

Emission and Air Quality Trends Review

Maryland

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, NO_x, SO₂, 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

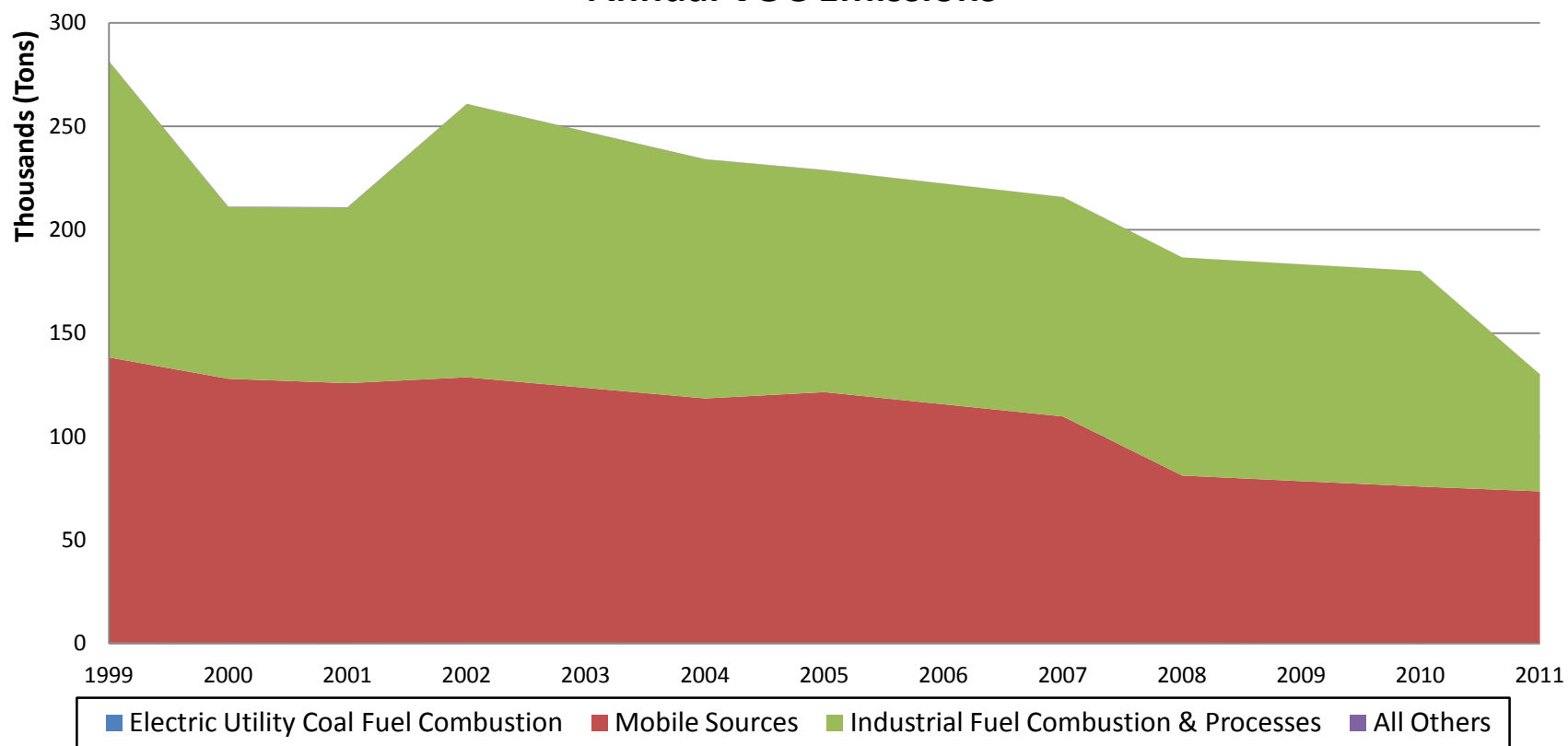
Maryland Emission Trends (VOC)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	393	337	371	365	364	368	354	312	330	218
Mobile Sources	137,875	125,505	123,210	121,139	115,259	109,379	80,824	78,174	75,525	73,326
Industrial Fuel Combustion & Processes	142,984	84,836	123,778	107,262	106,642	106,022	105,401	104,781	104,161	56,590
All Others	190	240	129	130	65	72	53	40	52	17
Total	281,442	210,918	247,488	228,896	222,329	215,840	186,634	183,307	180,068	130,150

Source Category	Annual Emissions Change (Percent since 1999)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0%	-14%	-6%	-7%	-7%	-6%	-10%	-21%	-16%	-45%
Mobile Sources	0%	-9%	-11%	-12%	-16%	-21%	-41%	-43%	-45%	-47%
Industrial Fuel Combustion & Processes	0%	-41%	-13%	-25%	-25%	-26%	-26%	-27%	-27%	-60%
All Others	0%	26%	-32%	-32%	-66%	-62%	-72%	-79%	-73%	-91%
Total	0%	-25%	-12%	-19%	-21%	-23%	-34%	-35%	-36%	-54%

