NOx emissions reduction

- ESL Code Compliance (0.76 tons/day)
- PUC SB7 programs (1.83 tons/day)
- SECO Political Sub. (0.66 tons/day)
- Green Power (Wind) (11.97 tons/day)
- Residential AC Retrofits (0.48 tons/day)

➢ **Total (2013) (15.70 tons/day)**

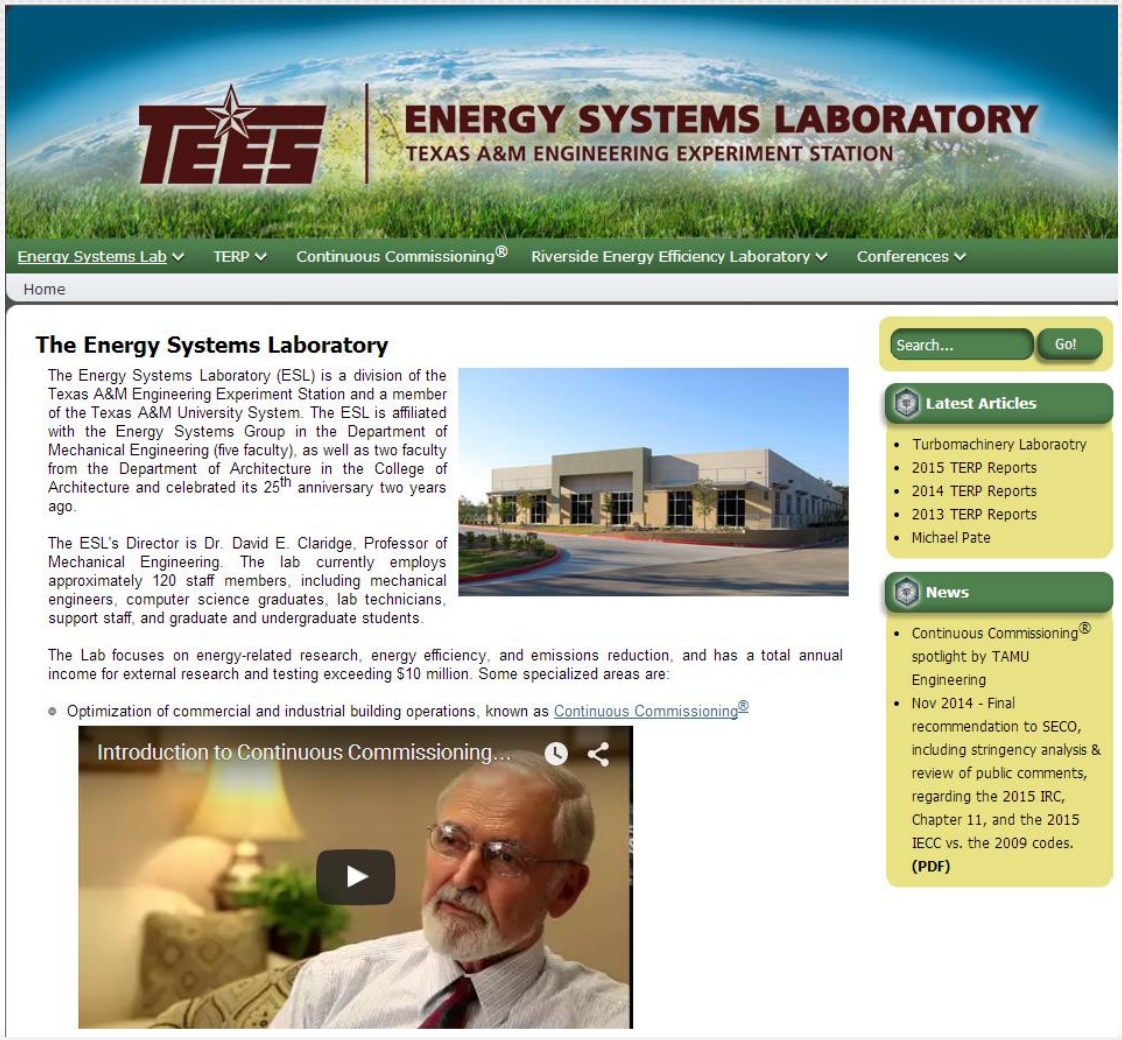
2020 integrated OSD NOx emissions reduction

- ESL Code Compliance (1.68 tons/day)
- PUC SB7 programs (3.24 tons/day)
- SECO Political Sub. (1.46 tons/day)
- Green Power (Wind) (15.84 tons/day)
- Residential AC Retrofits (0.35 tons/day)

➢ **Total (2020) (22.58 tons/day)**

REPORTS AND PAPERS: TERP

ESL Homepage: http://esl.eslwin.tamu.edu/



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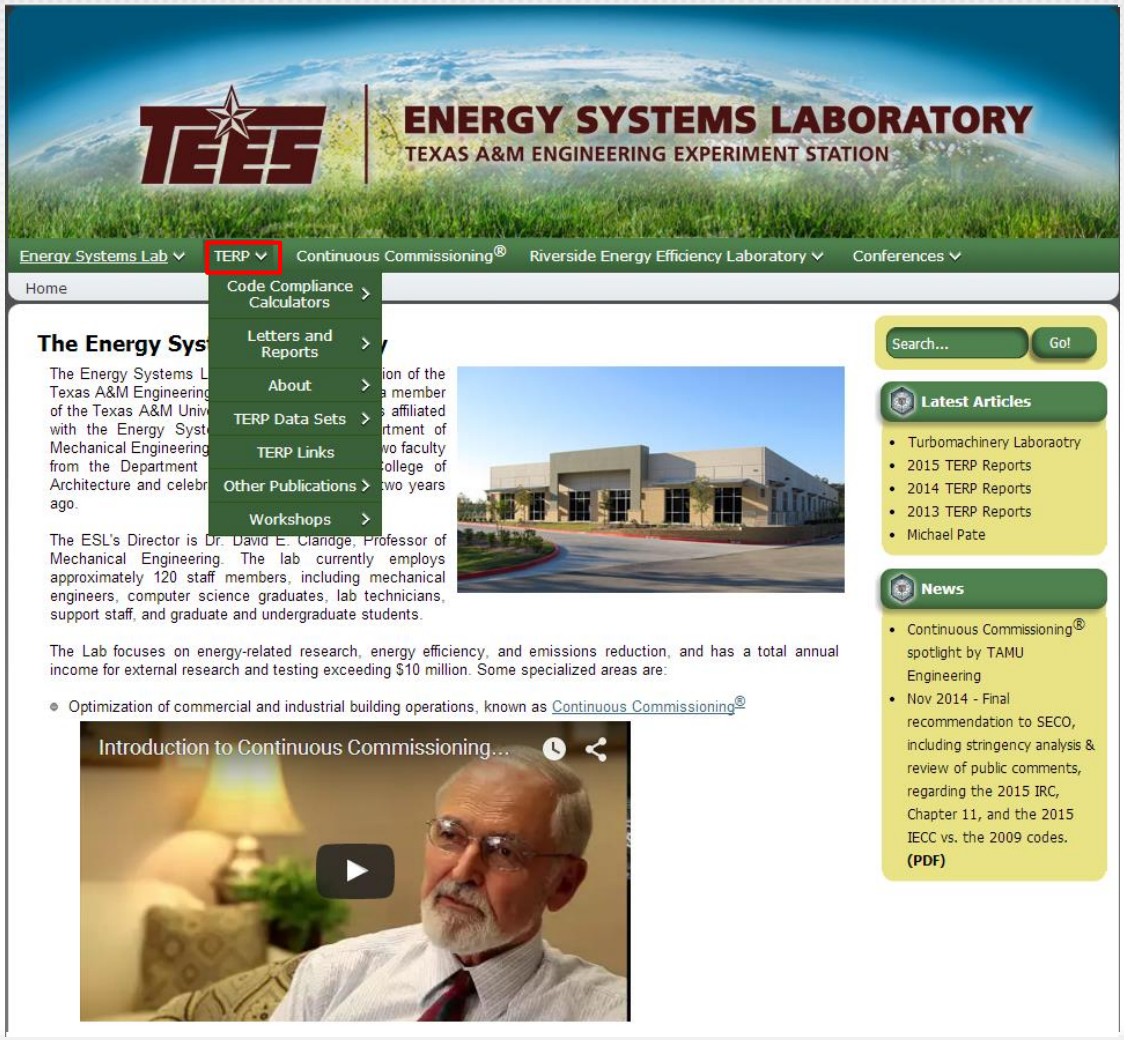
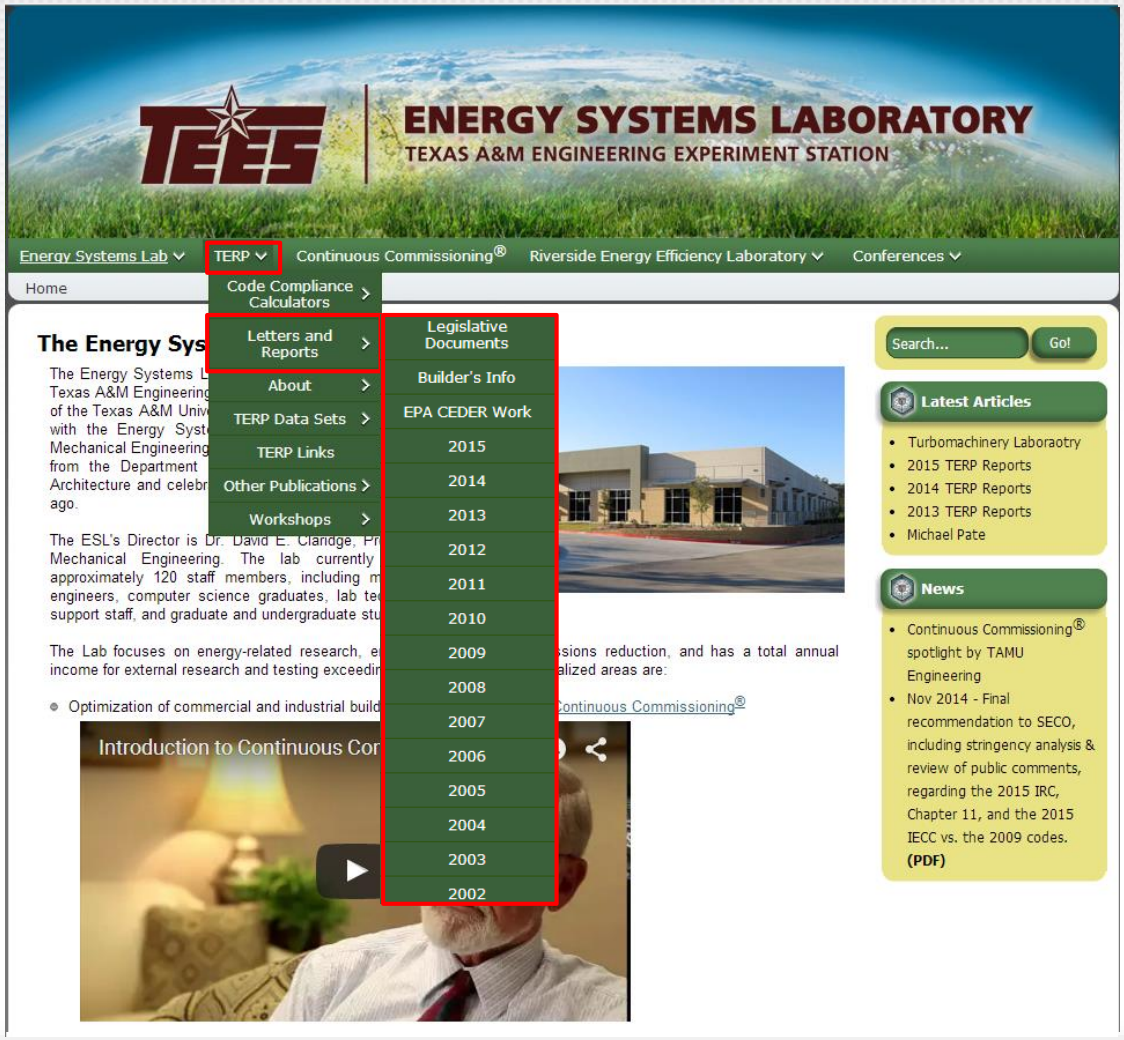


