Emission and Air Quality Trends Review 1999-2011

West Virginia

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

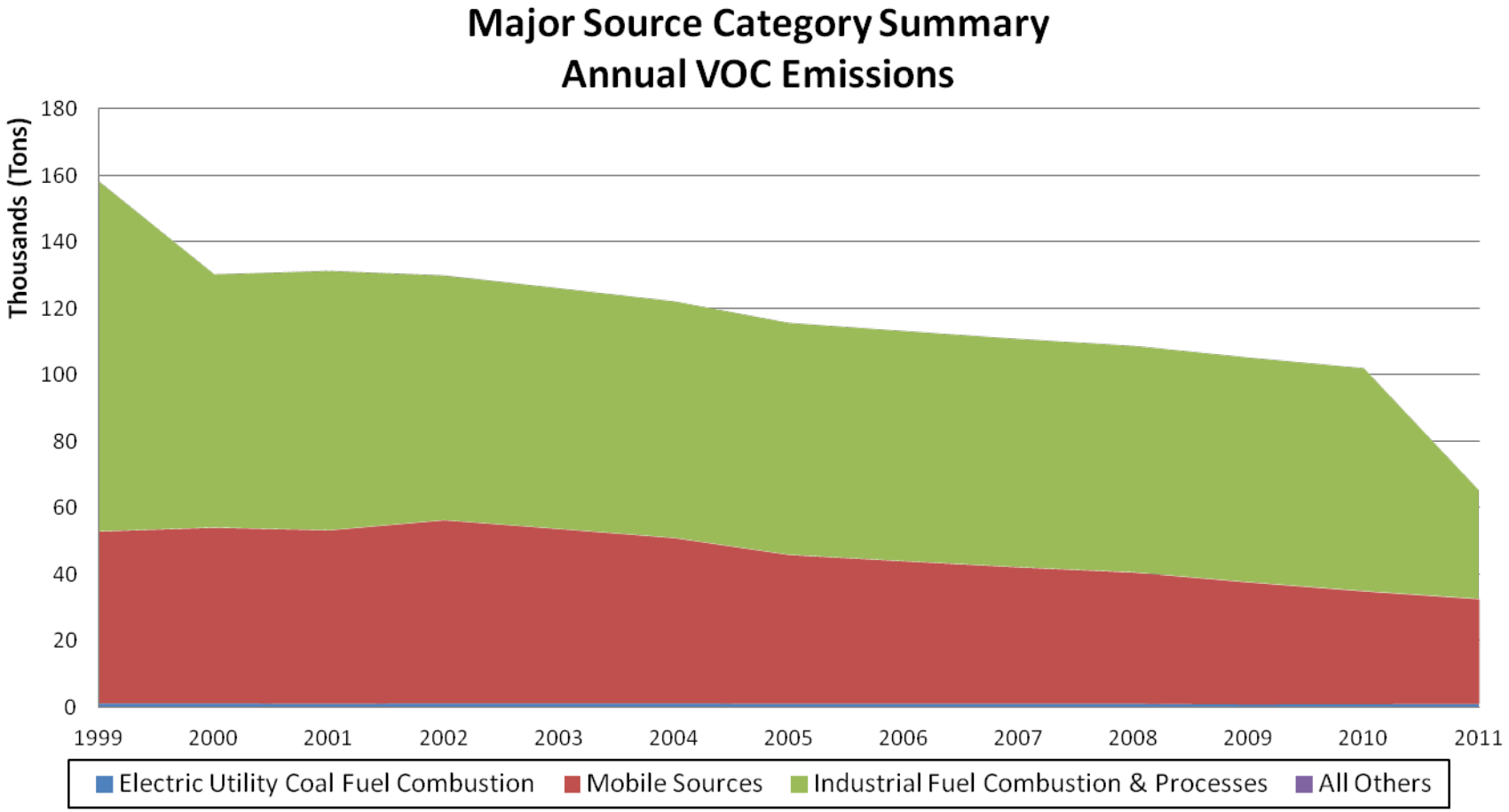
- Negative values indicate decrease in emissions, positive values indicate an increase

West Virginia Emission Trends (VOC)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	1,151	1,055	1,195	1,048	1,035	1,075	1,062	837	923	1,007
Mobile Sources	51,716	52,146	52,398	44,746	42,860	40,975	39,444	36,683	33,922	31,483
Industrial Fuel Combustion & Processes	105,319	78,107	72,465	69,823	69,283	68,742	68,202	67,661	67,121	32,692
All Others	10	11	8	5	6	6	9	9	8	4
Total	**158,195**	**131,319**	**126,066**	**115,622**	**113,183**	**110,798**	**108,716**	**105,190**	**101,974**	**65,186**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-8%	4%	-9%	-10%	-7%	-8%	-27%	-20%	-13%
Mobile Sources	0%	1%	1%	-13%	-17%	-21%	-24%	-29%	-34%	-39%
Industrial Fuel Combustion & Processes	0%	-26%	-31%	-34%	-34%	-35%	-35%	-36%	-36%	-69%
All Others	0%	8%	-20%	-52%	-44%	-43%	-7%	-11%	-24%	-58%
Total	**0%**	**-17%**	**-20%**	**-27%**	**-28%**	**-30%**	**-31%**	**-34%**	**-36%**	**-59%**