Maryland Emission Trends (VOC)

**Major Source Category Summary
Annual VOC Emissions**



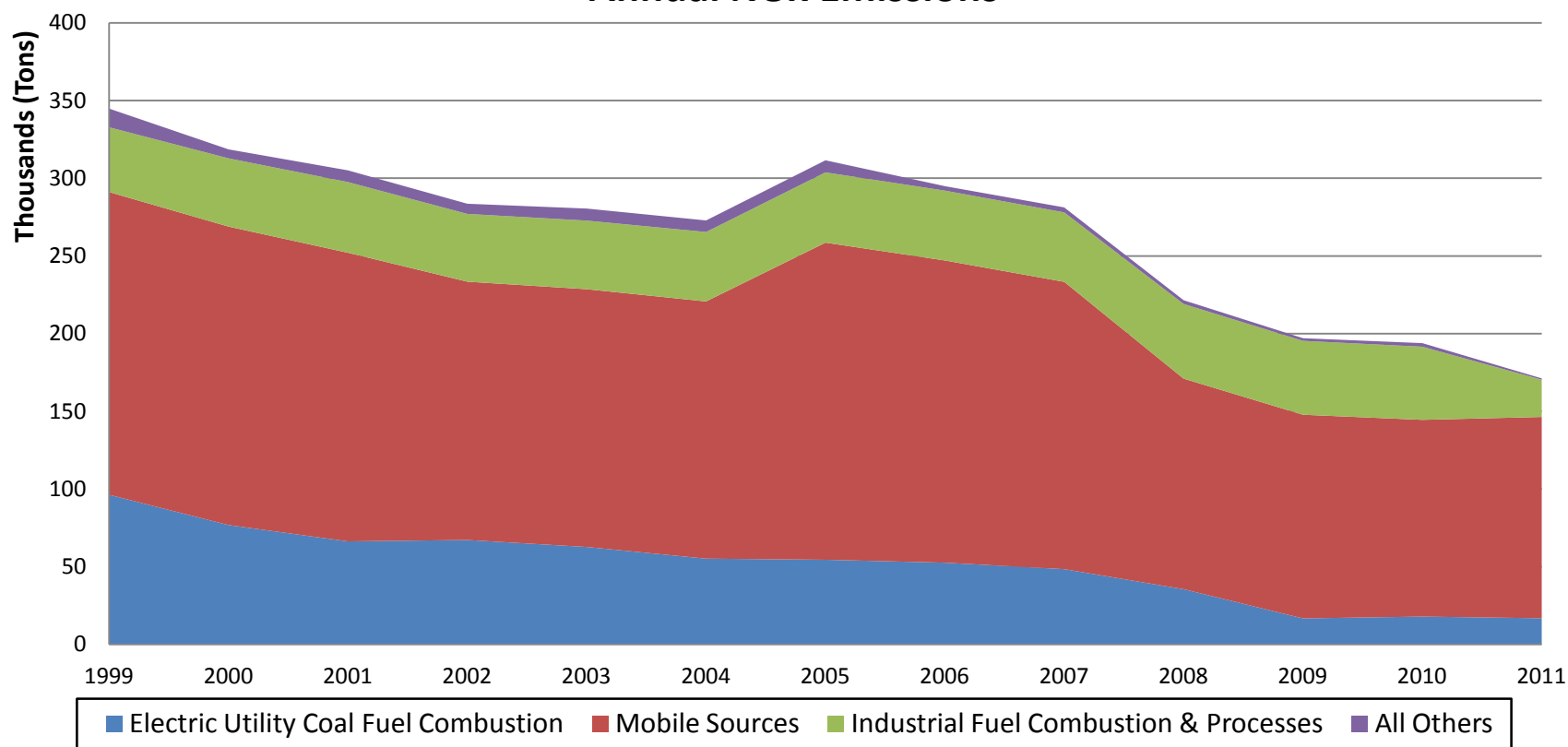
Maryland Emission Trends (NO_x)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	96,271	66,300	62,698	54,465	52,577	48,423	35,518	16,732	17,882	16,823
Mobile Sources	194,822	185,752	165,901	204,106	194,514	184,921	135,524	131,077	126,631	129,558
Industrial Fuel Combustion & Processes	41,704	45,491	44,156	45,224	44,961	44,697	48,060	47,549	47,074	23,977
All Others	12,015	7,545	7,747	7,769	2,869	3,197	2,412	1,706	2,294	834
Total	344,813	305,088	280,502	311,563	294,920	281,238	221,514	197,064	193,881	171,192

