

Accounting for Energy Efficiency & Renewable Energy for the Texas State Implementation Plans (SIP)



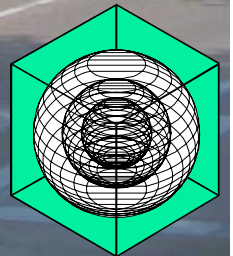
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Don Gilman, Tom Fitzpatrick, Shirley Muns

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Texas Engineering Experiment Station

Texas A&M University System, College Station, Texas



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

TERP Amended (79th Legislature, 2005)

- Ch. 382 & 386. 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*



Weather Normalize?

- Normalize energy use for “Year X” to SIP base year (tons-NOX/OSD), 17 climate zones.
 - Use simulation, regression, actual weather files (peak OSD =same).
 - Texas: Base Years...1999, 2002 > future years 2009, 2010

Trace Savings to Pollution Sources?

- Spatially allocate using eGRID
 - Need to know utility supplier or county
 - eGRID converts MWh to NO_x,SO_x, CO₂ by power plant by county

Other Factors?

- Cumulative savings (degradation, discount, T&D losses, etc.)

Verify Calculations?

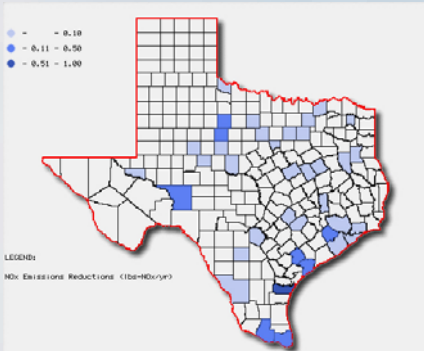
- SF,MF, Commercial – Case study buildings, utility bill analysis & site visits
- PUC – 3rd party, independent, peer-review
- SECO – 3rd party, independent review
- Wind energy – utility bill verification using ERCOT data



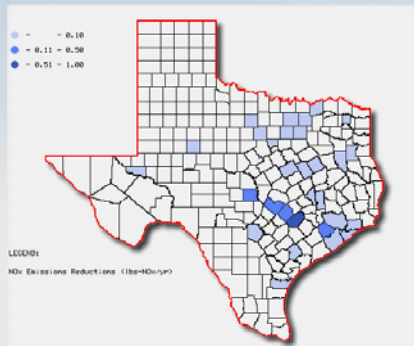
Example: EPA's 1999 eGRID Contains Emissions/PCA

