ALPINE GEOPHYSICS

ENVIRON

Emission and Air Quality Trends Review 1999-2011

Texas

July 2013

Project Objective

- To develop and present publicly available information on trends in emissions and ambient air quality in the U.S. since 1999 in easy to understand visual and tabular formats

Emission Trends

- Study Team collected and processed U.S. EPA emission inventories for years within the study period of interest (1999-2011)

- By pollutant and source category
  - electric utility coal fuel combustion
  - mobile sources
  - industrial fuel combustion & industrial processes
  - all other

Emissions Data Summary

- Data Obtained from EPA National Emission Inventory (NEI) and Trends Websites
  - EPA's Trends reports and emission comparisons include interpolations of all categories between key years (1999, 2002, 2005, 2008, 2011) at county-pollutant level
  - Represented Pollutants: VOC, NOx, SO_2, and $PM_{2.5}$
- Project Improvement
  - The Study Team augmented above data with year specific CEM emissions (2002 through 2011)

Emission Changes

- The following slides also include the tonnage-based emissions change from 1999 to 2011 for each pollutant

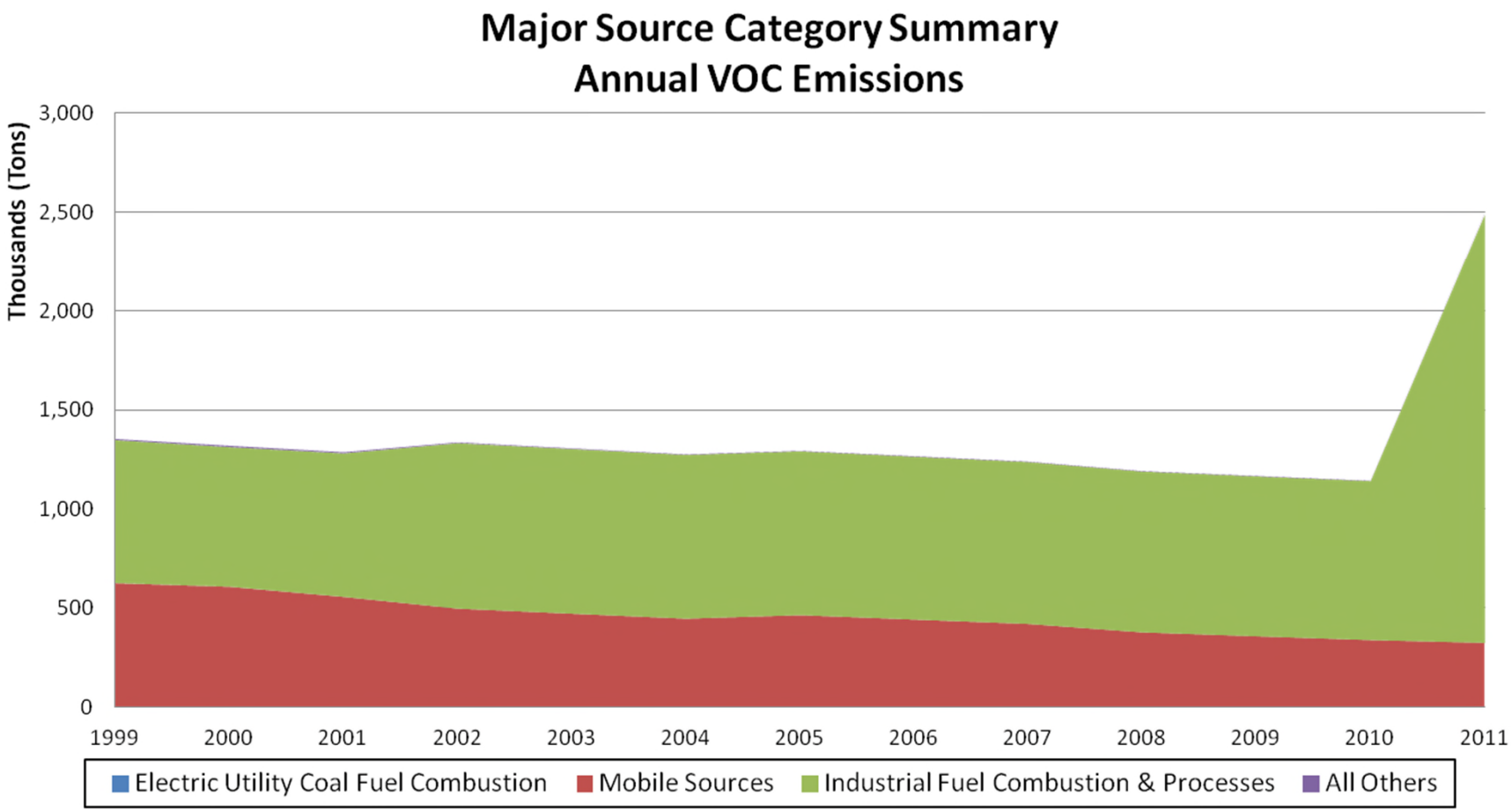
- Negative values indicate decrease in emissions, positive values indicate an increase