Source Category	Annual Emissions Change (Percent since 1999)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0%	-31%	-35%	-43%	-45%	-50%	-63%	-83%	-81%	-83%
Mobile Sources	0%	-5%	-15%	5%	0%	-5%	-30%	-33%	-35%	-33%
Industrial Fuel Combustion & Processes	0%	9%	6%	8%	8%	7%	15%	14%	13%	-43%
All Others	0%	-37%	-36%	-35%	-76%	-73%	-80%	-86%	-81%	-93%
Total	0%	-12%	-19%	-10%	-14%	-18%	-36%	-43%	-44%	-50%

Maryland Emission Trends (NO_x)

**Major Source Category Summary
Annual NO_x Emissions**



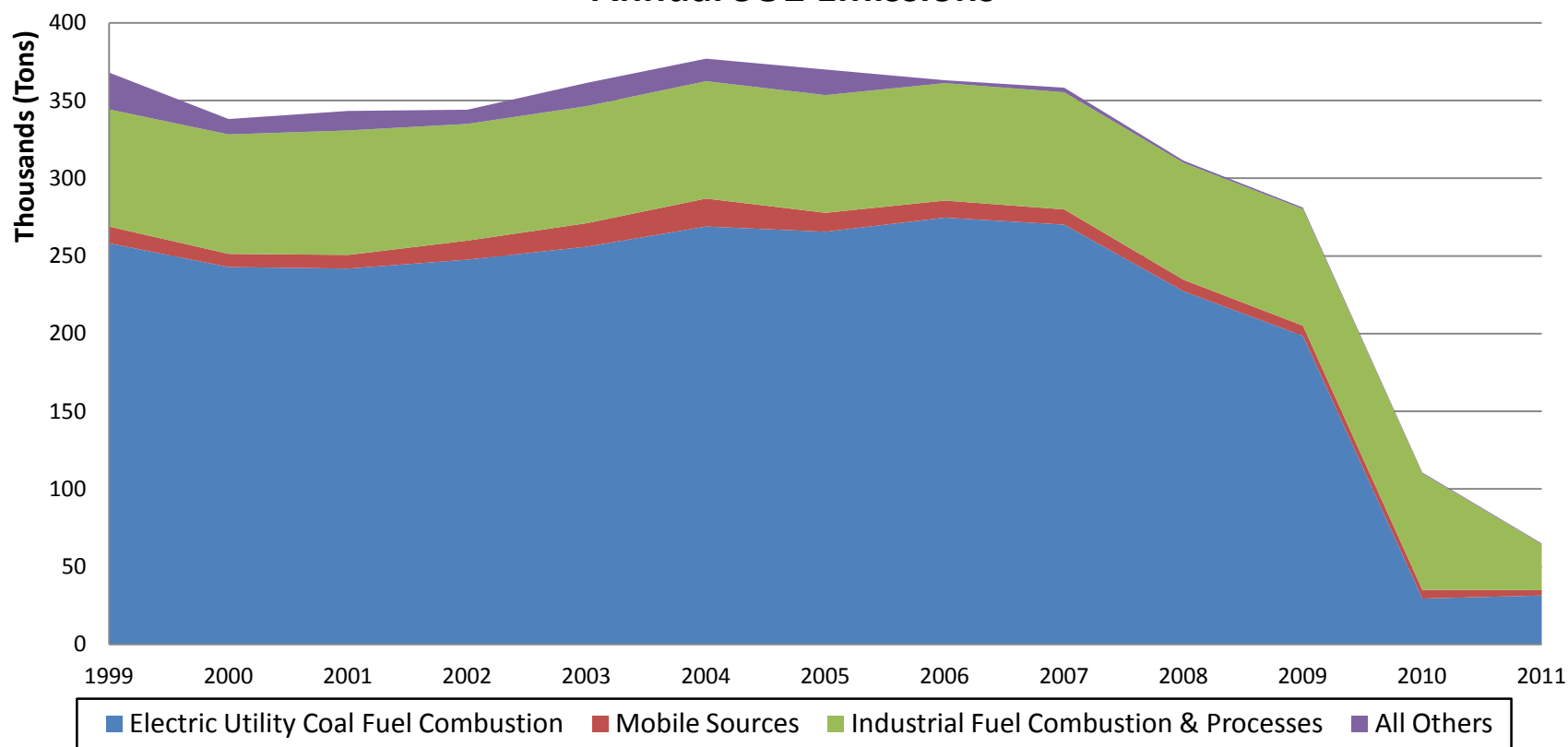
Maryland Emission Trends (SO₂)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	258,173	241,869	255,958	265,595	274,669	270,161	227,225	198,537	29,498	31,465
Mobile Sources	10,754	8,763	15,130	12,182	10,983	9,784	7,462	6,555	5,648	3,425
Industrial Fuel Combustion & Processes	75,384	80,152	75,326	75,743	75,579	75,414	75,250	75,086	74,922	29,660
All Others	23,693	12,546	14,978	16,466	1,866	2,940	1,360	925	541	439
Total	368,003	343,330	361,392	369,986	363,097	358,299	311,297	281,102	110,608	64,988

