

Emission and Air Quality Trends Review 1999-2011

Maine

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, 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

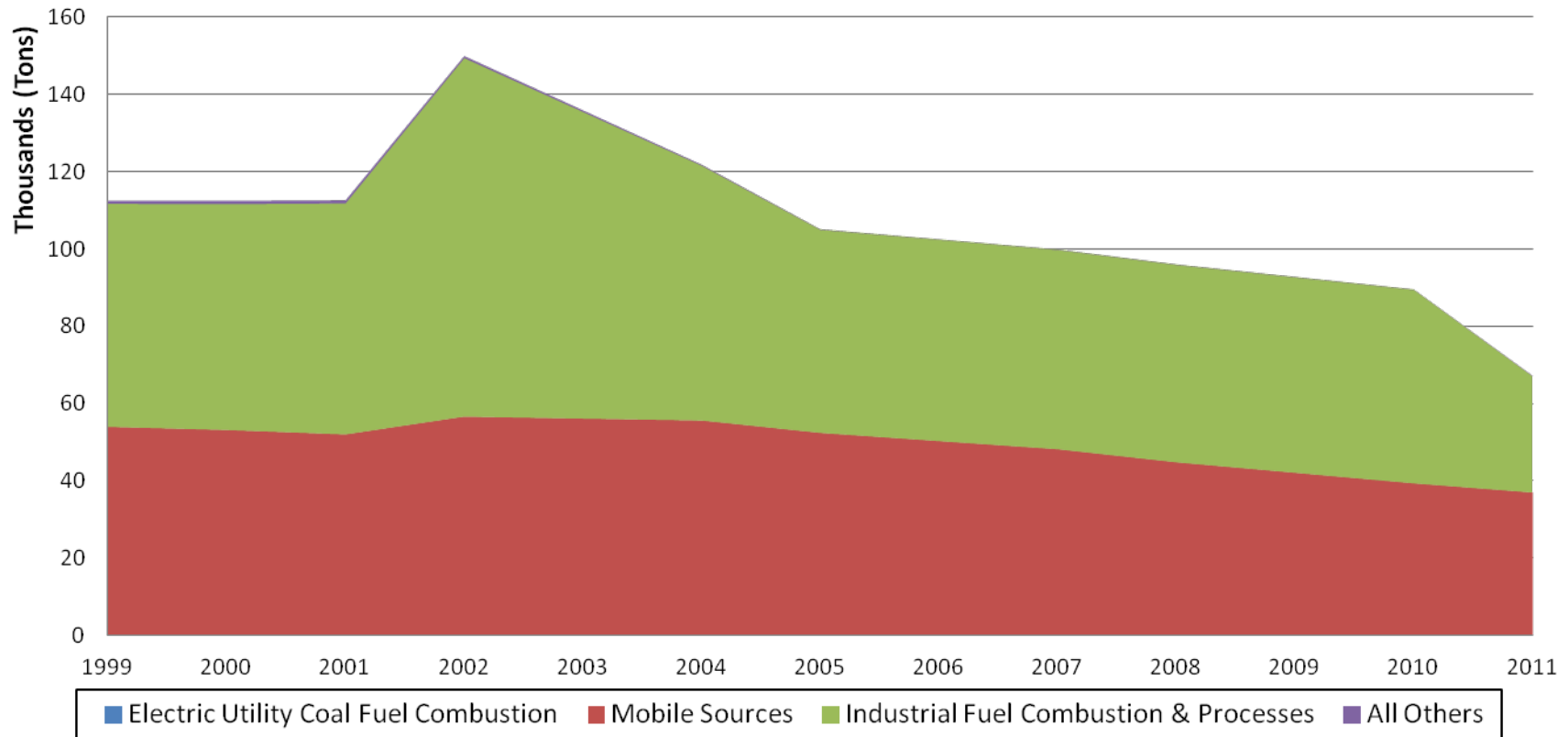
Maine Emission Trends (VOC)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0	0	2	0	0	0	0	0	0	0
Mobile Sources	53,879	51,914	56,021	52,309	50,200	48,091	44,716	41,990	39,264	36,883
Industrial Fuel Combustion & Processes	57,907	59,979	79,561	52,702	52,202	51,701	51,201	50,700	50,200	30,243
All Others	804	816	411	117	91	93	85	81	77	117
Total	112,589	112,710	135,994	105,128	102,492	99,885	96,002	92,772	89,541	67,243

