

Emission and Air Quality Trends Review

Arizona

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

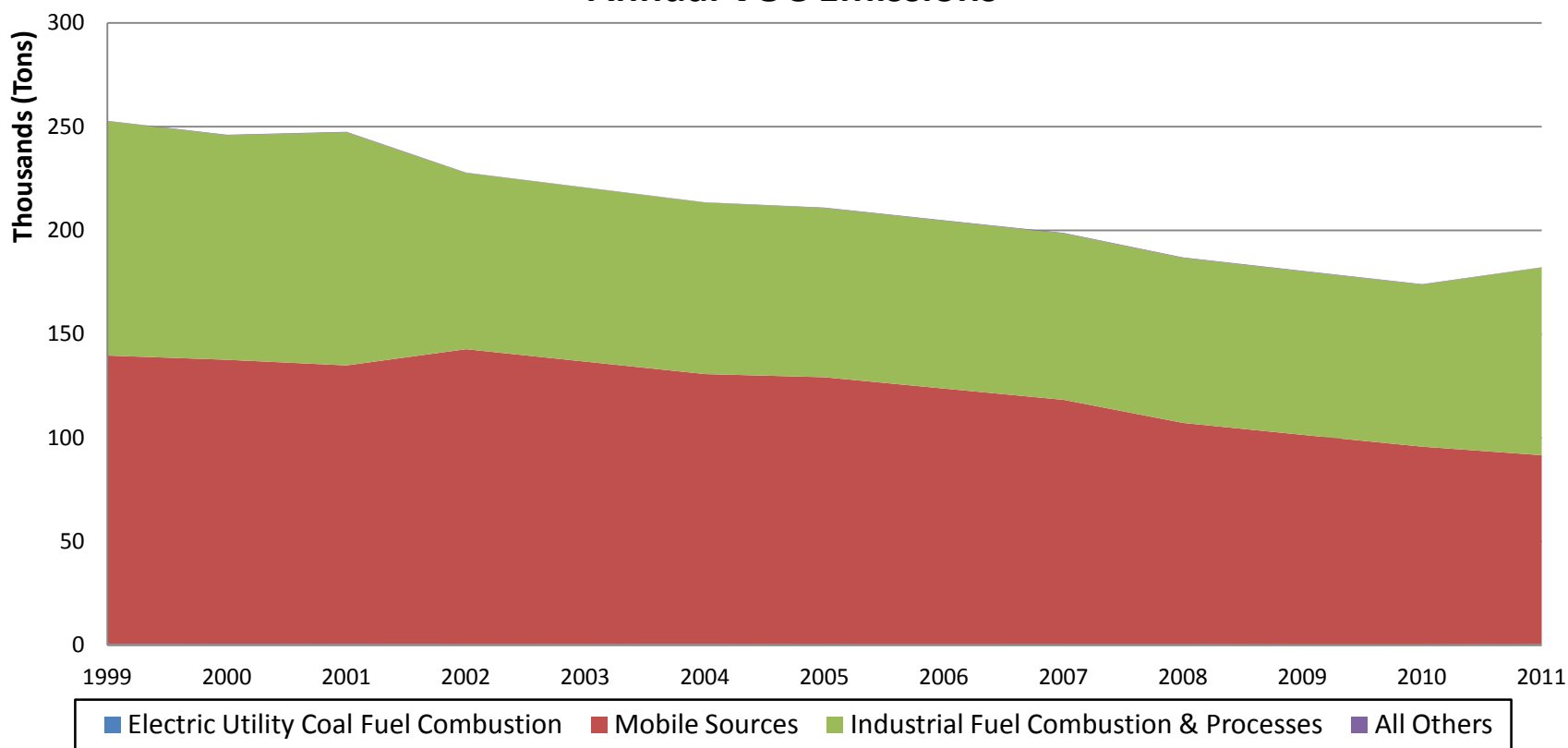
Arizona Emission Trends (VOC)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	587	600	503	446	440	450	453	402	407	482
Mobile Sources	139,061	134,291	136,206	128,749	123,296	117,842	106,713	101,015	95,317	91,113
Industrial Fuel Combustion & Processes	112,976	112,350	83,809	81,543	80,855	80,207	79,513	78,816	78,115	90,467
All Others	187	274	153	242	265	284	275	257	230	143
Total	252,811	247,515	220,670	210,980	204,855	198,783	186,954	180,490	174,069	182,206

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%	-14%	-24%	-25%	-23%	-23%	-32%	-31%	-18%
Mobile Sources	0%	-3%	-2%	-7%	-11%	-15%	-23%	-27%	-31%	-34%
Industrial Fuel Combustion & Processes	0%	-1%	-26%	-28%	-28%	-29%	-30%	-30%	-31%	-20%
All Others	0%	46%	-18%	30%	42%	52%	47%	38%	23%	-23%
Total	0%	-2%	-13%	-17%	-19%	-21%	-26%	-29%	-31%	-28%