Texas Emission Trends (VOC)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	2,035	2,920	2,065	2,091	2,071	2,155	2,091	1,962	1,969	1,843
Mobile Sources	623,626	553,337	469,529	462,084	439,902	417,721	374,978	355,699	336,419	322,493
Industrial Fuel Combustion & Processes	723,986	726,908	833,442	829,152	824,319	819,506	814,676	809,863	805,020	2,164,187
All Others	5,335	5,344	3,112	2,253	2,330	2,225	2,224	2,143	2,090	1,884
Total	**1,354,982**	**1,288,508**	**1,308,149**	**1,295,580**	**1,268,621**	**1,241,606**	**1,193,970**	**1,169,667**	**1,145,498**	**2,490,407**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	43%	1%	3%	2%	6%	3%	-4%	-3%	-9%
Mobile Sources	0%	-11%	-25%	-26%	-29%	-33%	-40%	-43%	-46%	-48%
Industrial Fuel Combustion & Processes	0%	0%	15%	15%	14%	13%	13%	12%	11%	199%
All Others	0%	0%	-42%	-58%	-56%	-58%	-58%	-60%	-61%	-65%
Total	**0%**	**-5%**	**-3%**	**-4%**	**-6%**	**-8%**	**-12%**	**-14%**	**-15%**	**84%**

Texas Emission Trends (VOC)

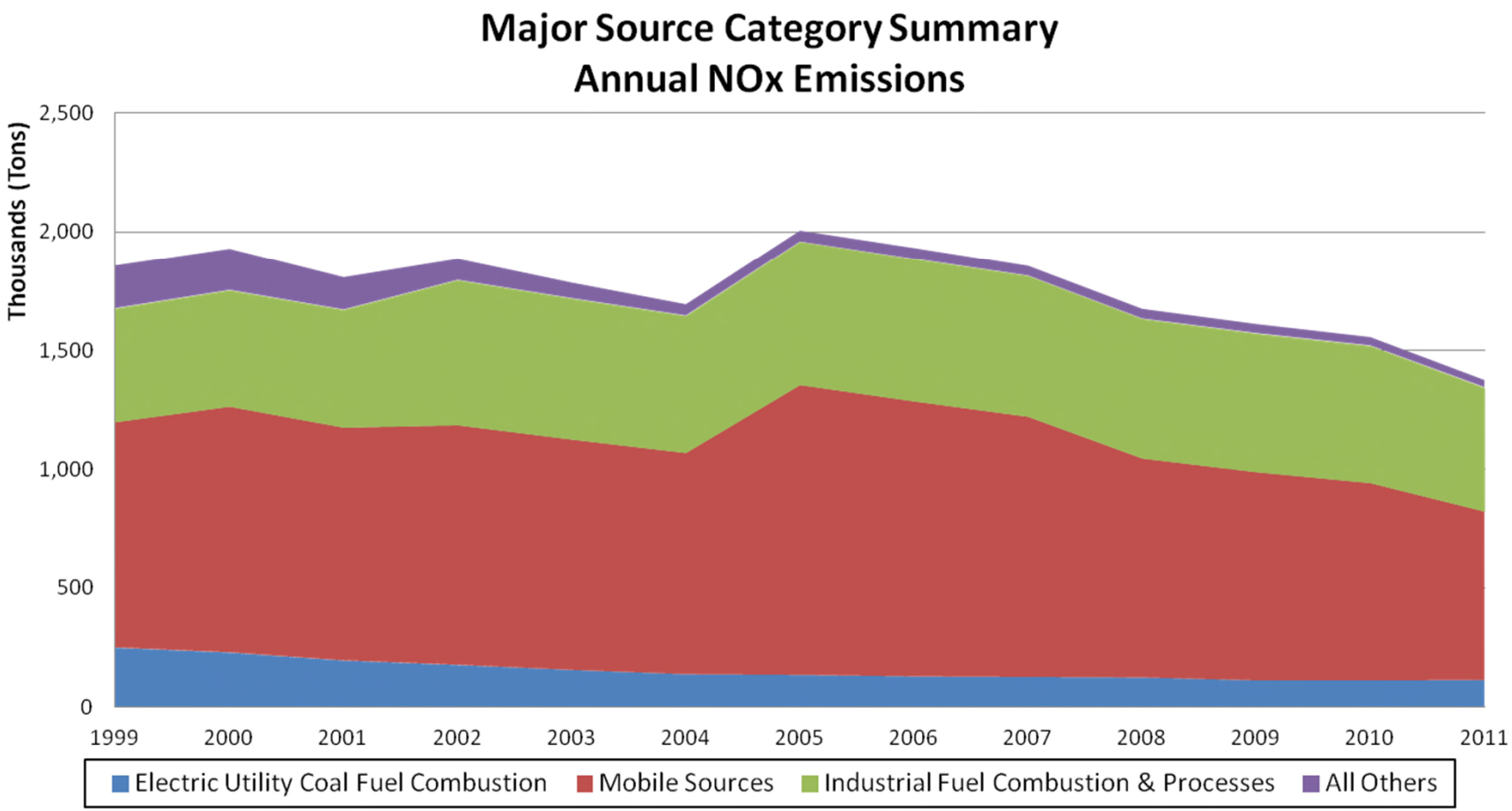


Texas Emission Trends (NOx)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	249,539	195,197	155,111	134,182	128,063	125,495	123,269	111,434	110,586	113,204
Mobile Sources	950,195	982,086	971,934	1,221,765	1,159,465	1,097,165	924,309	879,014	833,719	711,835
Industrial Fuel Combustion & Processes	477,737	494,515	592,234	604,405	599,180	591,987	586,047	581,697	575,810	519,450
All Others	180,290	136,059	65,507	45,920	45,716	41,145	40,479	37,910	34,796	29,861
Total	**1,857,761**	**1,807,857**	**1,784,786**	**2,006,271**	**1,932,424**	**1,855,793**	**1,674,105**	**1,610,055**	**1,554,910**	**1,374,349**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-22%	-38%	-46%	-49%	-50%	-51%	-55%	-56%	-55%
Mobile Sources	0%	3%	2%	29%	22%	15%	-3%	-7%	-12%	-25%
Industrial Fuel Combustion & Processes	0%	4%	24%	27%	25%	24%	23%	22%	21%	9%
All Others	0%	-25%	-64%	-75%	-75%	-77%	-78%	-79%	-81%	-83%
Total	**0%**	**-3%**	**-4%**	**8%**	**4%**	**0%**	**-10%**	**-13%**	**-16%**	**-26%**

