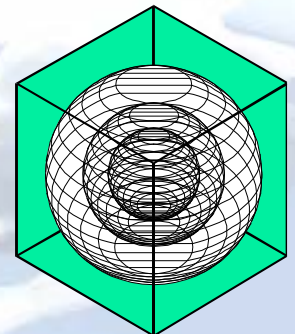


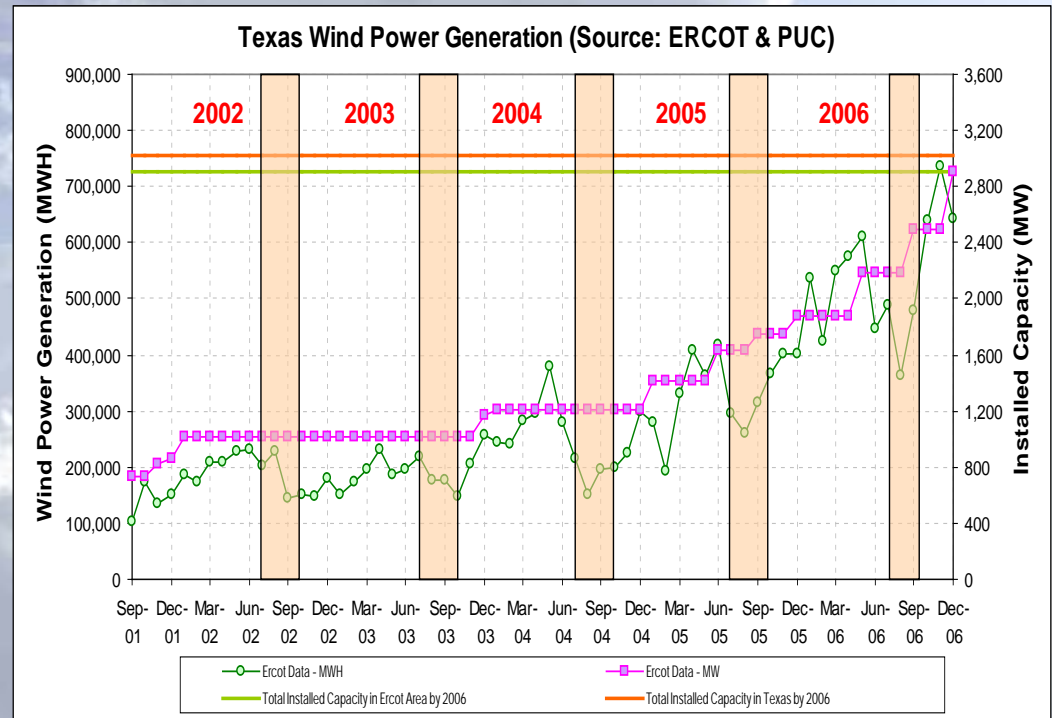
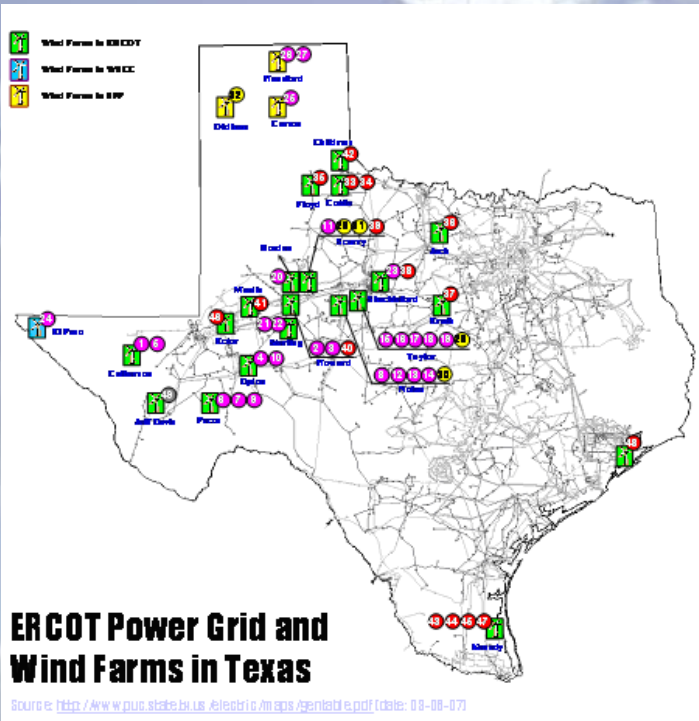
# **STATEWIDE AIR EMISSIONS CALCULATIONS FROM ENERGY EFFICIENCY, WIND AND RENEWABLES**