REPORTS AND PAPERS: TERP

Reports: 2002 through 2013



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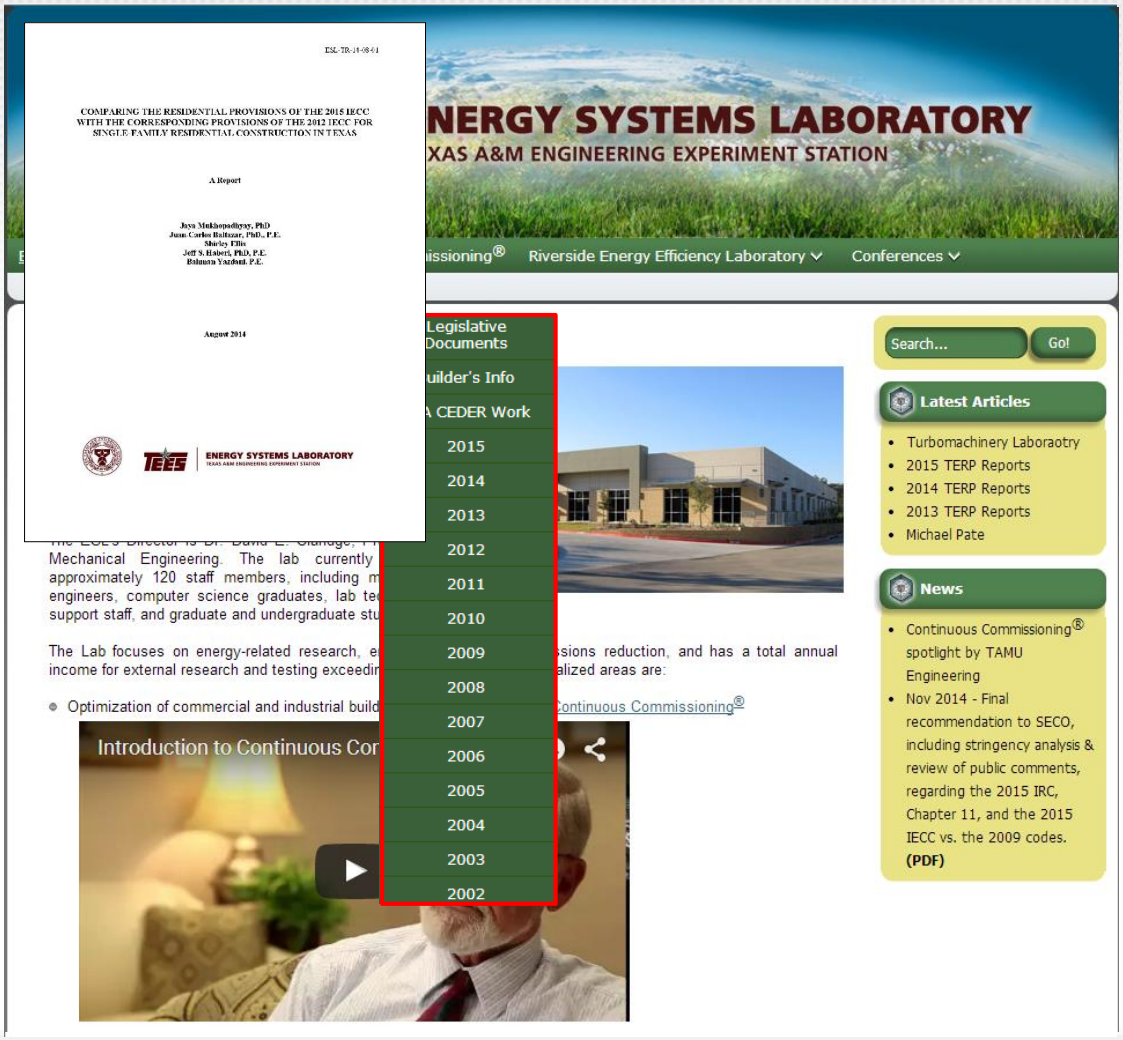