County-wide NOx Reductions in pounds per MWh for EE/RE implemented in each listed PCA											
Cnty_FIP	County	American Electric Power - West (ERCOT)/PCA	Austin Energy/PCA	Brownsville Public Utils Board/PCA	Lower Colorado River Authority/PCA	Reliant Energy HL&P/PCA	San Antonio Public Service Bd/PCA	South Texas Electric Coop Inc/PCA	Texas Municipal Power Pool/PCA	Texas-New Mexico Power Co/PCA	TXU Electric/PCA
48021	BASTROP	0.01	0.20		0.34		0.01				
48029	BEXAR	0.06	0.09	0.04	0.16		2.00	0.08	0.01		
48039	BRAZORIA	0.01	0.01			0.05	0.01				
48041	BRAZOS		0.01		0.01			0.03	0.11		0.01
48057	CALHOUN	0.19		0.14	0.01			0.04	0.01		0.01
48061	CAMERON	0.14		0.20				0.03			0.01
48071	CHAMBERS	0.05	0.06	0.03	0.02	0.35	0.08	0.03	0.02	0.02	0.03
48073	CHEROKEE	0.01	0.01	0.01	0.02			0.02	0.06	0.02	0.10
48081	COKE	0.03		0.02				0.01			
48083	COLEMAN	0.02		0.01							
48085	COLLIN	0.01	0.01		0.02	0.01		0.05	0.19		0.02
48105	CROCKETT	0.14		0.11				0.03			0.01
48113	DALLAS	0.06	0.06	0.04	0.09	0.03	0.01	0.09	0.30	0.09	0.51
48121	DENTON		0.01		0.01			0.04	0.15		0.01
48147	FANNIN	0.02	0.02	0.01	0.03	0.01		0.03	0.09	0.03	0.17
48149	FAYETTE	0.02	0.86	0.02	1.51	0.01	0.04	0.01	0.02		0.02
48157	FORT BEND	0.13	0.17	0.10	0.06	1.01	0.23	0.09	0.06	0.07	0.10
48161	FREESTONE	0.02	0.02	0.02	0.04	0.01		0.03	0.12	0.04	0.22
48163	FRIO	0.05		0.04	0.01			1.15	0.07		
48167	GALVESTON	0.05	0.06	0.04	0.02	0.39	0.09	0.04	0.03	0.42	0.04
48185	GRIMES	0.01	0.01		0.02	0.01		0.06	0.23		0.01
48197	HARDEMAN	0.01		0.01							
48201	HARRIS	0.05	0.07	0.04	0.02	0.41	0.09	0.04	0.02	0.03	0.04
48207	HASKELL	0.16		0.12	0.01			0.03	0.01		0.01
48213	HENDERSON				0.01				0.02	0.01	0.03
48215	HIDALGO	0.13		0.10				0.03			
48221	HOOD	0.02	0.02	0.02	0.04	0.01		0.03	0.12	0.04	0.22
48251	JOHNSON								0.01		
48253	JONES	0.14		0.11				0.03			0.01
48277	LAMAR										0.01
48293	LIMESTONE	0.01	0.01			0.05	0.01				
48299	LLANO		0.12		0.21		0.01				
48309	MCLENNAN	0.04	0.04	0.03	0.07	0.02	0.01	0.06	0.22	0.07	0.40
48335	MITCHELL	0.04	0.04	0.03	0.07	0.02	0.01	0.06	0.21	0.07	0.39
48353	NOLAN										0.01
48355	NUECES	0.74	0.01	0.55	0.02	0.01	0.01	0.15	0.02	0.01	0.03
48363	PALO PINTO	0.01	0.02	0.01	0.03	0.01		0.09	0.36		0.02
48367	PARKER							0.01	0.03		
48387	RED RIVER								0.01		0.02
48395	ROBERTSON					0.01				0.40	0.01
48401	RUSK	0.01	0.01	0.01	0.01			0.01	0.04	0.01	0.07
48439	TARRANT	0.04	0.04	0.03	0.06	0.02	0.01	0.05	0.18	0.06	0.33
48441	TAYLOR	0.01									
48449	TITUS	0.01	0.01	0.01	0.02			0.02	0.05	0.02	0.10
48453	TRAVIS		0.46		0.05						
48469	VICTORIA	0.30	0.01	0.22	0.01			0.68	0.05		0.01
48475	WARD	0.06	0.06	0.04	0.09	0.02	0.01	0.08	0.28	0.10	0.51
48479	WEBB	0.06		0.05				0.01			
48481	WHARTON					0.01					
48503	YOUNG	0.02	0.02	0.01	0.03	0.01		0.03	0.09	0.03	0.16
	TOTAL	2.90	2.56	2.24	3.16	2.50	2.65	3.28	3.22	1.59	3.66

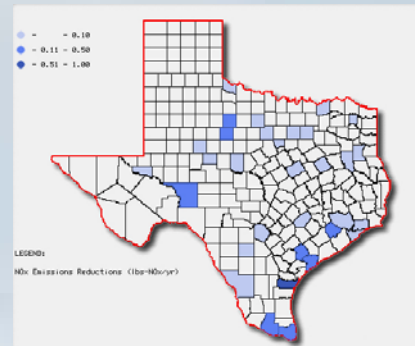
Example: EPA's 1999 eGRID Contains Emissions/PCA



