

Emission and Air Quality Trends Review 1999-2011

Rhode Island

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

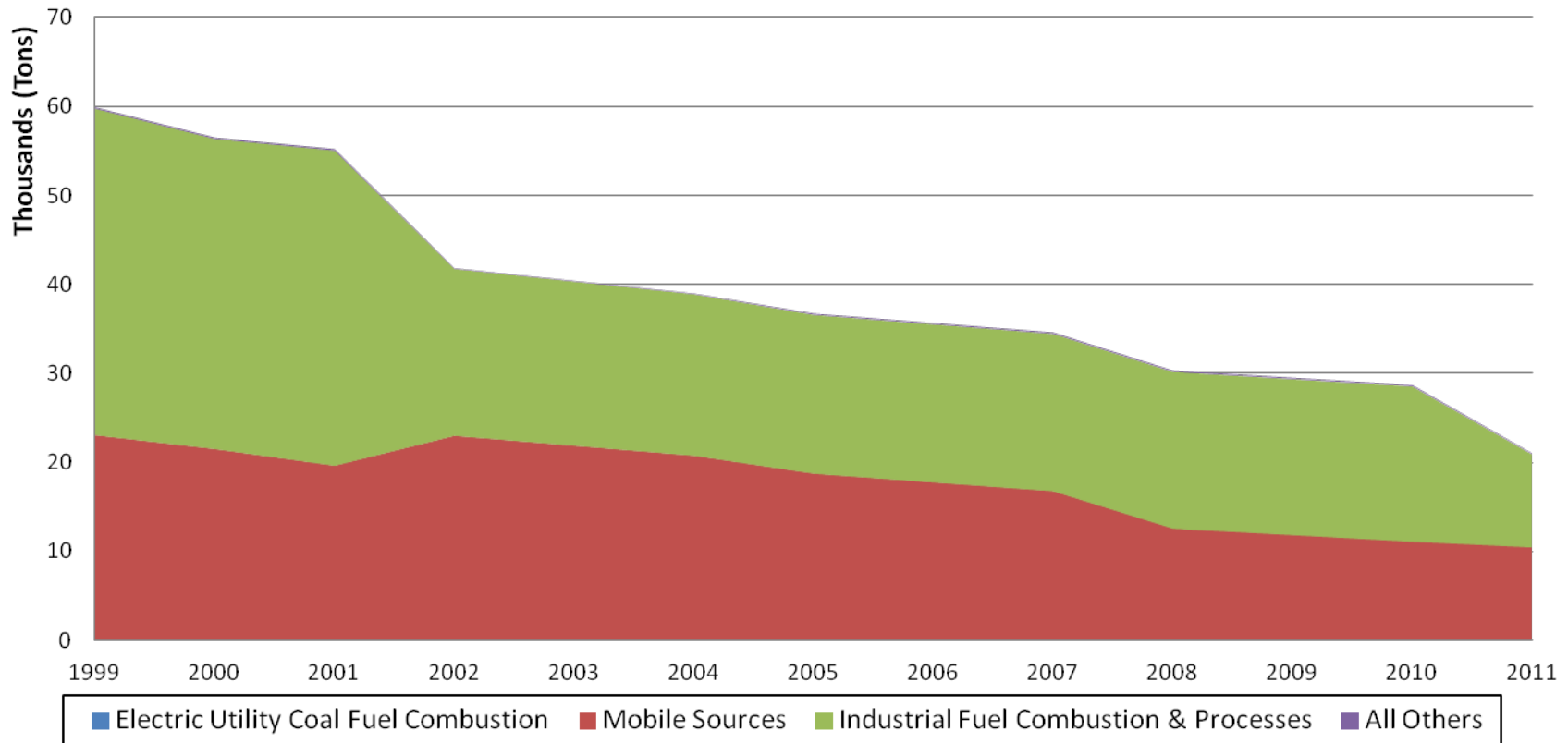
Rhode Island Emission Trends (VOC)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0	0	0	0	0	0	0	0	0	0
Mobile Sources	23,083	19,660	21,903	18,772	17,788	16,804	12,613	11,879	11,145	10,500
Industrial Fuel Combustion & Processes	36,645	35,366	18,425	17,815	17,735	17,655	17,575	17,495	17,415	10,443
All Others	142	153	62	128	127	136	134	133	131	94
Total	59,869	55,180	40,390	36,714	35,650	34,595	30,323	29,508	28,692	21,037