Source Category	Annual Emissions Change (Percent since 1999)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0%	-6%	-1%	3%	6%	5%	-12%	-23%	-89%	-88%
Mobile Sources	0%	-19%	41%	13%	2%	-9%	-31%	-39%	-47%	-68%
Industrial Fuel Combustion & Processes	0%	6%	0%	0%	0%	0%	0%	0%	-1%	-61%
All Others	0%	-47%	-37%	-31%	-92%	-88%	-94%	-96%	-98%	-98%
Total	0%	-7%	-2%	1%	-1%	-3%	-15%	-24%	-70%	-82%

Maryland Emission Trends (SO₂)

**Major Source Category Summary
Annual SO₂ Emissions**



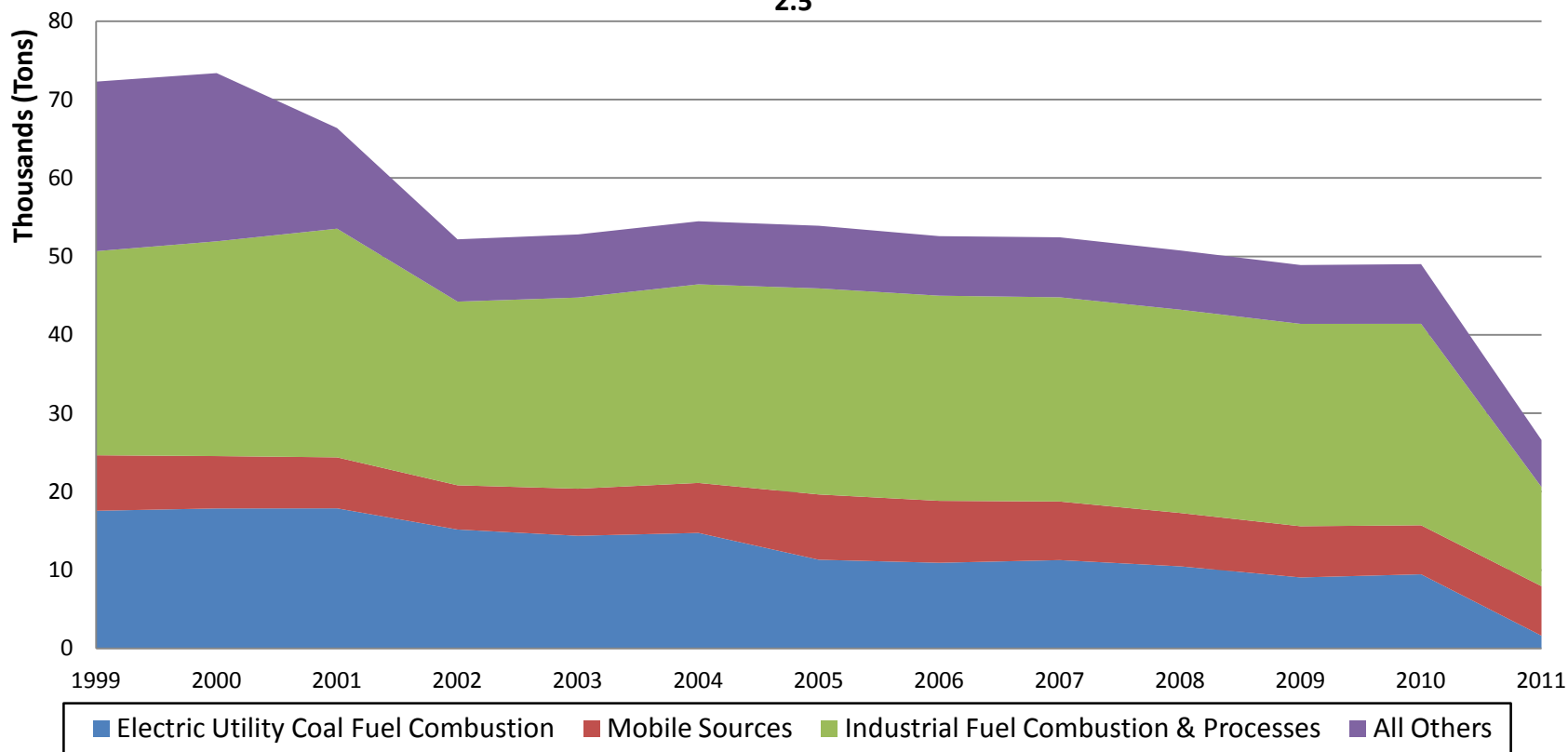
Maryland Emission Trends (PM_{2.5})