Source Category	Annual Emissions Change (Percent since 1999)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mobile Sources	0%	-4%	4%	-3%	-7%	-11%	-17%	-22%	-27%	-32%
Industrial Fuel Combustion & Processes	0%	4%	37%	-9%	-10%	-11%	-12%	-12%	-13%	-48%
All Others	0%	2%	-49%	-85%	-89%	-88%	-89%	-90%	-90%	-85%
Total	0%	0%	21%	-7%	-9%	-11%	-15%	-18%	-20%	-40%

Maine Emission Trends (VOC)

**Major Source Category Summary
Annual VOC Emissions**



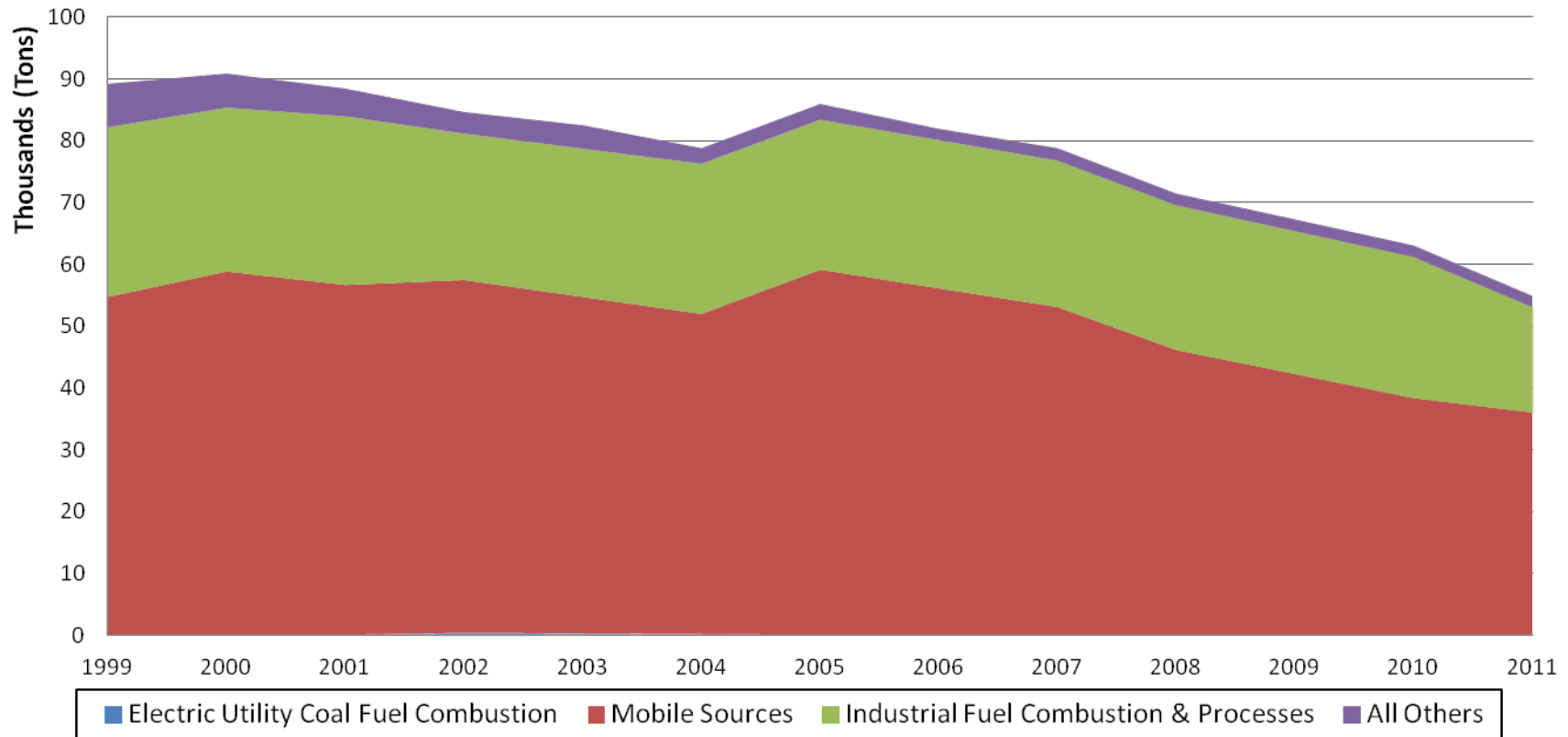
Maine Emission Trends (NO_x)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0	0	190	0	0	0	0	0	0	0
Mobile Sources	54,756	56,677	54,550	59,156	56,130	53,104	46,160	42,257	38,353	36,010
Industrial Fuel Combustion & Processes	27,471	27,290	24,012	24,267	23,990	23,714	23,437	23,161	22,884	17,108
All Others	7,002	4,476	3,771	2,549	1,812	1,999	1,882	1,882	1,847	1,826
Total	89,230	88,443	82,523	85,971	81,933	78,817	71,480	67,299	63,085	54,944