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%	-15%	-5%	-19%	-23%	-27%	-45%	-49%	-52%	-55%
Industrial Fuel Combustion & Processes	0%	-3%	-50%	-51%	-52%	-52%	-52%	-52%	-52%	-72%
All Others	0%	8%	-56%	-10%	-10%	-4%	-5%	-6%	-7%	-33%
Total	0%	-8%	-33%	-39%	-40%	-42%	-49%	-51%	-52%	-65%

Rhode Island Emission Trends (VOC)

**Major Source Category Summary
Annual VOC Emissions**



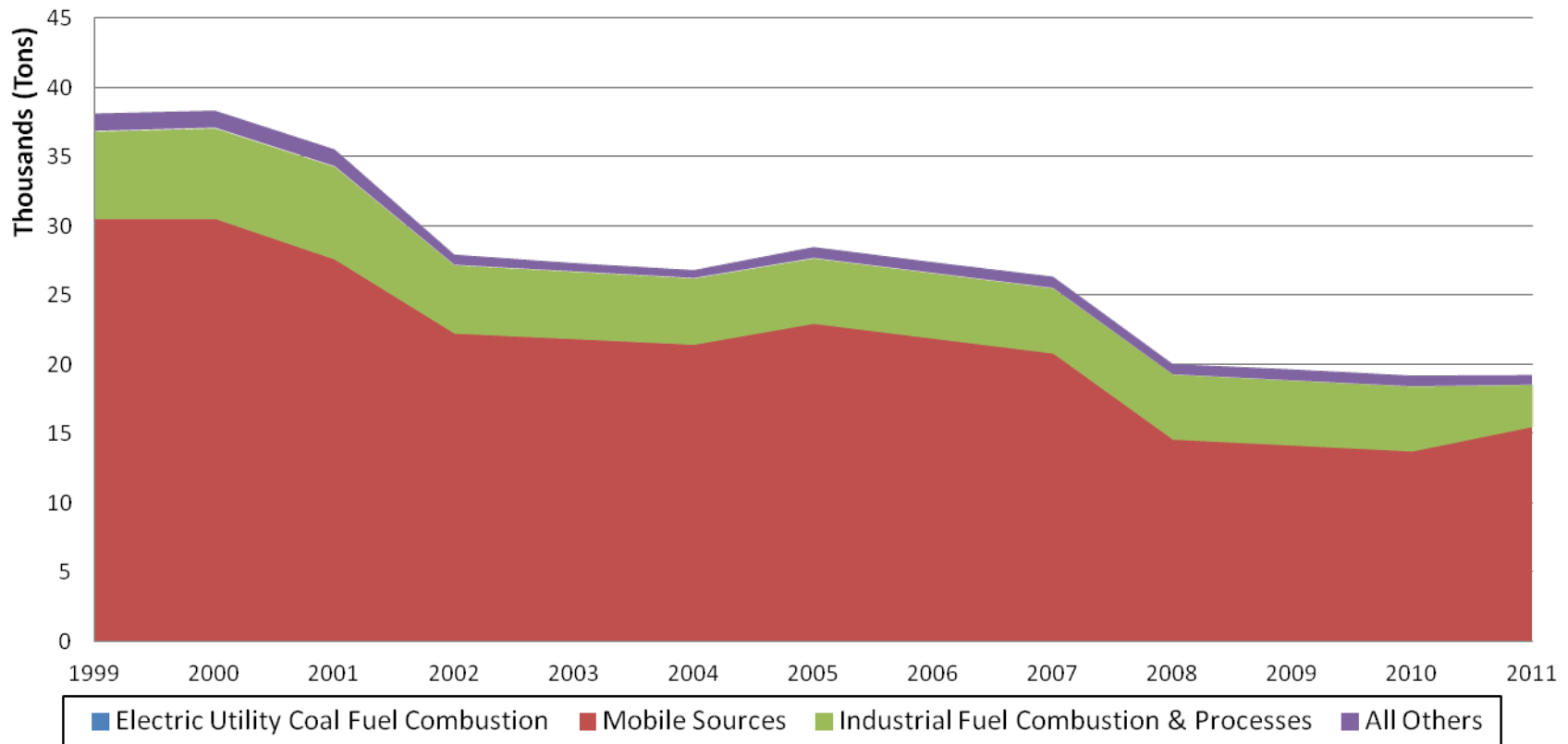
Rhode Island Emission Trends (NO_x)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0	0	0	0	0	0	0	0	0	0
Mobile Sources	30,533	27,609	21,854	22,963	21,889	20,816	14,595	14,168	13,740	15,508
Industrial Fuel Combustion & Processes	6,317	6,695	4,870	4,728	4,721	4,713	4,706	4,698	4,691	3,041
All Others	1,251	1,210	592	783	769	812	744	786	774	703
Total	38,101	35,515	27,316	28,474	27,379	26,341	20,045	19,652	19,205	19,251