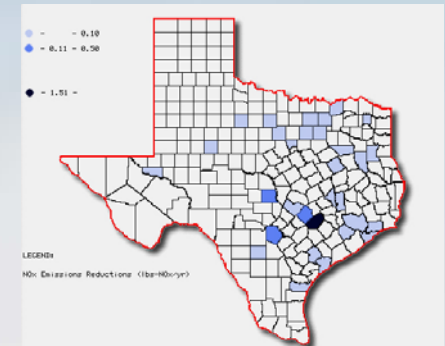
AEP



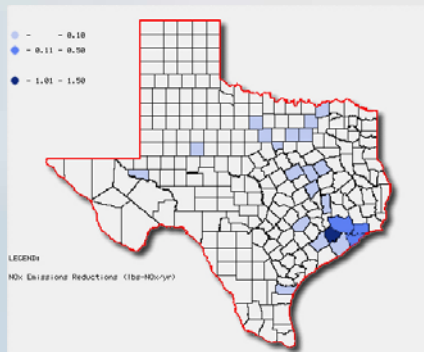
Austin



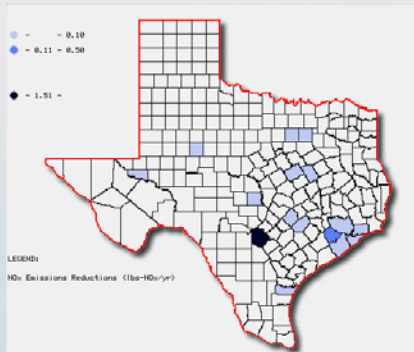
Brownsville



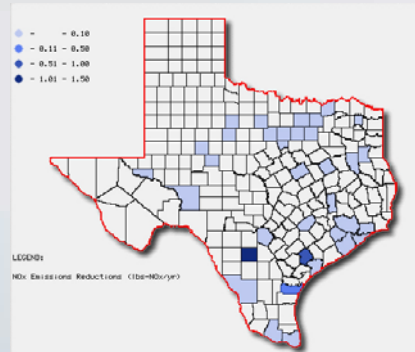
LCRA



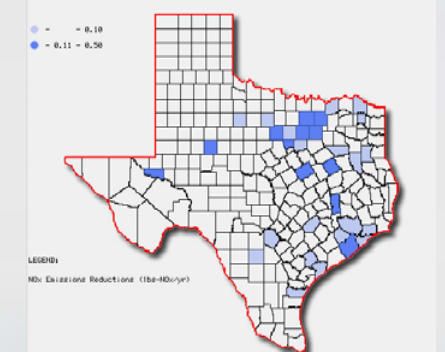
Reliant



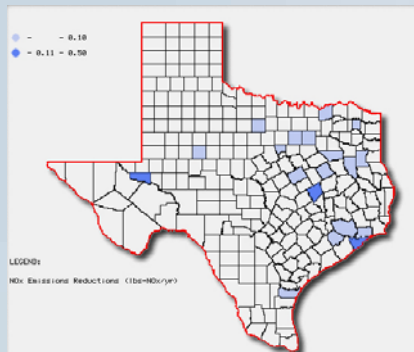
San Antonio



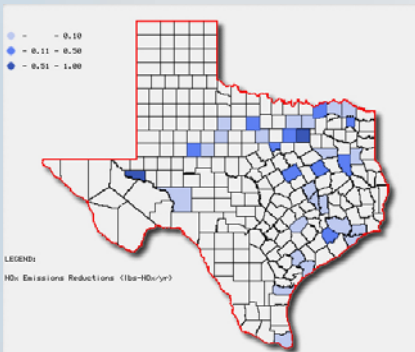
South Texas



Texas Mun. Power



TNMPA



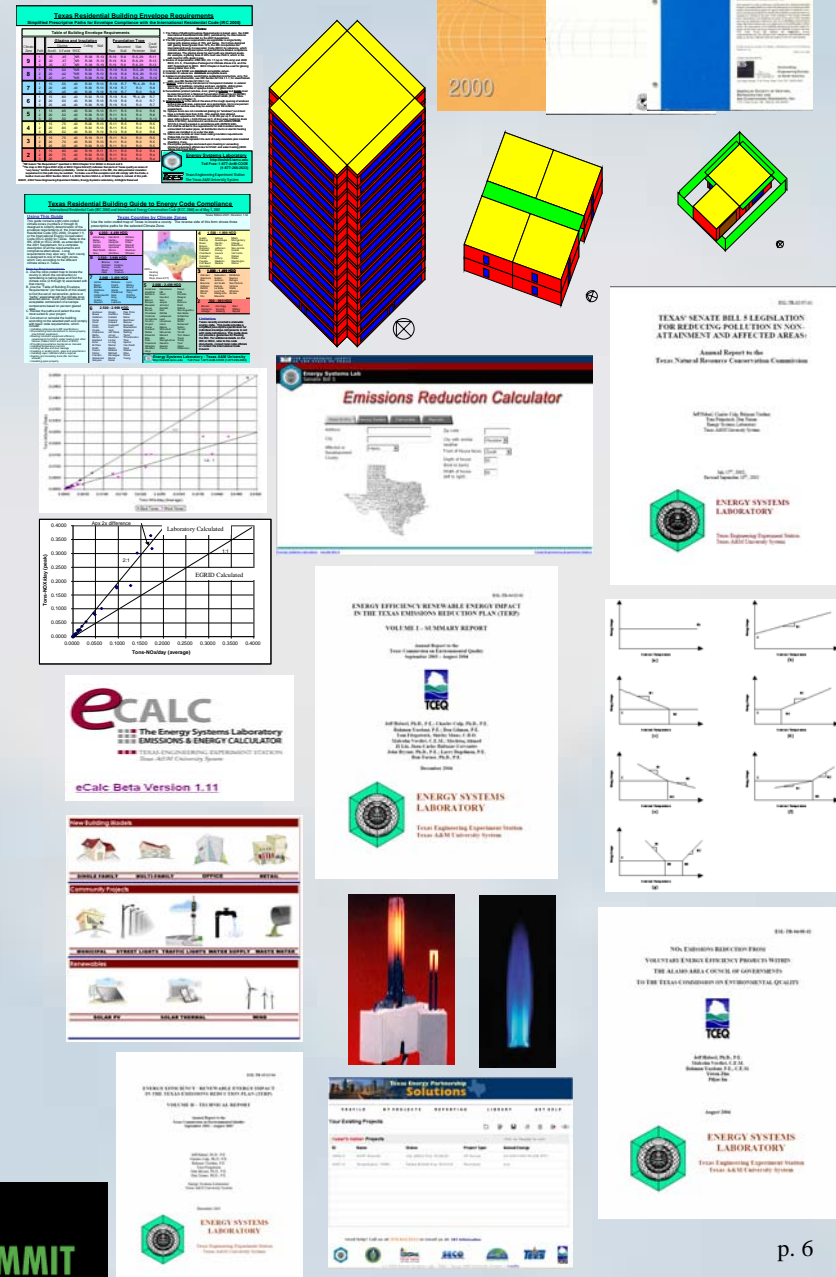
TXU



Progress 2001 to 2005

• 2001 - 2003

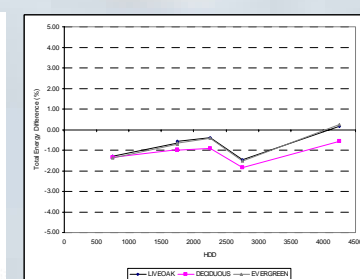
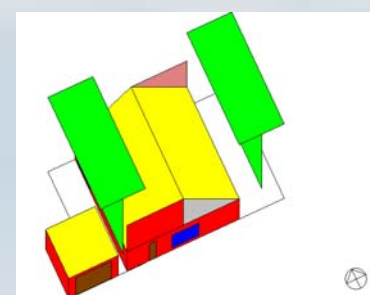
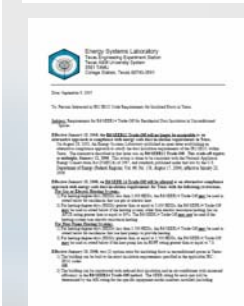
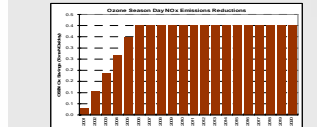
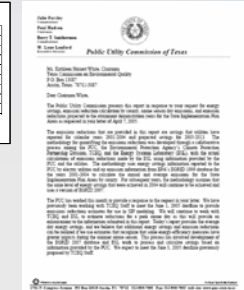