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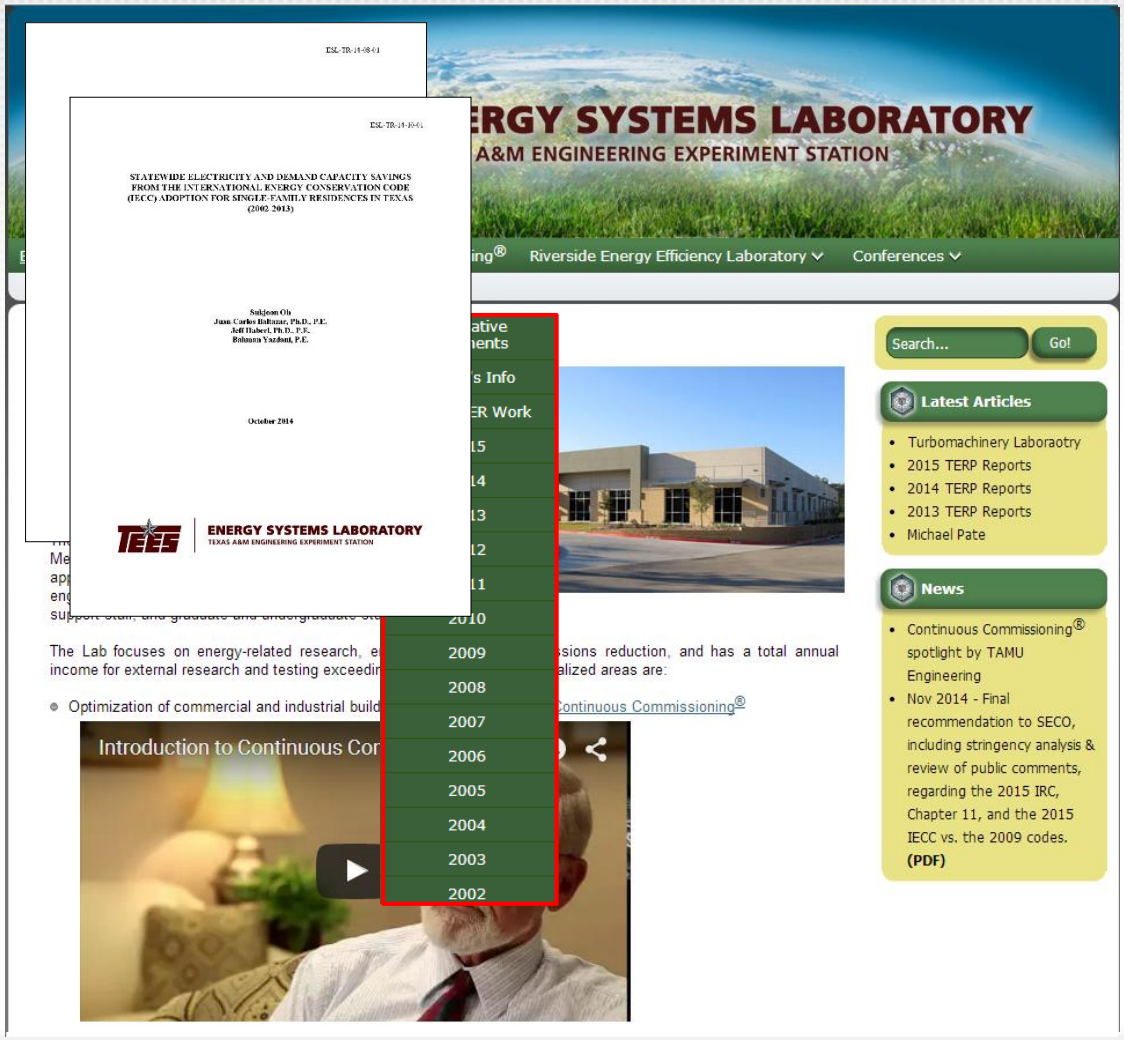

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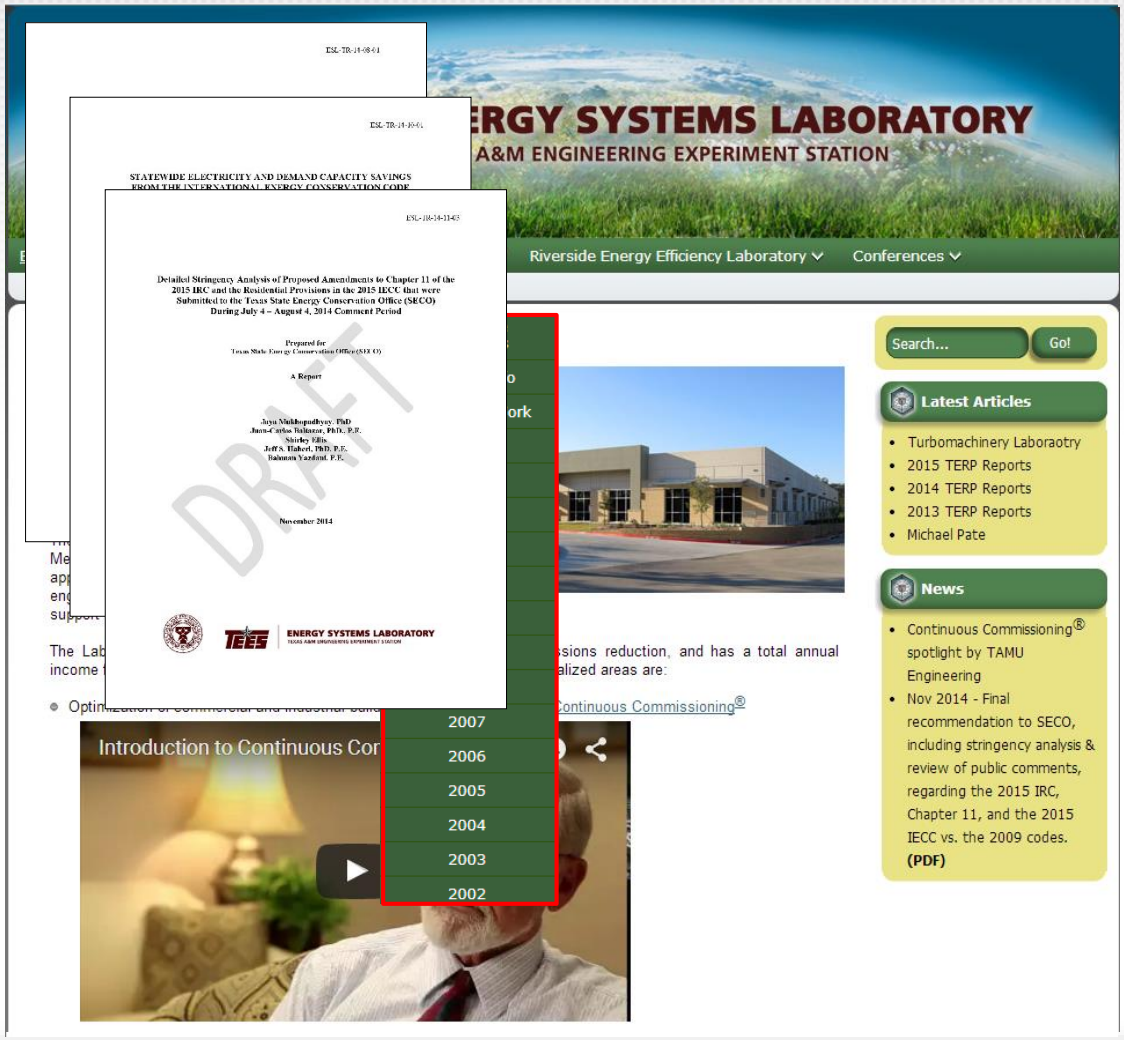

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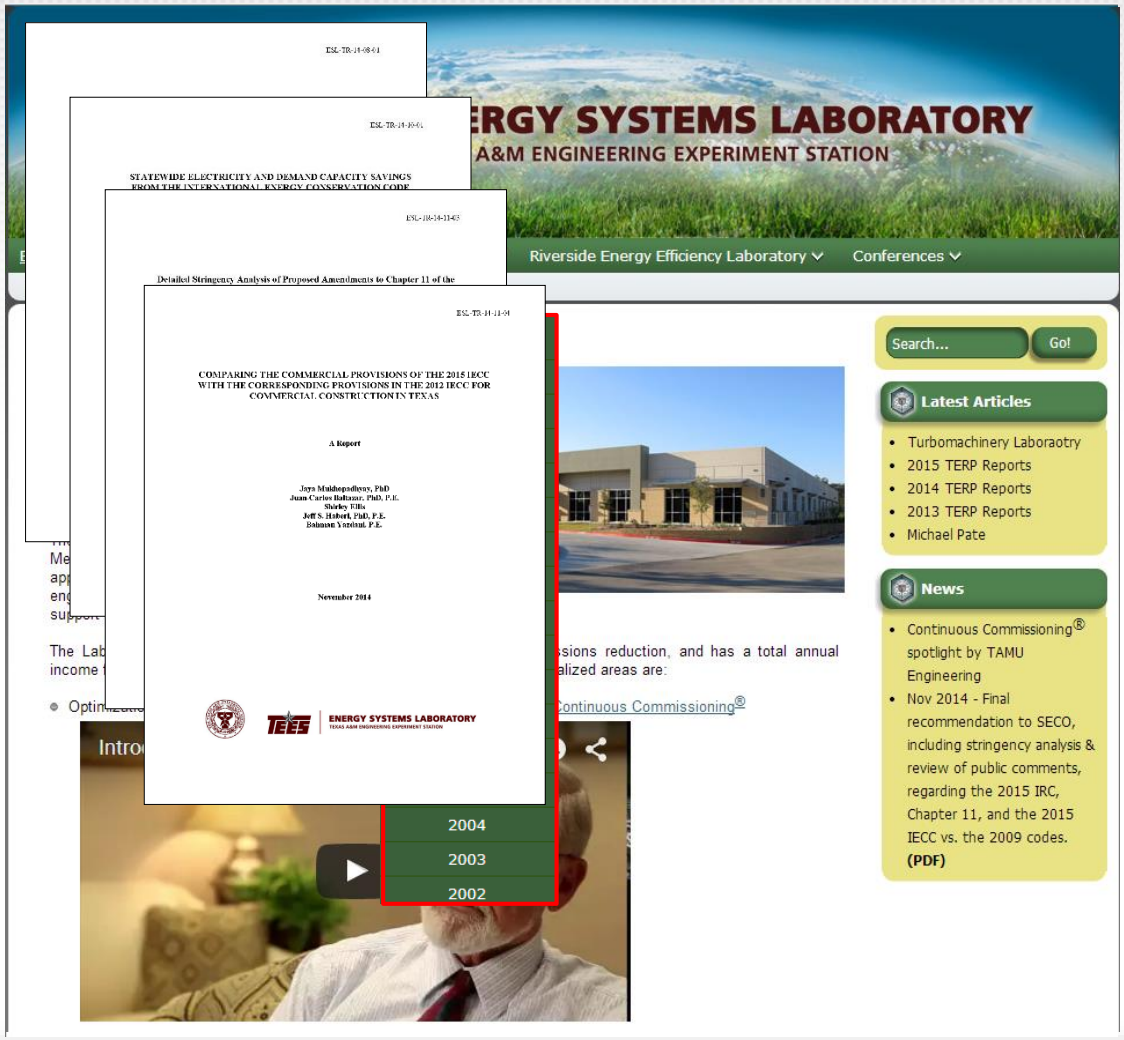