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%	-10%	-28%	-25%	-28%	-32%	-52%	-54%	-55%	-49%
Industrial Fuel Combustion & Processes	0%	6%	-23%	-25%	-25%	-25%	-26%	-26%	-26%	-52%
All Others	0%	-3%	-53%	-37%	-39%	-35%	-40%	-37%	-38%	-44%
Total	0%	-7%	-28%	-25%	-28%	-31%	-47%	-48%	-50%	-49%

Rhode Island Emission Trends (NO_x)

Major Source Category Summary
Annual NO_x Emissions



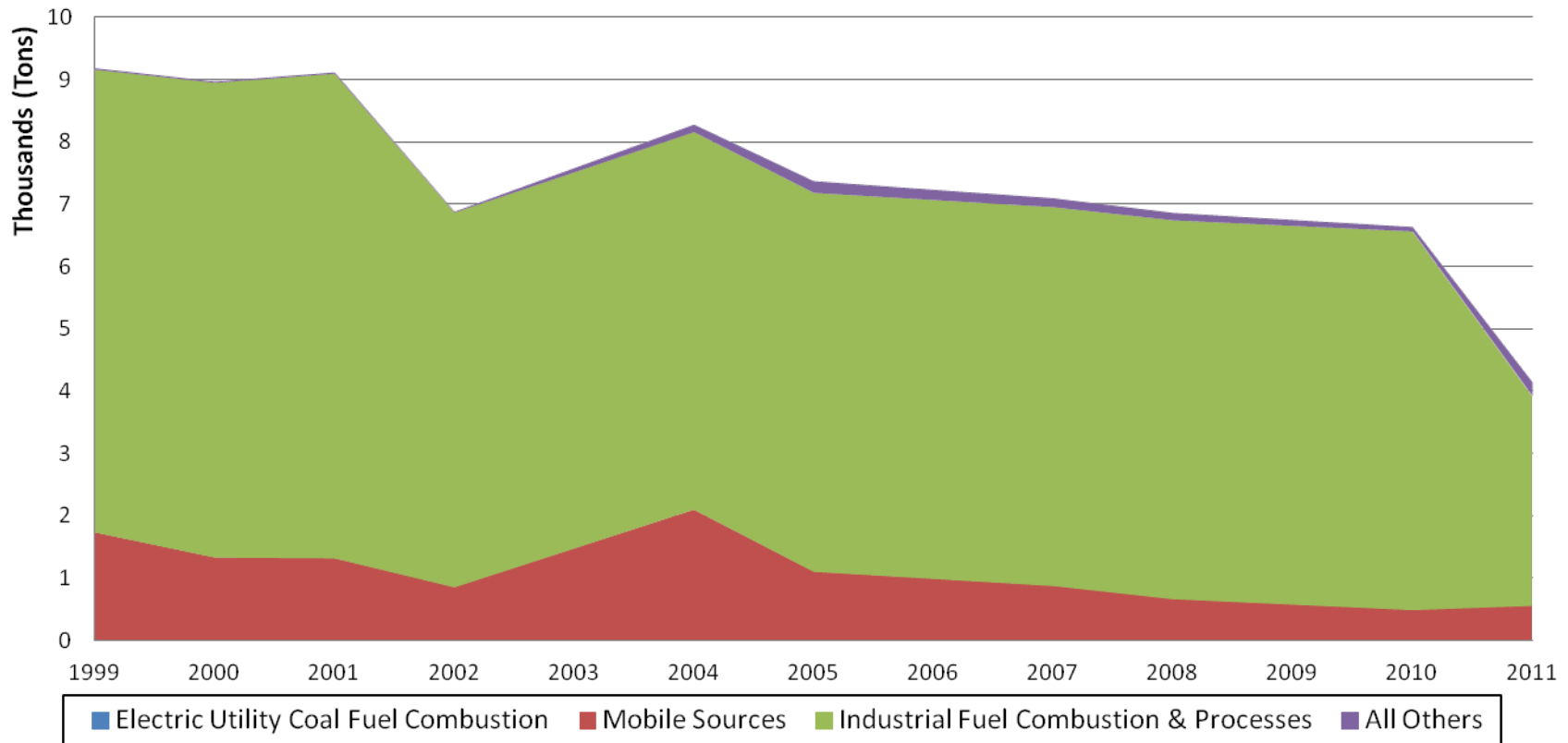
Rhode Island Emission Trends (SO₂)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0	0	0	0	0	0	0	0	0	0
Mobile Sources	1,738	1,322	1,480	1,107	993	879	668	580	491	560
Industrial Fuel Combustion & Processes	7,428	7,779	6,038	6,081	6,080	6,080	6,079	6,079	6,078	3,369
All Others	22	21	66	187	163	142	119	94	70	220
Total	9,188	9,122	7,584	7,376	7,237	7,101	6,866	6,752	6,640	4,149