Source Category	Annual Emissions Change (Percent since 1999)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mobile Sources	0%	4%	0%	8%	3%	-3%	-16%	-23%	-30%	-34%
Industrial Fuel Combustion & Processes	0%	-1%	-13%	-12%	-13%	-14%	-15%	-16%	-17%	-38%
All Others	0%	-36%	-46%	-64%	-74%	-71%	-73%	-73%	-74%	-74%
Total	0%	-1%	-8%	-4%	-8%	-12%	-20%	-25%	-29%	-38%

Maine Emission Trends (NO_x)

Major Source Category Summary
Annual NO_x Emissions



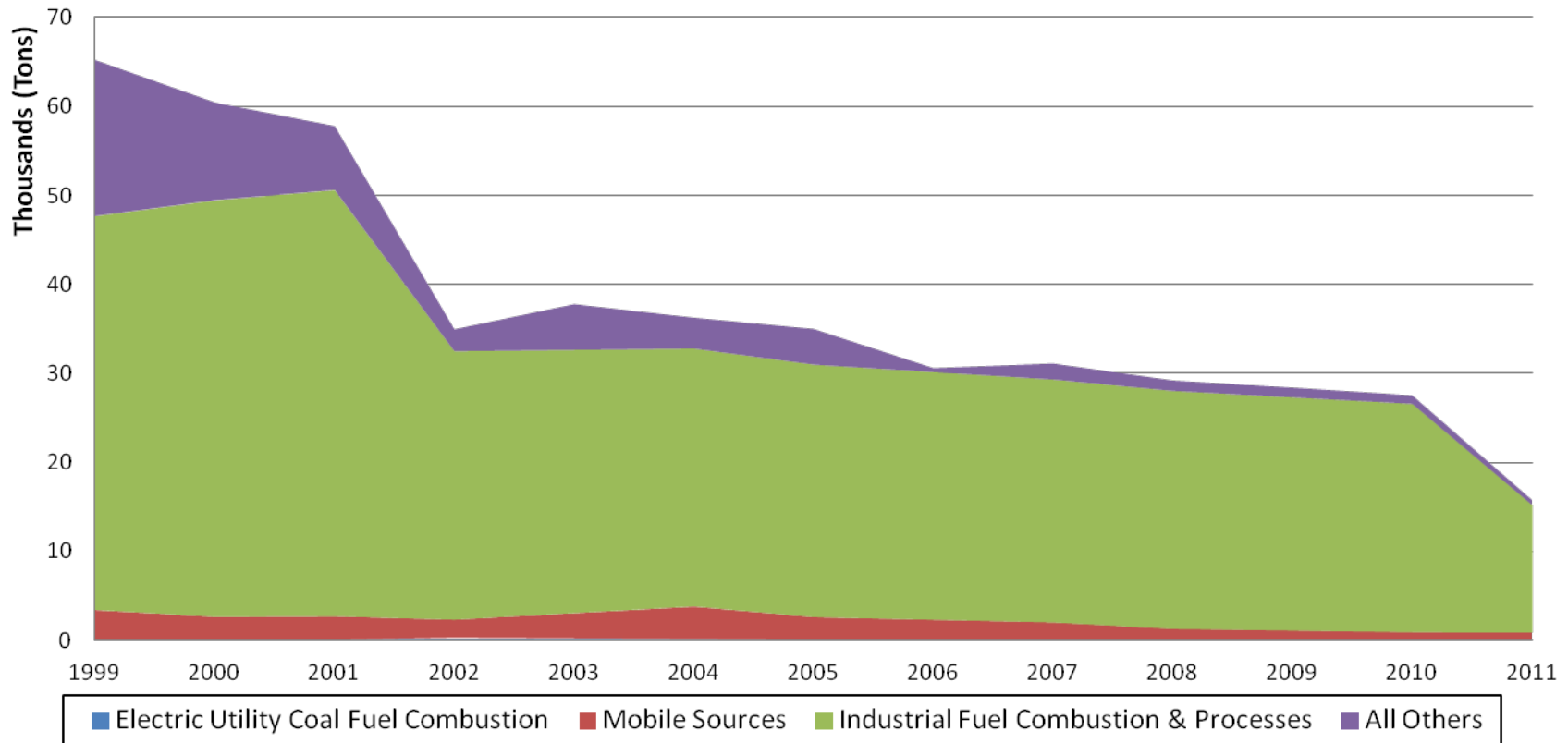
Maine Emission Trends (SO₂)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0	0	172	0	0	0	0	0	0	0
Mobile Sources	3,431	2,708	2,911	2,623	2,328	2,034	1,294	1,110	925	892
Industrial Fuel Combustion & Processes	44,257	47,898	29,576	28,380	27,841	27,301	26,761	26,221	25,682	14,367
All Others	17,496	7,165	5,123	4,002	441	1,790	1,162	1,083	945	552
Total	65,184	57,771	37,782	35,005	30,610	31,125	29,218	28,415	27,552	15,811