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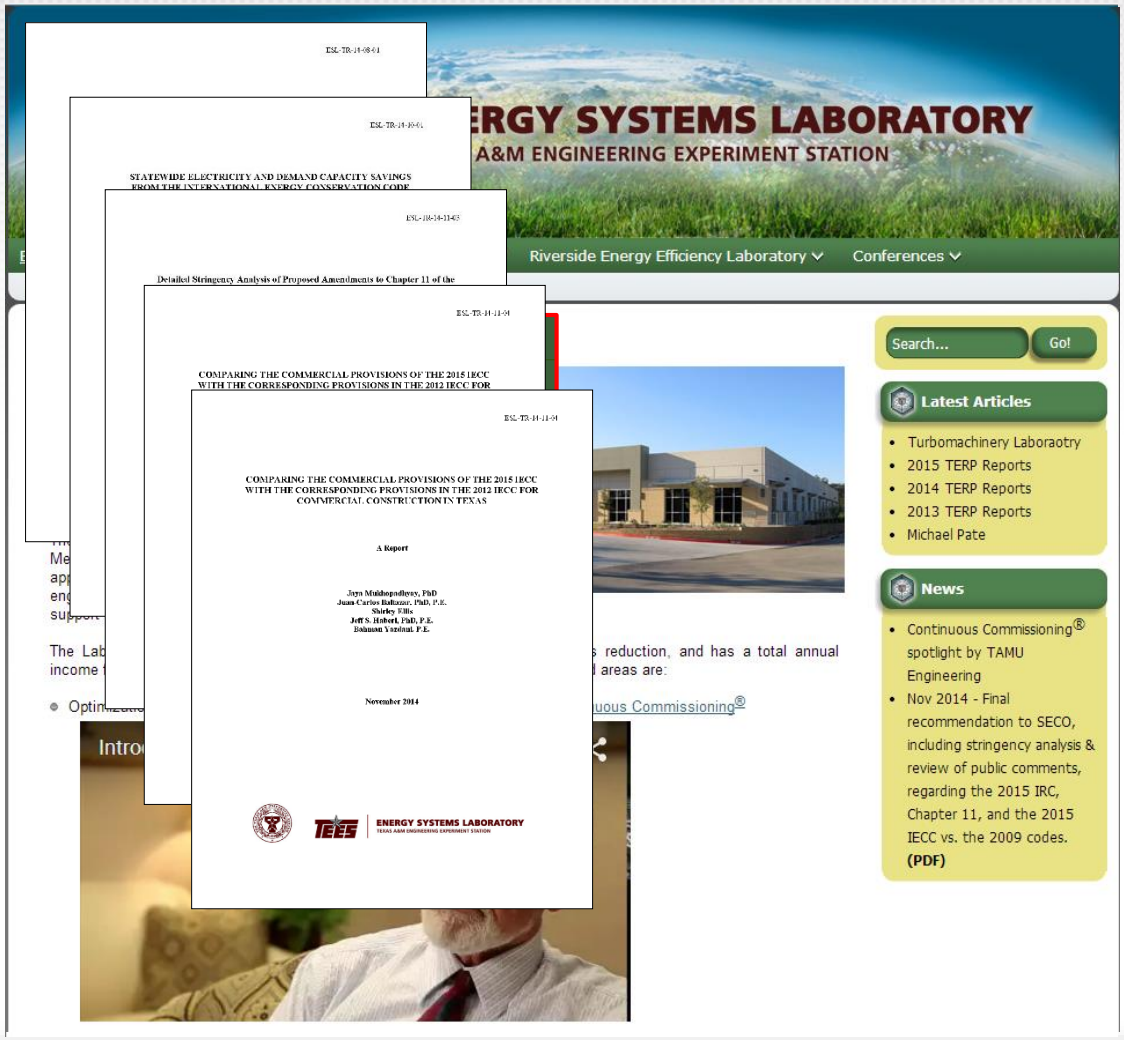

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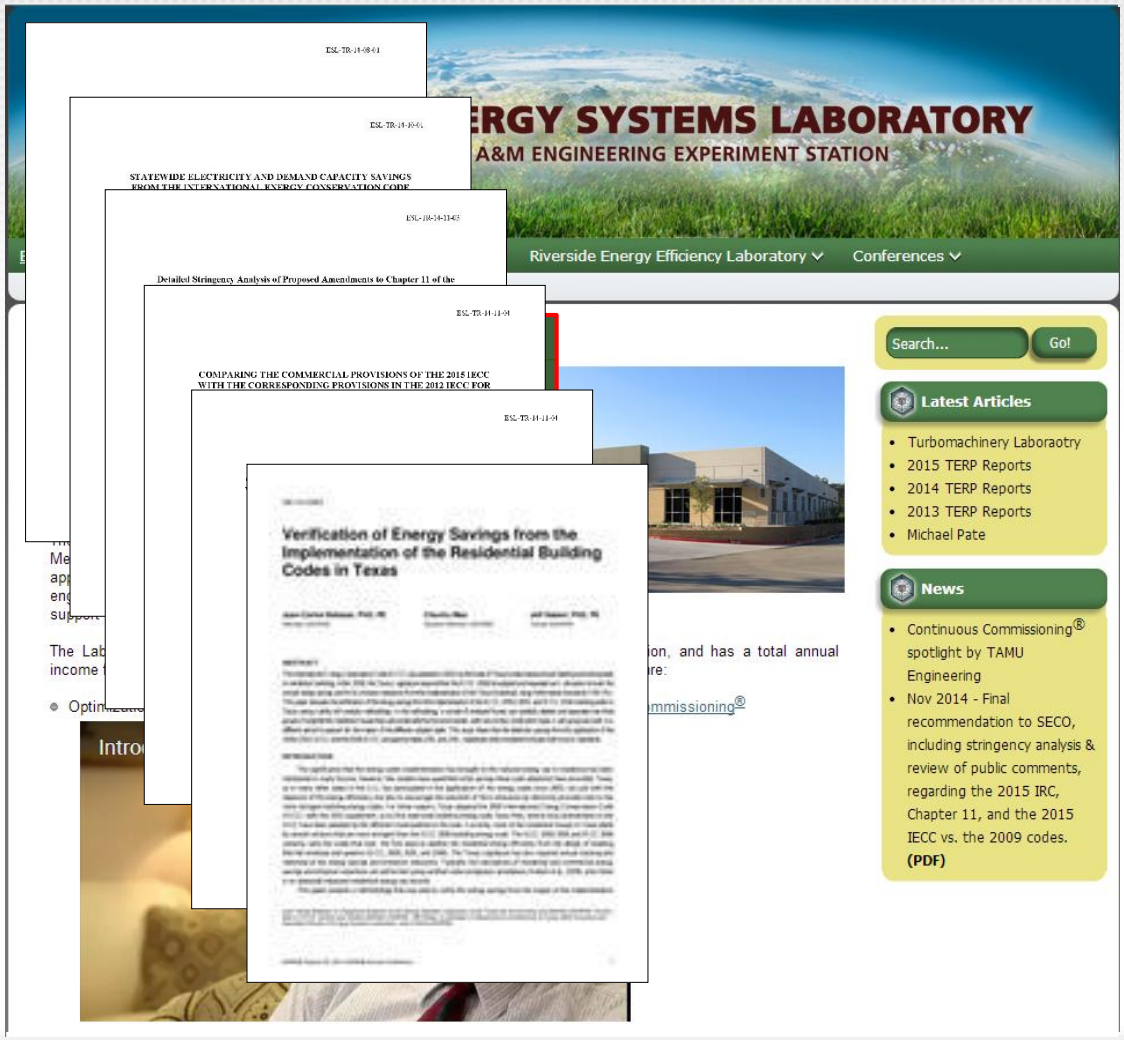