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%	-24%	-15%	-36%	-43%	-49%	-62%	-67%	-72%	-68%
Industrial Fuel Combustion & Processes	0%	5%	-19%	-18%	-18%	-18%	-18%	-18%	-18%	-55%
All Others	0%	-6%	204%	760%	649%	553%	446%	332%	222%	910%
Total	0%	-1%	-17%	-20%	-21%	-23%	-25%	-27%	-28%	-55%

Rhode Island Emission Trends (SO₂)

Major Source Category Summary
Annual SO₂ Emissions



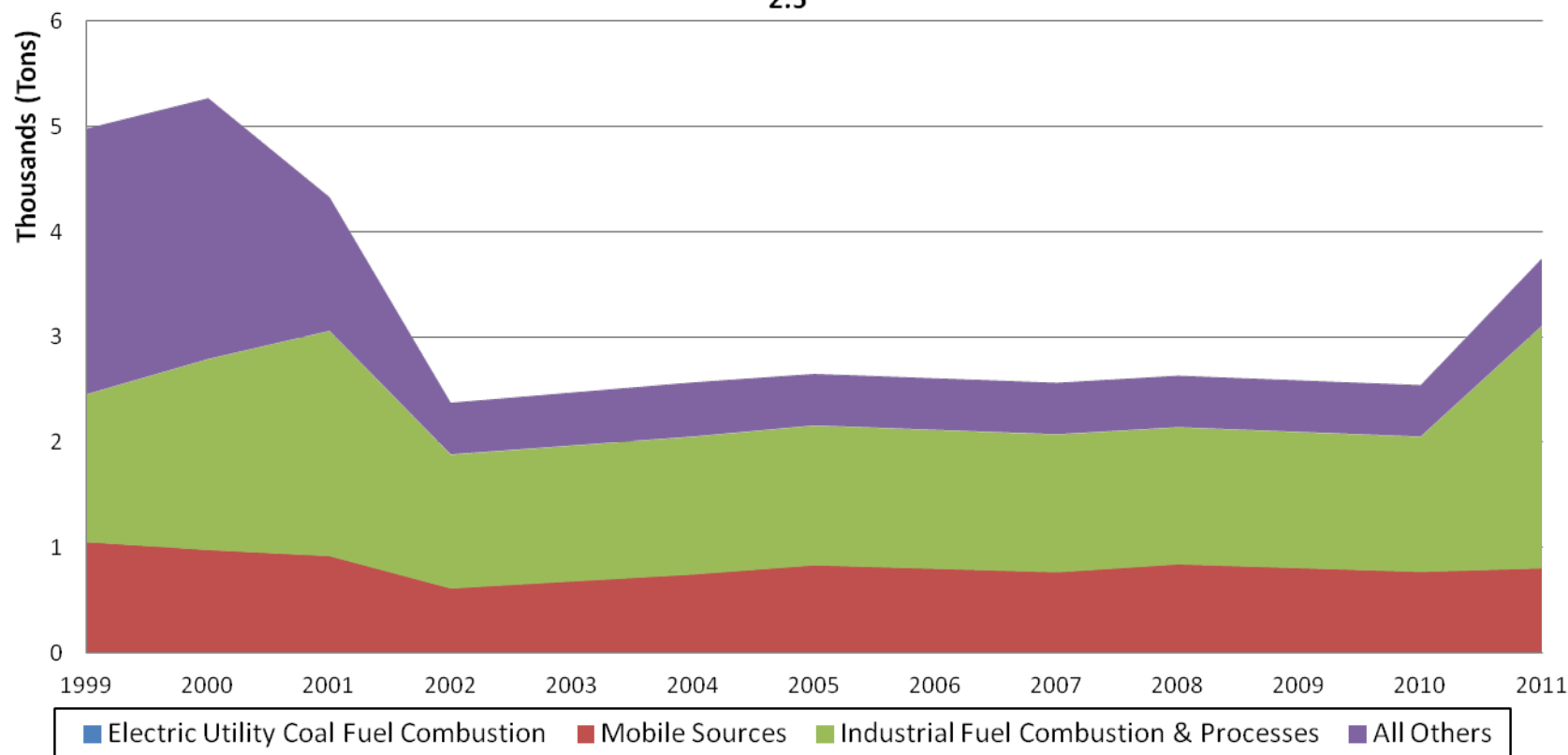
Rhode Island Emission Trends (PM_{2.5})