Source Category	Annual Emissions Change (Percent since 1999)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mobile Sources	0%	-21%	-15%	-24%	-32%	-41%	-62%	-68%	-73%	-74%
Industrial Fuel Combustion & Processes	0%	8%	-33%	-36%	-37%	-38%	-40%	-41%	-42%	-68%
All Others	0%	-59%	-71%	-77%	-97%	-90%	-93%	-94%	-95%	-97%
Total	0%	-11%	-42%	-46%	-53%	-52%	-55%	-56%	-58%	-76%

Maine Emission Trends (SO₂)

**Major Source Category Summary
Annual SO₂ Emissions**



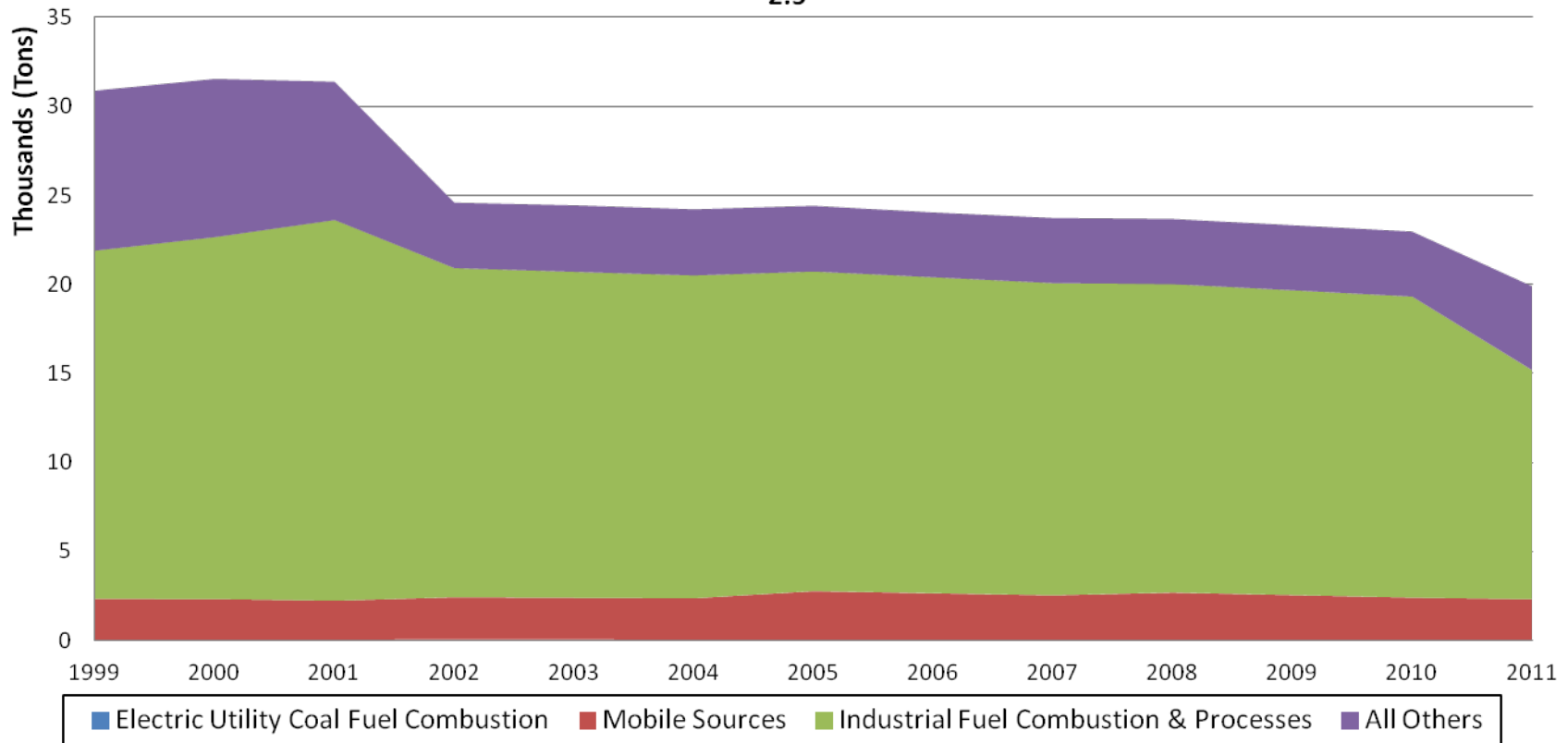
Maine Emission Trends (PM_{2.5})