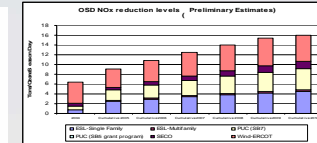
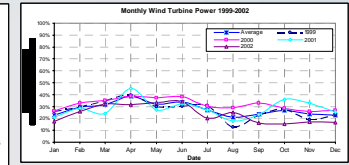
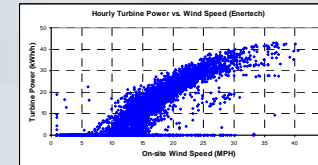
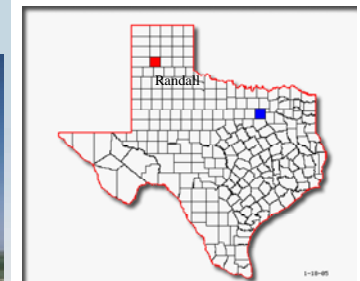
- Provided IECC/IRC workshops
 - Resolved issues: 90.1-1999, economizers, EnergyStar, SEER 12, R-6 flex-duct
- Developed accounting methods.
 - Code-compliant Test Suite for SF, MF, Commercial.
- Developed Simplified Builder's Guide.
- Published 2002 Report to the TNRCC
 - 2.1 tons NO_x/peak-day (DOE-2, '98 eGRID, SF, by avg. PCA, TMY2)
- Developed Emissions Calculator (Beta, 12/02)
- Demonstrated value of peak day vs annual avg. calcs.
- Recommended weather-normalization methods (Peak day from monthly utility bills).
- Published 2003 Report to the TCEQ
 - 2.4 tons NO_x/peak-day (DOE-2, '98 eGRID, SF & MF, by PCA, by Co., TMY2)
- Developed eCALC with funding from EPA
 - SF, MF, Office, Retail, Solar, Street & Traffic Lights, Water/Waste Water, Solar, PV, Wind
- Studied NO_x reductions from DHW pilot lights (2020)
- Studied Cumulative NO_x reductions: SF + MF
- Developed AACOG Report
 - Discount factors, degradation, SIP credits
- Developed web-based input for SECO Political Subdivisions.
- 2004 Emissions Reduction & Energy Leadership Conf., San Antonio, Texas
- Published 2003 Report to the TCEQ
 - 1.9 tons NO_x/peak-day (DOE-2, '99 eGRID, SF & MF, by PCA, by Co., 1999 NWS, fuel-neutral)