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0	0	0	0	0	0	0	0	0	0
Mobile Sources	1,055	923	682	836	802	769	844	808	772	806
Industrial Fuel Combustion & Processes	1,404	2,137	1,289	1,326	1,318	1,309	1,301	1,292	1,283	2,300
All Others	2,520	1,268	501	488	488	488	488	488	487	639
Total	4,979	4,328	2,472	2,650	2,608	2,566	2,633	2,588	2,543	3,745

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%	-13%	-35%	-21%	-24%	-27%	-20%	-23%	-27%	-24%
Industrial Fuel Combustion & Processes	0%	52%	-8%	-6%	-6%	-7%	-7%	-8%	-9%	64%
All Others	0%	-50%	-80%	-81%	-81%	-81%	-81%	-81%	-81%	-75%
Total	0%	-13%	-50%	-47%	-48%	-48%	-47%	-48%	-49%	-25%

Rhode Island 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 Rhode Island
- 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

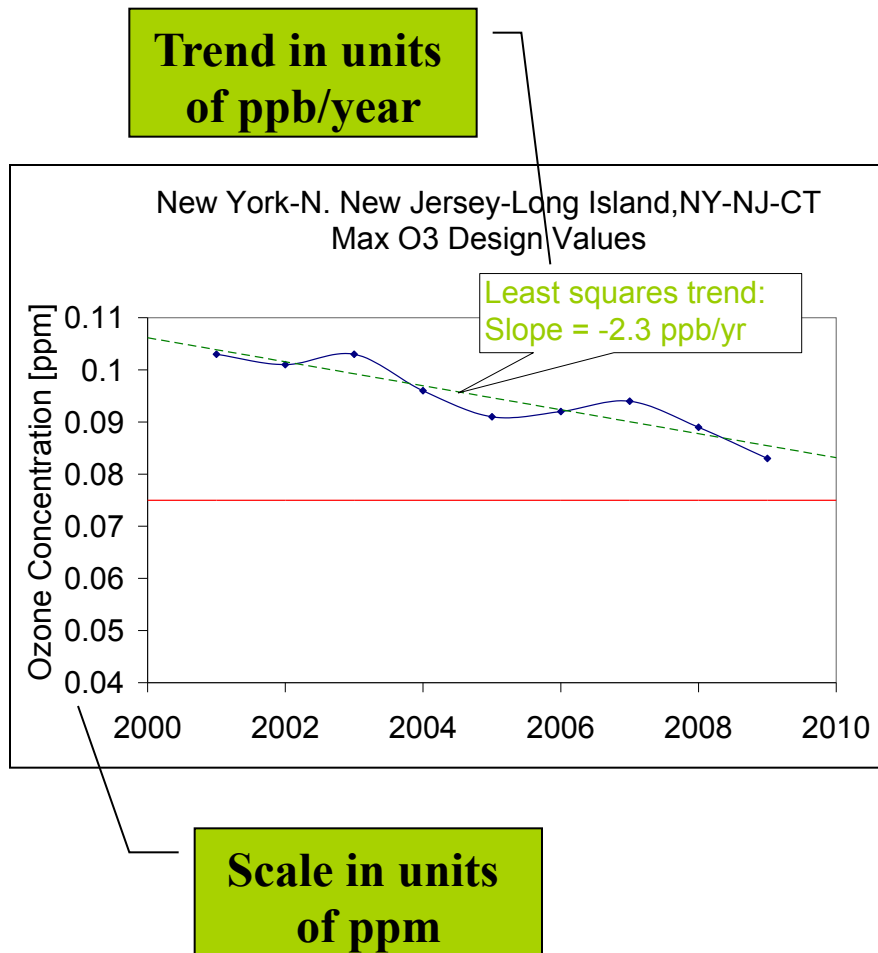
Data Handling Procedures

- 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

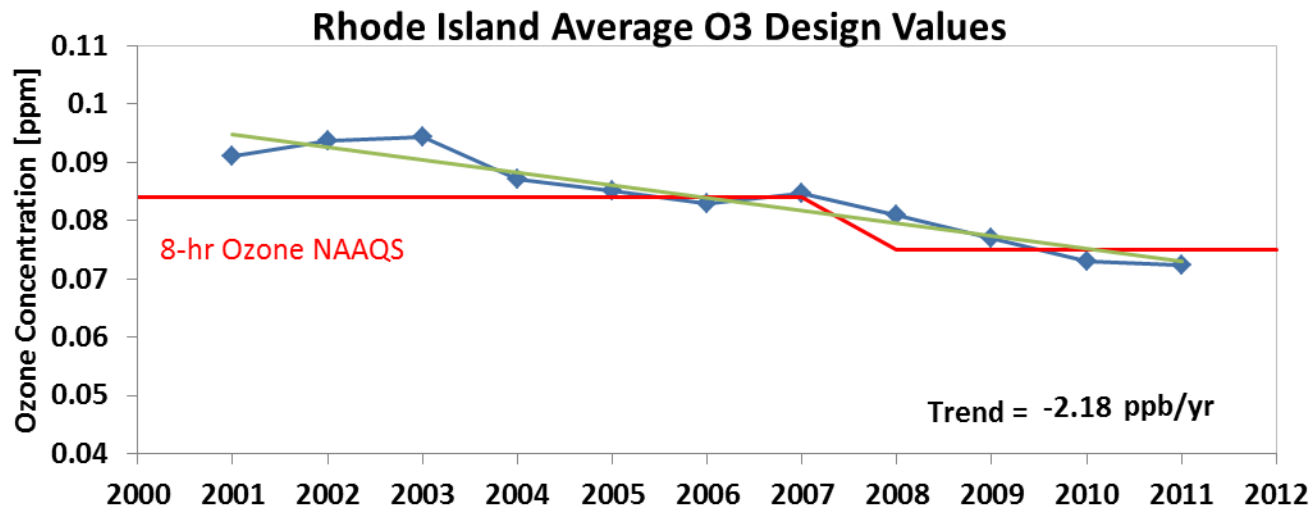
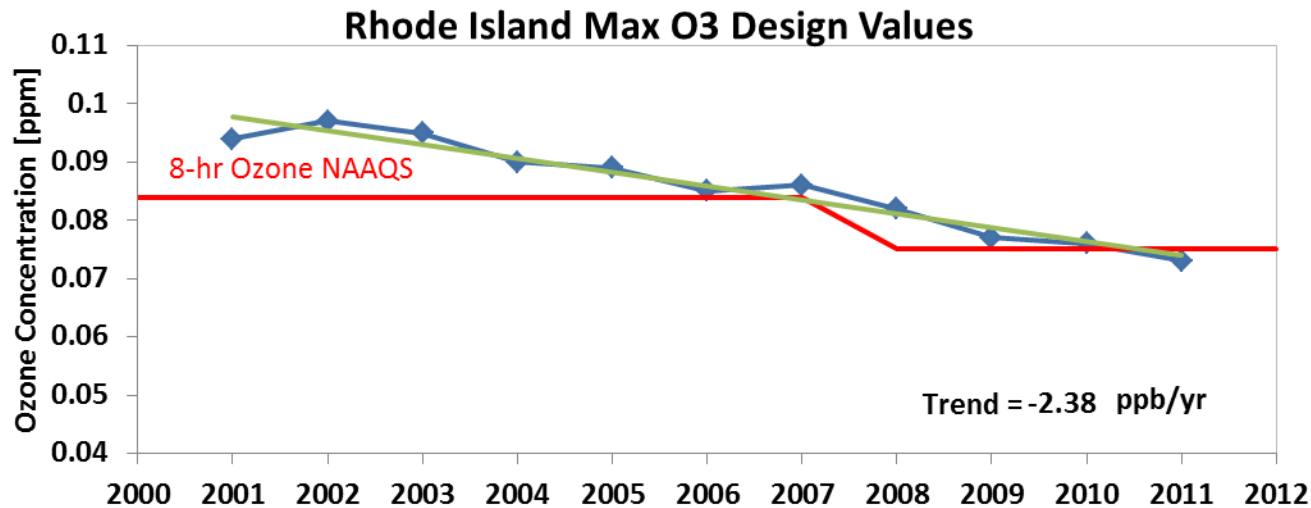
- ❑ Annual $\text{PM}_{2.5}$ DV and 24-hr $\text{PM}_{2.5}$ DV for each overlapping three-year period starting with 1999-2001 and ending with 2009-2011
 - DV calculations based on EPA data handling conventions
 - Data extracted from monitors that have a non-regulatory monitoring type are omitted
 - Selection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