West Virginia Emission Trends (VOC)

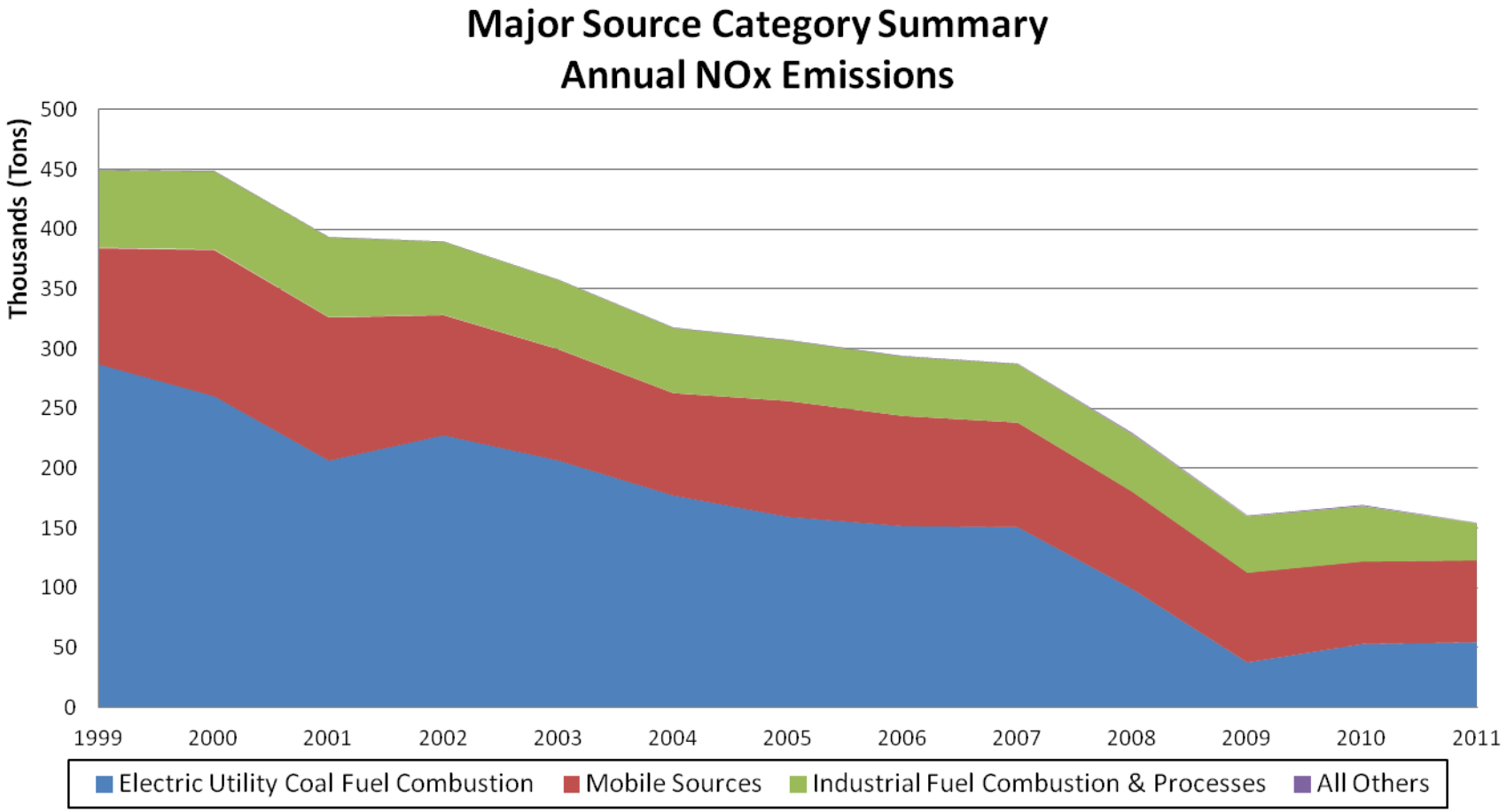


West Virginia Emission Trends (NOx)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	287,079	206,481	206,553	159,407	151,573	150,743	98,787	37,250	52,716	54,218
Mobile Sources	97,510	120,059	93,324	97,244	92,495	87,746	81,749	75,635	69,521	68,992
Industrial Fuel Combustion & Processes	64,957	66,759	57,820	50,500	49,677	48,854	48,031	47,208	46,385	31,281
All Others	310	292	270	382	389	377	951	577	800	72
Total	**449,856**	**393,591**	**357,967**	**307,533**	**294,134**	**287,720**	**229,517**	**160,669**	**169,420**	**154,563**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-28%	-28%	-44%	-47%	-47%	-66%	-87%	-82%	-81%
Mobile Sources	0%	23%	-4%	0%	-5%	-10%	-16%	-22%	-29%	-29%
Industrial Fuel Combustion & Processes	0%	3%	-11%	-22%	-24%	-25%	-26%	-27%	-29%	-52%
All Others	0%	-6%	-13%	23%	25%	22%	206%	86%	158%	-77%
Total	**0%**	**-13%**	**-20%**	**-32%**	**-35%**	**-36%**	**-49%**	**-64%**	**-62%**	**-66%**