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0	0	23	0	0	0	0	0	0	0
Mobile Sources	2,352	2,246	2,393	2,787	2,669	2,552	2,708	2,565	2,422	2,332
Industrial Fuel Combustion & Processes	19,553	21,380	18,301	17,946	17,737	17,527	17,318	17,109	16,900	12,859
All Others	8,994	7,772	3,734	3,687	3,644	3,661	3,651	3,655	3,652	4,711
Total	30,899	31,398	24,450	24,420	24,050	23,740	23,678	23,329	22,974	19,902

Source Category	Annual Emissions Change (Percent since 1999)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mobile Sources	0%	-5%	2%	18%	13%	8%	15%	9%	3%	-1%
Industrial Fuel Combustion & Processes	0%	9%	-6%	-8%	-9%	-10%	-11%	-13%	-14%	-34%
All Others	0%	-14%	-58%	-59%	-59%	-59%	-59%	-59%	-59%	-48%
Total	0%	2%	-21%	-21%	-22%	-23%	-23%	-25%	-26%	-36%

Maine 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 Maine
- 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

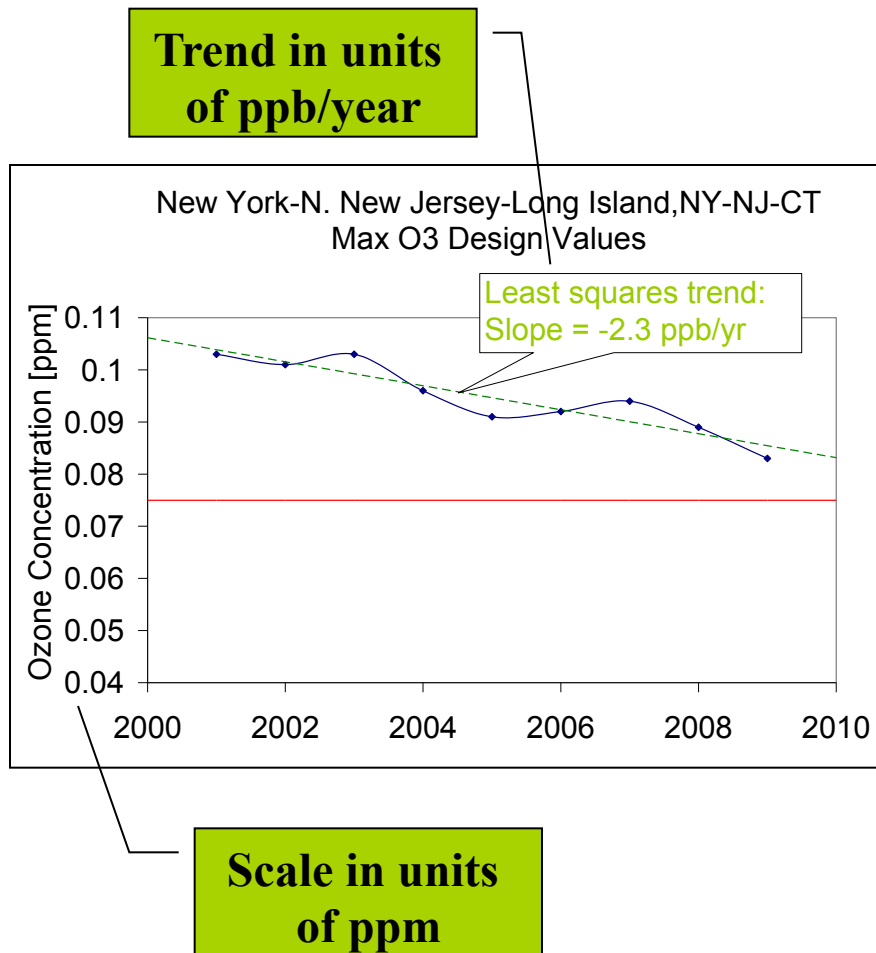
Data Handling Procedures

- 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

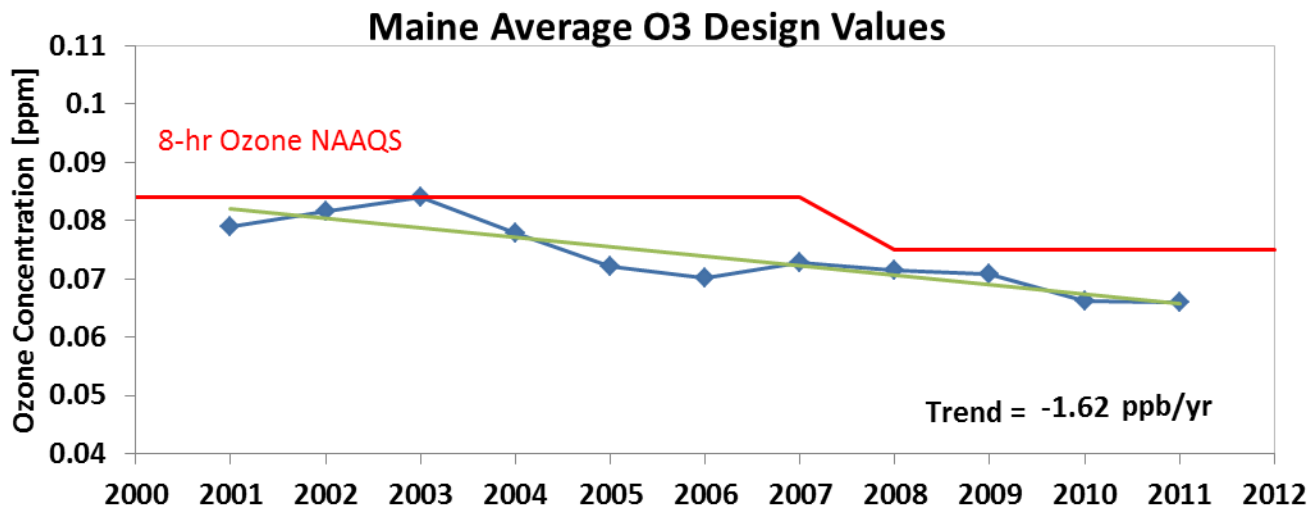
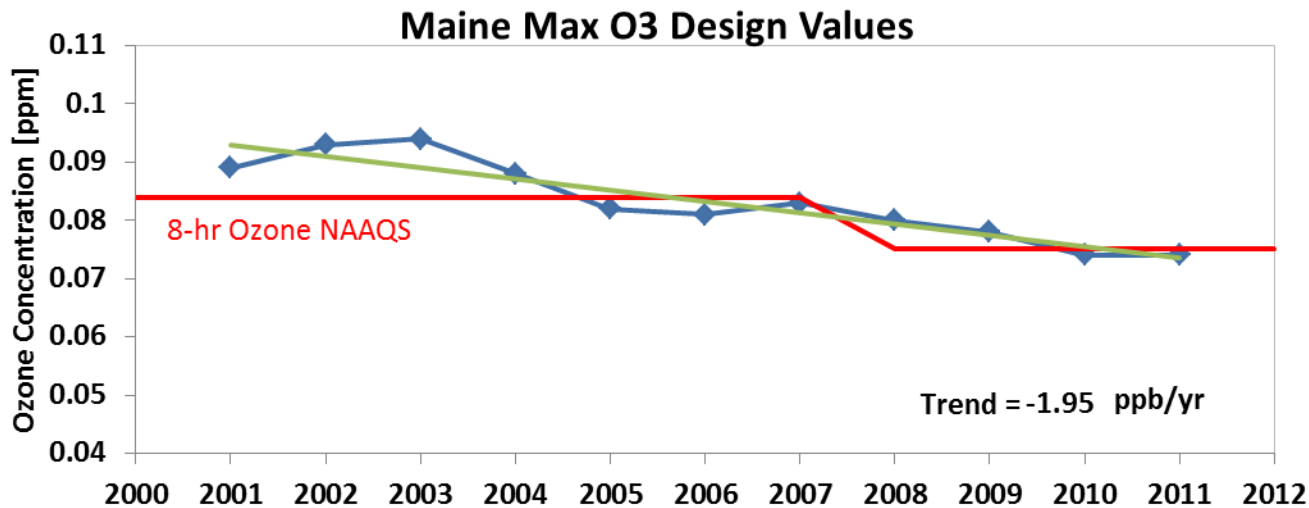
- Annual $\text{PM}_{2.5}$ DV and 24-hr $\text{PM}_{2.5}$ DV for each overlapping three-year period starting with 1999-2001 and ending with 2009-2011
 - DV calculations based on EPA data handling conventions
 - Data extracted from monitors that have a non-regulatory monitoring type are omitted
 - Selection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