**May 2008**

**Jeff Haberl, Bahman Yazdani, Charles Culp  
Energy Systems Laboratory  
Texas Engineering Experiment Station  
Texas A&M University System**



# Electricity Production from Wind Farms (2002-2007)

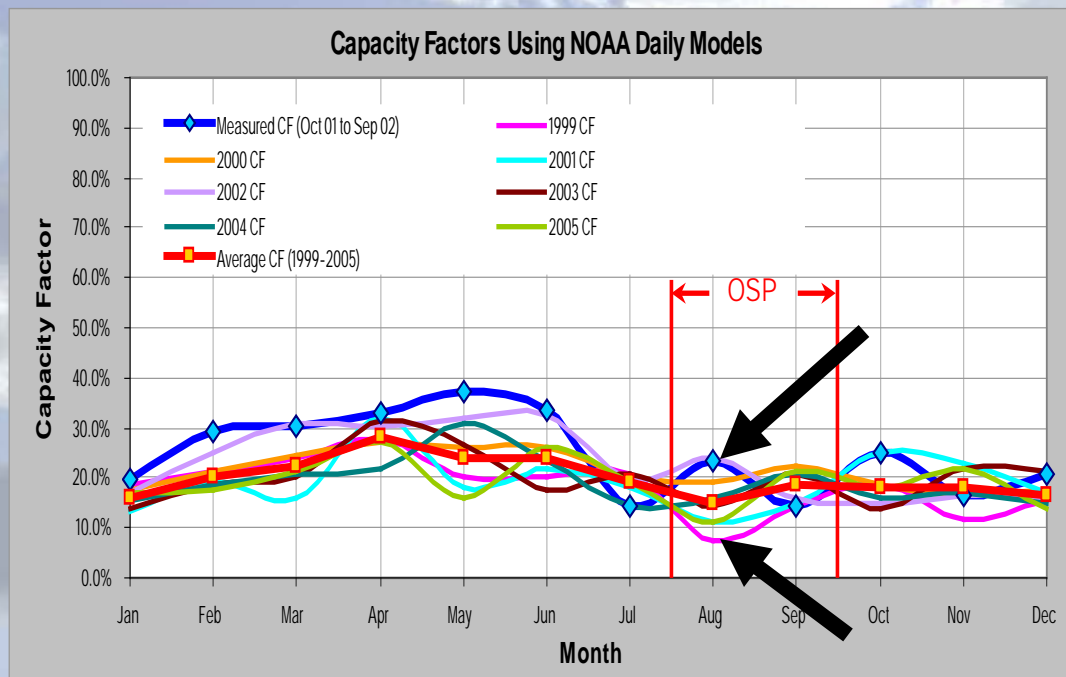


- *Installed capacity of wind turbines was 3,026 MW (March 2007).*
- *Announced new project capacity is 3,125 MW by 2010.*
- *Lowest electricity period occurs during Ozone Season Period.*



# Calculating NOx Reductions from Wind Farms

What issues did TCEQ ask ESL to resolve to calculate OSP NOx reductions from wind farms in the base year?

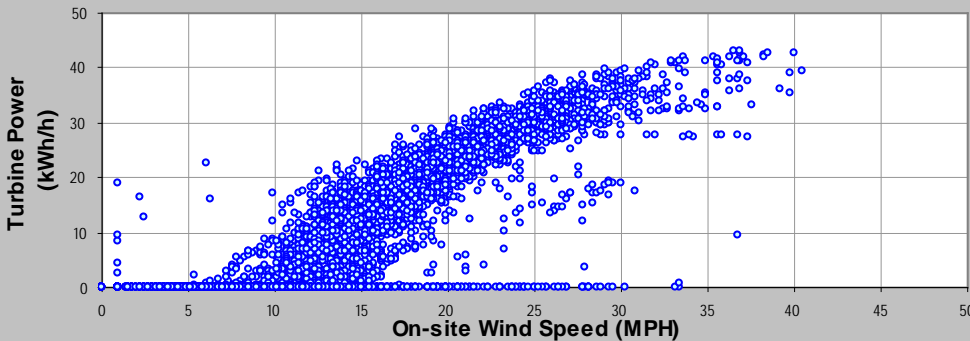


*Large variations in measured power vs base year power production in the OSP.*



# Calculating NOx Reductions from Wind Farms

Hourly Turbine Power vs. Wind Speed (On-site)



