Emission and Air Quality Trends Review

Wisconsin

May 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 generation 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

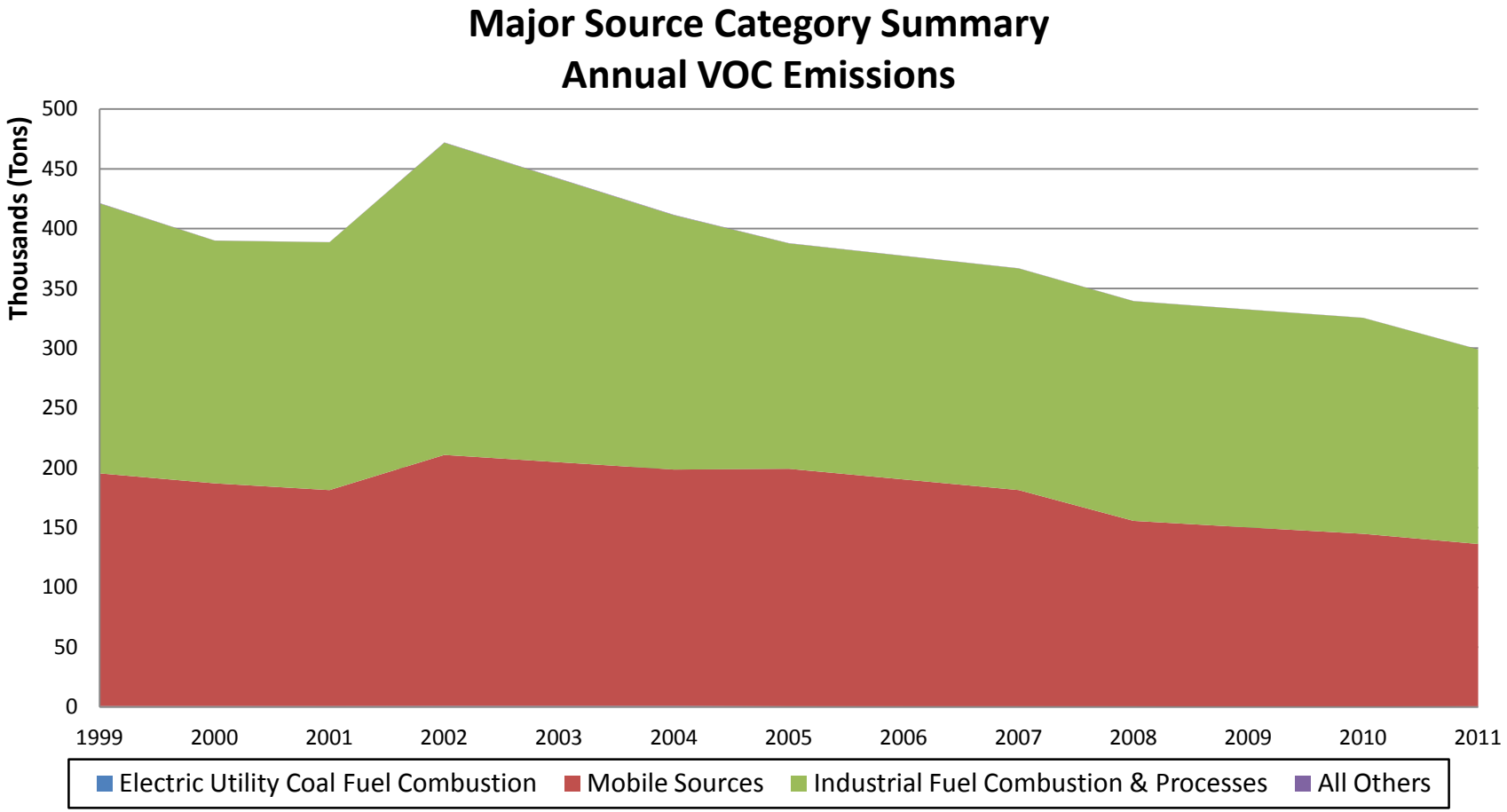
- Negative values indicate decrease in emissions, positive values indicate an increase

Wisconsin Emission Trends (VOC)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	788	768	906	638	602	599	574	486	522	622
Mobile Sources	194,575	180,602	203,765	198,540	189,674	180,808	155,068	149,685	144,302	135,697
Industrial Fuel Combustion & Processes	225,681	207,192	236,827	188,456	186,866	185,276	183,686	182,095	180,505	162,688
All Others	286	115	287	192	179	173	155	140	128	157
Total	**421,329**	**388,677**	**441,785**	**387,826**	**377,321**	**366,854**	**339,483**	**332,406**	**325,457**	**299,164**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-2%	15%	-19%	-24%	-24%	-27%	-38%	-34%	-21%
Mobile Sources	0%	-7%	5%	2%	-3%	-7%	-20%	-23%	-26%	-30%
Industrial Fuel Combustion & Processes	0%	-8%	5%	-16%	-17%	-18%	-19%	-19%	-20%	-28%
All Others	0%	-60%	0%	-33%	-37%	-40%	-46%	-51%	-55%	-45%
Total	**0%**	**-8%**	**5%**	**-8%**	**-10%**	**-13%**	**-19%**	**-21%**	**-23%**	**-29%**