Progress 2001 to 2005

• 2004/2005

- Develop preliminary emissions reductions calculations from green power (wind) purchases. Demonstrated weather normalization, forecasting, emissions reductions (hourly,daily,monthly). Calculated 1999 NOx reductions from 2002 electrical production data.
- Provided Technical Support to PUC to report emissions reductions from SB5 and SB7 programs (4.17 tons NOx/day – 2010).
- Helped TCEQ Develop an Integrated Emissions Reporting Tool (2010): ESL, PUC, SECO, Wind power.
- Developed joint survey with TREIA for solar installations.
- Developed revised analysis of NOx reductions from DHW (2.5 tons NOx/day, 2010, new+replacement)
- Developed analysis of NOx reductions from replacement furnaces (0.4 tons-NOx/day, 2006)
- Developed New R-6/SEER 14 tradeoff to replace R-6/SEER 12 tradeoff, including, SHCG, and AFUE.
- Asked to offer Technical Assistance to PUC by State Senator John Carona
- Developed preliminary shading analysis for potential PUC tree planting program.
- Add new water/waste water design module to eCALC (EPA funding)



Emissions Reductions Calculator: eCALC

New Building Models



SINGLE FAMILY



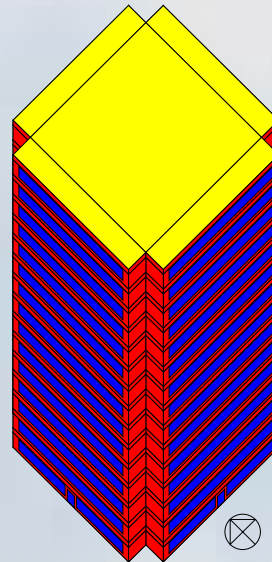
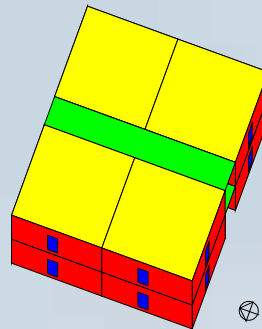
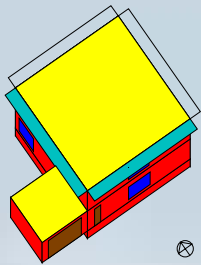
MULTI-FAMILY



OFFICE



RETAIL



- New building models use the DOE-2 simulation
- Actual 1999 weather data used to calculate peak day for each location
- eGRID then calculates emissions by PCA for 1999 and 2007.
- 2000 and 2002 base year simulations planned for 2006