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	17,561	17,868	14,367	11,312	10,925	11,266	10,472	9,055	9,457	1,624
Mobile Sources	7,077	6,505	6,010	8,330	7,903	7,476	6,808	6,532	6,256	6,316
Industrial Fuel Combustion & Processes	26,035	29,168	24,378	26,282	26,165	26,048	25,930	25,813	25,696	12,646
All Others	21,629	12,834	8,052	7,989	7,595	7,651	7,551	7,503	7,611	5,998
Total	72,301	66,375	52,808	53,913	52,587	52,441	50,762	48,903	49,019	26,585

Source Category	Annual Emissions Change (Percent since 1999)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0%	2%	-18%	-36%	-38%	-36%	-40%	-48%	-46%	-91%
Mobile Sources	0%	-8%	-15%	18%	12%	6%	-4%	-8%	-12%	-11%
Industrial Fuel Combustion & Processes	0%	12%	-6%	1%	1%	0%	0%	-1%	-1%	-51%
All Others	0%	-41%	-63%	-63%	-65%	-65%	-65%	-65%	-65%	-72%
Total	0%	-8%	-27%	-25%	-27%	-27%	-30%	-32%	-32%	-63%

Maryland Emission Trends (PM_{2.5})

**Major Source Category Summary
Annual PM_{2.5} Emissions**



Emission Trends Summary

- ❑ All pollutants have decreased since 1999 in aggregate across Maryland
- ❑ NO_x and SO₂ from Electric Utility Fuel Combustion sources show significant decrease over time as a result of Acid Rain Program, NO_x 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/m³

□ PM_{2.5} 24-Hour

- Annual 98th percentile of daily averages averaged over three consecutive years
- Current standard = 35 ug/m³