Wisconsin Emission Trends (VOC)

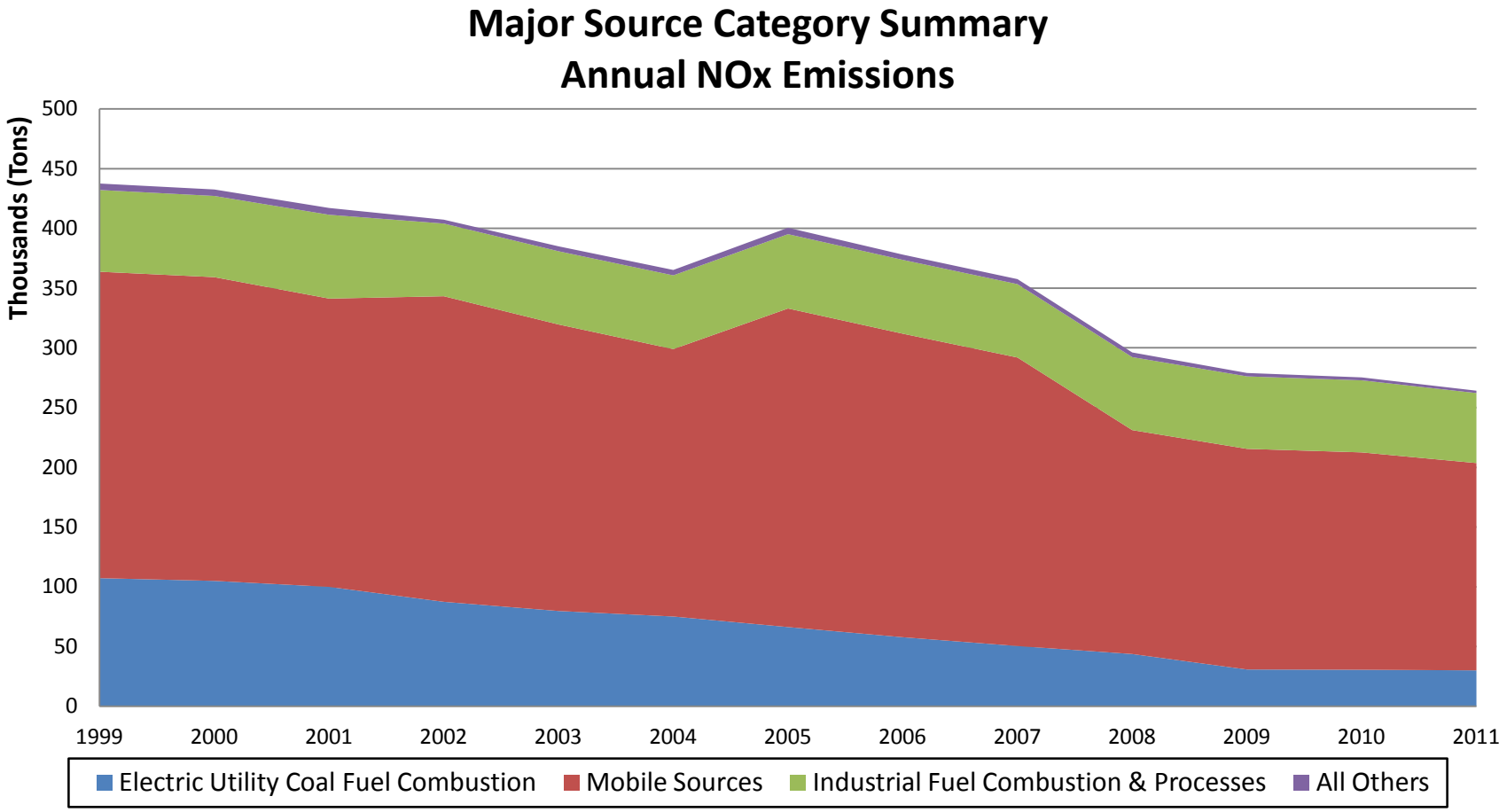


Wisconsin Emission Trends (NOx)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	107,221	99,927	79,751	66,291	57,783	50,422	43,730	30,777	30,550	30,049
Mobile Sources	256,479	241,300	239,801	266,646	254,056	241,466	187,416	184,676	181,936	173,514
Industrial Fuel Combustion & Processes	68,410	70,154	61,285	62,201	61,792	61,426	61,067	60,652	60,313	58,583
All Others	5,406	5,678	4,110	5,378	4,389	4,189	3,919	2,846	2,460	1,971
Total	**437,516**	**417,059**	**384,947**	**400,516**	**378,020**	**357,504**	**296,132**	**278,952**	**275,259**	**264,117**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-7%	-26%	-38%	-46%	-53%	-59%	-71%	-72%	-72%
Mobile Sources	0%	-6%	-7%	4%	-1%	-6%	-27%	-28%	-29%	-32%
Industrial Fuel Combustion & Processes	0%	3%	-10%	-9%	-10%	-10%	-11%	-11%	-12%	-14%
All Others	0%	5%	-24%	-1%	-19%	-23%	-28%	-47%	-55%	-64%
Total	**0%**	**-5%**	**-12%**	**-8%**	**-14%**	**-18%**	**-32%**	**-36%**	**-37%**	**-40%**