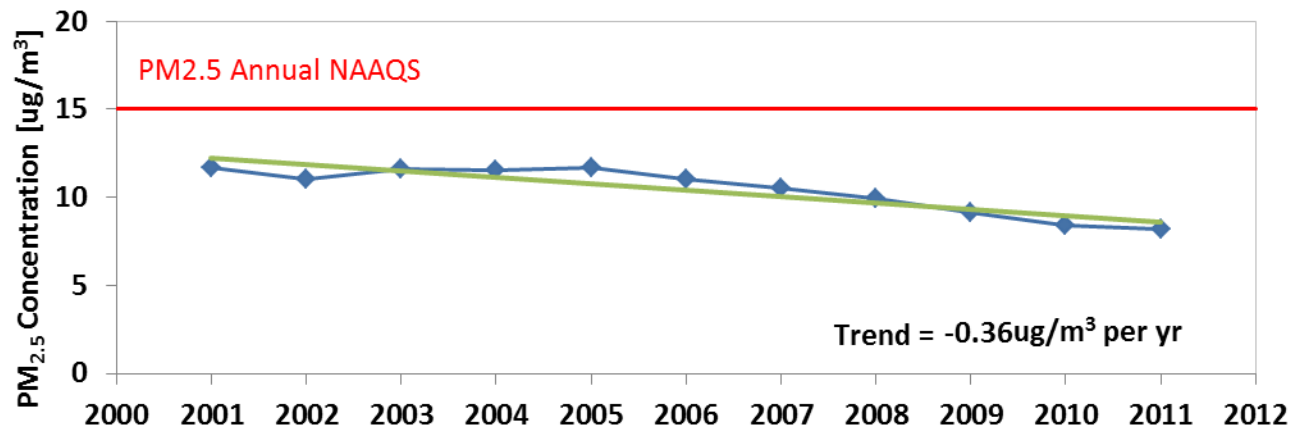
Ozone Trends by Site in Maine

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
2300520034420101	Cumberland, ME	0.07	-1.47
2300901024420101	Hancock, ME	0.074	-1.95
2300901034420101	Hancock, ME	0.069	-1.80
2301120054420101	Kennebec, ME	0.062	-1.45
2301300044420102	Knox, ME	0.069	-1.77
2301730014420101	Oxford, ME	0.055	-0.34
2301940084420101	Penobscot, ME	0.057	-2.27
2303120024420101	York, ME	0.072	-1.87

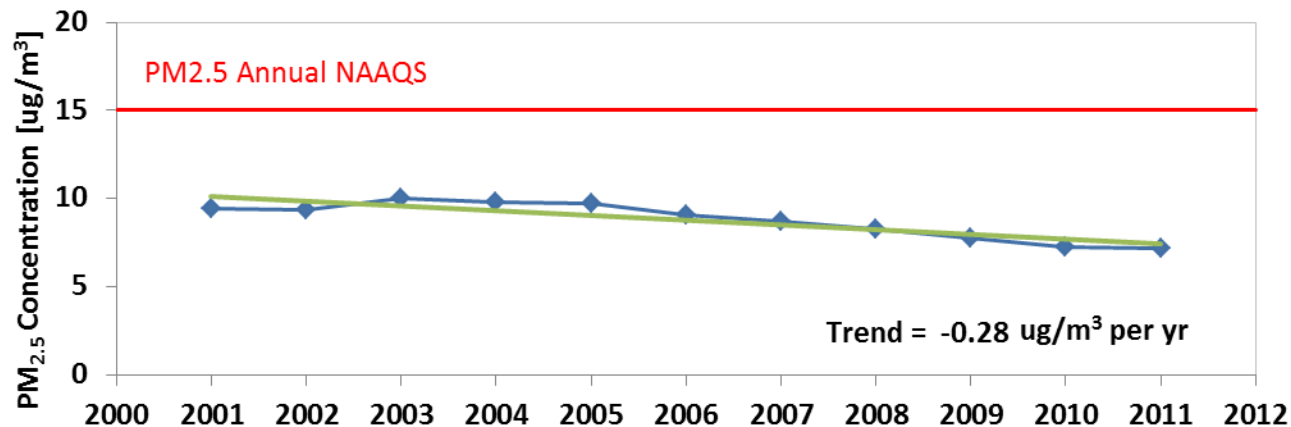
Note: Only monitoring sites meeting data completeness criteria listed