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

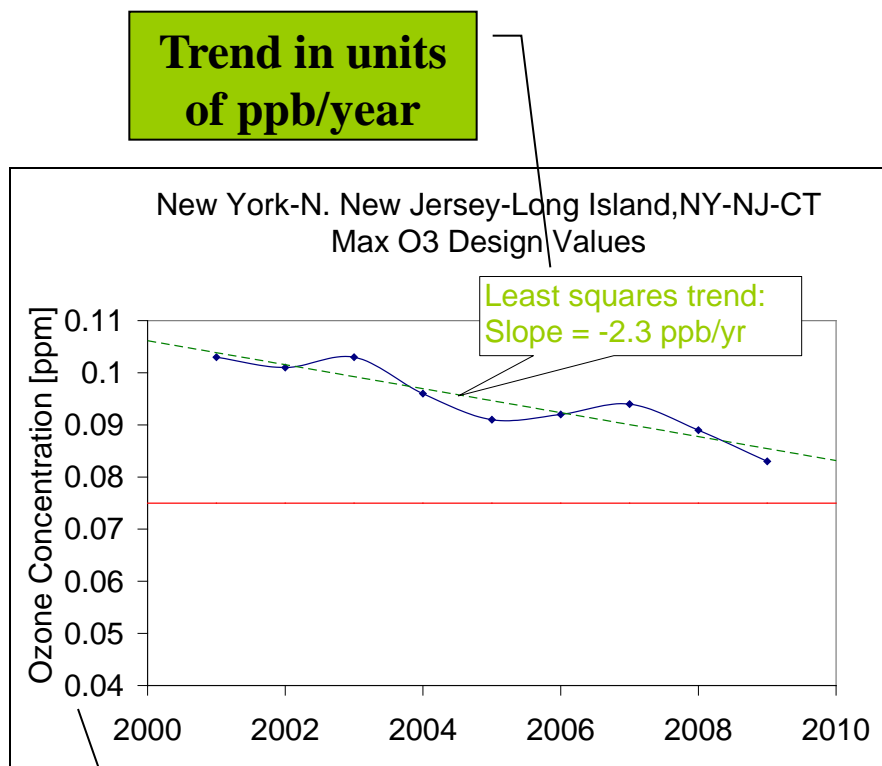
Data Handling Procedures

- O₃ 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

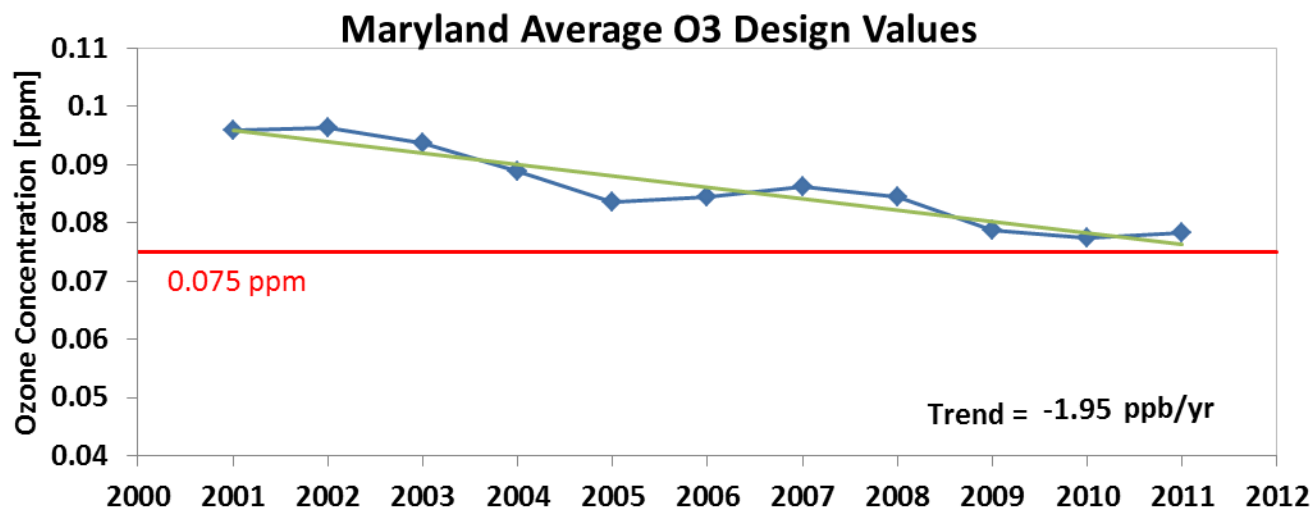
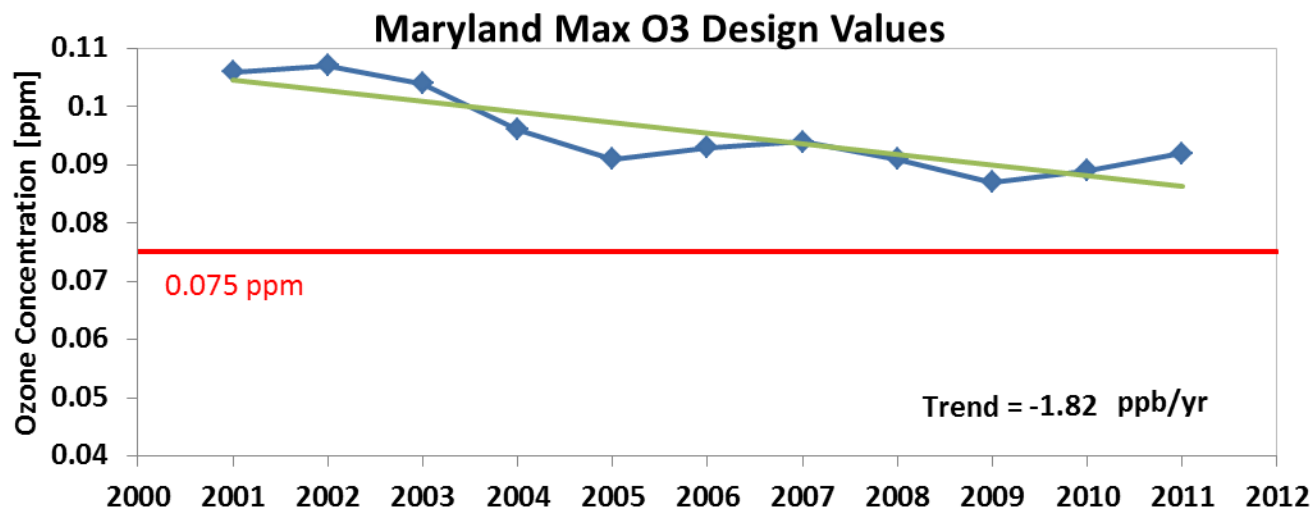
- Annual $PM_{2.5}$ DV and 24-hr $PM_{2.5}$ DV for each overlapping three-year period starting with 1999-2001 and ending with 2009-2011
 - DV calculations based on EPA data handling conventions
 - Data extracted from monitors that have a non-regulatory monitoring type are omitted
 - Selection of trend 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 O₃ DVs and Trend