Wisconsin Emission Trends (NOx)

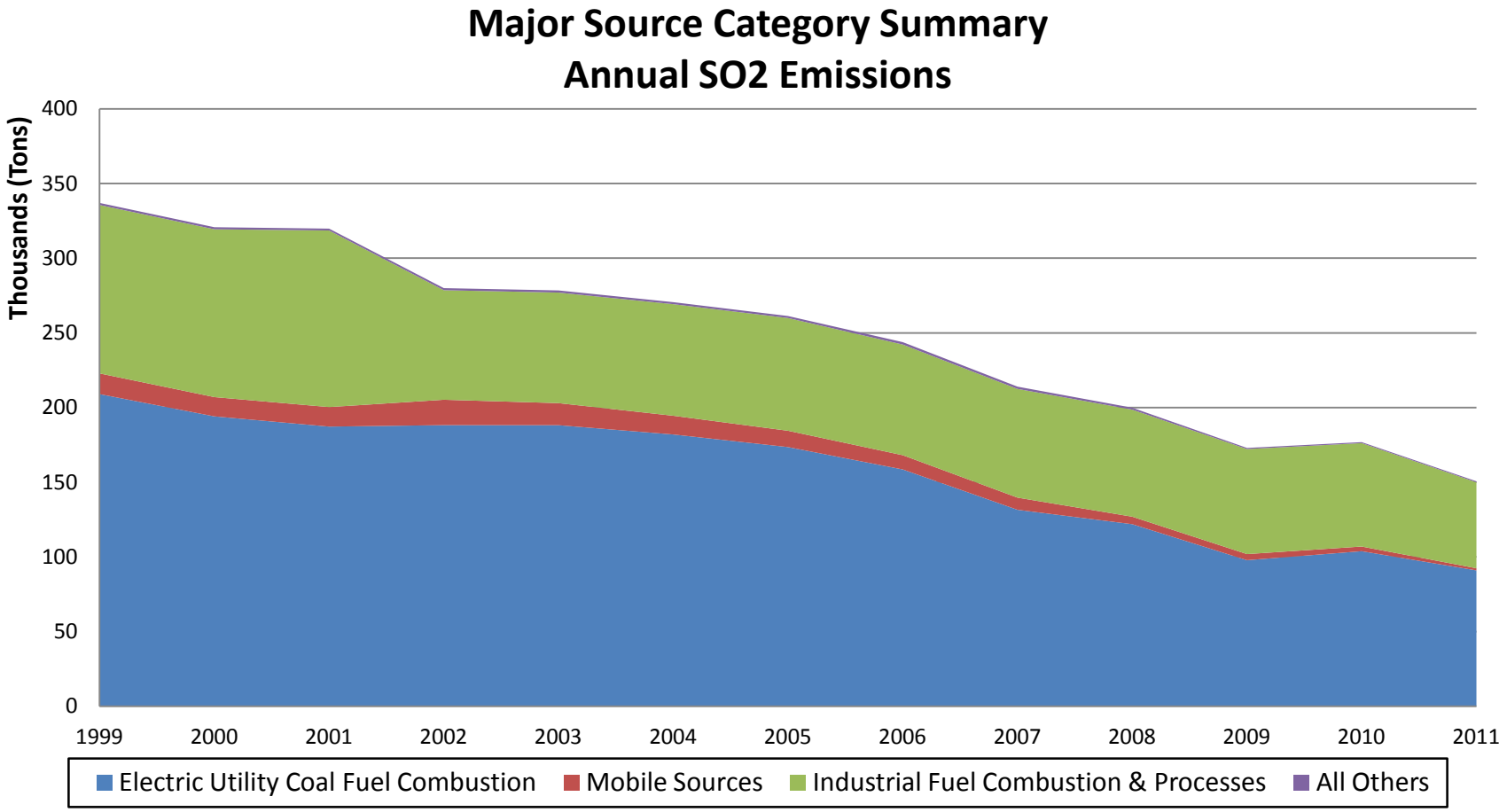


Wisconsin Emission Trends (SO_2)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	209,008	187,264	188,197	173,548	158,573	131,561	121,924	97,818	103,823	90,976
Mobile Sources	13,855	13,057	14,776	10,931	9,536	8,141	5,022	4,078	3,135	1,420
Industrial Fuel Combustion & Processes	112,774	118,244	74,024	75,479	74,104	72,794	71,681	70,312	69,244	57,575
All Others	1,375	1,250	1,434	1,335	1,602	1,513	1,273	757	658	673
Total	**337,011**	**319,815**	**278,431**	**261,292**	**243,816**	**214,009**	**199,900**	**172,966**	**176,860**	**150,644**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-10%	-10%	-17%	-24%	-37%	-42%	-53%	-50%	-56%
Mobile Sources	0%	-6%	7%	-21%	-31%	-41%	-64%	-71%	-77%	-90%
Industrial Fuel Combustion & Processes	0%	5%	-34%	-33%	-34%	-35%	-36%	-38%	-39%	-49%
All Others	0%	-9%	4%	-3%	17%	10%	-7%	-45%	-52%	-51%
Total	**0%**	**-5%**	**-17%**	**-22%**	**-28%**	**-36%**	**-41%**	**-49%**	**-48%**	**-55%**