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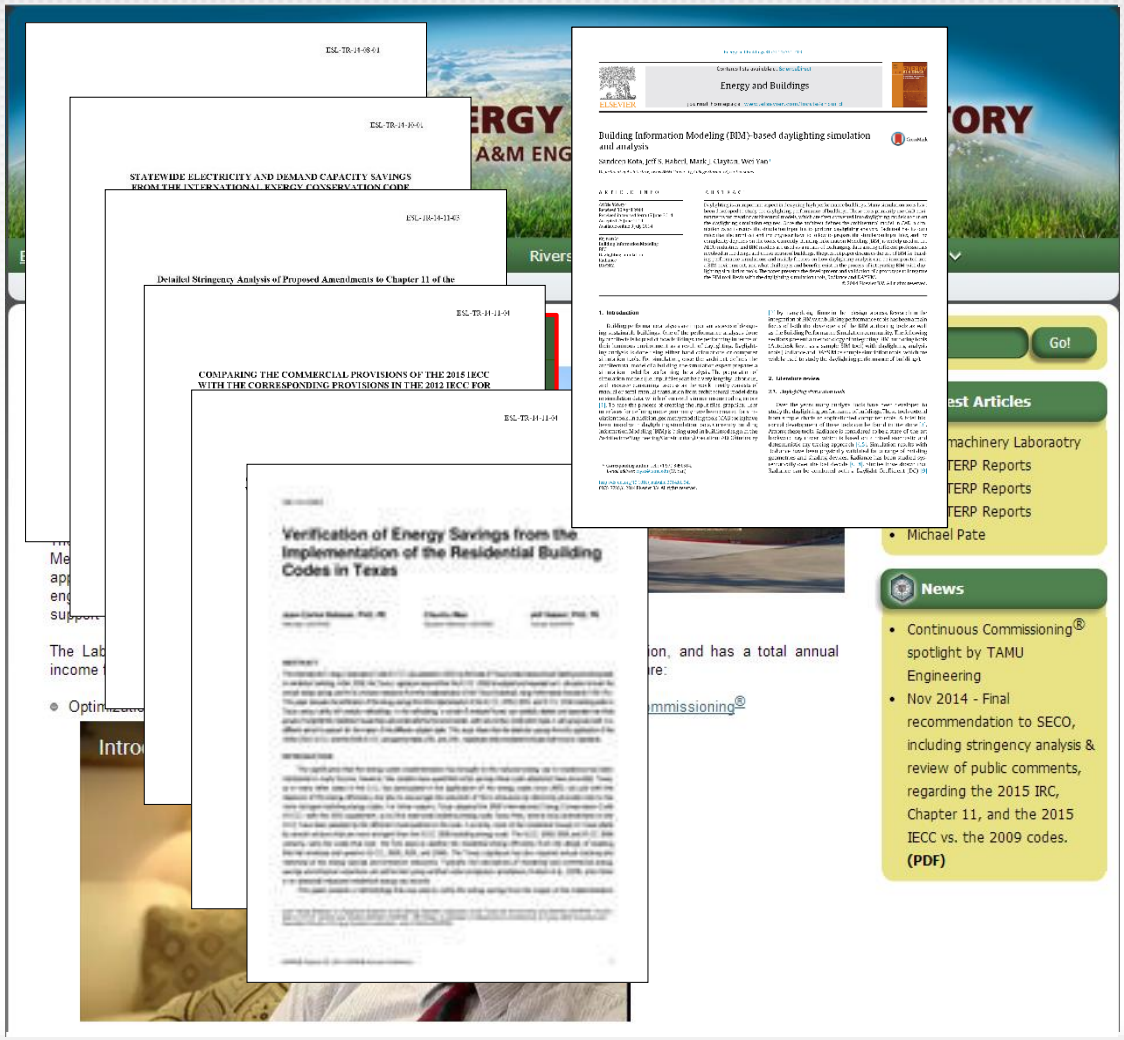

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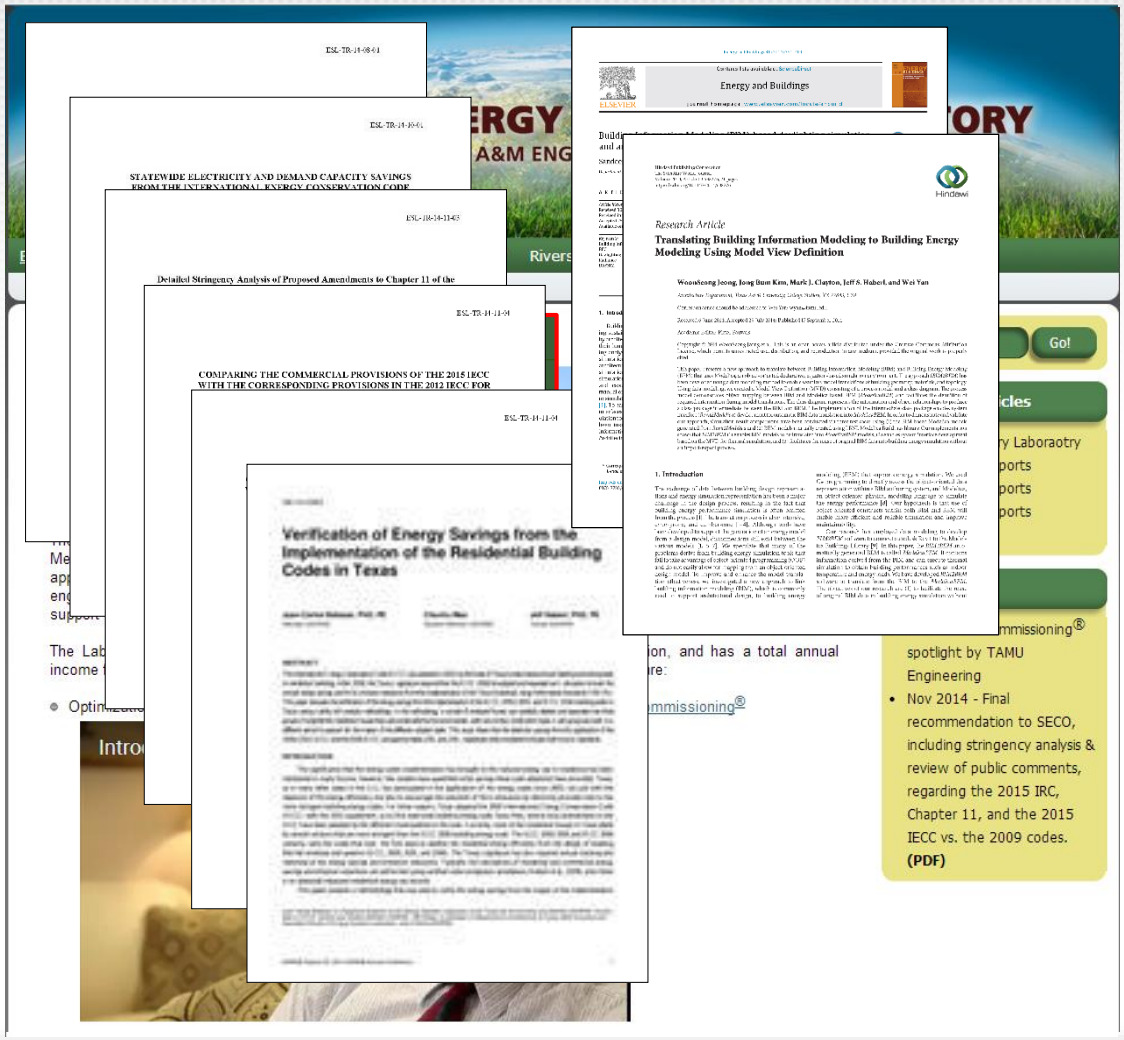