Texas Emission Trends (NOx)

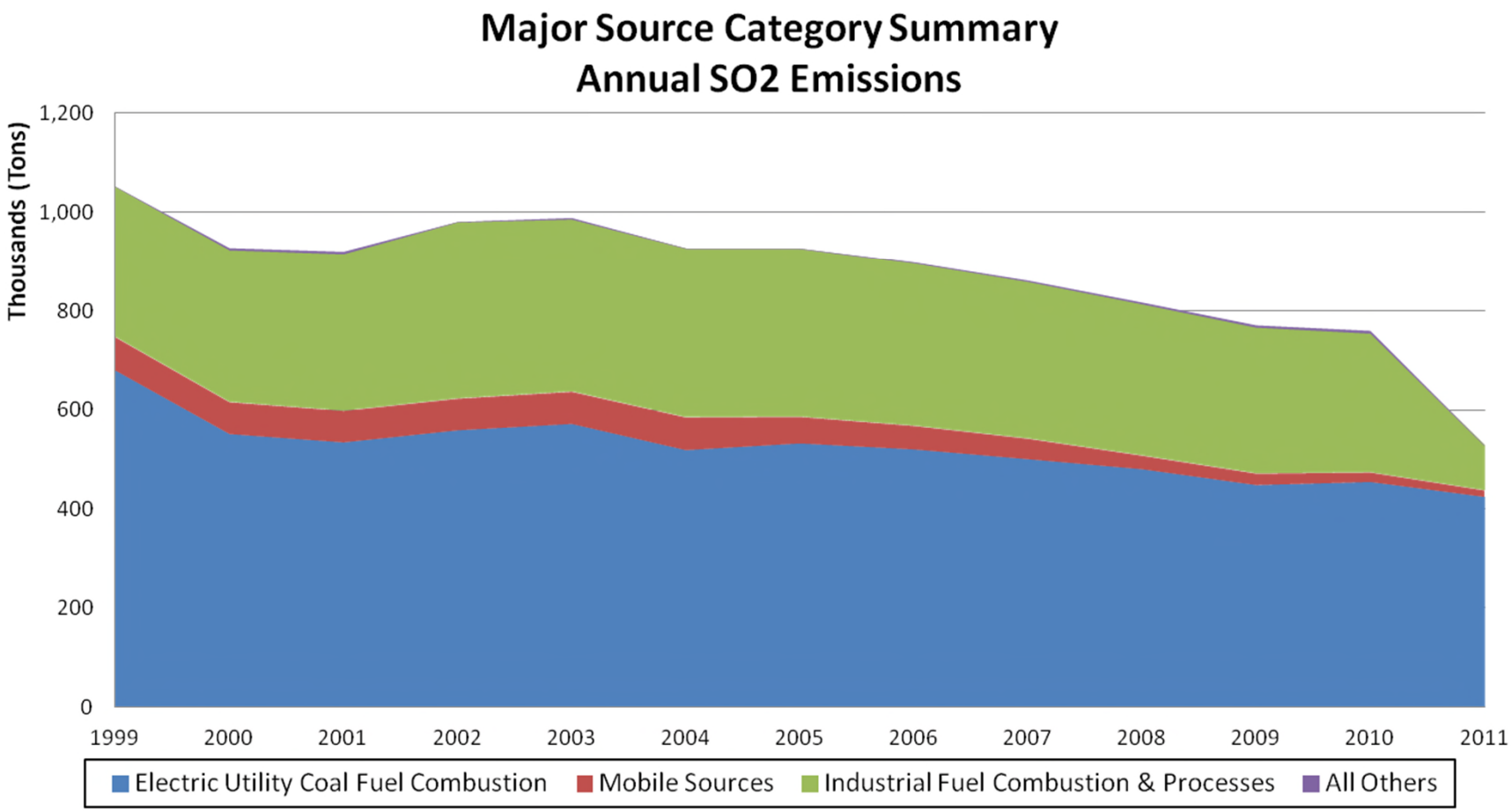


Texas Emission Trends (SO_2)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	679,451	534,456	571,773	532,448	520,326	500,677	480,471	448,447	454,770	424,628
Mobile Sources	66,936	63,476	64,805	53,526	47,368	41,209	27,292	23,203	19,114	13,003
Industrial Fuel Combustion & Processes	304,451	317,440	349,058	339,573	328,183	316,466	305,419	294,725	280,410	90,857
All Others	936	5,080	3,083	1,351	2,058	2,804	3,725	4,663	5,545	1,673
Total	**1,051,775**	**920,452**	**988,719**	**926,898**	**897,934**	**861,156**	**816,906**	**771,038**	**759,840**	**530,161**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-21%	-16%	-22%	-23%	-26%	-29%	-34%	-33%	-38%
Mobile Sources	0%	-5%	-3%	-20%	-29%	-38%	-59%	-65%	-71%	-81%
Industrial Fuel Combustion & Processes	0%	4%	15%	12%	8%	4%	0%	-3%	-8%	-70%
All Others	0%	443%	229%	44%	120%	199%	298%	398%	492%	79%
Total	**0%**	**-12%**	**-6%**	**-12%**	**-15%**	**-18%**	**-22%**	**-27%**	**-28%**	**-50%**