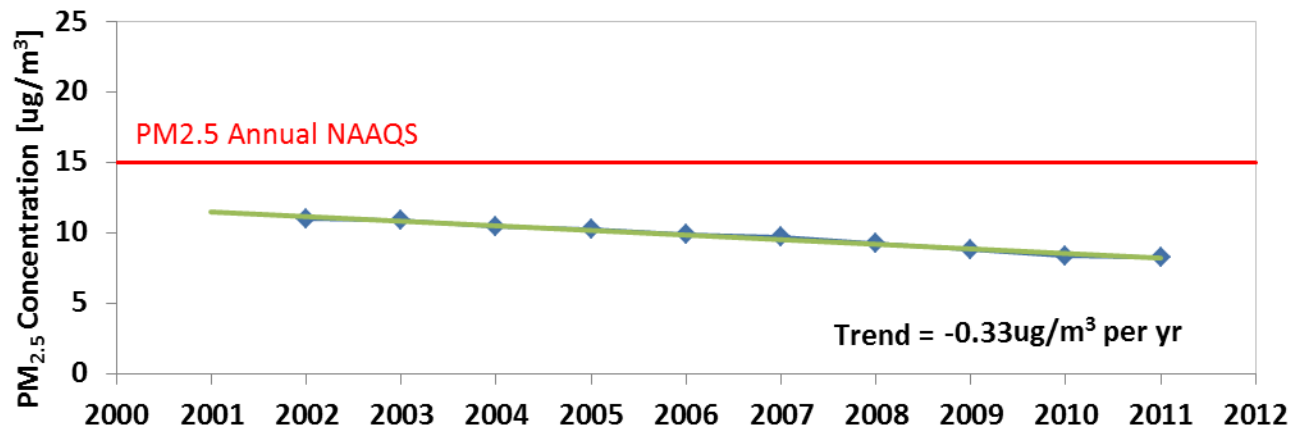
Ozone Trends by Site in Rhode Island

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/ yr]
4400300024420101	Kent, RI	0.073	-2.50
4400710104420101	Providence, RI	0.071	-1.87
4400900074420101	Washington, RI	0.073	-2.18