West Virginia Emission Trends (NOx)

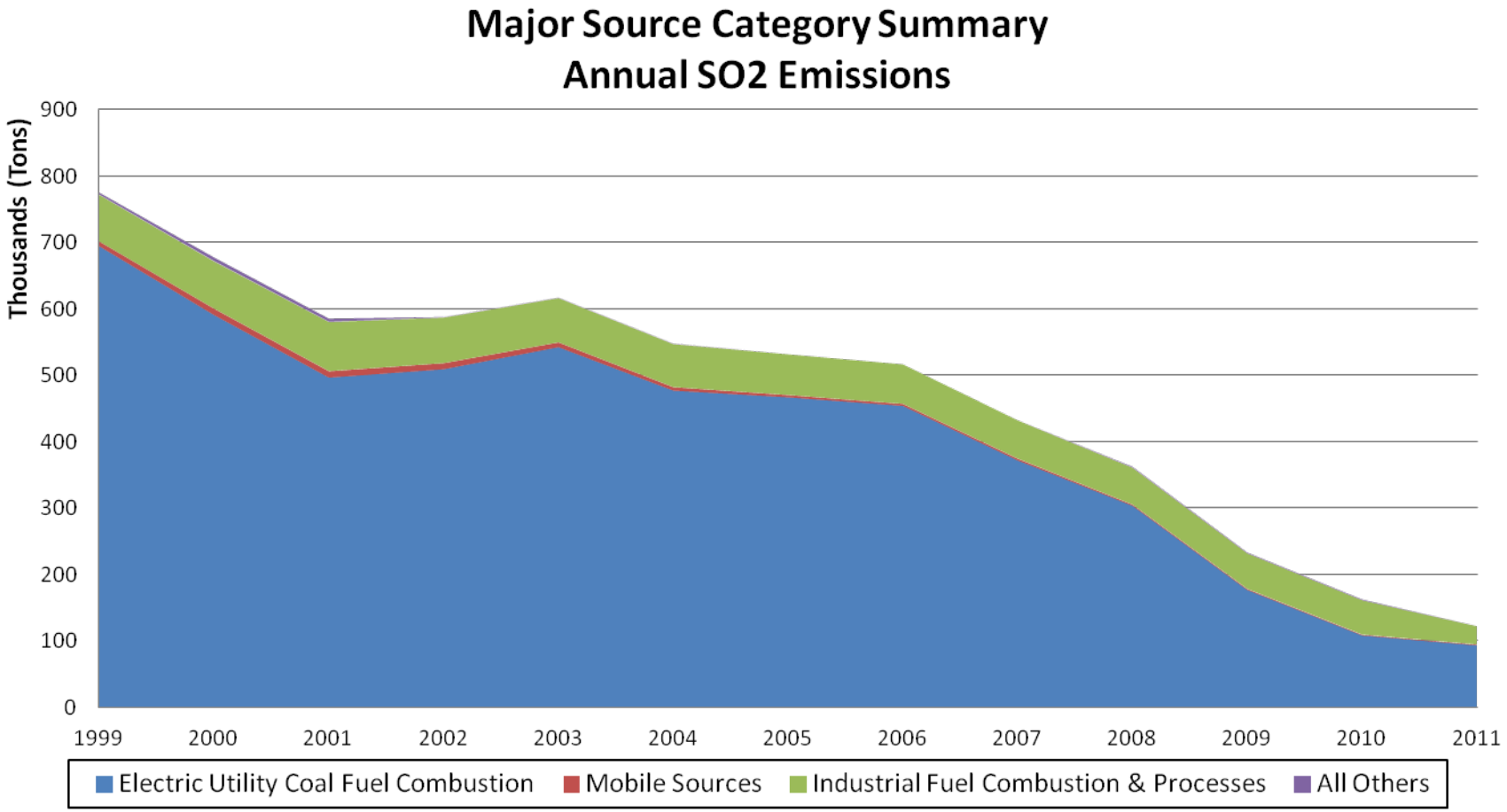


West Virginia Emission Trends (SO_2)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	694,827	496,819	542,757	467,076	454,156	371,991	303,685	176,614	108,076	93,064
Mobile Sources	7,241	9,656	7,185	3,426	3,022	2,617	1,649	1,387	1,125	1,112
Industrial Fuel Combustion & Processes	70,241	74,147	66,784	61,310	59,391	57,472	55,553	53,634	51,715	27,378
All Others	2,787	4,534	282	10	5	9	1,092	992	992	17
Total	**775,096**	**585,156**	**617,009**	**531,822**	**516,575**	**432,089**	**361,979**	**232,628**	**161,908**	**121,570**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-28%	-22%	-33%	-35%	-46%	-56%	-75%	-84%	-87%
Mobile Sources	0%	33%	-1%	-53%	-58%	-64%	-77%	-81%	-84%	-85%
Industrial Fuel Combustion & Processes	0%	6%	-5%	-13%	-15%	-18%	-21%	-24%	-26%	-61%
All Others	0%	63%	-90%	-100%	-100%	-100%	-61%	-64%	-64%	-99%
Total	**0%**	**-25%**	**-20%**	**-31%**	**-33%**	**-44%**	**-53%**	**-70%**	**-79%**	**-84%**