Arizona Emission Trends (VOC)

**Major Source Category Summary
Annual VOC Emissions**



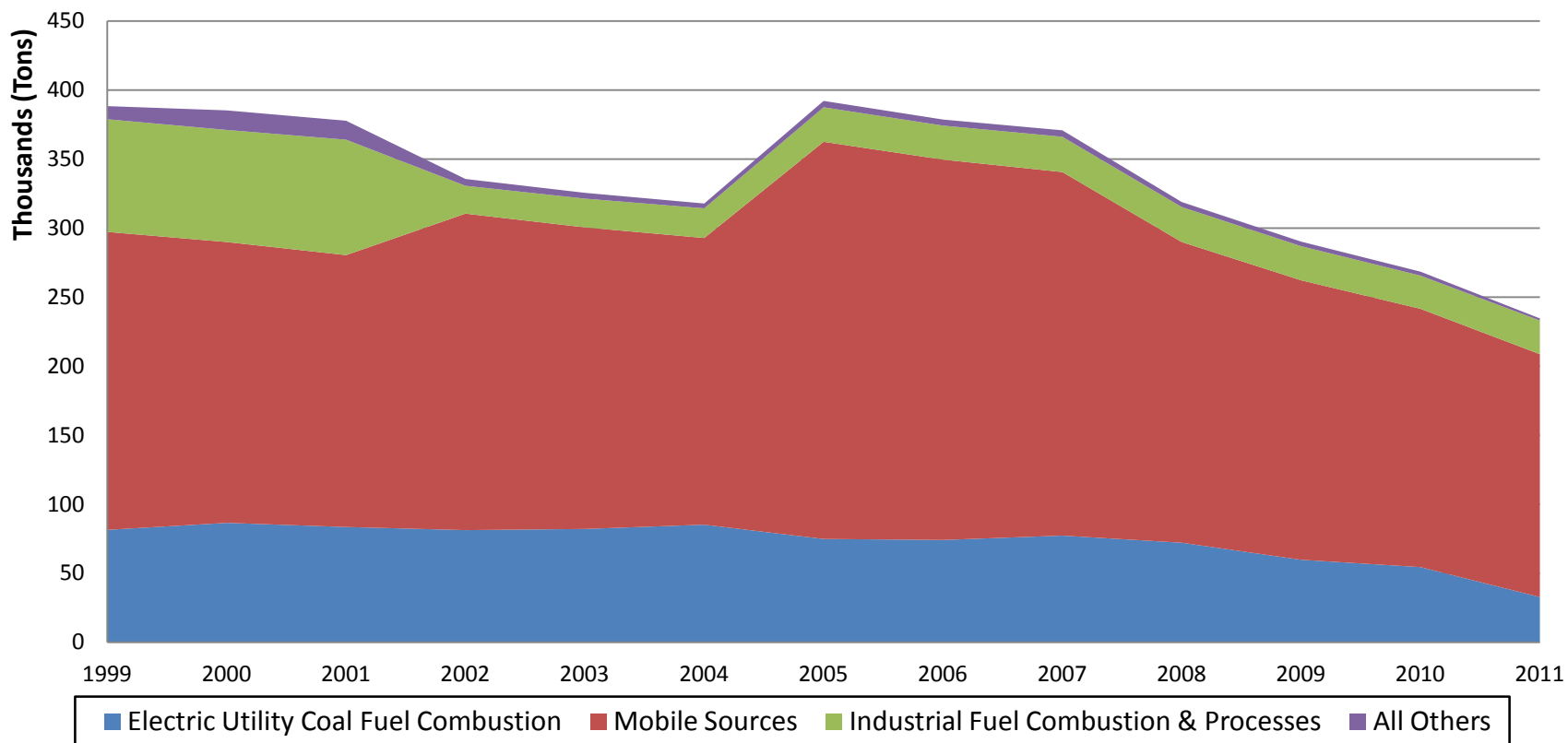
Arizona Emission Trends (NO_x)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	81,430	83,491	82,069	74,820	74,104	77,249	72,111	59,752	54,437	32,752
Mobile Sources	215,809	196,961	218,469	287,683	275,525	263,368	217,811	202,454	187,096	175,933
Industrial Fuel Combustion & Processes	81,633	83,606	20,837	25,028	24,633	25,542	25,359	24,718	24,058	24,372
All Others	9,489	13,726	4,183	4,626	4,384	4,687	3,607	3,287	2,860	1,525
Total	388,361	377,784	325,557	392,157	378,646	370,846	318,888	290,210	268,451	234,583

Source Category	Annual Emissions Change (Percent since 1999)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0%	3%	1%	-8%	-9%	-5%	-11%	-27%	-33%	-60%
Mobile Sources	0%	-9%	1%	33%	28%	22%	1%	-6%	-13%	-18%
Industrial Fuel Combustion & Processes	0%	2%	-74%	-69%	-70%	-69%	-69%	-70%	-71%	-70%
All Others	0%	45%	-56%	-51%	-54%	-51%	-62%	-65%	-70%	-84%
Total	0%	-3%	-16%	1%	-3%	-5%	-18%	-25%	-31%	-40%