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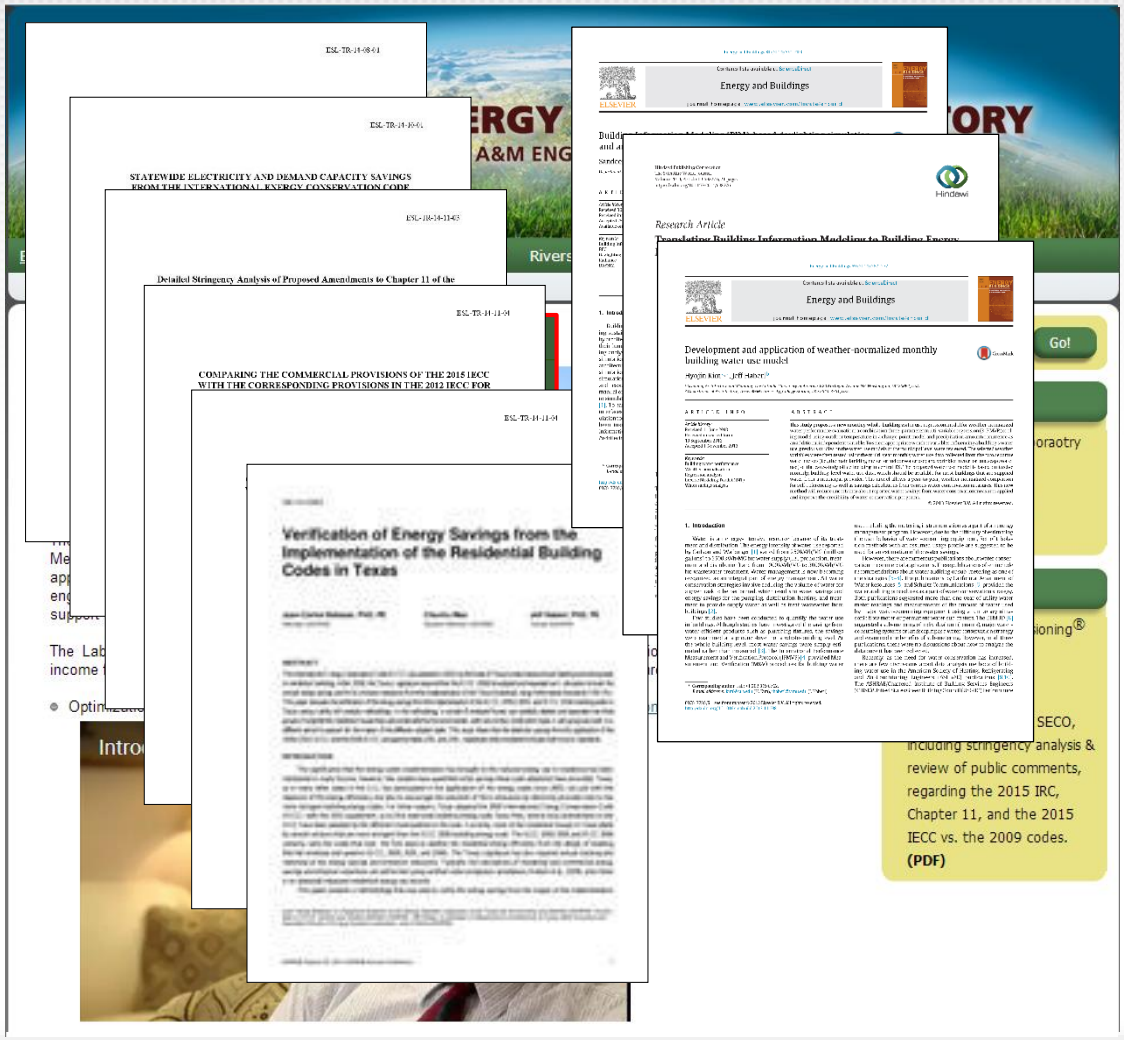

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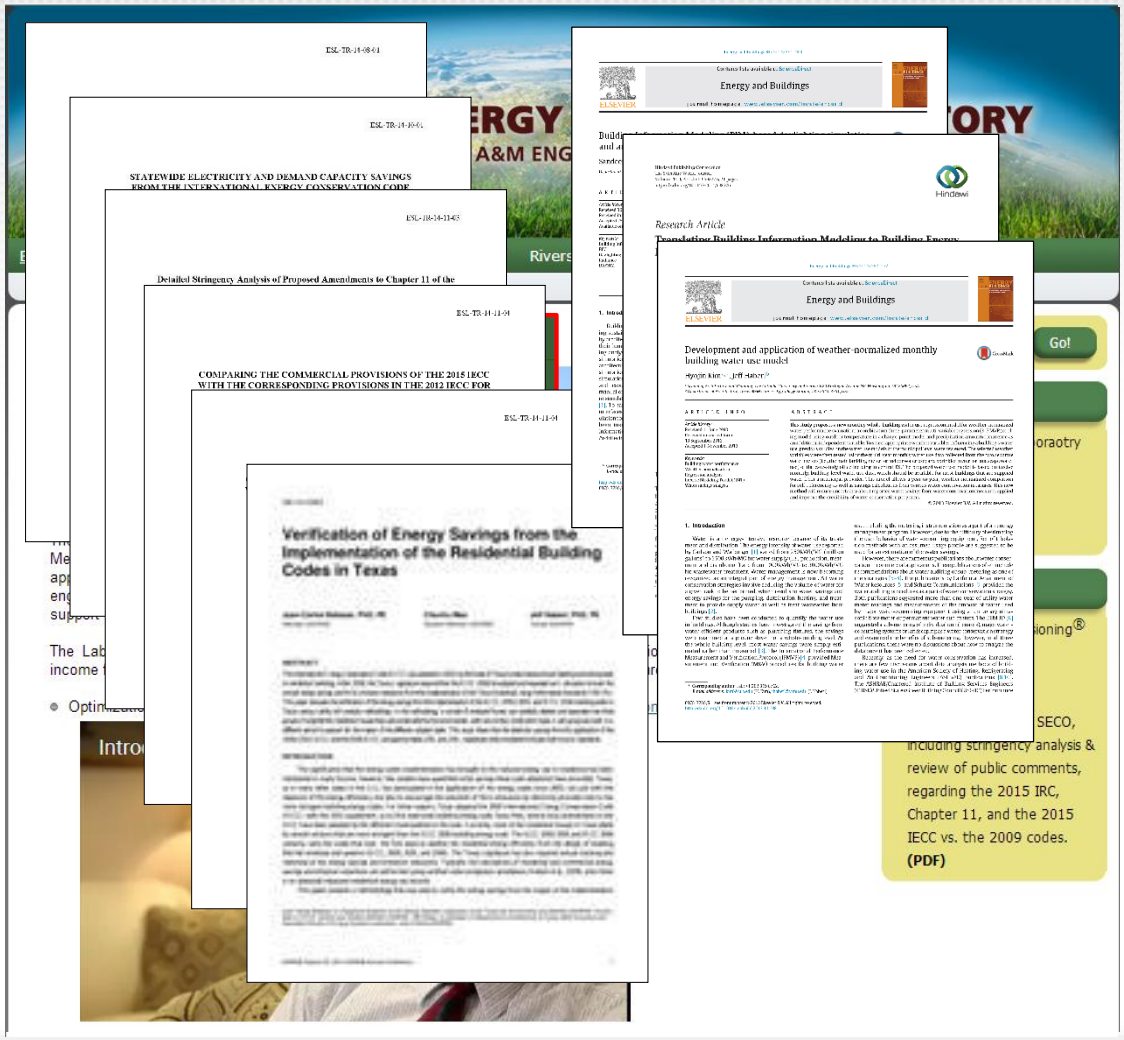

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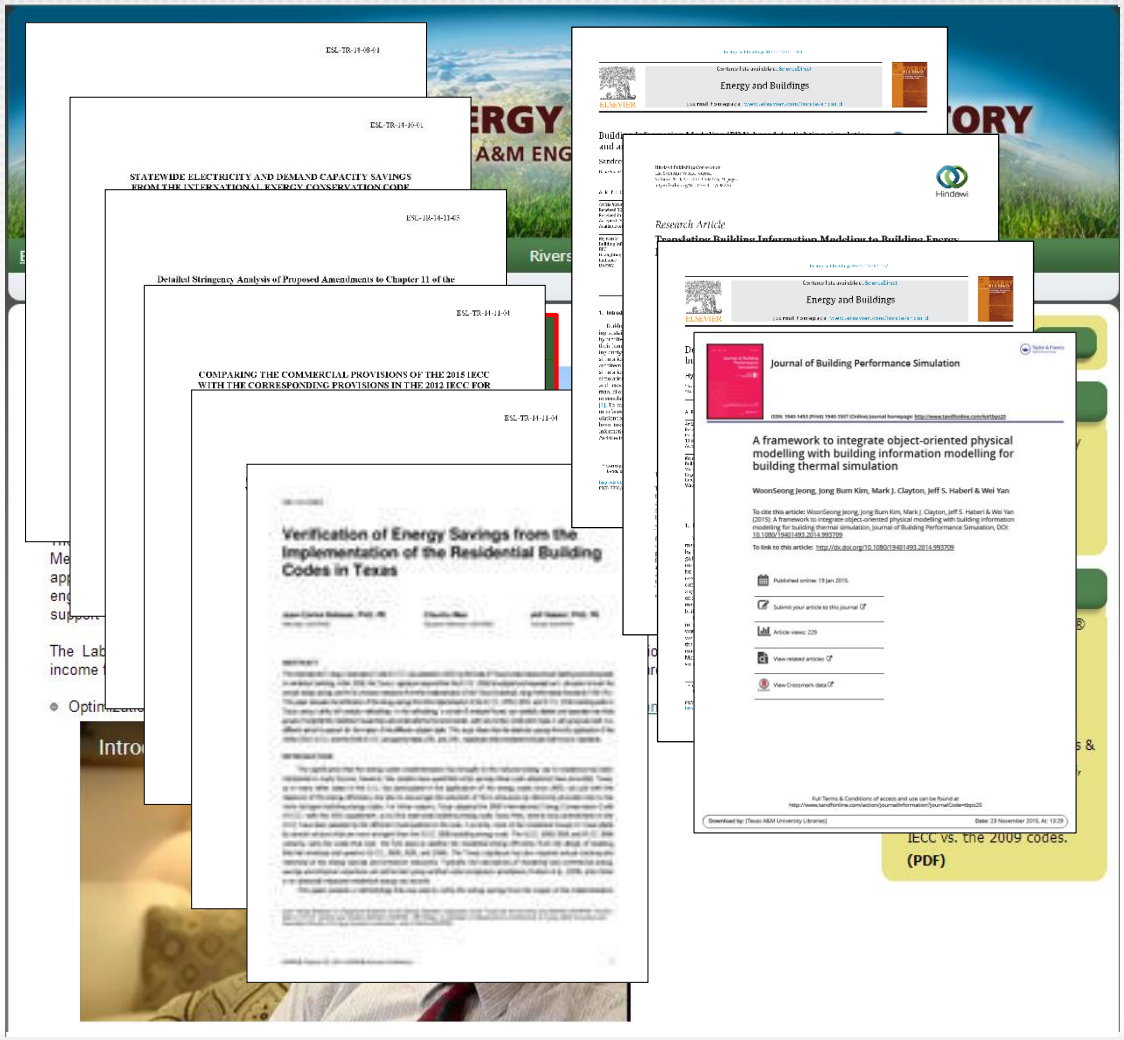