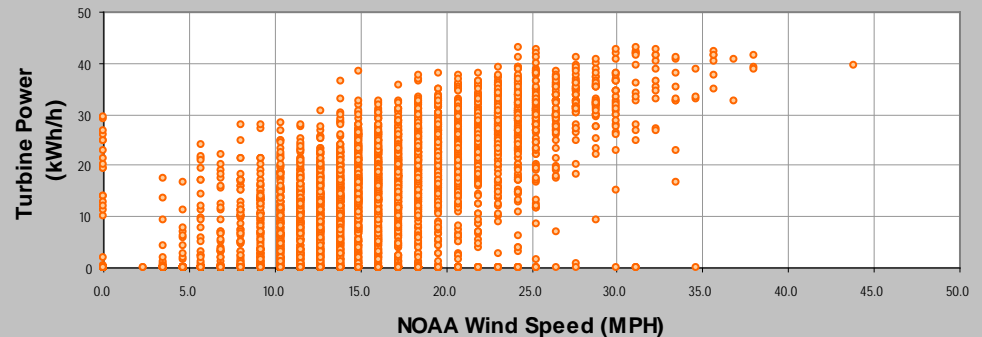
*Hourly electricity produced vs on-site wind data acceptable for hourly modeling.*

*Issue: hourly on-site data not always available.*

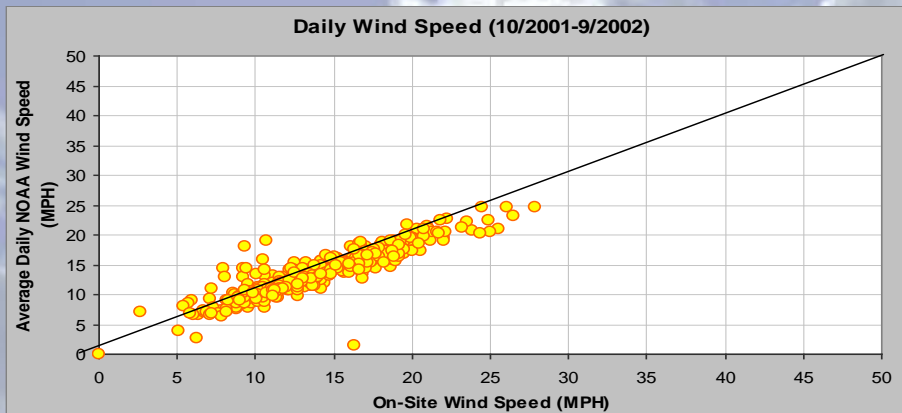
*Next, looked at hourly electricity produced vs NOAA wind data.*

*Issue: too much scatter.*

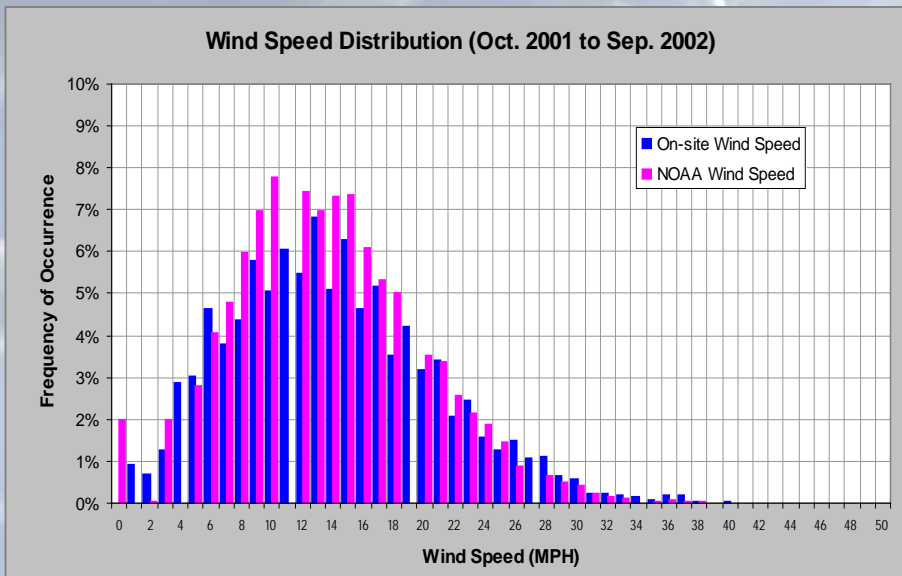
Hourly Turbine Power vs. Wind Speed (NOAA)