Arizona Emission Trends (NO_x)

**Major Source Category Summary
Annual NO_x Emissions**



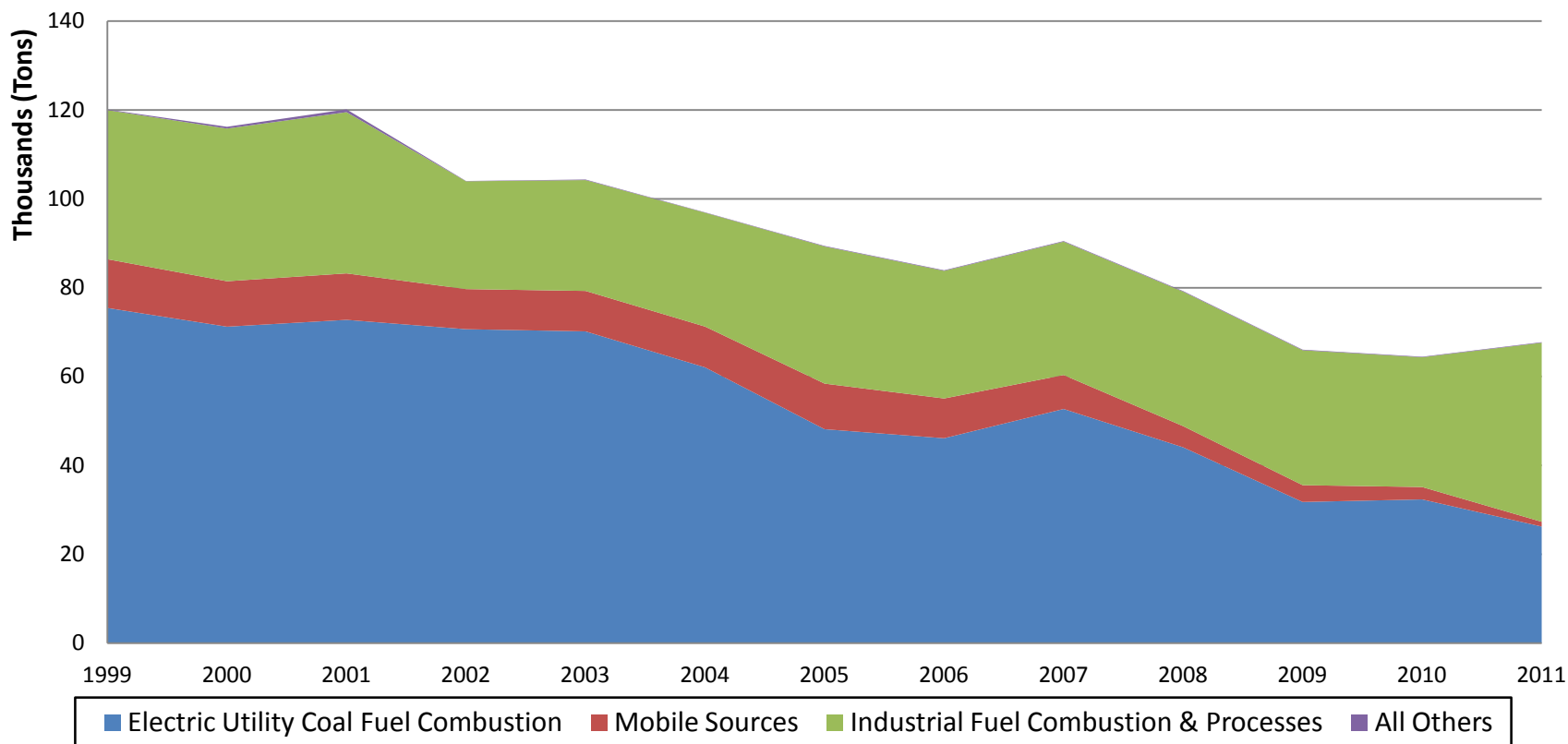
Arizona Emission Trends (SO₂)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	75,428	72,758	70,162	48,146	46,112	52,699	44,071	31,770	32,344	26,239
Mobile Sources	10,972	10,456	9,105	10,263	8,952	7,641	4,766	3,778	2,790	1,073
Industrial Fuel Combustion & Processes	33,568	36,283	24,949	30,860	28,722	30,011	30,263	30,367	29,208	40,298
All Others	126	631	125	124	132	137	137	129	116	121
Total	120,094	120,128	104,341	89,393	83,917	90,488	79,236	66,044	64,457	67,732