West Virginia Emission Trends (SO_2)

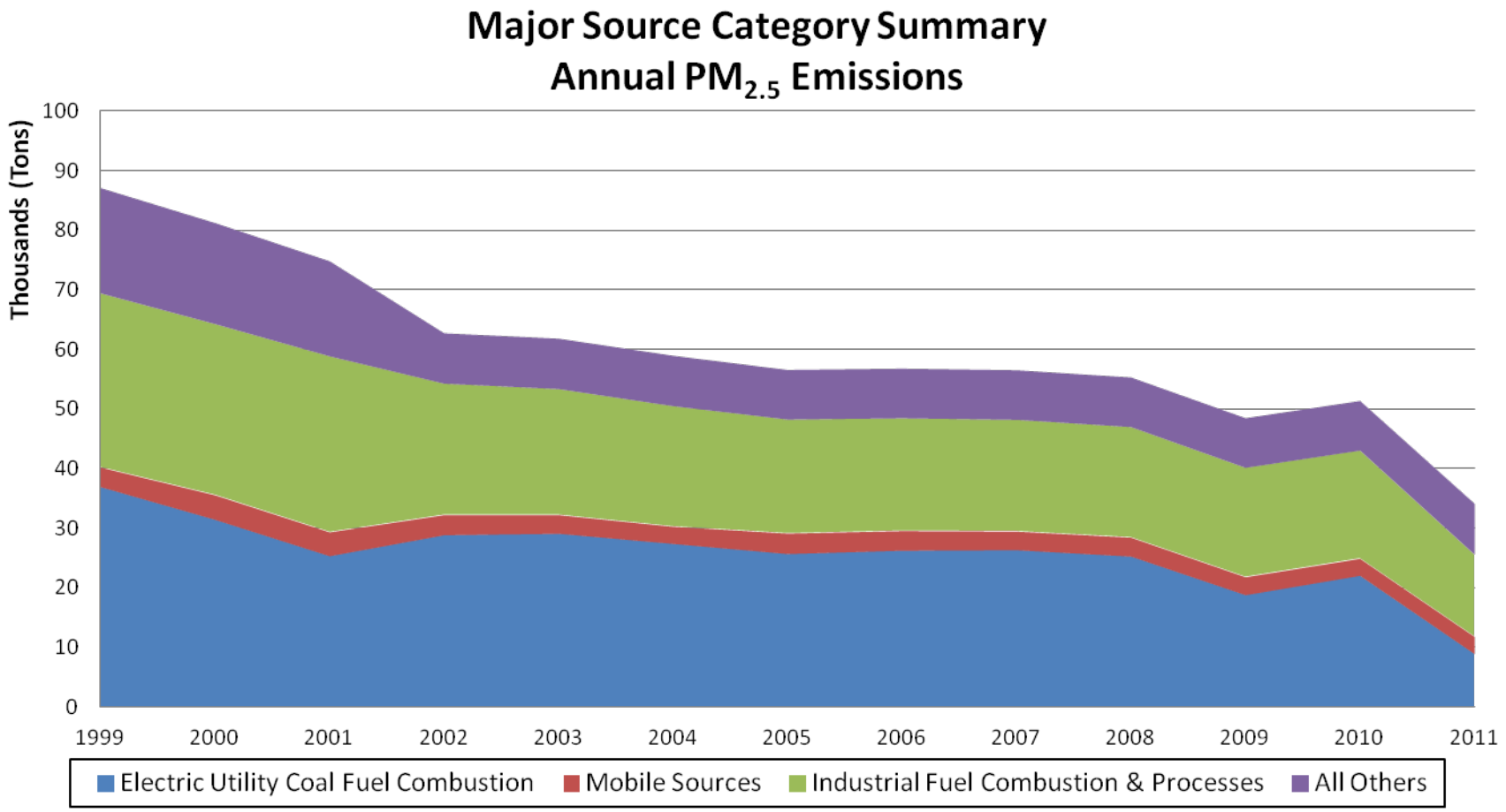


West Virginia Emission Trends ($PM_{2.5}$)

	Annual Emissions (Tons)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	36,963	25,350	29,123	25,711	26,279	26,355	25,287	18,802	22,062	8,914
Mobile Sources	3,278	4,006	3,134	3,448	3,294	3,139	3,181	3,018	2,856	2,884
Industrial Fuel Combustion & Processes	29,169	29,484	21,082	19,064	18,871	18,679	18,486	18,294	18,101	13,742
All Others	17,664	15,951	8,452	8,308	8,310	8,312	8,320	8,321	8,319	8,537
Total	**87,074**	**74,792**	**61,791**	**56,530**	**56,754**	**56,485**	**55,274**	**48,435**	**51,338**	**34,076**