Texas Emission Trends (SO_2)

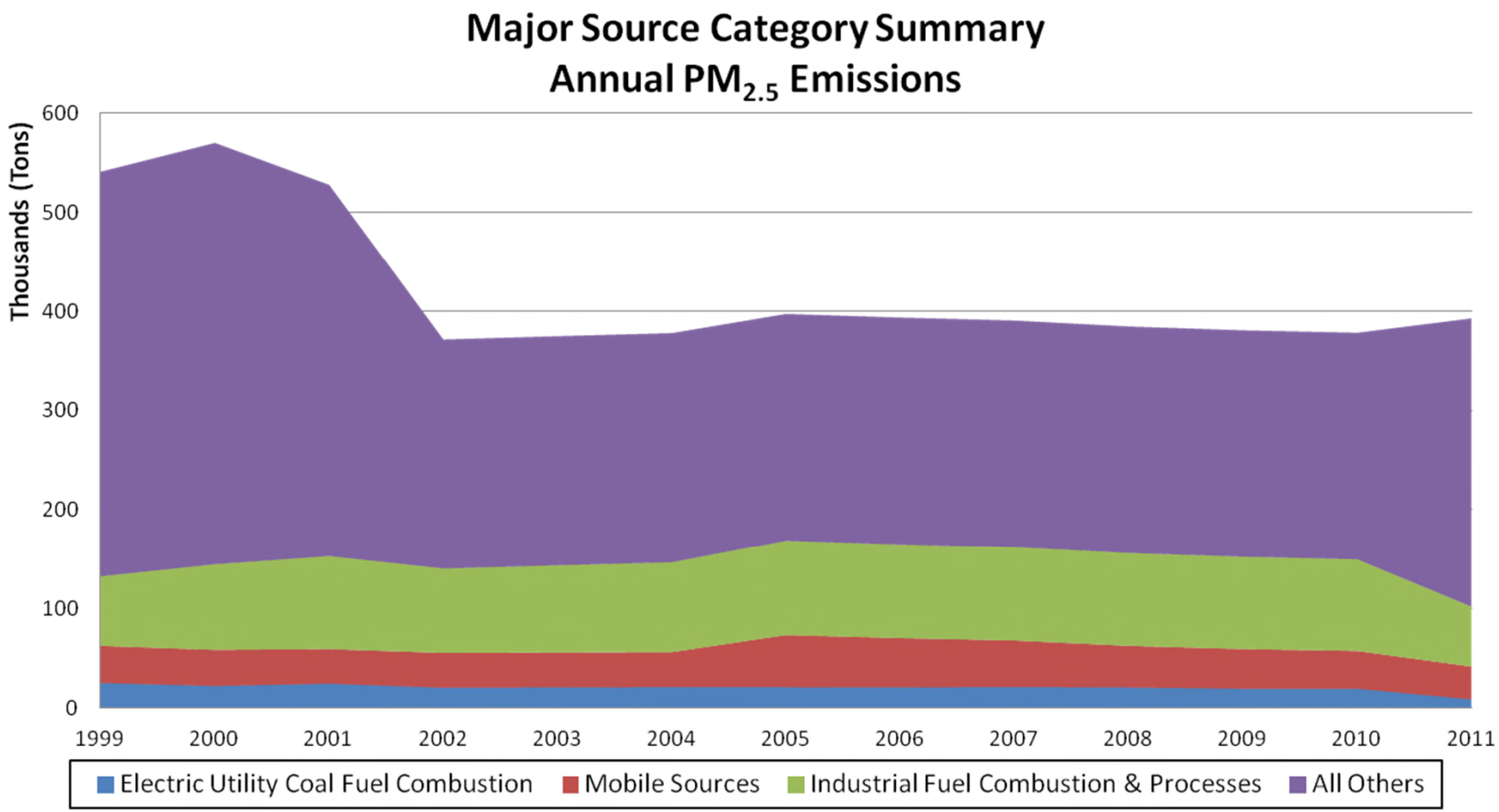


Texas Emission Trends ($PM_{2.5}$)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	25,289	24,569	20,882	21,012	20,804	21,284	20,732	19,527	19,580	8,835
Mobile Sources	37,242	34,749	35,088	52,375	49,519	46,663	41,821	39,841	37,861	32,943
Industrial Fuel Combustion & Processes	70,316	93,958	87,976	95,771	95,141	94,543	93,920	93,289	92,660	60,614
All Others	408,168	374,624	230,890	227,997	228,043	228,057	228,079	228,089	228,141	290,300
Total	**541,014**	**527,899**	**374,836**	**397,154**	**393,507**	**390,546**	**384,552**	**380,746**	**378,241**	**392,692**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-3%	-17%	-17%	-18%	-16%	-18%	-23%	-23%	-65%
Mobile Sources	0%	-7%	-6%	41%	33%	25%	12%	7%	2%	-12%
Industrial Fuel Combustion & Processes	0%	34%	25%	36%	35%	34%	34%	33%	32%	-14%
All Others	0%	-8%	-43%	-44%	-44%	-44%	-44%	-44%	-44%	-29%
Total	**0%**	**-2%**	**-31%**	**-27%**	**-27%**	**-28%**	**-29%**	**-30%**	**-30%**	**-27%**

Texas Emission Trends ($PM_{2.5}$)