Wisconsin Emission Trends (SO_2)

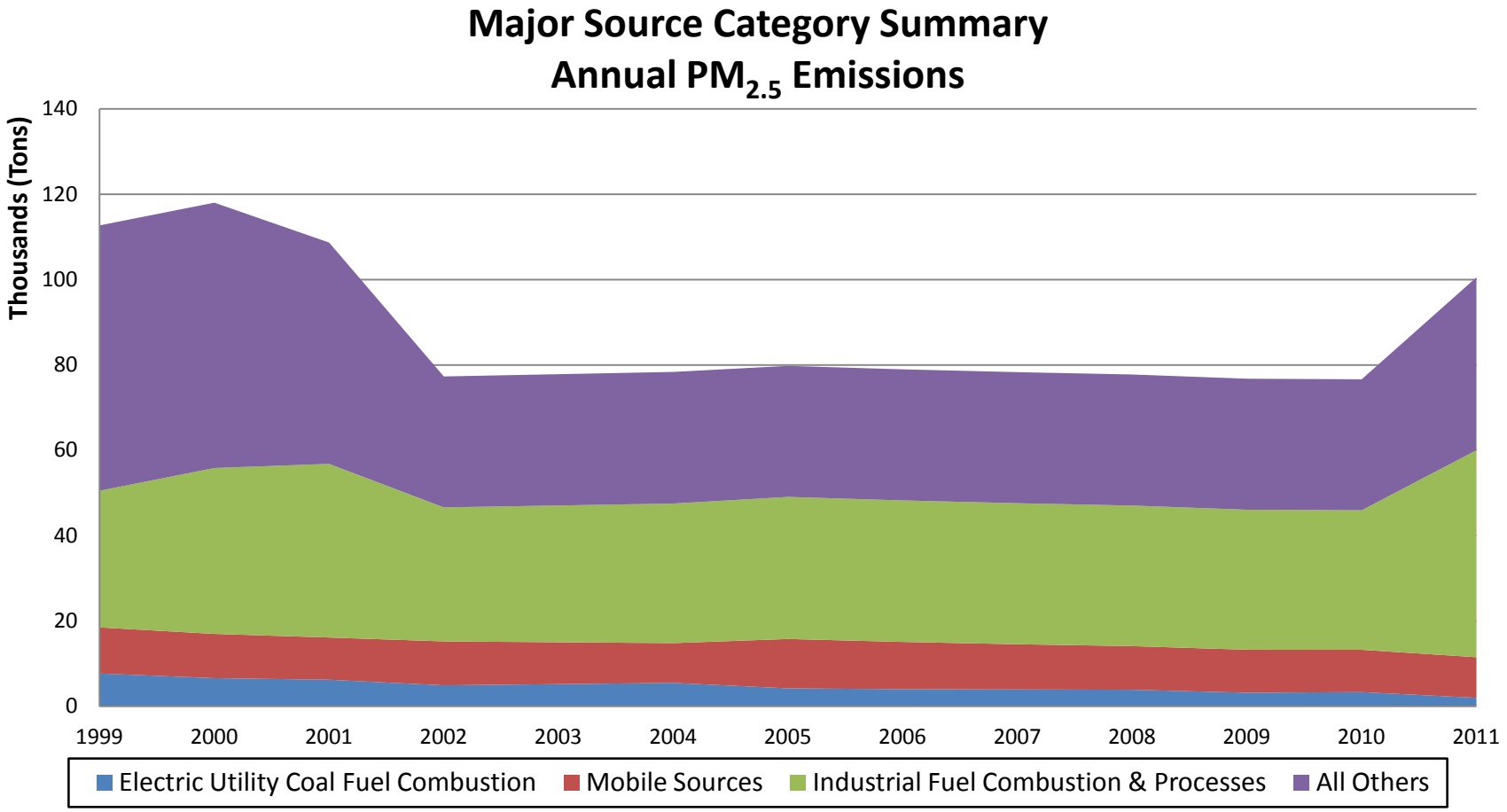


Wisconsin Emission Trends ($PM_{2.5}$)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	7,677	6,222	5,195	4,202	3,999	3,947	3,870	3,178	3,315	1,986
Mobile Sources	10,806	9,893	9,808	11,570	11,078	10,587	10,227	10,074	9,923	9,516
Industrial Fuel Combustion & Processes	32,028	40,690	32,054	33,294	33,167	33,051	32,941	32,809	32,694	48,502
All Others	62,183	51,872	30,768	30,706	30,715	30,716	30,711	30,702	30,697	40,510
Total	**112,693**	**108,678**	**77,824**	**79,771**	**78,959**	**78,301**	**77,748**	**76,764**	**76,629**	**100,514**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-19%	-32%	-45%	-48%	-49%	-50%	-59%	-57%	-74%
Mobile Sources	0%	-8%	-9%	7%	3%	-2%	-5%	-7%	-8%	-12%
Industrial Fuel Combustion & Processes	0%	27%	0%	4%	4%	3%	3%	2%	2%	51%
All Others	0%	-17%	-51%	-51%	-51%	-51%	-51%	-51%	-51%	-35%
Total	**0%**	**-4%**	**-31%**	**-29%**	**-30%**	**-31%**	**-31%**	**-32%**	**-32%**	**-11%**