# Calculating NOx Reductions from Wind Farms



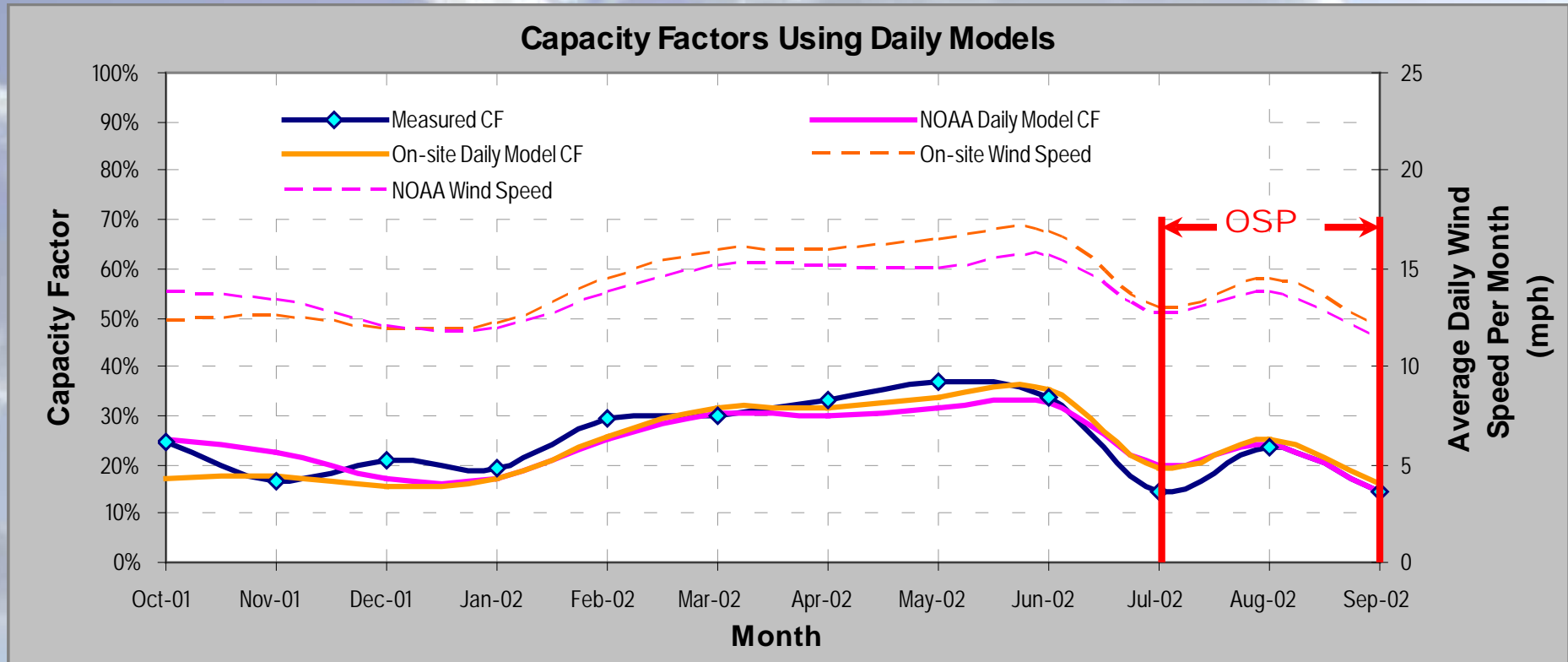
*Next, compared daily on-site wind data vs daily NOAA data*