Source Category	Annual Emissions Change (Percent since 1999)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0%	-4%	-7%	-36%	-39%	-30%	-42%	-58%	-57%	-65%
Mobile Sources	0%	-5%	-17%	-6%	-18%	-30%	-57%	-66%	-75%	-90%
Industrial Fuel Combustion & Processes	0%	8%	-26%	-8%	-14%	-11%	-10%	-10%	-13%	20%
All Others	0%	401%	-1%	-1%	5%	9%	9%	3%	-8%	-4%
Total	0%	0%	-13%	-26%	-30%	-25%	-34%	-45%	-46%	-44%

Arizona Emission Trends (SO₂)

**Major Source Category Summary
Annual SO₂ Emissions**



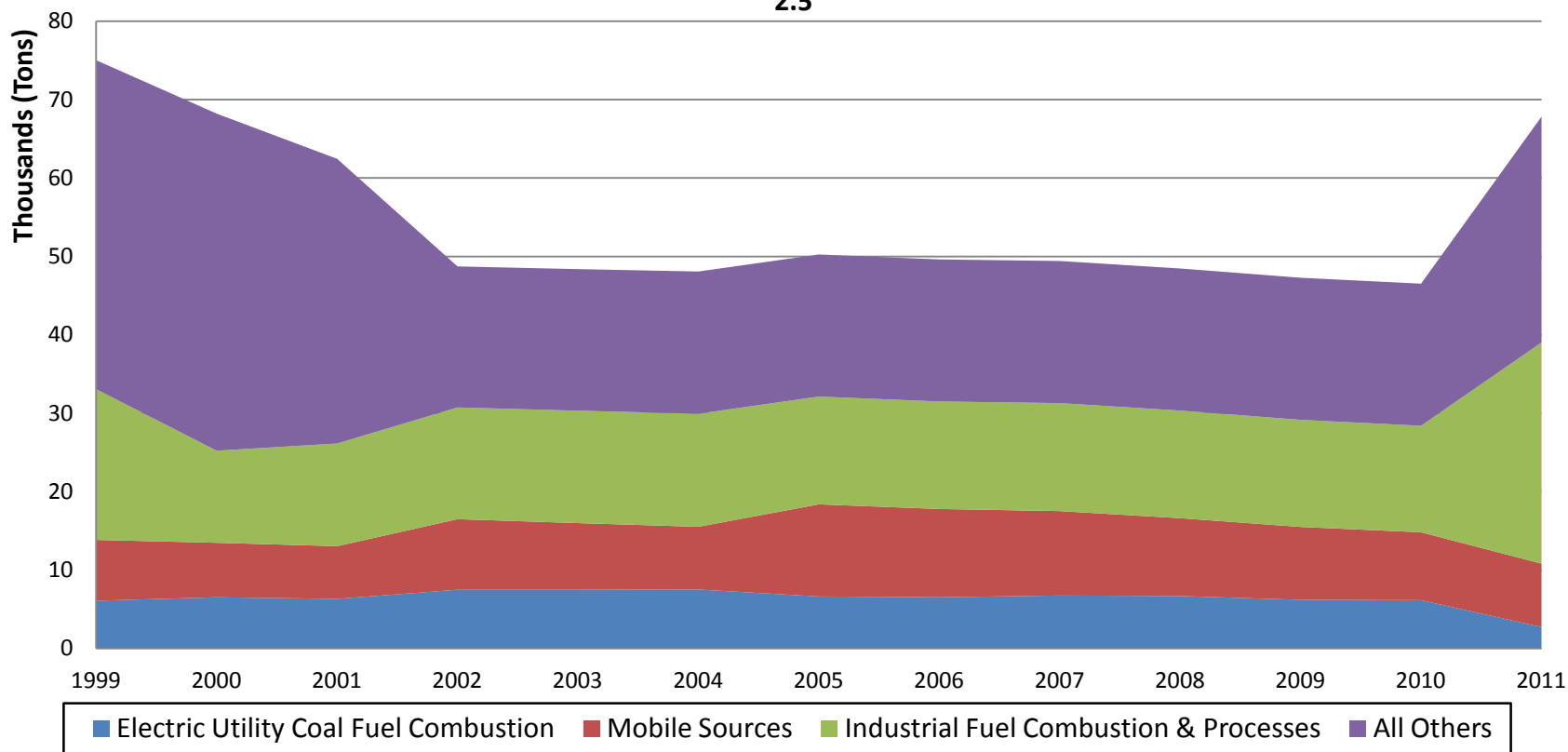
Arizona Emission Trends (PM_{2.5})

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	6,087	6,325	7,486	6,630	6,529	6,751	6,686	6,205	6,158	2,727
Mobile Sources	7,758	6,719	8,503	11,751	11,259	10,768	9,930	9,294	8,659	8,095
Industrial Fuel Combustion & Processes	19,221	13,098	14,337	13,747	13,709	13,778	13,724	13,662	13,590	28,201
All Others	41,963	36,313	18,057	18,120	18,121	18,122	18,122	18,121	18,120	28,802
Total	75,028	62,454	48,382	50,248	49,618	49,419	48,462	47,282	46,527	67,824