Wisconsin Emission Trends ($PM_{2.5}$)



Emission Trends Summary

- All pollutants have decreased since 1999 in aggregate across Wisconsin
- NOx and SO2 from Electric Utility Fuel Combustion sources show significant decrease over time as a result of Acid Rain Program, NOx Budget Trading 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

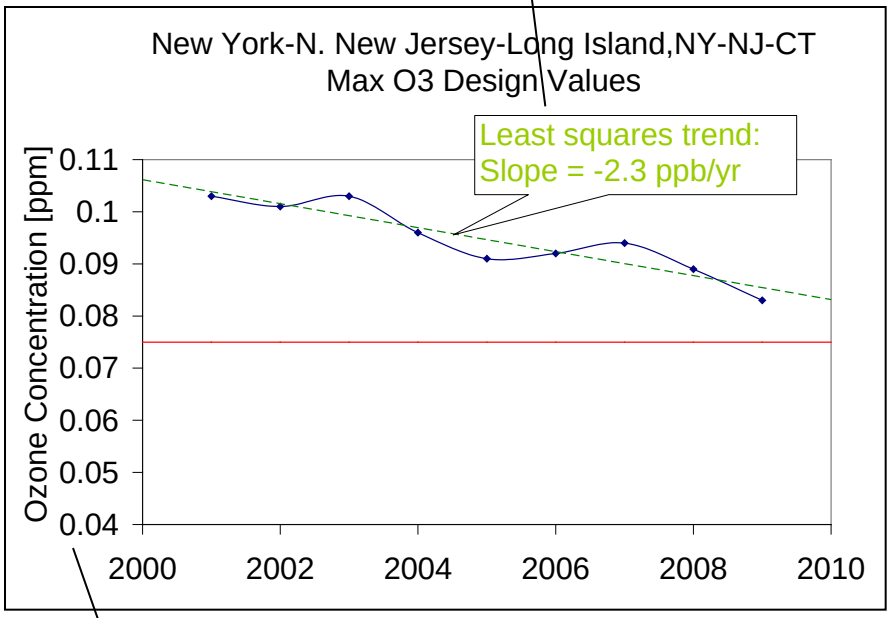
Data Handling Procedures

- 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

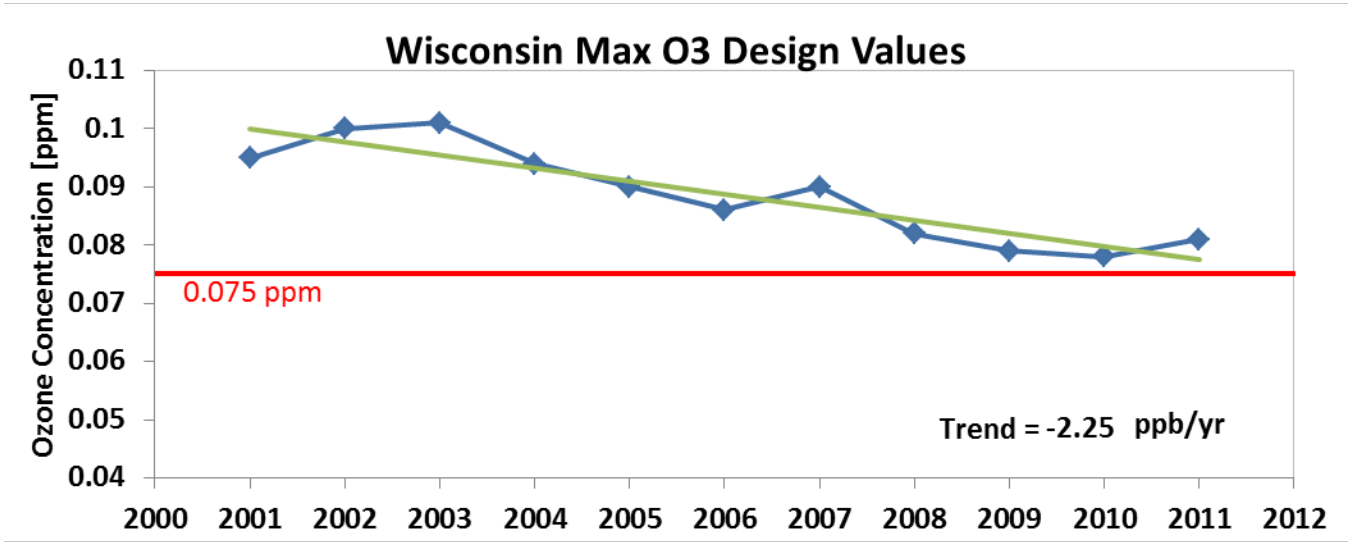
- Annual $PM_{2.5}$ DV and 24-hr $PM_{2.5}$ DV for each overlapping three-year period starting with 1999-2001 and ending with 2009-2011
  - DV calculations based on EPA data handling conventions
  - Data extracted from monitors that have a non-regulatory monitoring type are omitted
  - Selection of trend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