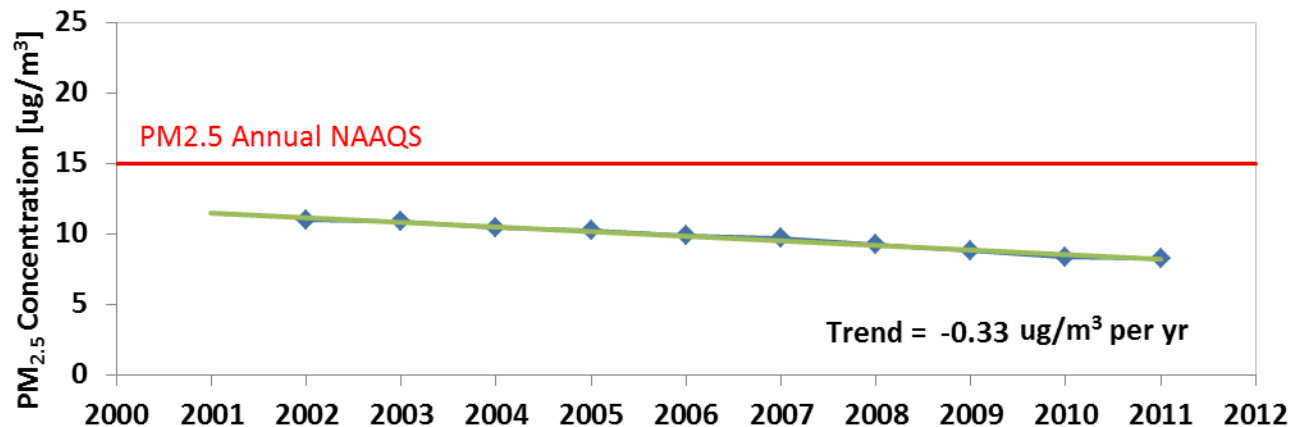
Note: Only monitoring sites meeting data completeness criteria listed

Max/Ave PM_{2.5} Annual DVs and Trend

Rhode Island Max PM_{2.5} Annual Design Values

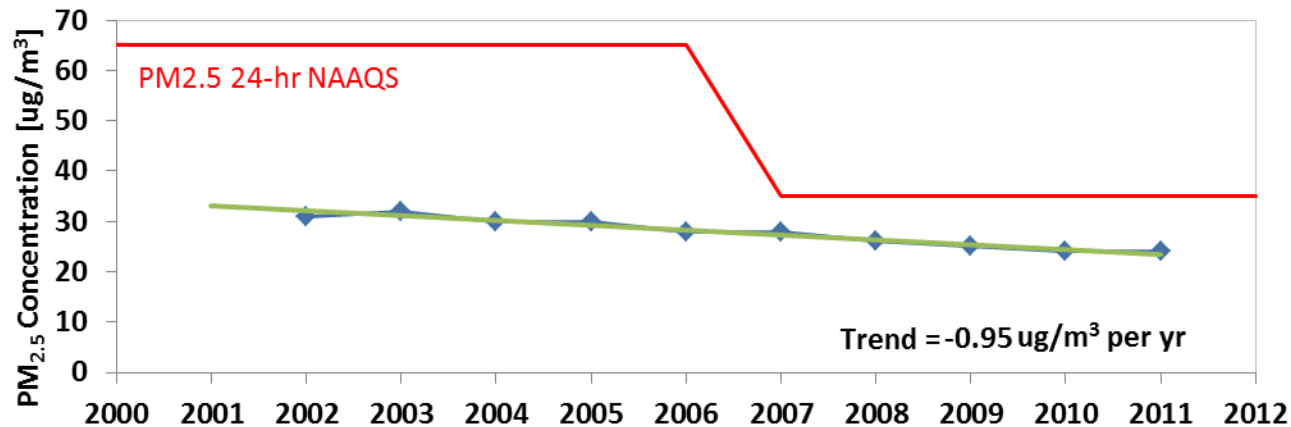


Rhode Island Average PM_{2.5} Annual Design Values



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

Rhode Island Max PM_{2.5} 24-Hour Design Values



Rhode Island Average PM_{2.5} 24-Hour Design Values



PM_{2.5} Trends by Site in Rhode Island

		2009-2011 DV [ug/m ³]		Trend [ug/m ³ per year]	
Monitoring Site	County	Annual	24-Hr	Annual DV	24-Hr DV
440071010	Providence	8.2	24	-0.33	-0.95

Note: Only monitoring sites meeting data completeness criteria listed

Air Quality Trends Summary

- Average O_3 design values have decreased since 1999 in Rhode Island. Average $PM_{2.5}$ design values have decreased since 2000 (incomplete data in 1999) based on data from one monitor station.
- There are no currently designated O_3 or $PM_{2.5}$ non-attainment areas in Rhode Island