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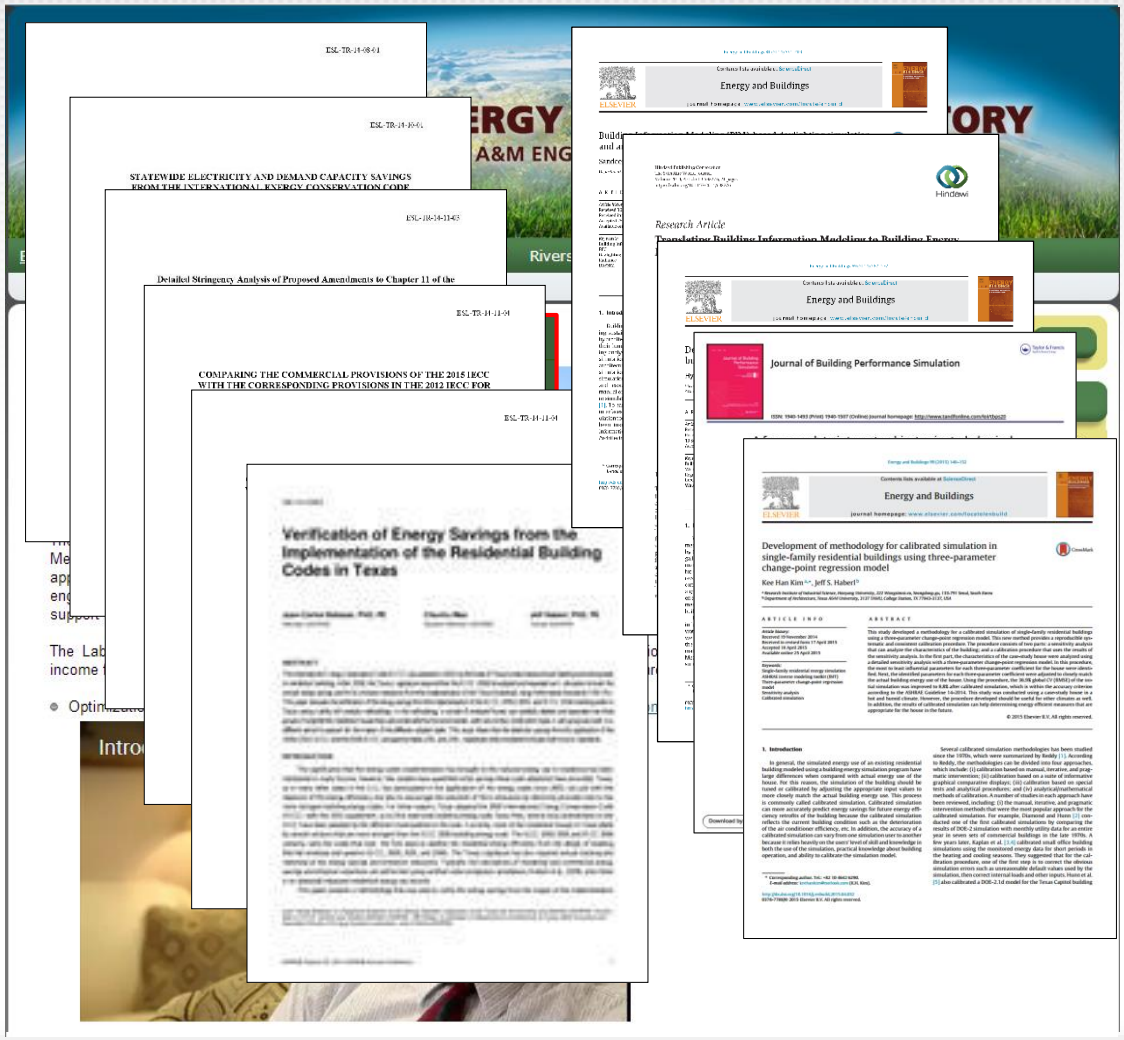

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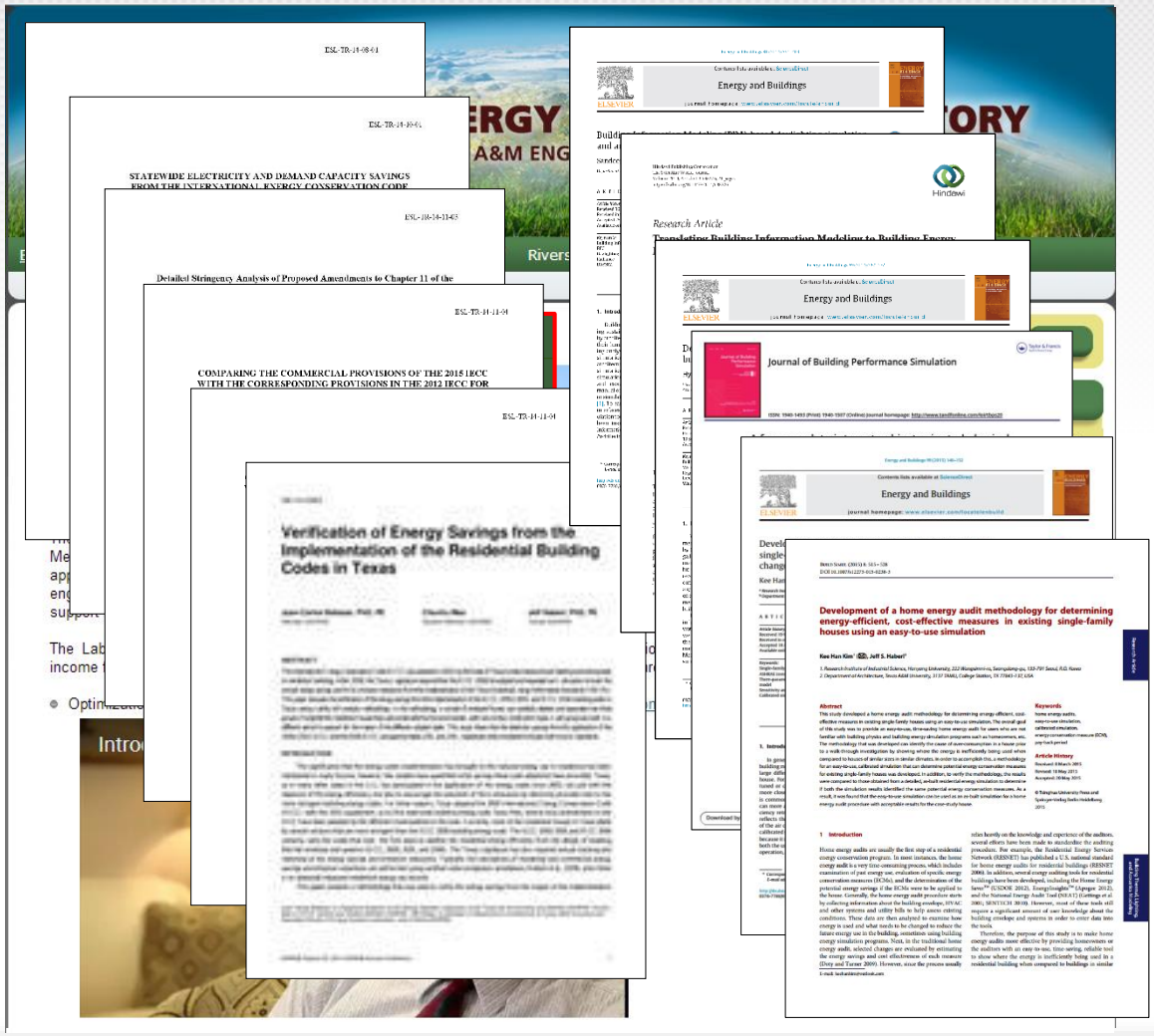