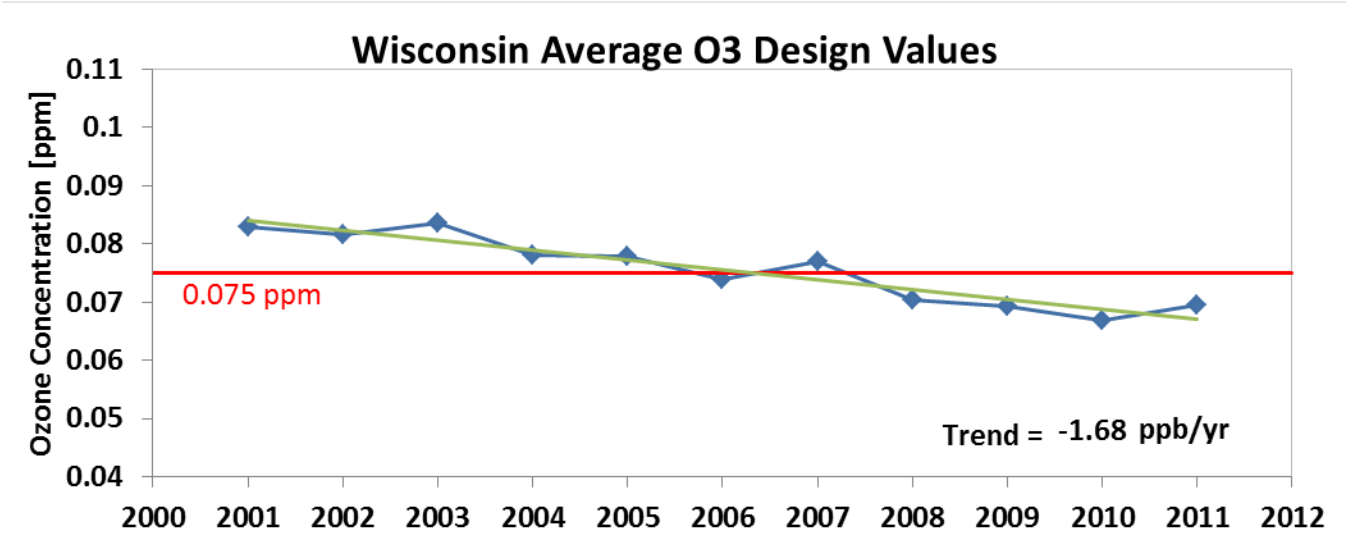
Trend Calculation



- 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





Ozone Trends by Site in Wisconsin

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
5500900264420101	Brown, WI	0.065	-1.83
5502100154420101	Columbia, WI	0.064	-1.53
5502500414420101	Dane, WI	0.063	-1.55
5502700074420101	Dodge, WI	N/A	-1.82
5502900044420101	Door, WI	0.074	-2.10
5503700014420101	Florence, WI	N/A	-1.18
5503900064420101	Fond du Lac, WI	0.067	-1.61
5505500024420101	Jefferson, WI	0.067	-1.96
5505900194420101	Kenosha, WI	0.077	-2.75
5506100024420101	Kewaunee, WI	0.073	-2.14

Note: Only monitoring sites meeting data completeness criteria listed

Ozone Trends by Site in Wisconsin

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
550710007442010 1	Manitowoc, WI	0.077	-1.79
550730012442010 1	Marathon, WI	0.061	-1.35
550790026442010 1	Milwaukee, WI	N/A	-1.58
550790041442010 1	Milwaukee, WI	N/A	-1.73
550790085442010 1	Milwaukee, WI	N/A	-2.25
550850004442010 1	Oneida, WI	N/A	-0.62
550870009442010 1	Outagamie, WI	0.066	-1.46
550890008442010 1	Ozaukee, WI	0.072	-2.38
550890009442010 1	Ozaukee, WI	0.073	-2.78
551010017442010 1	Racine, WI	0.075	-2.30

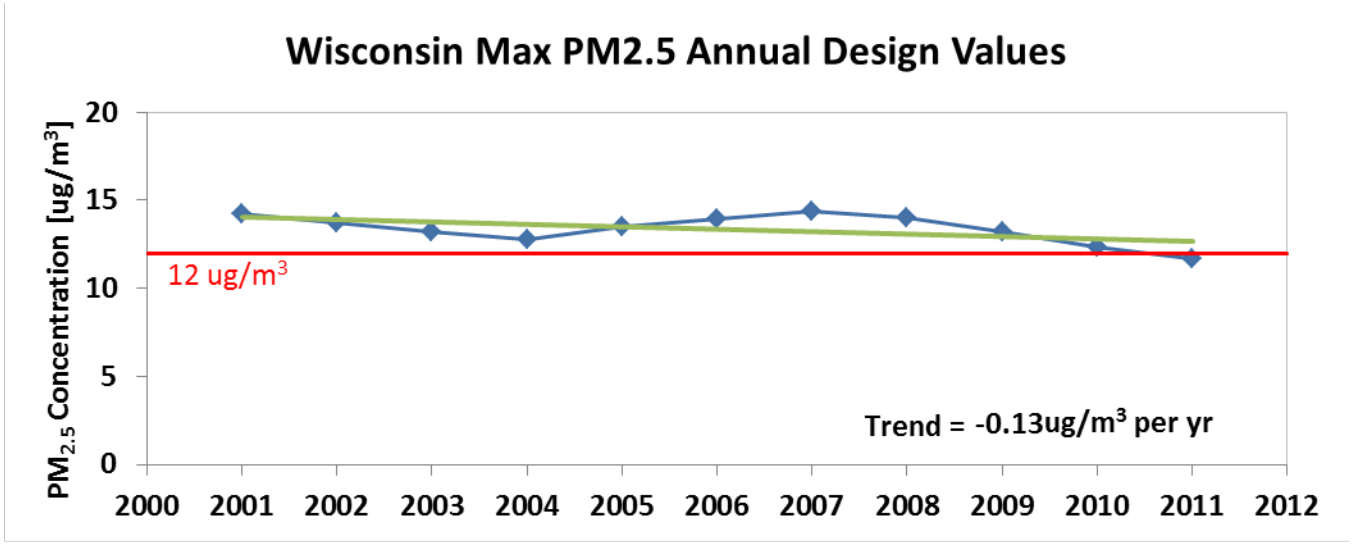
Note: Only monitoring sites meeting data completeness criteria listed