	Annual Emissions Change (Percent since 1999)									
Source Category	**1999**	**2001**	**2003**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Electric Utility Coal Fuel Combustion	0%	-31%	-21%	-30%	-29%	-29%	-32%	-49%	-40%	-76%
Mobile Sources	0%	22%	-4%	5%	0%	-4%	-3%	-8%	-13%	-12%
Industrial Fuel Combustion & Processes	0%	1%	-28%	-35%	-35%	-36%	-37%	-37%	-38%	-53%
All Others	0%	-10%	-52%	-53%	-53%	-53%	-53%	-53%	-53%	-52%
Total	**0%**	**-14%**	**-29%**	**-35%**	**-35%**	**-35%**	**-37%**	**-44%**	**-41%**	**-61%**

West Virginia Emission Trends ($PM_{2.5}$)



Emission Trends Summary

- All pollutants have decreased since 1999 in aggregate across West Virginia
- 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

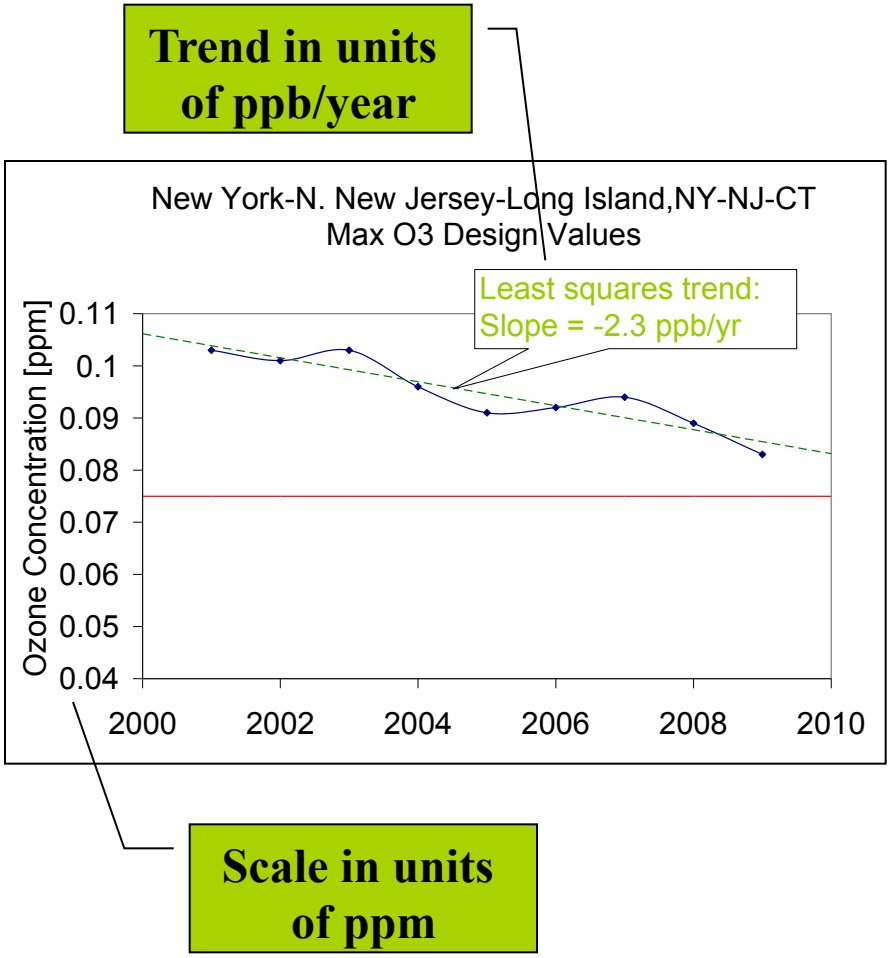
Data Handling Procedures

- 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

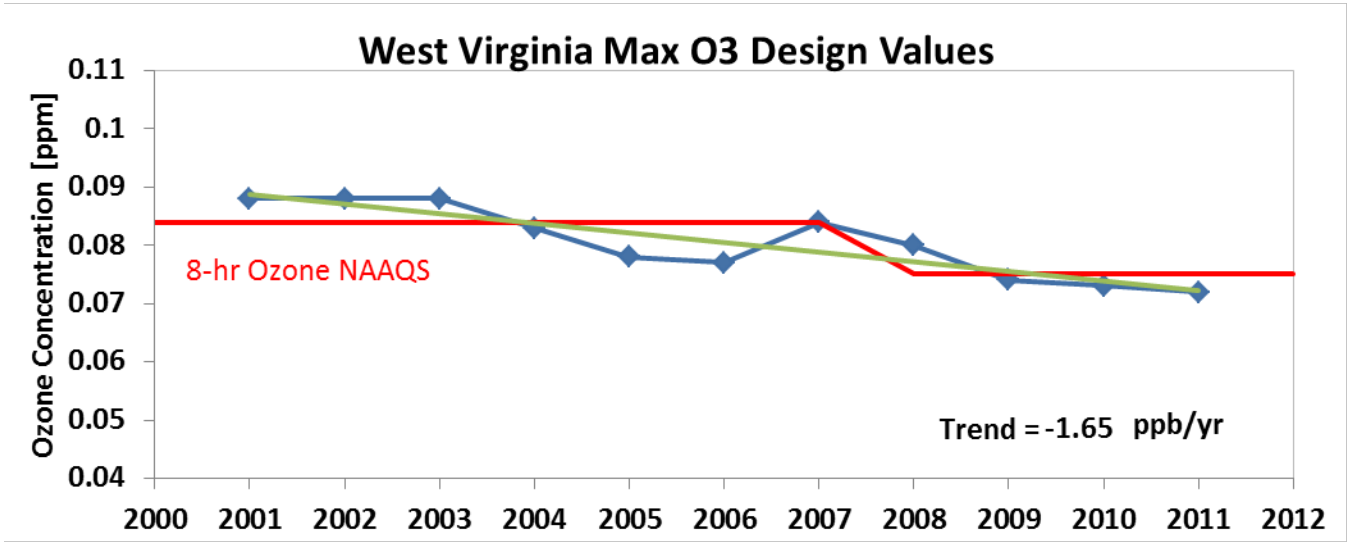
- Annual $PM_{2.5}$ DV and 24-hr $PM_{2.5}$ DV for each overlapping three-year period starting with 1999-2001 and ending with 2009-2011
  - DV calculations based on EPA data handling conventions
  - Data extracted from monitors that have a non-regulatory monitoring type are omitted
  - Selection of trend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