Emission Trends Summary

- All pollutants with the exception of VOC have decreased since 1999 in aggregate across Texas
  - VOC increases due largely to industrial processes
- NOx and SO2 from Electric Utility Fuel Combustion sources show decrease over time as a result of Acid Rain Program and CAIR control implementation
- Onroad emission step increase seen between 2004 and 2005 is the result of EPA's method change and MOVES model integration for estimating onroad mobile source emissions

Air Quality Design Values

- Ozone
  - Annual 4th highest daily maximum 8-hour average averaged over three consecutive years
  - Current standard = 0.075 ppm
- $PM_{2.5}$ Annual
  - Annual arithmetic mean of quarterly means averaged over three consecutive years
  - Current standard = 12 ug/m^3
- $PM_{2.5}$ 24-Hour
  - Annual 98th percentile of daily averages averaged over three consecutive years
  - Current standard = 35 ug/m^3

State-Wide Design Value (DV) Trends

- Trends in state-wide maximum DV and average DV
  - Max DV: Maximum DVs over all valid trend monitoring sites in the state in each overlapping three year period
  - Average DV: Average of DVs over all valid trend monitoring sites in the state in each overlapping three year period
- Compute linear trend via least-squares regression

Data Handling Procedures

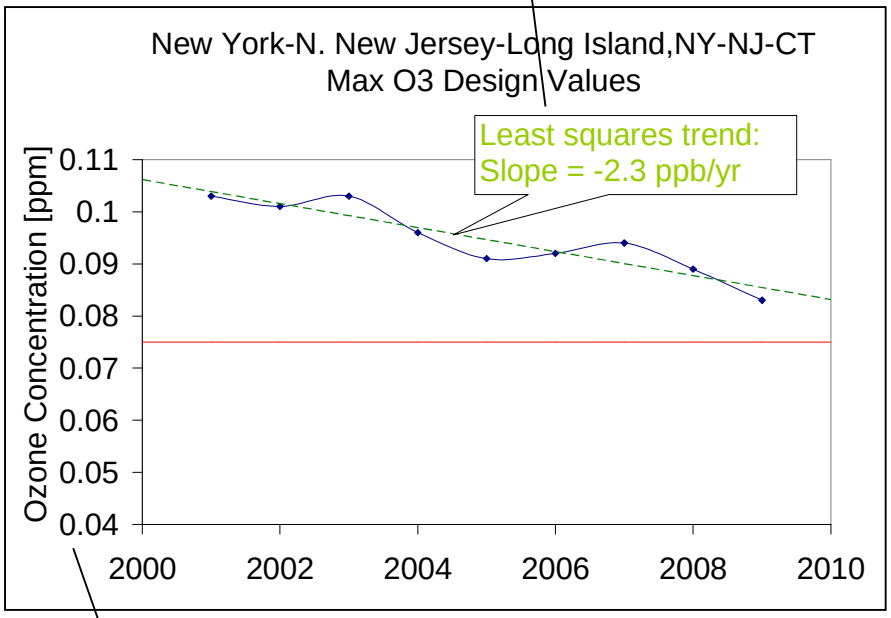
- O_3 design value (DV) for each overlapping three-year period starting with 1999-2001 and ending with 2009-2011
  - DV calculated using annual 4th highest daily max 8-hr averages and percent of valid observations, based on EPA data handling conventions
  - Data associated with exceptional events that have received EPA concurrence are omitted
  - Selection of trend sites require valid DV in 9 out of 11 three-year periods between 1999 and 2011
  - Identification of nonattainment areas is with respect to the 2008 8-hour standard only

Data Handling Procedures

- Annual $PM_{2.5}$ DV and 24-hr $PM_{2.5}$ DV for each overlapping three-year period starting with 1999-2001 and ending with 2009-2011
  - DV calculations based on EPA data handling conventions
  - Data extracted from monitors that have a non-regulatory monitoring type are omitted
  - Selection of trend sites require valid DV in 9 out of 11 three-year periods between 1999 and 2011