Source Category	Annual Emissions Change (Percent since 1999)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0%	4%	23%	9%	7%	11%	10%	2%	1%	-55%
Mobile Sources	0%	-13%	10%	51%	45%	39%	28%	20%	12%	4%
Industrial Fuel Combustion & Processes	0%	-32%	-25%	-28%	-29%	-28%	-29%	-29%	-29%	47%
All Others	0%	-13%	-57%	-57%	-57%	-57%	-57%	-57%	-57%	-31%
Total	0%	-17%	-36%	-33%	-34%	-34%	-35%	-37%	-38%	-10%

Arizona 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 Arizona
- ❑ NO_x and SO₂ from Electric Utility Fuel Combustion sources show decrease over time as a result of participation in the Acid Rain Program
- ❑ 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

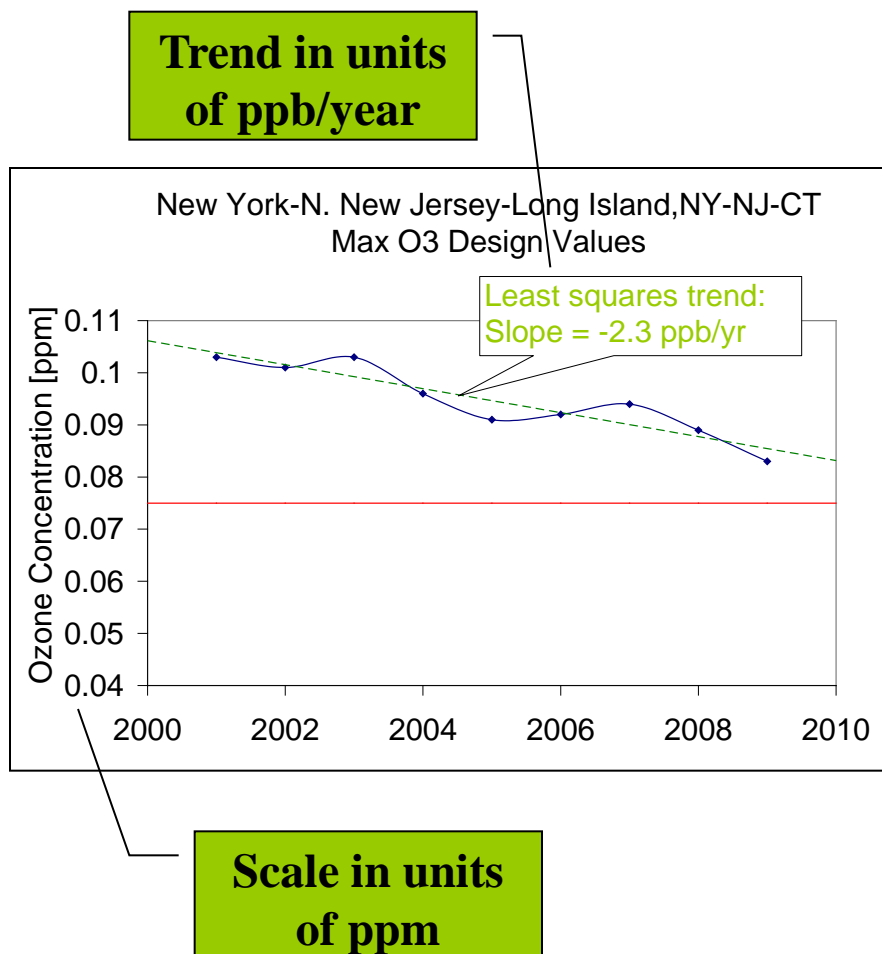
Data Handling Procedures

- 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

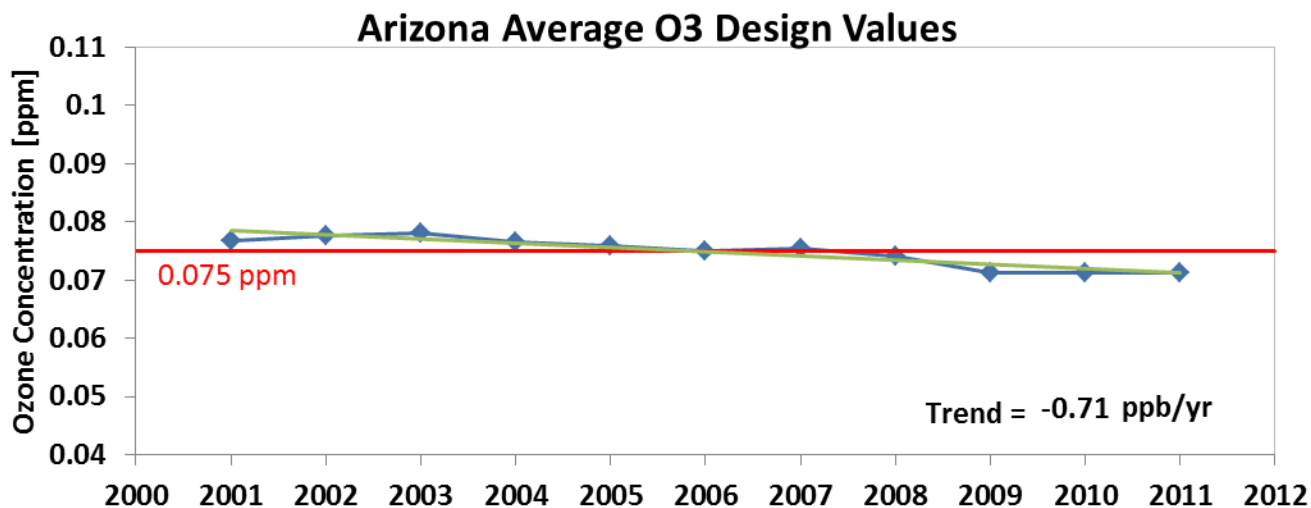
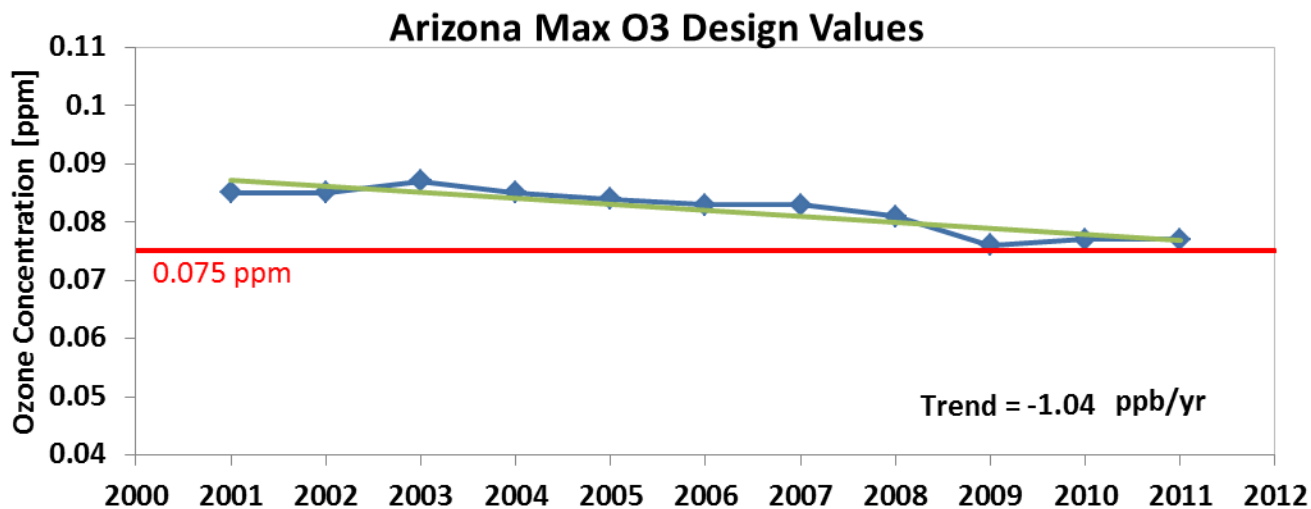
- Annual $PM_{2.5}$ DV and 24-hr $PM_{2.5}$ DV for each overlapping three-year period starting with 1999-2001 and ending with 2009-2011
 - DV calculations based on EPA data handling conventions
 - Data extracted from monitors that have a non-regulatory monitoring type are omitted
 - Selection of trend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

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
0400380014420101	Cochise, AZ	0.070	-0.22
0400580014420101	Coconino, AZ	0.069	-0.57
0401300194420101	Maricopa, AZ	0.073	-0.76
0401310044420101	Maricopa, AZ	0.077	-0.95
0401310104420101	Maricopa, AZ	0.068	-1.16
0401320014420101	Maricopa, AZ	0.072	-1.12
0401320054420101	Maricopa, AZ	0.074	-1.34
0401330024420101	Maricopa, AZ	0.071	-0.58

Note: Only monitoring sites meeting data completeness criteria listed

Ozone Trends by Site in Arizona

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
0401330034420101	Maricopa, AZ	0.074	-0.41
0401340034420101	Maricopa, AZ	0.072	-0.64
0401340044420101	Maricopa, AZ	0.072	-0.72
0401340054420101	Maricopa, AZ	0.068	-1.01
0401340084420101	Maricopa, AZ	0.075	-1.13
0401395084420101	Maricopa, AZ	0.071	-1.61
0401397024420101	Maricopa, AZ	0.072	-1.96
0401397044420101	Maricopa, AZ	0.073	-1.17