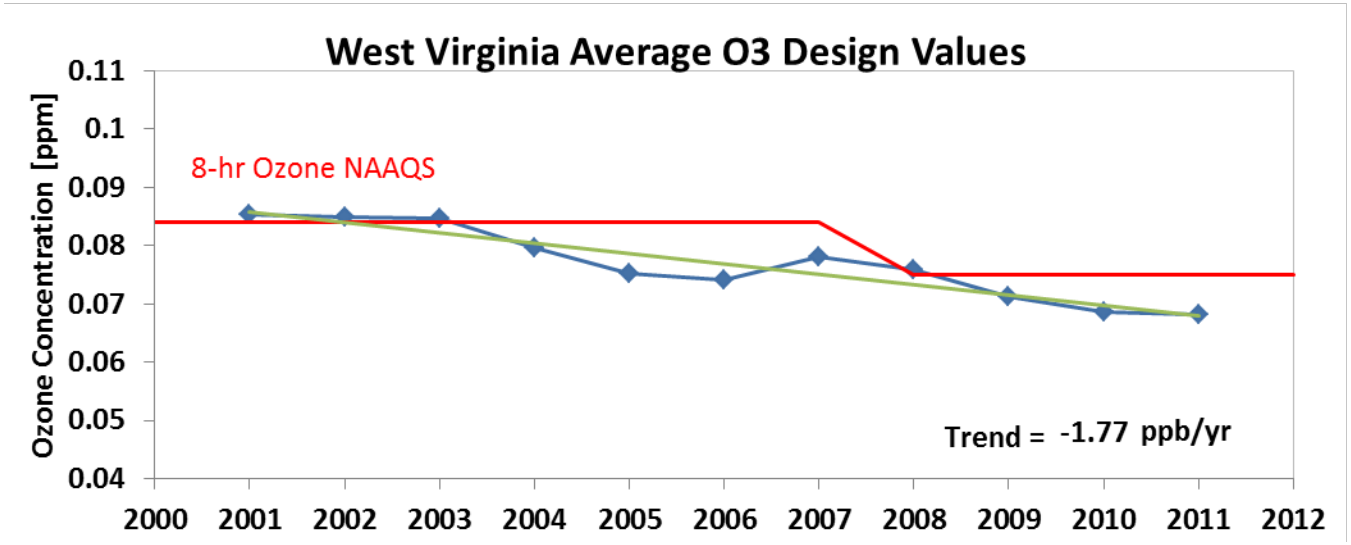
Trend Calculation



- 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



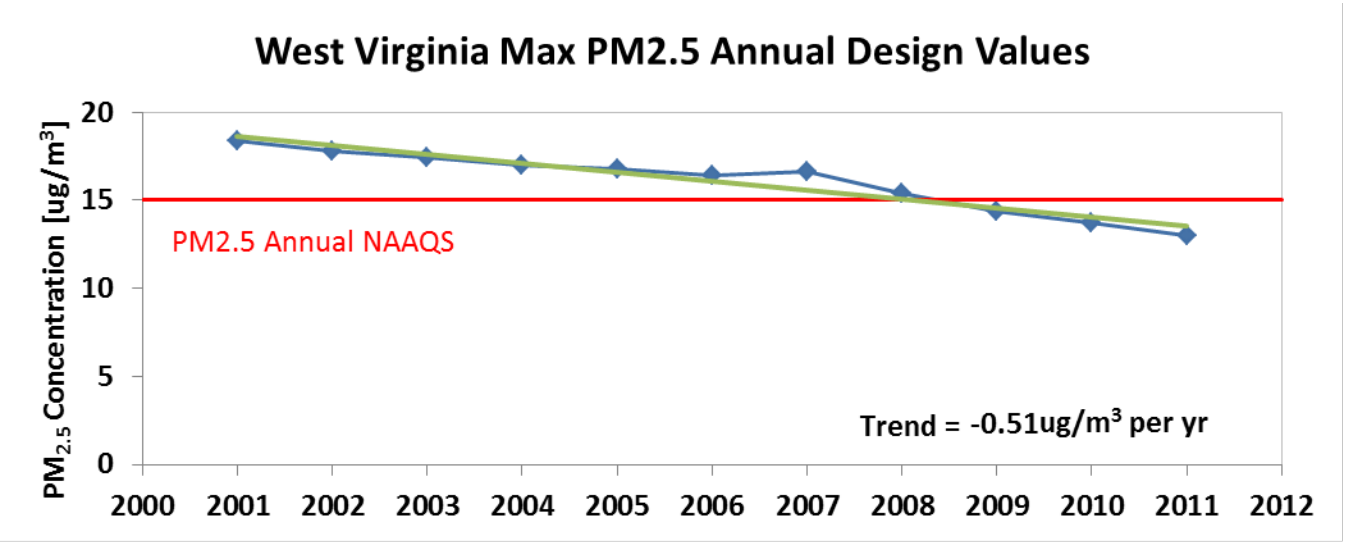


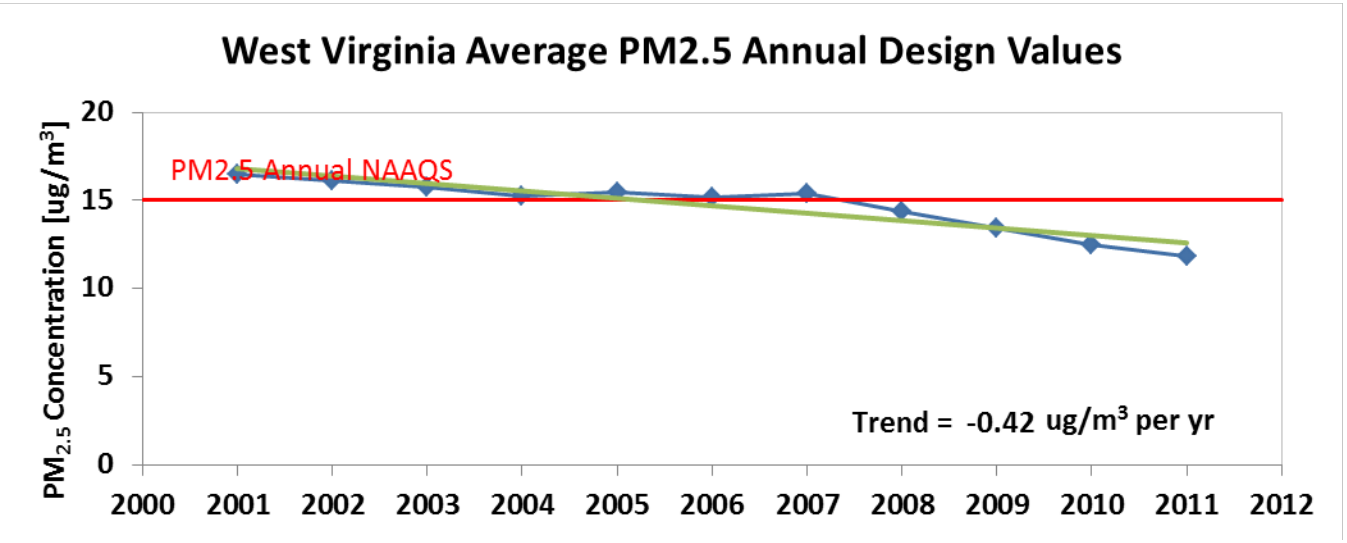
Ozone Trends by Site in West Virginia

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
5400300034420101	Berkeley, WV	0.068	-1.90