Trend Calculation

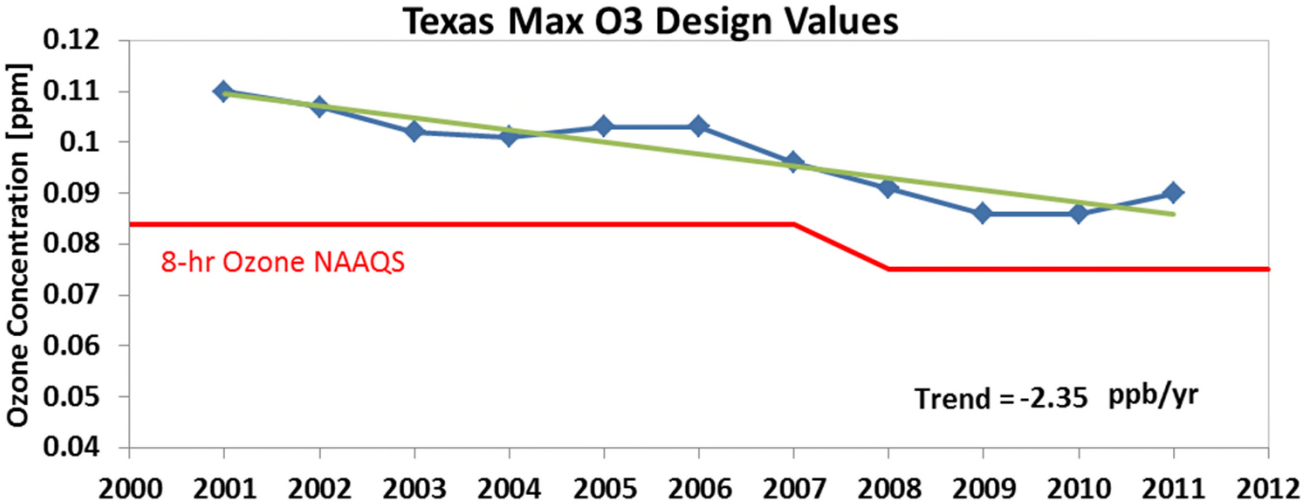
Trend in units of ppb/year

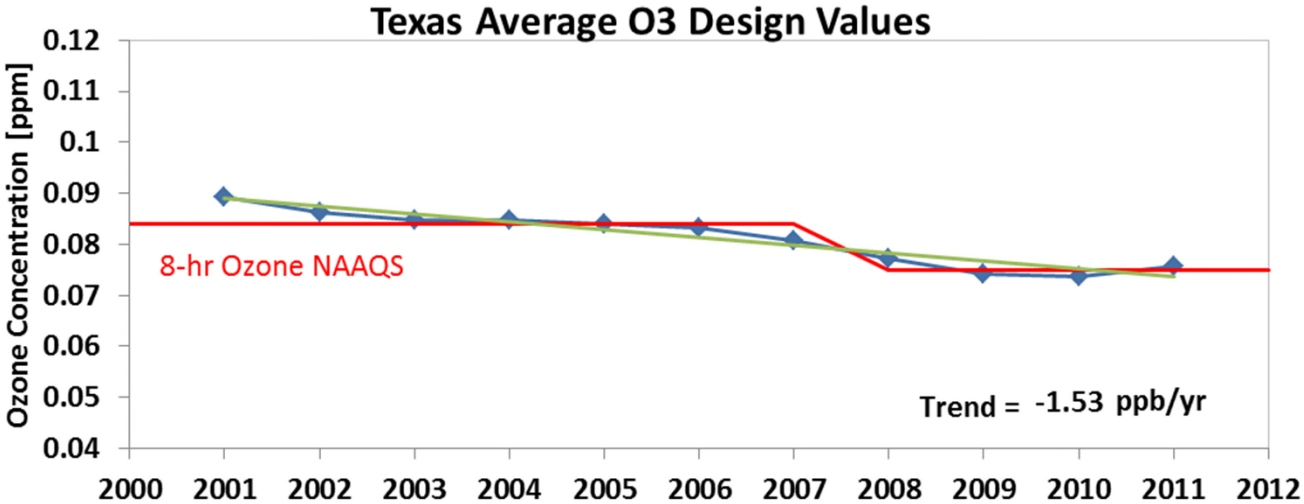


Scale in units of ppm

- Trends based on linear least squares fit to rolling three year design values (DVs)
- Negative trend indicates improving air quality
- DVs based on each 3-year period: 1999-2001, 2000-2002, … 2009-2011
- Notes
  - On plots, DVs are for three year period ending in year shown (i.e., 2009-2011 DV plotted as 2011 value)
  - Ozone trend values expressed as ppb/year (1,000 ppb = 1 ppm); DVs are plotted as ppm

Max/Ave O_3 DVs and Trend





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Ozone Trends by Site in Texas

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
4802900324420102	Bexar, TX	0.075	-1.46
4802900524420101	Bexar, TX	0.075	-1.30
4802900594420101	Bexar, TX	0.066	-1.55
4803910044420101	Brazoria, TX	0.089	-1.40
4804301014420101	Brewster, TX	0.069	0.72
4806100064420101	Cameron, TX	0.064	-0.15
4808500054420101	Collin, TX	0.081	-1.78
4811300694420103	Dallas, TX	0.073	-2.09
4811300754420101	Dallas, TX	0.082	-1.20
4811300874420101	Dallas, TX	0.079	-0.75
4812100344420101	Denton, TX	0.083	-1.92
4814100374420102	El Paso, TX	0.069	-0.65

Note: Only monitoring sites meeting data completeness criteria listed

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Ozone Trends by Site in Texas

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
4814100444420101	El Paso, TX	0.068	-1.02
4814100554420101	El Paso, TX	0.067	-1.50
4814100574420101	El Paso, TX	0.066	-0.54
4814100584420101	El Paso, TX	0.071	-0.65
4818300014420102	Gregg, TX	0.077	-1.61
4820100244420102	Harris, TX	0.083	-2.76
4820100264420103	Harris, TX	0.080	-1.52
4820100294420102	Harris, TX	0.084	-2.30
4820100464420101	Harris, TX	0.075	-2.32
4820100474420102	Harris, TX	0.078	-1.00
4820100514420102	Harris, TX	0.080	-3.07

Note: Only monitoring sites meeting data completeness criteria listed

Ozone Trends by Site in Texas

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
4820100554420101	Harris, TX	0.083	-2.62
4820100624420101	Harris, TX	0.074	-2.35
4820100664420101	Harris, TX	0.074	-2.25
4820100704420101	Harris, TX	0.077	-2.63
4820100754420101	Harris, TX	0.077	-2.05
4820110344420102	Harris, TX	0.081	-2.92
4820110354420103	Harris, TX	0.079	-2.60
4820110394420101	Harris, TX	0.083	-2.83
4820110504420101	Harris, TX	0.078	-2.05
4820300024420101	Harrison, TX	0.072	-1.35
4821500434420101	Hidalgo, TX	0.062	-1.89

Note: Only monitoring sites meeting data completeness criteria listed

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Ozone Trends by Site in Texas