Note: Only monitoring sites meeting data completeness criteria listed

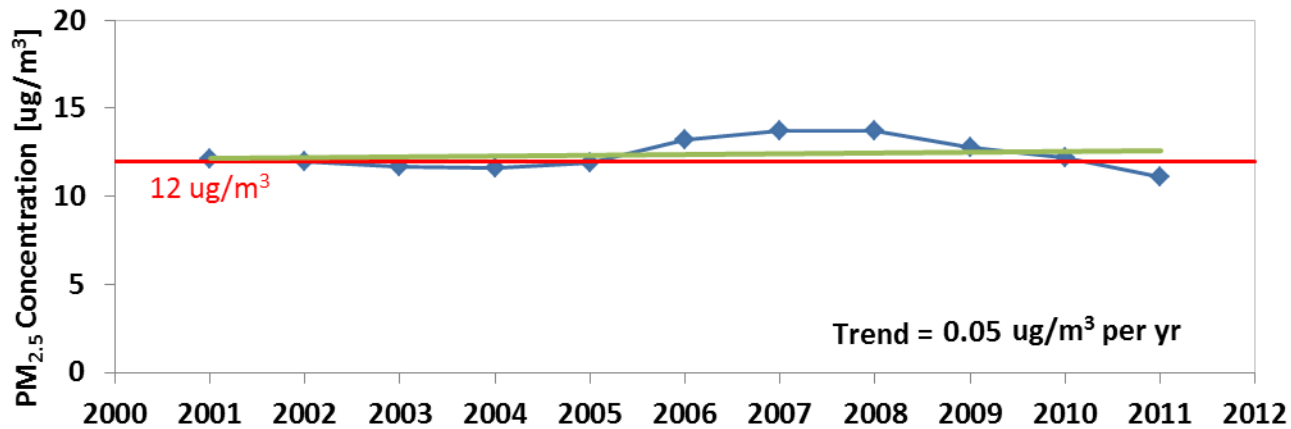
Ozone Trends by Site in Arizona

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
0401397064420101	Maricopa, AZ	0.073	-1.18
0401399974420101	Maricopa, AZ	0.075	-0.07
0401900024420101	Pima, AZ	N/A	0.15
0401900214420101	Pima, AZ	0.070	-0.15
0401910114420101	Pima, AZ	0.066	-0.82
0401910184420101	Pima, AZ	0.068	-0.28
0401910204420101	Pima, AZ	0.068	-0.07
0401910284420101	Pima, AZ	0.067	-0.57
0402180014420101	Pinal, AZ	0.073	-1.22

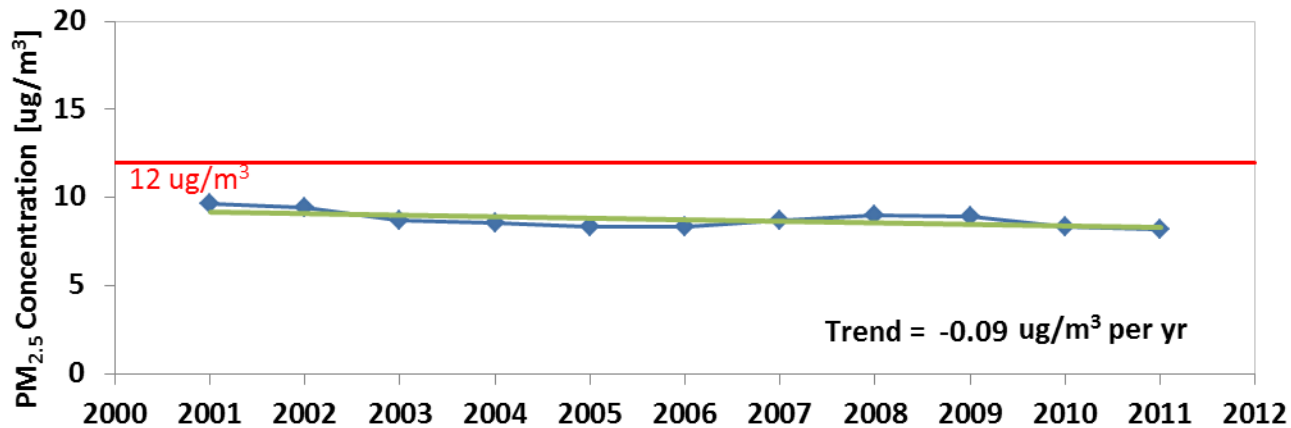
Note: Only monitoring sites meeting data completeness criteria listed