Max/Ave PM_{2.5} Annual DVs and Trend

Maine Max PM2.5 Annual Design Values

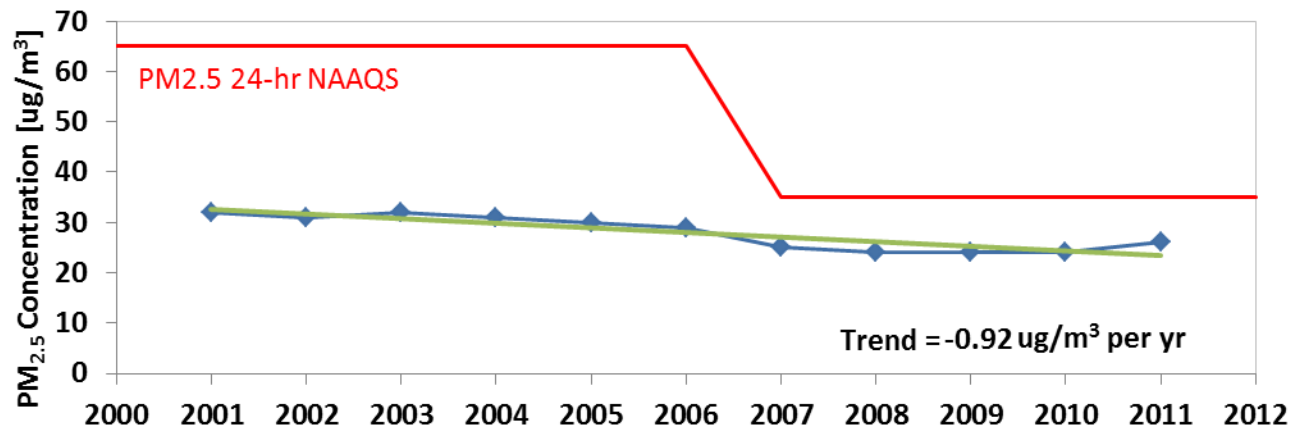


Maine Average PM2.5 Annual Design Values

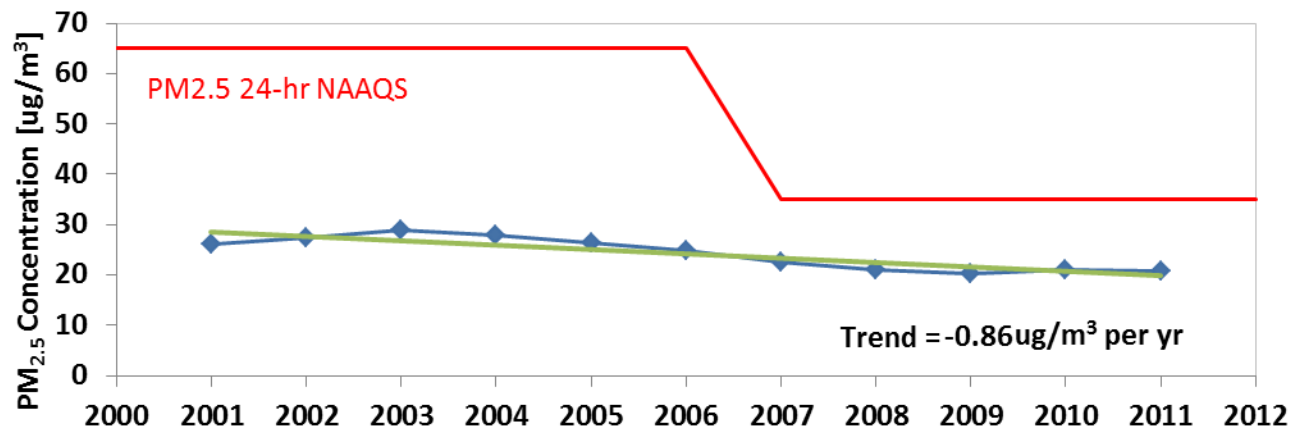


Max/Ave PM_{2.5} 24-Hour DVs and Trend

Maine Max PM_{2.5} 24-Hour Design Values



Maine Average PM_{2.5} 24-Hour Design Values



PM_{2.5} Trends by Site in Maine

Monitoring Site	County	2009-2011 DV [ug/m ³]		Trend [ug/m ³ per year]	
		Annual	24-Hr	Annual DV	24-Hr DV
230010011	Androscoggin	7.5	22	-0.35	-1.00
230031011	Aroostook	7.1	20	-0.18	-0.44
230050015	Cumberland	8.2	22	-0.36	-1.20
230090103	Hancock	4.5	13	-0.20	-0.92
230110016	Kennebec	7.3	21	-0.32	-1.41
230172011	Oxford	8.2	26	-0.23	-0.85
230190002	Penobscot	7.3	21	-0.29	-0.75

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 Maine
- There are no currently designated O_3 or $PM_{2.5}$ non-attainment areas in Maine