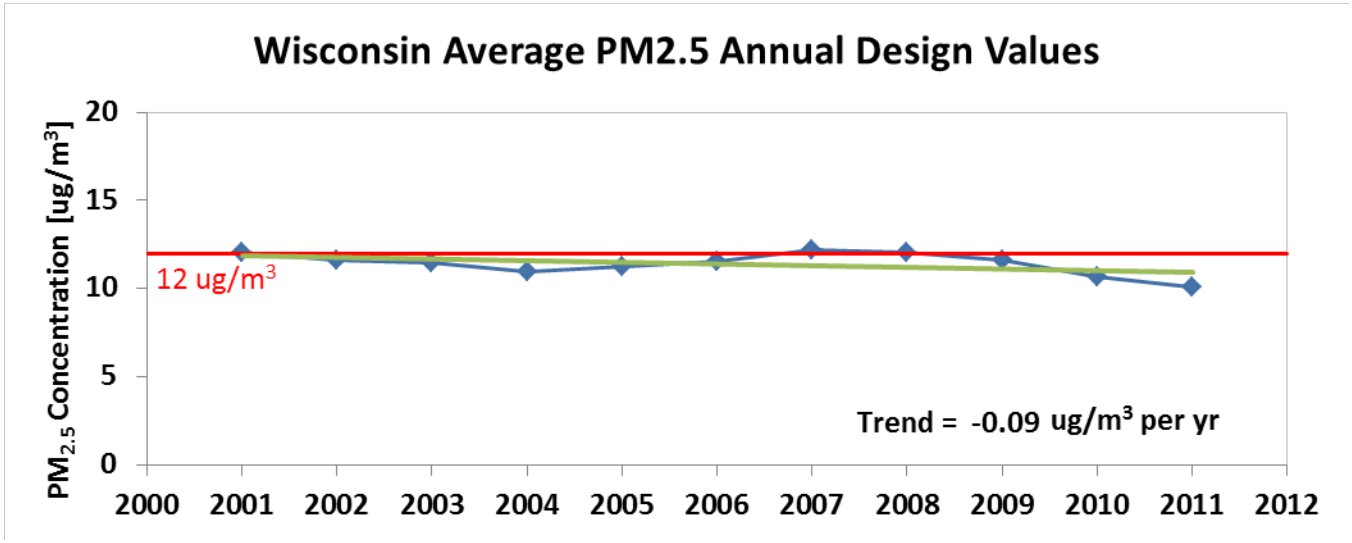
Ozone Trends by Site in Wisconsin

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
5510500244420101	Rock, WI	0.067	-2.12
5510910024420101	St. Croix, WI	N/A	-0.98
5511100074420101	Sauk, WI	0.062	-1.46
5511700064420101	Sheboygan, WI	0.081	-2.15
5512300084420101	Vernon, WI	N/A	-0.87
5512500014420101	Vilas, WI	N/A	-0.48
5512700054420101	Walworth, WI	0.067	-1.92
5513100094420101	Washington, WI	N/A	-2.49