5401100064420101	Cabell, WV	0.067	-2.11
5402500034420101	Greenbrier, WV	0.065	-1.77
5402910044420101	Hancock, WV	0.072	-1.31
5403900104420101	Kanawha, WV	0.07	-1.76
5406100034420101	Monongalia, WV	0.069	-1.33
5410710024420101	Wood, WV	0.066	-2.17

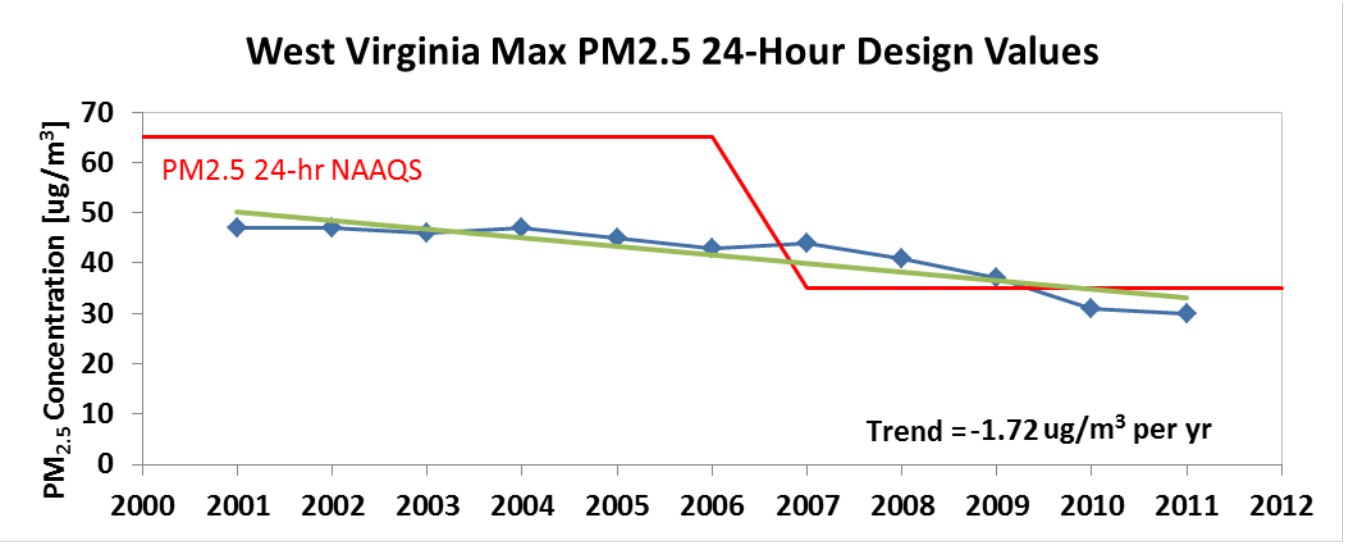
Note: Only monitoring sites meeting data completeness criteria listed