*Result: Daily data was acceptable when frequency of occurrence was similar.*



# Calculating NOx Reductions from Wind Farms

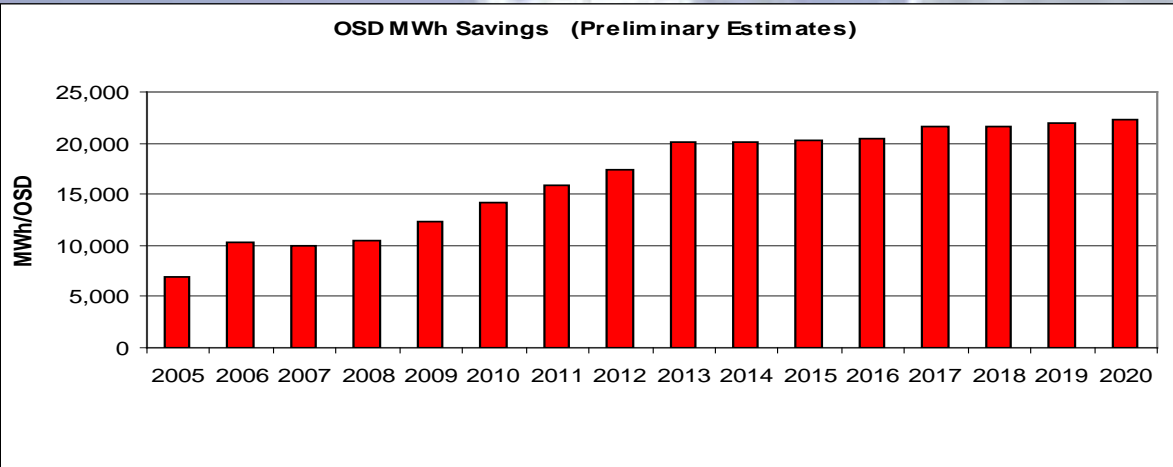


*Next, compared NOAA and on-site daily models to see how well the predicted OSP electricity production. (Result: acceptable).*



# Calculating NOx Reductions from Wind Farms

OSD MWh Savings (Preliminary Estimates)



Energy savings summary: (program wise)

Base year **1999**  
 Projection year **2020**

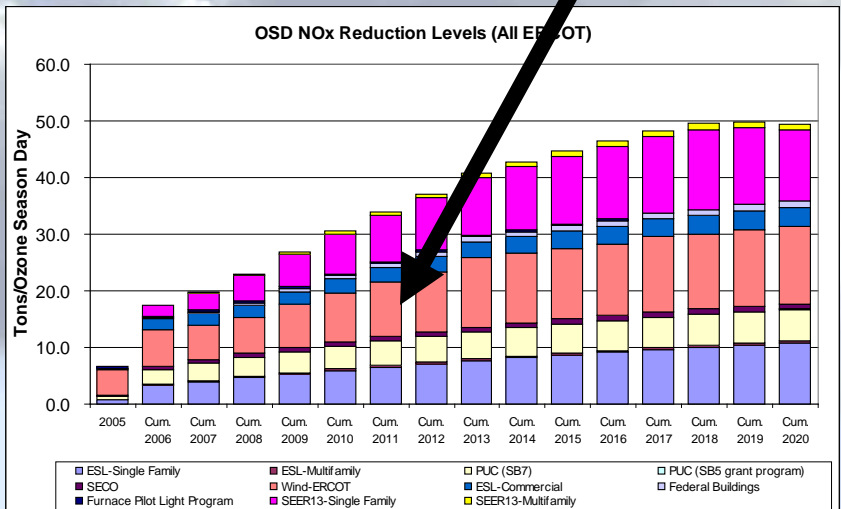
Adjustment factors

Annual degradation factor <sup>5</sup>	5.00%
T&D loss	0.00%
Initial discount factor <sup>6</sup>	25.00%
Growth factor	According to SB 20, section 39.904



Final Issue: TCEQ asked ESL to develop an integrated tool to project NOx reductions from wind farms through 2020 by county, using eGRID, including:

- + discount,
- + degradation,
- + T&D losses &
- + growth.