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
4822100014420101	Hood, TX	0.076	-0.94
4824500094420102	Jefferson, TX	0.073	-0.71
4824500114420101	Jefferson, TX	0.076	-0.98
4824500224420101	Jefferson, TX	0.071	-0.84
4825100034420101	Johnson, TX	0.079	-1.30
4825700054420101	Kaufman, TX	0.068	-0.45
4833900784420101	Montgomery, TX	0.074	-1.55
4835500254420102	Nueces, TX	0.071	-1.43
4835500264420101	Nueces, TX	0.072	-0.85
4836110014420102	Orange, TX	0.075	-0.83
4836111004420101	Orange, TX	0.069	-0.82

Note: Only monitoring sites meeting data completeness criteria listed

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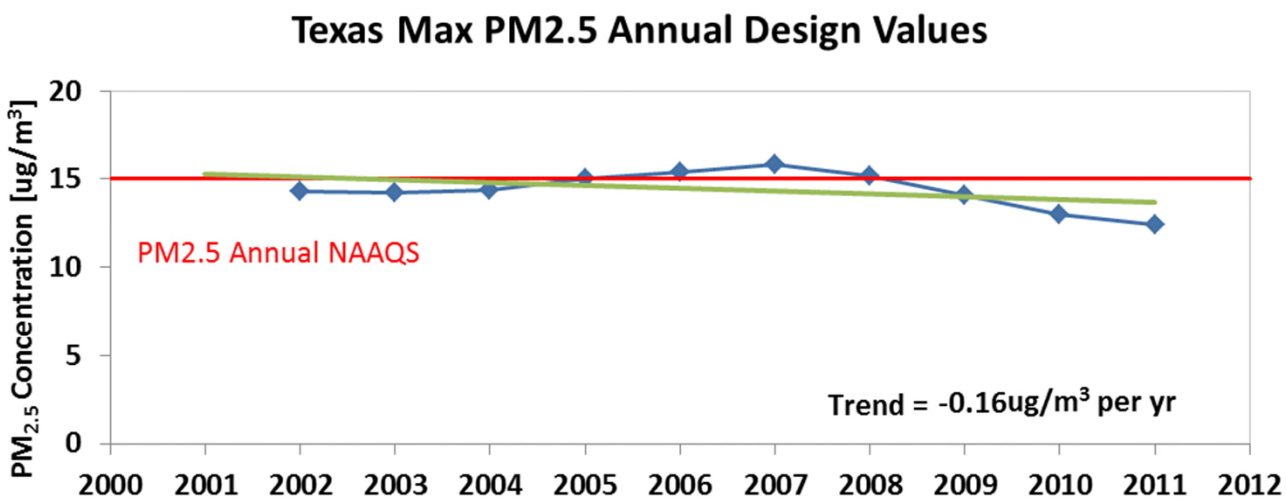
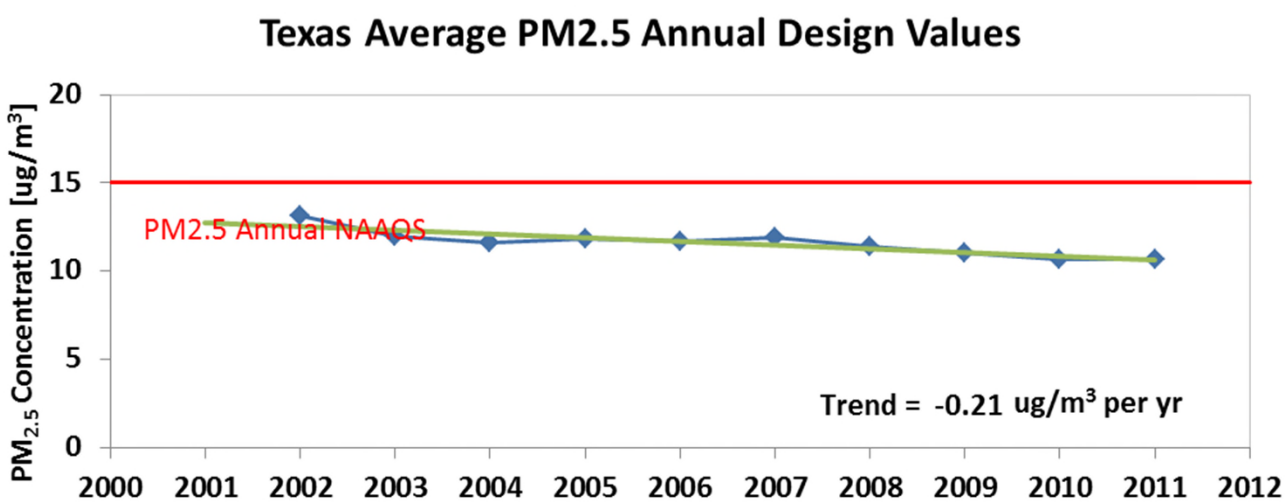
Ozone Trends by Site in Texas

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
4836700814420101	Parker, TX	0.079	-1.16
4839700014420101	Rockwall, TX	0.077	-0.96
4842300074420101	Smith, TX	0.075	-1.13
4843900754420101	Tarrant, TX	0.083	-1.48
4843910024420102	Tarrant, TX	0.082	-2.00
4843920034420102	Tarrant, TX	0.090	-1.36
4843930094420101	Tarrant, TX	0.086	-1.79
4845300144420102	Travis, TX	0.075	-1.22
4845300204420101	Travis, TX	0.070	-1.77
4846900034420101	Victoria, TX	0.070	-1.43
4847900164420101	Webb, TX	N/A	-1.22