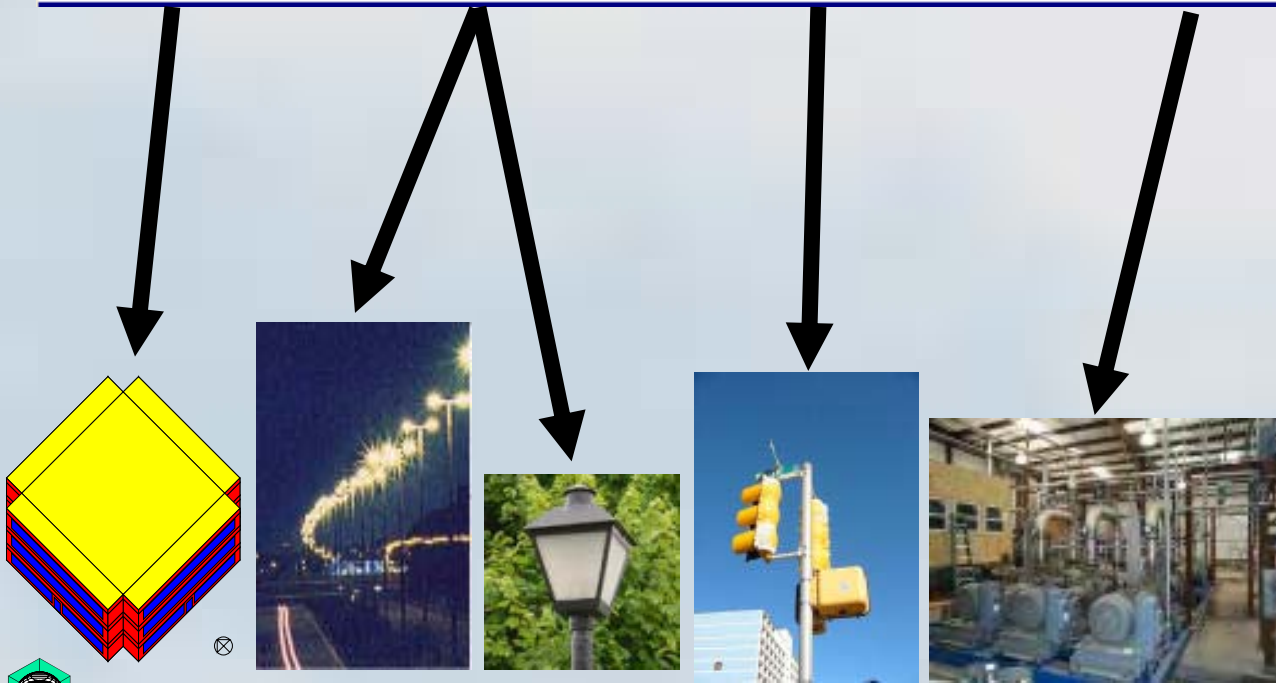


eCALC: Emissions Reductions Calculator

Community Projects



MUNICIPAL STREET LIGHTS TRAFFIC LIGHTS WATER SUPPLY WASTE WATER



- Municipal models use:
 - DOE-2 simulations for new buildings
 - Component models for street & traffic lights
 - Monthly utility billing models for before-after analysis
- eGRID then calculates emissions by PCA for 1999 and 2007.



eCALC: Renewables – Solar, Wind

Renewables



SOLAR PV



SOLAR THERMAL



WIND

- Renewable tools use:
 - F-CHART for solar thermal
 - PV F-CHART for photovoltaics
 - ASHRAE IMT utility billing analysis for wind energy
- eGRID used to calculate emissions by PCA for 1999 and 2007.