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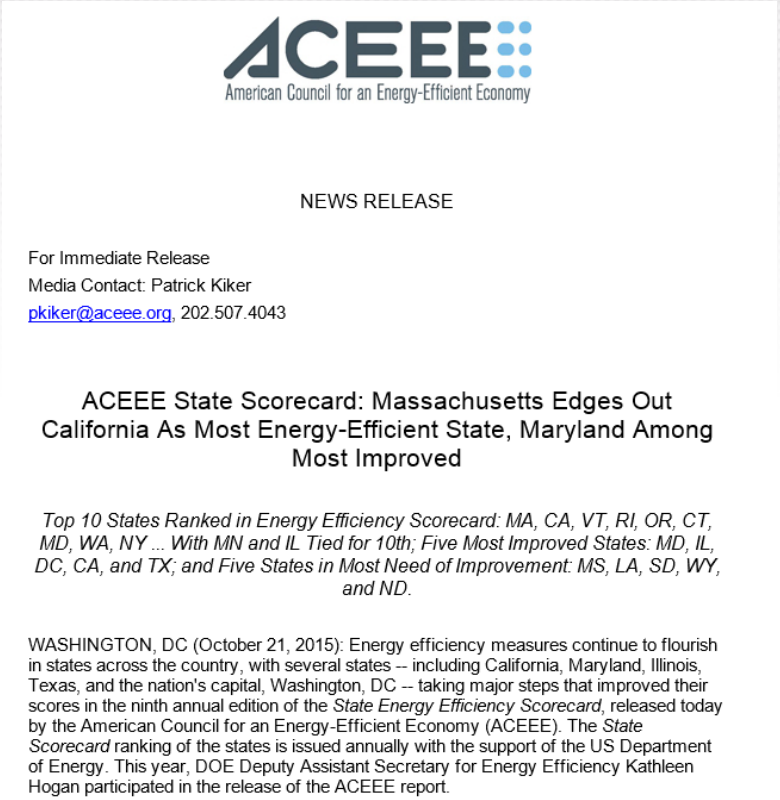
ACEEE: NATIONAL RECOGNITION FOR CODE CHANGES (2015)

A solid 20 states rose in the *State Scorecard* rankings. California, a leading state, is also one of the most improved states this year. Maryland, Illinois, the District of Columbia, and Texas also deserve recognition for improvement over the past year. Maryland increased its commitment to energy efficiency in 2015 by establishing new, more aggressive energy savings targets for utilities. Illinois is one of the first states to adopt the newest building energy codes, and has increased the amount of energy efficiency available to utilities through procurement agreements with the Illinois Power Agency. Like Illinois, Texas has been aggressive in adopting the latest building energy codes, and has also taken notable actions to ensure code compliance across the state. The District of Columbia is among the most improved for the second year in a row, due to its progress across a number of policy areas and the ramping up of DC Sustainable Energy Utility programs.



ACEEE
American Council for an Energy-Efficient Economy

NEWS RELEASE

For Immediate Release
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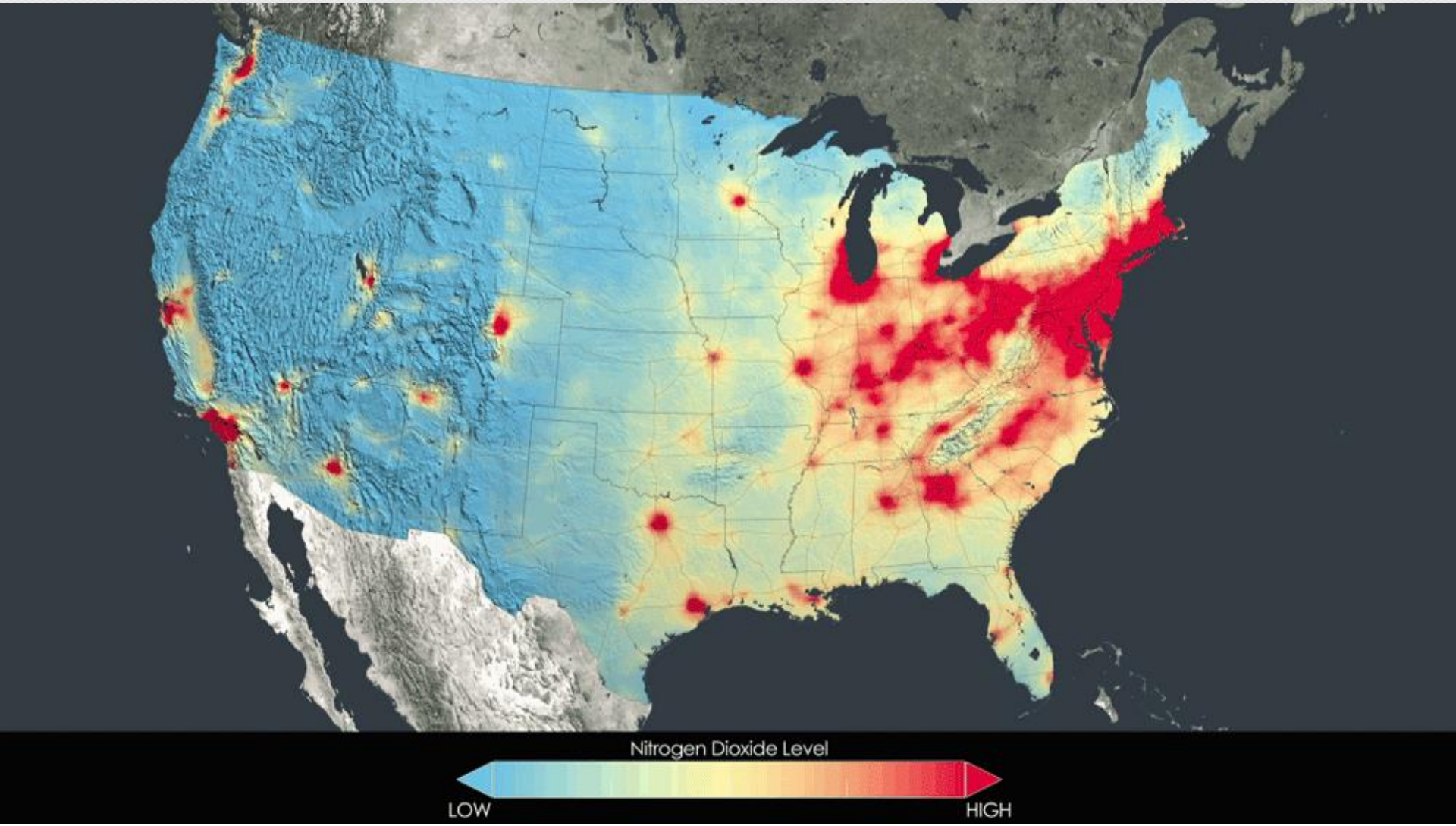
ACEEE State Scorecard: Massachusetts Edges Out California As Most Energy-Efficient State, Maryland Among Most Improved

Top 10 States Ranked in Energy Efficiency Scorecard: MA, CA, VT, RI, OR, CT, MD, WA, NY ... With MN and IL Tied for 10th; Five Most Improved States: MD, IL, DC, CA, and TX; and Five States in Most Need of Improvement: MS, LA, SD, WY, and ND.

WASHINGTON, DC (October 21, 2015): Energy efficiency measures continue to flourish in states across the country, with several states -- including California, Maryland, Illinois, Texas, and the nation's capital, Washington, DC -- taking major steps that improved their scores in the ninth annual edition of the *State Energy Efficiency Scorecard*, released today by the American Council for an Energy-Efficient Economy (ACEEE). The *State Scorecard* ranking of the states is issued annually with the support of the US Department of Energy. This year, DOE Deputy Assistant Secretary for Energy Efficiency Kathleen Hogan participated in the release of the ACEEE report.

Available online at http://aceee.org/state-policy/scorecard, the following are key findings of the 2015 *State Scorecard*:

U.S. AIR QUALITY IMPROVEMENT FROM 2005 - 2011



Source from NASA: http://www.nasa.gov/content/goddard/new-nasa-images-highlight-us-air-quality-improvement/#.U_-CNxzKbxQ

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