Max/Ave PM_{2.5} Annual DVs and Trend

Arizona Max PM_{2.5} Annual Design Values

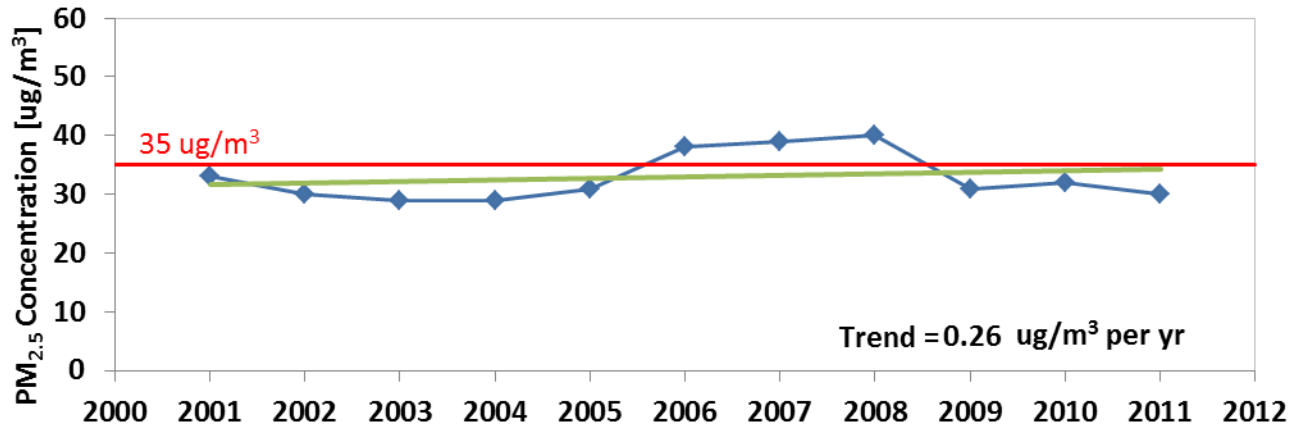


Arizona Average PM_{2.5} Annual Design Values

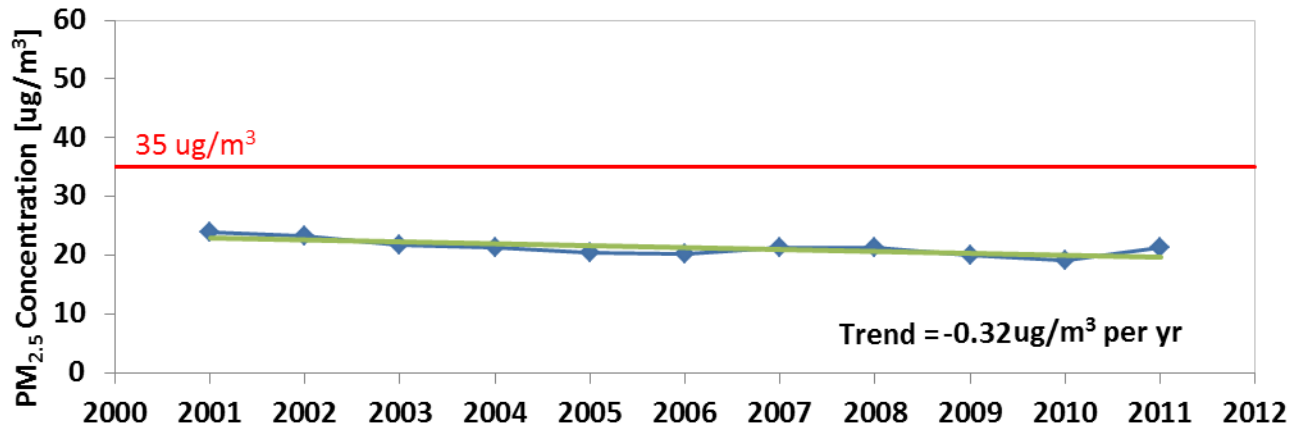


Max/Ave PM_{2.5} 24-Hour DVs and Trend

Arizona Max PM_{2.5} 24-Hour Design Values



Arizona Average PM_{2.5} 24-Hour Design Values



PM_{2.5} Trends by Site in Arizona

Monitoring Site	County	2009-2011 DV [ug/m ³]		Trend [ug/m ³ per year]	
		Annual	24-Hr	Annual DV	24-Hr DV
040139997	Maricopa	8.4	22	-0.29	-0.98
040191028	Pima	5.4	12	-0.15	-0.37
040210001	Pinal	9.3	20	0.17	0.12
040213002	Pinal	6.9	22	0.02	0.09
040230004	Santa Cruz	11.1	30	0.05	0.30

Note: Only monitoring sites meeting data completeness criteria listed

Air Quality Trends Summary

- Average O₃ design values have decreased since 1999 in Arizona; average annual and 24-hour PM_{2.5} design values have decreased slightly since 1999 in Arizona

- O₃ design values have decreased since 1999 in Phoenix-Mesa, AZ, the only currently designated O₃ non-attainment area in Arizona. 24-hour PM_{2.5} design values have increased since 1999 in the Nogales, AZ non-attainment area; additional PM_{2.5} non-attainment areas in Arizona in which monitoring data did not meet the 1999–2011 trends completeness criteria include:
 - West Central Pinal County, AZ (24-hour PM_{2.5})