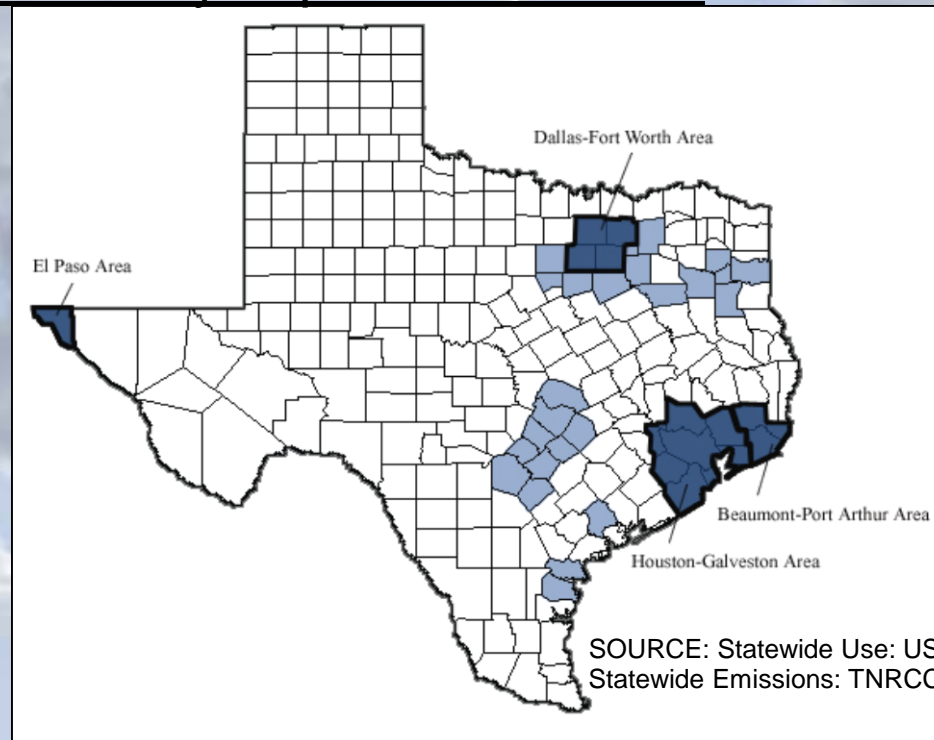


# Introduction

## Energy Emissions and Impact Factor

	<u>Use</u>	<u>NOx</u>	<u>Upgrade Avg.Life</u>	<u>Impact Factor</u>
Industries:	60%	23%	5 – 20 yr	1 – 5
Vehicles:	19%	54%	7 – 10 yr	4 – 5
<b>Buildings:</b>	<b>21%</b>	<b>22%</b>	<b>25 – 50 yr</b>	<b>5 – 11</b>

Buildings substantially impact emissions!