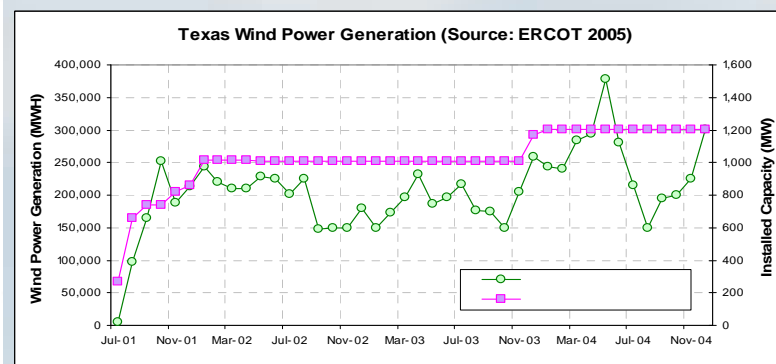
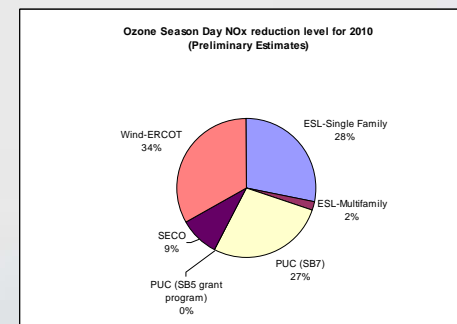
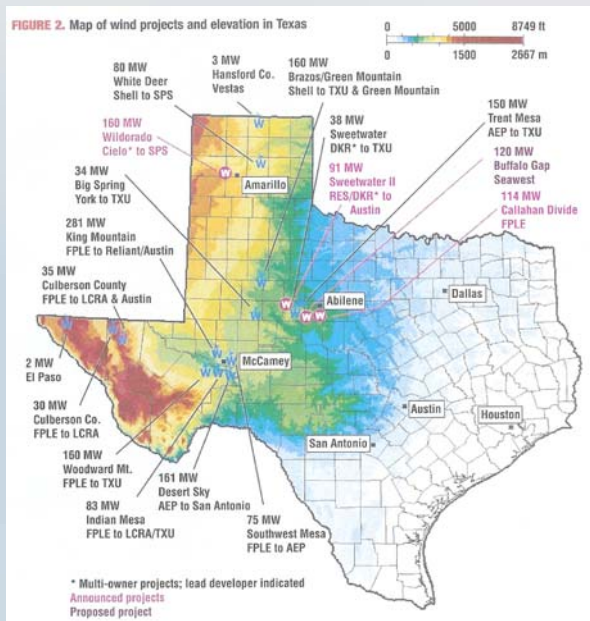
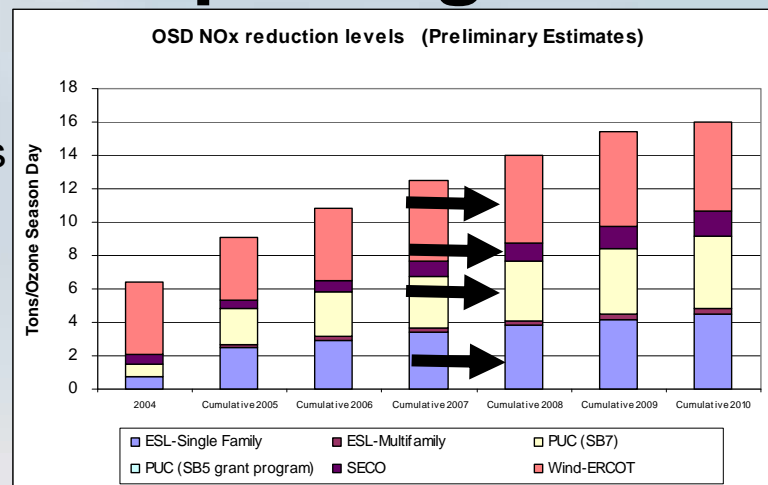
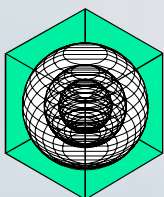
Integrated Emissions Reporting

- 2004/2005



Helped TCEQ Develop an Integrated Emissions Reporting Tool (2010): ESL, PUC, SECO, Wind

- ESL Code Compliance (4.5 tons/day)
- PUC SB5, SB7 programs (3.9 tons/day)
- SECO Political Sub. (1.3 tons/day)
- Green Power (Wind) (5.7 tons/day)
- Total (15.4 tons/day)



Lessons Learned

- **Involve everyone!**
 - Stakeholders, Other State Agencies, COGs, EPA, DOE, etc.
- **Accuracy counts!**
 - All procedures developed must be accurate from end-to-end (peer-reviewed).
 - Weather normalization required for SIP Credits, back-casting to base-year weather data allows for alignment with EPA's eGRID.
 - Future projections require multiple discounts, degradation, and growth factors.
 - Integrated accounting across State Agencies allows for State-wide, consistent, cumulative reporting to EPA.
- **Documentation important!**
 - EPA Quality Assurance Project Plan – QAPP.



Summary

- **Procedures developed to calculate NO_x, SO_x and CO₂ emissions from EE/RE projects.**
 - eCALC developed under EPA funding
 - SF, MF, COM, Solar, PV, Municipal, Wind, water/waste water systems
 - Future: new models, measured data
 - EE/RE simulation procedures currently under review by DOE (preliminary review very positive).
 - Integrated NO_x emissions procedures developed
 - (4) State Agencies: TCEQ, ESL, SECO, PUC (includes ERCOT)
 - TCEQ is considering submitting EE/RE as part of State SIP
- **Other states investigating Texas EE/RE procedures.**



Questions?

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Tom Fitzpatrick: tfitzpatrick@mail.utexas.edu

Visit the Calculator: “<http://ecalc.tamu.edu>”