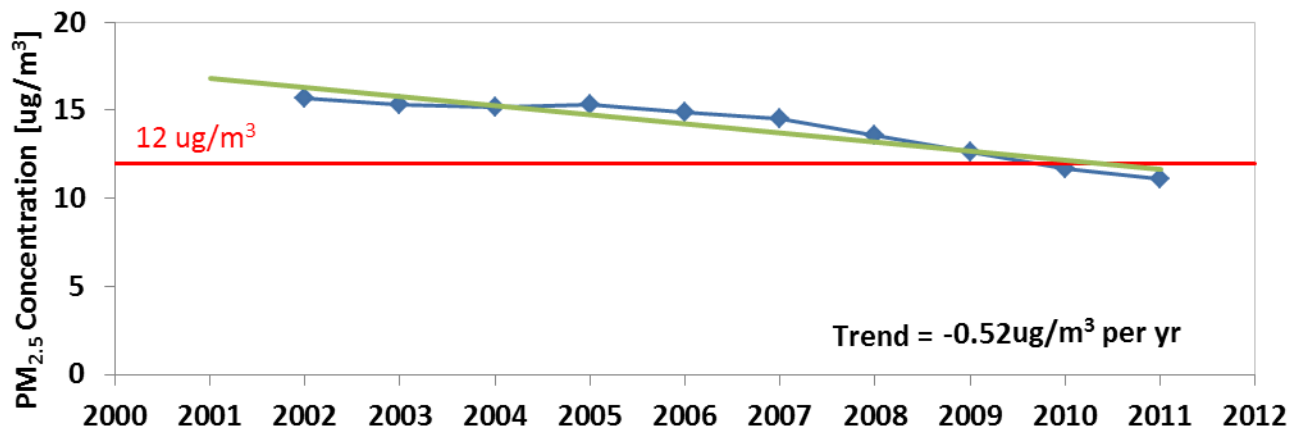
Ozone Trends by Site in Maryland

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
2400300144420101	Anne Arundel, MD	0.081	-2.46
2400510074420101	Baltimore, MD	0.077	-1.75
2400530014420101	Baltimore, MD	0.08	-1.56
2401300014420101	Carroll, MD	0.076	-1.65
2401500034420101	Cecil, MD	0.081	-2.62
2401700104420101	Charles, MD	0.077	-2.26
2402100374420101	Frederick, MD	0.076	-1.56
2402510014420101	Harford, MD	0.092	-1.69
2402590014420101	Harford, MD	0.078	-2.25
2402900024420101	Kent, MD	0.074	-2.73
2403130014420101	Montgomery, MD	0.076	-1.34
2404300094420101	Washington, MD	0.072	-1.57

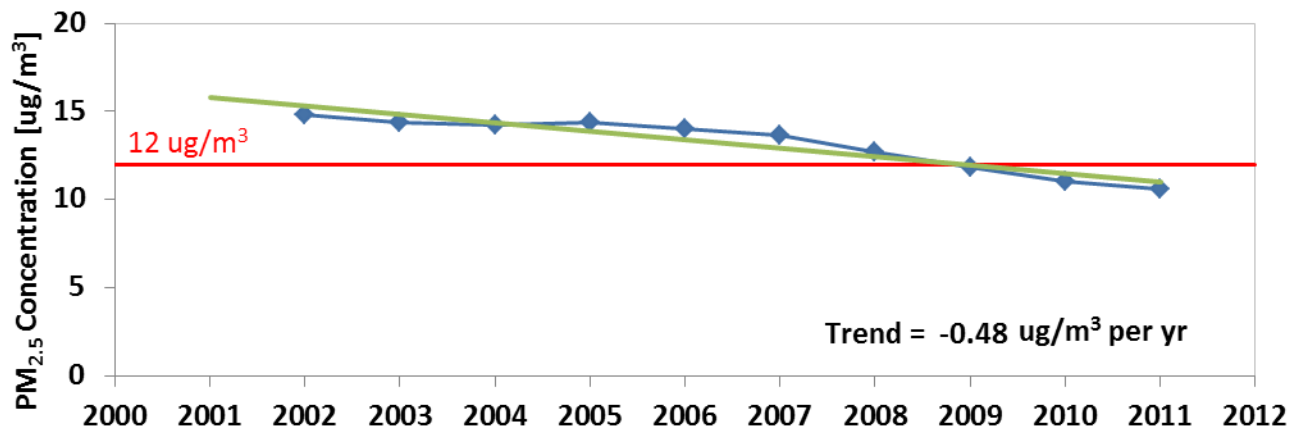
Note: Only monitoring sites meeting data completeness criteria listed