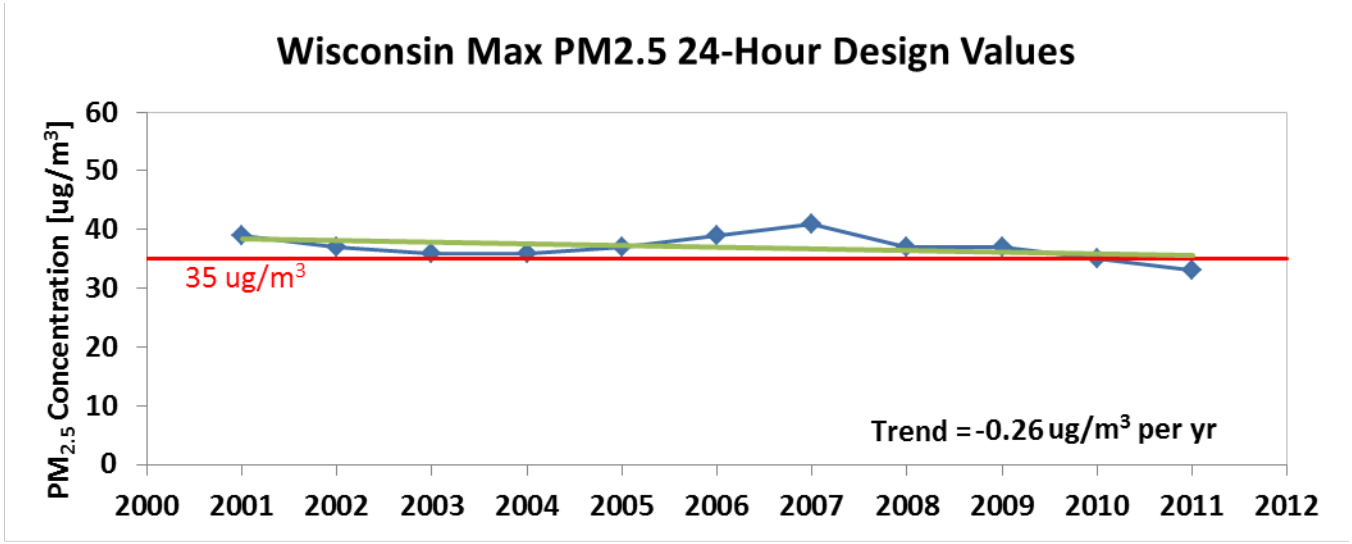
Note: Only monitoring sites meeting data completeness criteria listed

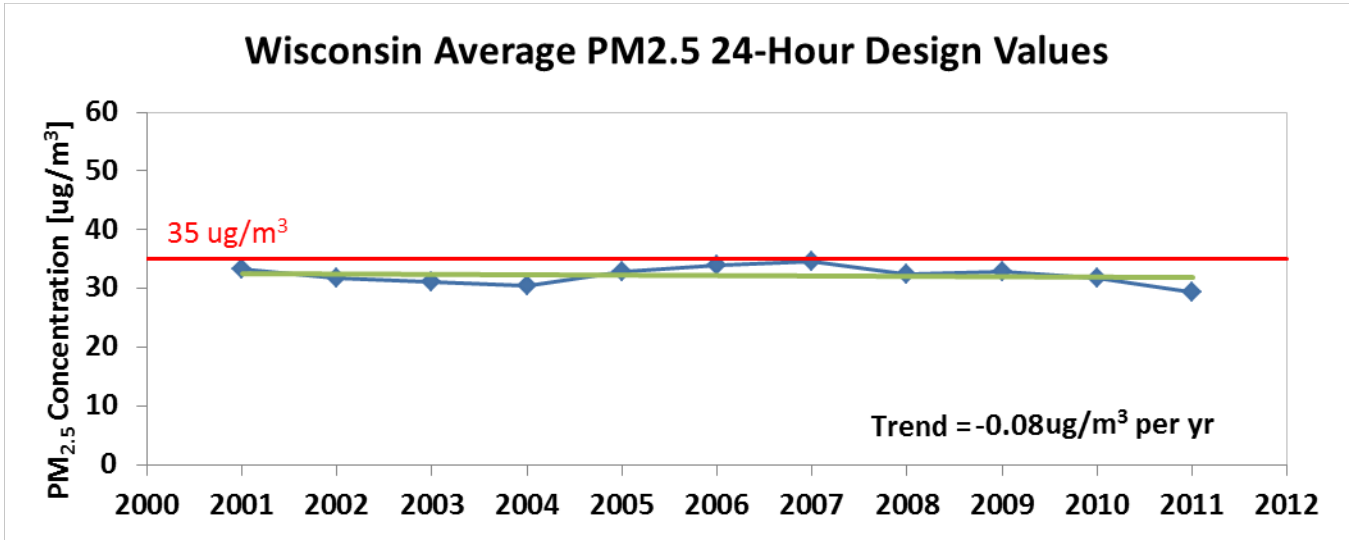
Max/Ave $PM_{2.5}$ Annual DVs and Trend





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





$PM_{2.5}$ Trends by Site in Wisconsin

		2009-2011 DV [ug/m³]		Trend [ug/m³ per year]	
Monitoring Site	County	Annual	24-Hr	Annual DV	24-Hr DV
550090005	Brown	10.4	33	-0.05	0.25
550250047	Dane	10.6	29	-0.15	-0.40
550270007	Dodge	N/A	N/A	-0.08	-0.75
550430009	Grant	10.7	29	-0.03	0.01
550590019	Kenosha	9.7	28	-0.10	-0.16
550710007	Manitowoc	N/A	N/A	0.03	0.02
550790010	Milwaukee	11.1	32	-0.17	-0.35
550790026	Milwaukee	10.8	31	-0.09	-0.09
550790099	Milwaukee	N/A	N/A	0.00	-0.03
550870009	Outagamie	9.8	31	-0.06	0.16
551250001	Vilas	6.1	21	0.00	0.99
551330027	Waukesha	11.7	31	-0.12	-0.43

Note: Only monitoring sites meeting data completeness criteria listed

Air Quality Trends Summary

- Average O_3 design values have decreased since 1999 in Wisconsin, but average $PM_{2.5}$ design values have remained steady since 1999 in Wisconsin

- O_3 and $PM_{2.5}$ design values have decreased since 1999 in all currently designated O_3 and $PM_{2.5}$ non-attainment areas