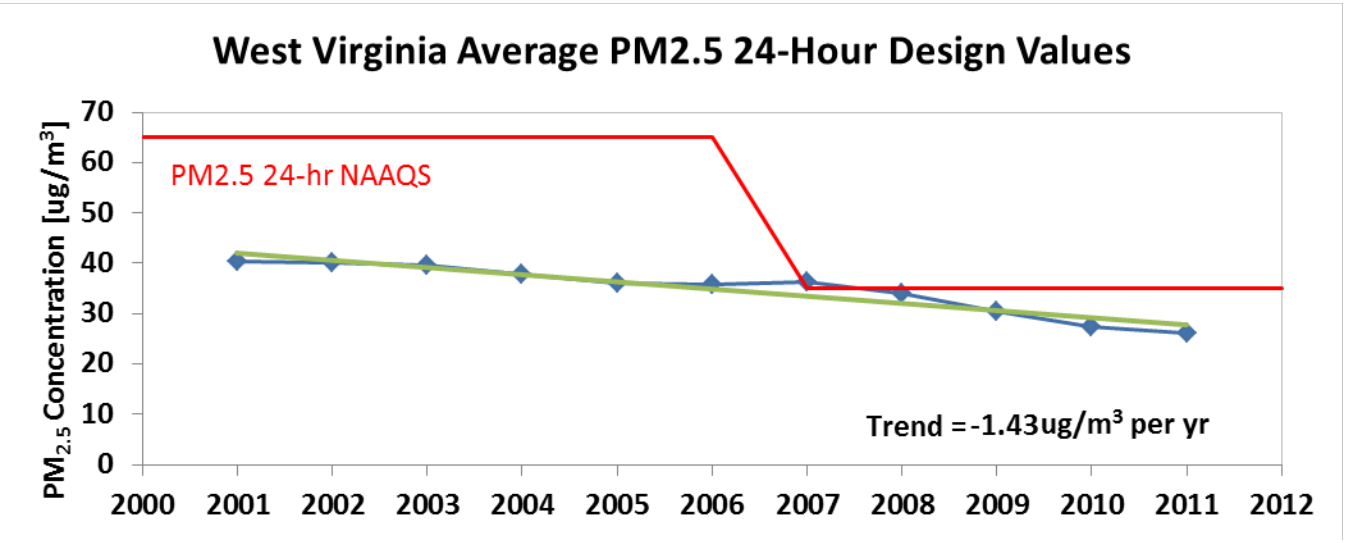
Max/Ave $PM_{2.5}$ Annual DVs and Trend





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





$PM_{2.5}$ Trends by Site in West Virginia

		2009-2011 DV [ug/m³]		Trend [ug/m³ per year]	
Monitoring Site	**County**	**Annual**	**24-Hr**	**Annual DV**	**24-Hr DV**
540030003	Berkeley	11.8	30	-0.40	-1.55
540090005	Brooke	13.0	27	-0.40	-1.38
540090011	Brooke	N/A	N/A	-0.32	-1.52
540110006	Cabell	12.1	25	-0.48	-1.81
540291004	Hancock	11.7	28	-0.61	-1.74
540330003	Harrison	N/A	N/A	-0.26	-1.21
540390010	Kanawha	11.0	24	-0.51	-1.31
540391005	Kanawha	12.5	26	-0.53	-1.32
540490006	Marion	12.1	26	-0.35	-1.59
540511002	Marshall	13.0	29	-0.34	-0.79
540610003	Monongalia	10.9	25	-0.39	-1.29
540810002	Raleigh	9.6	20	-0.39	-1.51
541071002	Wood	12.3	27	-0.46	-1.24

Note: Only monitoring sites meeting data completeness criteria listed

Air Quality Trends Summary

- Average O_3 and $PM_{2.5}$ design values have decreased since 1999 in West Virginia

- There are no currently designated O_3 non-attainment areas in West Virginia; $PM_{2.5}$ design values have decreased since 1999 in all currently designated $PM_{2.5}$ non-attainment areas in West Virginia