Max/Ave PM_{2.5} Annual DVs and Trend

Maryland Max PM2.5 Annual Design Values

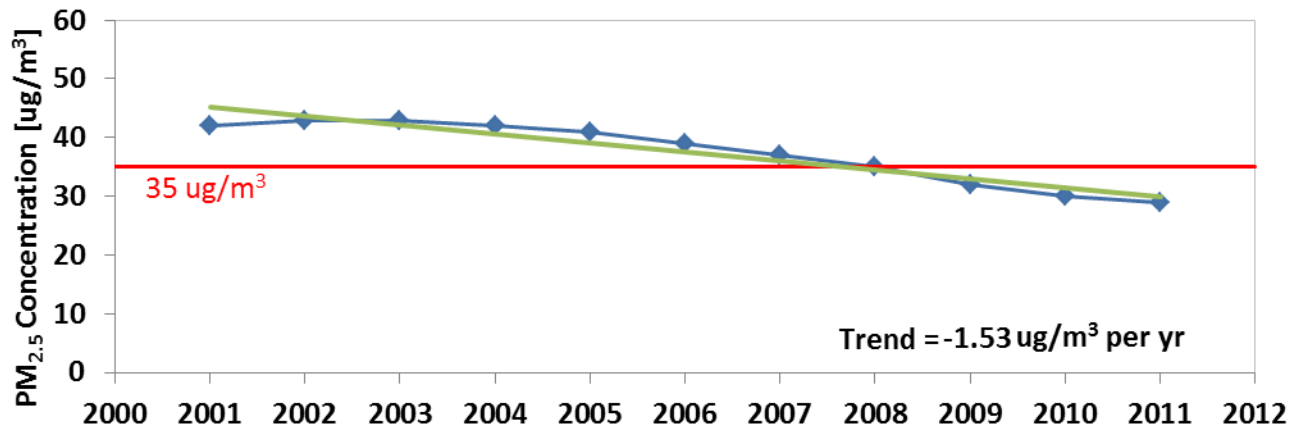


Maryland Average PM2.5 Annual Design Values

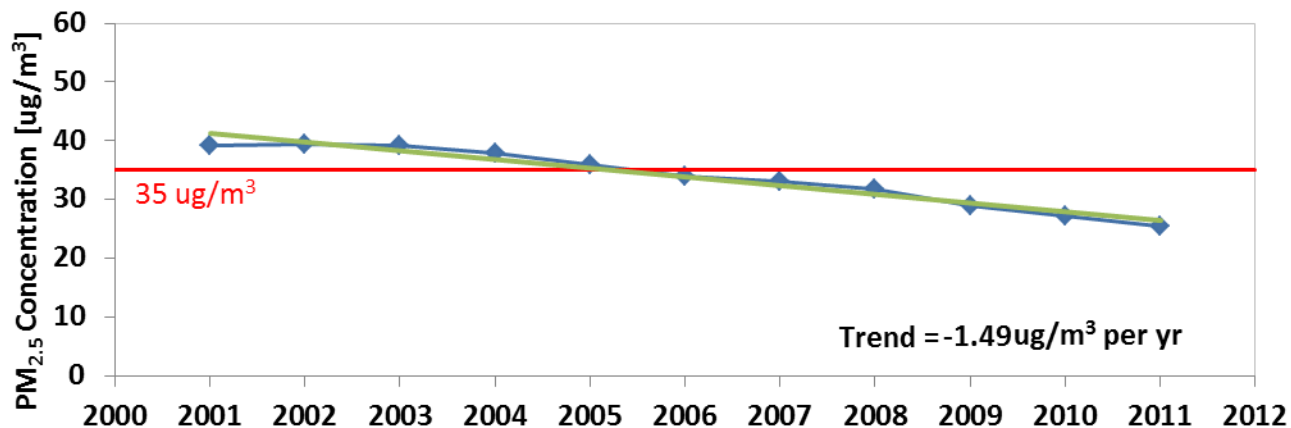


Max/Ave PM_{2.5} 24-Hour DVs and Trend

Maryland Max PM_{2.5} 24-Hour Design Values



Maryland Average PM_{2.5} 24-Hour Design Values



PM_{2.5} Trends by Site in Maryland

Monitoring Site	County	2009-2011 DV [ug/m ³]		Trend [ug/m ³ per year]	
		Annual	24-Hr	Annual DV	24-Hr DV
240031003	Anne Arundel	10.9	26	-0.55	-1.58
240051007	Baltimore	10.1	22	-0.52	-1.86
240053001	Baltimore	11.1	29	-0.54	-1.27
240150003	Cecil	N/A	28	N/A	-0.98
240251001	Harford	N/A	22	N/A	-2.03
240313001	Montgomery	10.2	25	-0.35	-1.33
240430009	Washington	10.9	27	-0.45	-1.76
245100006	Baltimore city	N/A	22	N/A	-1.68
245100007	Baltimore city	10.2	23	-0.58	-1.65
245100008	Baltimore city	N/A	27	N/A	-1.10
245100040	Baltimore city	N/A	29	N/A	-1.57

Note: Only monitoring sites meeting data completeness criteria listed

Air Quality Trends Summary

- Average O₃ and 24-hr PM_{2.5} design values have decreased since 1999 in Maryland; average annual PM_{2.5} design values have decreased since 2000 (incomplete data in 1999)
- O₃ and PM_{2.5} design values have decreased since 1999 in all currently designated O₃ and PM_{2.5} non-attainment areas