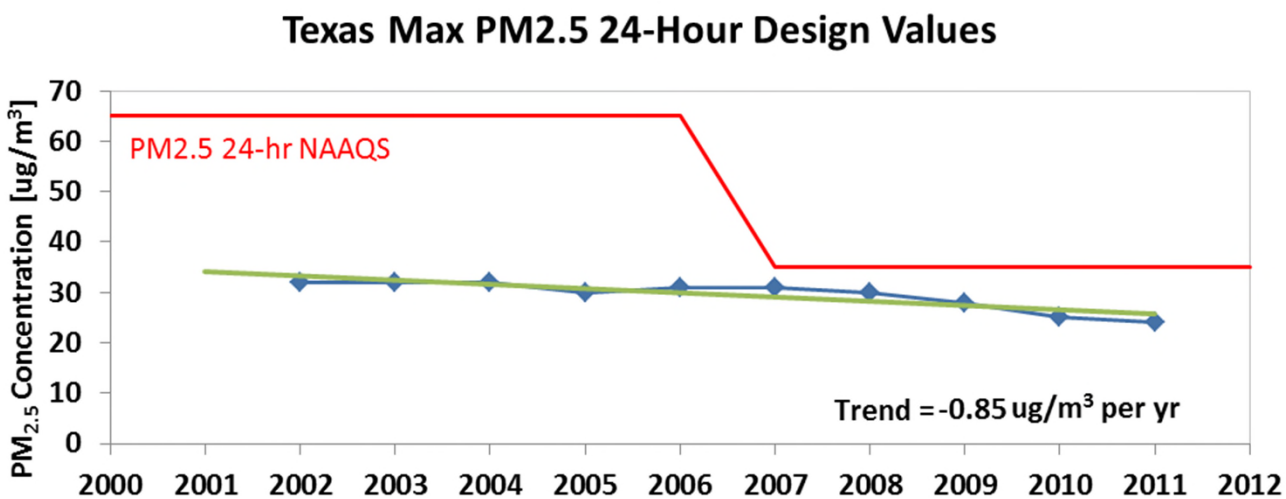
Note: Only monitoring sites meeting data completeness criteria listed

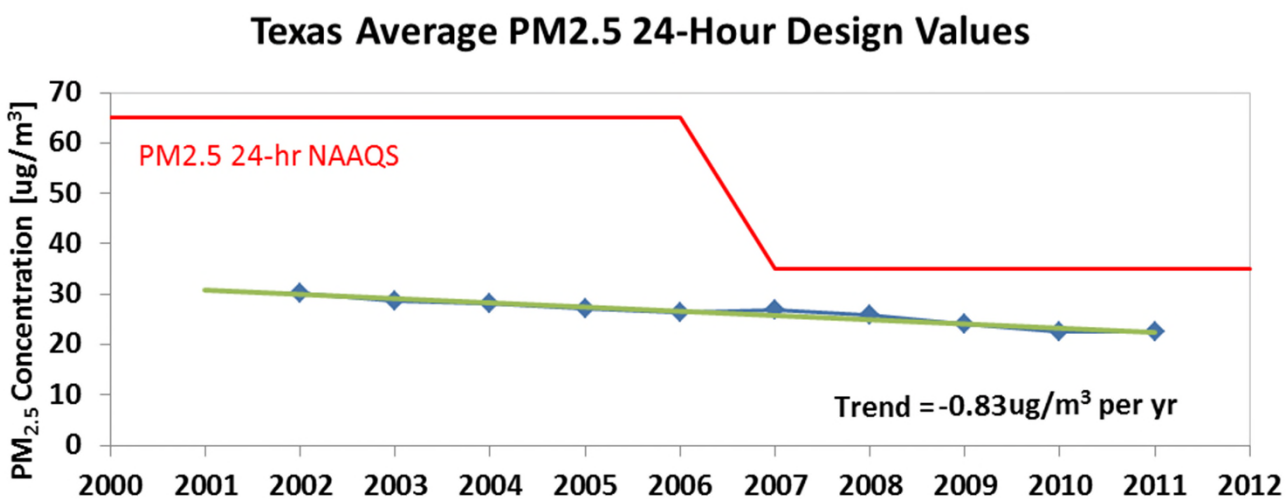
Max/Ave $PM_{2.5}$ Annual DVs and Trend





Max/Ave $PM_{2.5}$ 24-Hour DVs and Trend





$PM_{2.5}$ Trends by Site in Texas

		2009-2011 DV [ug/m³]		Trend [ug/m³ per year]	
Monitoring Site	**County**	**Annual**	**24-Hr**	**Annual DV**	**24-Hr DV**
480370004	Bowie	11.1	22	-0.34	-1.11
481130050	Dallas	N/A	21	N/A	-1.42
481130069	Dallas	10.2	21	-0.31	-1.16
482010058	Harris	11.2	N/A	-0.18	N/A
482011035	Harris	12.4	24	-0.15	-0.64
482150043	Hidalgo	10.5	23	-0.06	-1.00
483550032	Nueces	10.3	24	0.05	0.13
483550034	Nueces	9.4	23	0.04	0.07
484391002	Tarrant	10.0	22	-0.28	-0.92

Note: Only monitoring sites meeting data completeness criteria listed

Air Quality Trends Summary

- Average O_3 design values have decreased since 1999 in Texas; average $PM_{2.5}$ design values have decreased since 2000 (incomplete data in 1999) in Texas.

- O_3 design values have decreased since 1999 in both Dallas-Fort Worth, TX and Houston-Galveston-Brazoria, TX non-attainment areas. There are no currently designated $PM_{2.5}$ non-attainment areas in Texas.