SOURCE: Statewide Use: USDOE/EIA, 1999  
 Statewide Emissions: TNRCC 2000

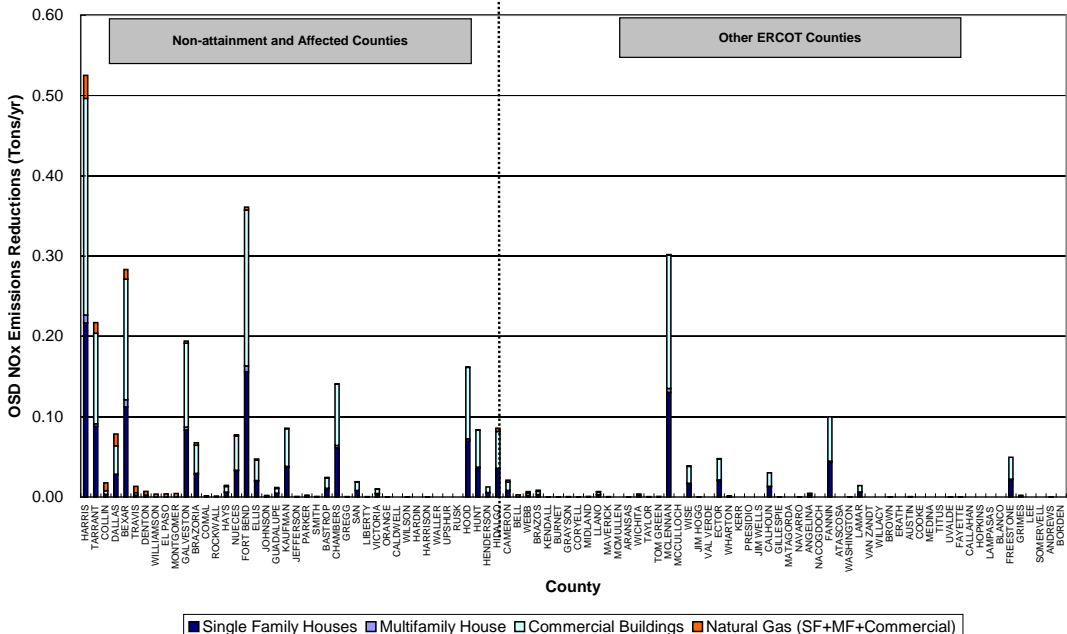




# Energy Efficiency Reporting

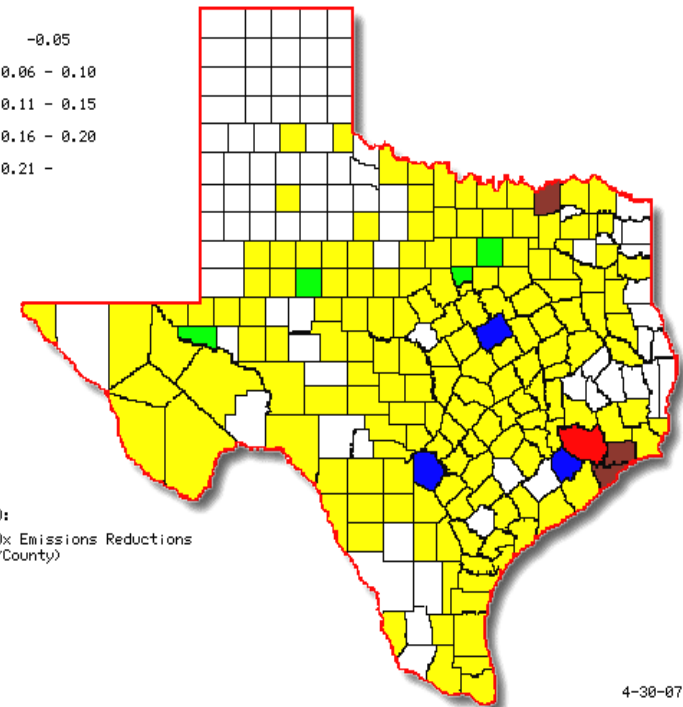
*NOx emissions reductions calculated from new residential and commercial construction using EPA's eGRID and AP-42 (Result: 10.75 tons/OSD).*

**Total OSD NOx Emissions Reductions (SF, MF and Commercial Buildings)**



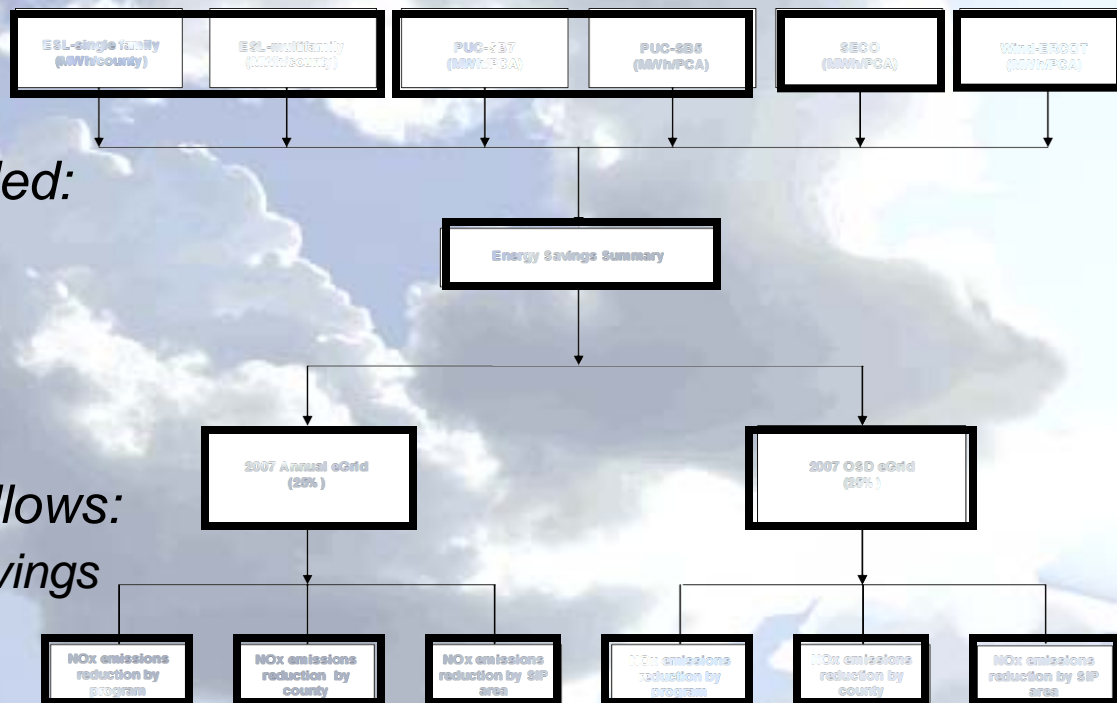
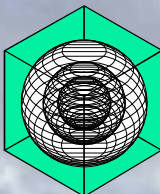
- Yellow - -0.05
- Brown - -0.06 - 0.10
- Green - -0.11 - 0.15
- Blue - -0.16 - 0.20
- Red - -0.21 -

**LEGEND:**  
JSD NOx Emissions Reductions (Tons/County)



# Integrated NOx Savings

In 2005 the TCEQ initiated a program to determine integrated NOx emissions savings (2013 and beyond) to allow for savings to be reported to the EPA



## State Agencies included:

- TEES/ESL,
- PUC,
- SECO,
- ERCOT/Wind

## Savings Integration allows:

- Annual, OSD savings
- By County
- By SIP
- By Program
- Integration tool = Adjustable Discount, Degradation, T&D losses

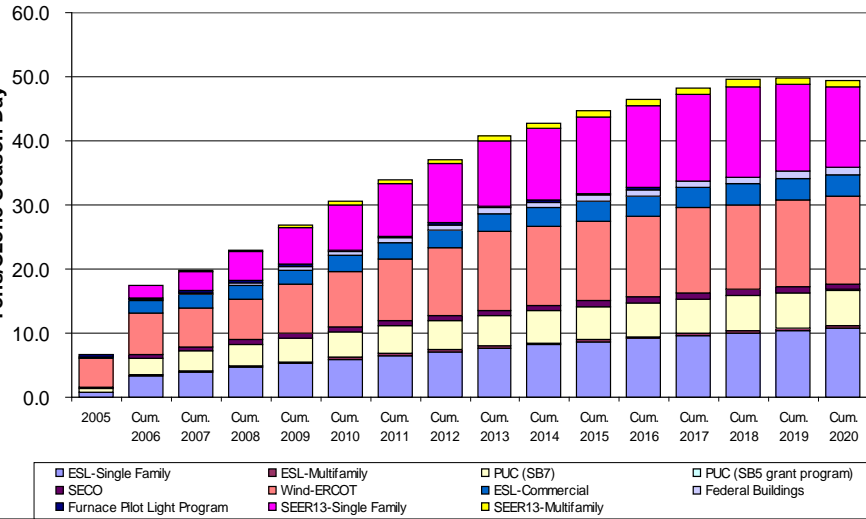
# Integrated NOx Savings: Results

ESL TR-08-05-02

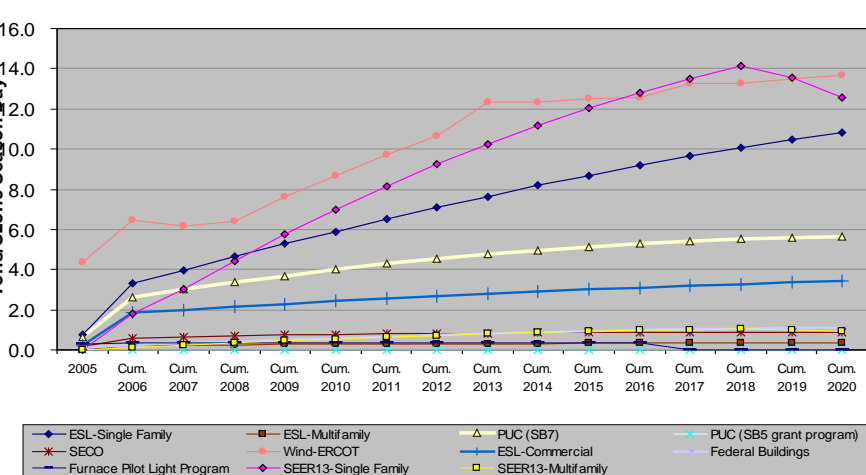
Cumulative NOx emissions reductions calculated across state programs (2013)

- Code Compliance (10.75 tons/day)
- Federal Buildings (0.81 tons/day)
- Furnace Pilot Lights (0.32 tons/day)
- PUCs SB7, SB5 programs (4.78 tons/day)
- SECO Political Sub. (0.84 tons/day)
- Green Power (Wind) (12.32 tons/day)
- SEER 13 Retrofits (11.03 tons/day)
- Total (40.86 tons/day)

OSD NOx Reduction Levels (All ERCOT)



OSD NOx Reduction Levels (All ERCOT)



# ESL CONTACT INFORMATION

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